

## THE EFFECT OF PRE-CLASS QUIZZES ASSISTED FLIPPED CLASSROOM LEARNING ON STUDENT LEARNING OUTCOMES IN THE BIOCHEMISTRY COURSE OF FATTY ACID METABOLISM

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**Abstract:** The study aims to determine the effect of the flipped classroom learning model assisted by pre-class quizzes on student learning outcomes of the Faculty of Mathematics and Natural Sciences, University of Mataram, in the subject of biochemistry, on fatty acid metabolism. The type of experimental research used in this study was a Quasi-Experimental Design with a Post-Test Only Non-Equivalent Control Group Design. The population in this study was the sixth-semester students of the Faculty of Mathematics and Natural Sciences, Mataram University, for the 2022 academic year, totaling 60 people with a sampling technique using saturated sampling. In this research, two classes were used: the control and experimental classes. In the experimental class, namely class A, the flipped classroom learning model was treated with the help of pre-class quizzes, while the control class only used the flipped classroom model without pre-class quizzes. This study measured student learning outcomes from post-test question scores with 30 multiple-choice questions. The data analysis techniques used are normality test, homogeneity test, hypothesis test using paired sample t-test, and effect size test. Based on the results of data analysis using the normality test and homogeneity test that was carried out, the data was usually and homogeneously distributed, so hypothesis testing was carried out using the t-test and effect size test. Based on the hypothesis testing that has been carried out, there is an influence of the flipped classroom learning model assisted by pre-class quizzes on student learning outcomes in the biochemistry course on fatty acid metabolism. This can be seen from the sig value. (2-tailed) of 0.000 in the paired sample t-test, resulting in the interpretation that H<sub>0</sub> is rejected and H<sub>1</sub> is accepted. As for the magnitude of the effect of the flipped classroom model assisted by pre-class quizzes using the effect size calculation formula, the result was 1.33, which shows the criteria for a high effect value.

**Keywords:** *Flipped Classroom Model, Pre-Class Quizzes, Learning Outcomes, Biochemistry, Fatty Acid Metabolism*

### INTRODUCTION

Science and technology have developed rapidly in the 21<sup>st</sup> century to meet the needs of human life. This development requires humans to have knowledge and skills to survive in global competition. One factor that can increase knowledge and skills is education [1]. Education is essential in producing complete resources, individually and in groups [2]. However, the Covid-19 pandemic has become a new problem in the world of education.

Many lecturers, parents, and students are confused about which learning system is suitable for use during the Covid-19 pandemic. The Indonesian government finally decided to organize distance learning by issuing Ministry of Education and Culture Circular Letter (SE) No. 15 of 2020. The SE emphasizes that distance learning is carried out using two approaches, namely (1) an in-network approach and (2) an out-of-network approach [3].

Online learning as an effect of the Covid-19 pandemic has advantages, namely that learning needs can be carried out in a free time and place to understand the material better. Understanding this material will increase students' cognitive learning outcomes [4].

Learning outcomes are the peak of student learning success towards predetermined learning goals. Student learning outcomes include cognitive (knowledge), emotional (attitude), and psychomotor (skills) aspects [5].

In the learning process, lecturers expect the students they teach to study well so that students achieve satisfactory learning outcomes. However, these hopes do not always come true because many students still get unsatisfactory learning results. This can be seen from the learning results of several students with high and low learning outcomes. This shows that many lecturers still face several students who experience learning difficulties [6-8].

Learning difficulties are when students are less able to face the demands of the learning process, so the process and results are less than satisfactory [9]. Learning difficulties can be identified by diagnosing learning difficulties. Diagnosis of learning difficulties needs to be done for various reasons. First, every student should have the opportunity and service to develop optimally. Second, there are differences in each student's abilities, intelligence, talents, interests, and environmental background. Third, the teaching

system on campus should provide opportunities for students to advance according to their abilities. Fourth, to deal with the problems that students face, lecturers should be more intensive in dealing with students by increasing their knowledge, having an open attitude, and honing skills in identifying learning difficulties [10].

Difficulties in learning are often found when students study chemistry material. This is because most chemistry studies abstract materials. One of the chemistry courses that has abstract material and is considered difficult by students is the biochemistry course. Biochemistry is one of the most essential subjects in universities, especially in chemistry study programs. Biochemistry is a science that studies the chemical composition of living organisms, the structure and properties of the substances that make them up, and the transformation of these substances in living organisms [11]. Biochemistry material discusses several topics, including 1) the structure and function of proteins and enzymes, 2) kinetics, mechanisms, regulation, and the role of transition metals in enzymes, 3) bioenergetics, 4) the metabolism of carbohydrates, lipids, proteins and amino acids, 5) structure, function and replication of macromolecules, 6) biochemistry of extracellular and intracellular communication [12].

Based on the analysis carried out by Rahmatan [13], topics considered difficult in biochemistry are carbohydrate metabolism, protein metabolism, and fatty metabolism. Lipid metabolism material studies the process of burning fat or breaking down or breaking down fat in the body. This learning topic is complex because it requires understanding the structure of compounds, enzymes, coenzymes, and cofactors required for chemical reactions and their phases.

The results of interviews conducted with several 6th-semester students at FMIPA Mataram University for the 2022 academic year showed that the majority thought that the biochemistry course was a complex subject. This is because too many reaction stages must be studied, especially material related to metabolism. Students' difficulties in studying biochemical material cause the learning outcomes obtained by students are still less than optimal. This is proven by the students' Final Semester Examination (UAS) scores, which are still very low, with an average score of 57.32, where the lowest score obtained by students was 33.33 and the highest score was 96.67. Another factor that causes low learning outcomes in biochemistry courses is the learning method, which still uses the lecture method, which causes students to get bored quickly during learning.

The existing problems require efforts to improve student learning outcomes in overcoming learning difficulties amidst learning conditions during the pandemic by providing direct experience to students using learning models that can provide sufficient space for students to develop all the processes and skills they have. One of them uses a flipped classroom learning model assisted by pre-class

quizzes. The basic idea of flipped learning is that students have more preparation before the classroom activities, and hence, students are more engaged and active during classroom activities [14,15]. The flipped classroom learning model is a model where students study more of the subject matter at home in the learning process so that teaching and learning activities in class are more effective for completing assignments and discussing material or problems that students do not yet understand. Thus, it is hoped that when students experience difficulties, they can immediately consult with their friends or lecturers to solve the problem. Students can even convey their learning results at home and discuss them together in class [16]. Pre-class quizzes are quizzes at the beginning of learning that determine students' learning readiness and to what extent the students have mastered the material or teaching materials the lecturer will teach.

Based on the description above, it is hoped that through the teaching and learning process, implementing the flipped classroom learning model will overcome the learning difficulties students face and improve student learning outcomes in general. Therefore, researchers are interested in conducting research entitled The Effect of the Flipped Classroom Learning Model Assisted with Pre-Class Quizzes on Student Learning Outcomes on Fatty Acid Metabolism Material.

## RESEARCH METHODS

This research uses a quantitative approach with a research method, namely the experimental method. The experimental research method is one of the methods in quantitative research. The experimental method examines causal relationships by manipulating one or more variables in one (or more) experimental groups and comparing the results with a control group that did not experience manipulation [17].

The type of experimental research used in this research is Quasi-Experimental Design. Quasi-Experimental Design has a control group, but it cannot function fully to control external variables that influence the implementation of the experiment [18]. The form of research design chosen in this study is Post-Test Only Non-Equivalent Control Group Design. The data obtained in this research came from 60 sixth-semester students of the Faculty of Mathematics and Natural Sciences, Department of Chemistry, Mataram University. The time of the research was carried out in 2022. This research was carried out using class A as a control class with a flipped class learning model without any pre-class quizzes before starting learning and class B as an experimental class with treatment with a flipped class learning model assisted by a pre-class learning class quiz.

After learning in the experimental and control classes was completed, the next step was to give post-test questions using multiple choice questions totaling 30. These questions have gone through validity and reliability tests to ensure the instrument's accuracy

[19]. Reliability testing is used to determine the consistency of the measuring instrument and whether the measuring instrument is consistent if the measurement is repeated [20]. The reliability test in this study used an inter-rater reliability test carried out using the Cohen's Kappa method obtained through the SPSS application.

Data analysis was carried out using normality, homogeneity, and hypothesis tests. The purpose of carrying out a normality test is to determine whether the data used is normally distributed, which can then be used to determine whether the data obtained can be analyzed using parametric or non-parametric statistics. The data normality test uses Chi-Square ( $\chi^2$ ) in this research. The test conditions are that if the calculated Chi-Square is smaller than the table Chi-Square, the data is usually distributed. If it is greater or equal to the table value, then the data is not normally distributed. The basis of the decision is that the data will be generally distributed if  $\chi^2_{count} \leq \chi^2_{table}$  at the significance level used is 5%.

The Homogeneity Test determines whether the data obtained from the two groups have homogeneous variants [21]. In this research, the homogeneity test was carried out using the Homogeneity of Variance Tests on One-Way ANOVA. The criteria for testing are if it is significant (Sig) > 0.05, then there is no difference between treatments. There is a significant difference in treatment if it is significant (Sig) < 0.05. Next, hypothesis testing uses parametric statistics because the data is usually distributed and homogeneous. Hypothesis testing uses the T-test, namely the paired sample t-test and the effect size test. The Paired Sample T Test aims to determine whether there is a difference in the average of two paired or related samples. Effect size is a measure of the magnitude of the effect of a variable on other variables, the magnitude of differences or relationships, which is accessible from the influence of sample size [22].

## RESULTS AND DISCUSSION

The data obtained in this research came from 60 sixth-semester students of the Faculty of Mathematics and Natural Sciences, Department of Chemistry, Mataram University. This research was carried out using two classes: class A as a control class treated with a flipped classroom learning model without any pre-class quizzes before starting learning and class B as an experimental class treated with a flipped classroom learning model assisted by pre-class quizzes. After learning in the experimental and control classes was completed, the next step was to give post-test questions using multiple choice questions totaling 30. These questions have gone through content validation and reliability testing. Data from post-test instrument test results are used to determine the validity and reliability of the research instruments used. Meanwhile, research results in student learning outcomes data in the cognitive domain are used to test normality, homogeneity, and research hypotheses.

The purpose of carrying out a normality test is to determine whether the data used is usually distributed. The following are the normality test results from the research results obtained.

Table 1 Normality Test Result

Class	Statistics	df	Sig	Description
Control	5.0	3	7.813	Normal
Experiment	4.7	3	7.813	Normal

The normality test results in the experimental and control classes have a value of  $\chi^2$  calculated <  $\chi^2$  table, so it can be concluded that the learning outcome data in both classes is normally distributed.

The criteria for homogeneity testing are if it is significant (Sig) or p-value > 0.05, then the data can be considered homogeneous. The data is not homogeneous if it is significant (Sig) or p-value < 0.05. The following homogeneity test results were obtained.

Table 2 Homogeneity Test Results

Levene Statistics	df1	df2	Sig	Description
0.84	1	58	0.05	Variation Homogen

From the homogeneity test results above, a significance value or p-value of 0.84 was obtained. Because the Sig value is > 0.05, the post-test learning outcomes data for students from the experimental class and control class have the same or homogeneous variety of values.

Based on the prerequisite test, post-test data analysis from both classes shows that the data has been proven to meet the assumptions of normality and homogeneity. Thus, hypothesis testing can be carried out using parametric statistical test analysis techniques. Testing the hypothesis of this research is related to the analysis of differences in the two average scores of learning outcomes in biochemistry on fatty acid metabolism material between the experimental and control classes. This test aims to determine whether the flipped classroom learning model assisted by pre-class quizzes significantly influences learning outcomes in biochemistry courses.

Hypothesis testing was carried out using the t-test, namely the paired sample t-test assisted by the SPSS application. The t-test results were carried out. The following data is extracted.

Table 3. Hypothesis Test Results

Sig. (2-tailed) t-test	Sig	Description
0.000	0.05	H <sub>0</sub> rejected H <sub>1</sub> accepted

Based on the conditions for hypothesis testing, namely if sig. (2-tailed) < 0.05 then  $H_0$  is rejected and  $H_1$  is accepted. Sig was obtained in testing the hypothesis with the help of SPSS using the T test, namely the paired sample t test at a significance level of 0.05. (2-tailed). The table above shows that sig. (2-tailed) post test data is below the significance level (0.05), namely 0.000, so it can be concluded that there is a difference in the average post-test scores in the control and experimental classes.

Researchers calculated the strength of the influence size of the flipped classroom learning model assisted by pre-class quizzes using the Cohen's d effect size technique. According to Suparman et al., the criteria proposed by Cohen's d regarding the size of the effect size are as follows [23]:

Table 4. Effect Size Interpretation Criteria

Size	Interpretation
0-0.20	Weak
0.21-0.50	Modest
0.51-1.00	Moderate
>1.00	Strong

The calculation results show that the Cohen's d effect size value is 1.33. This value falls in the significant effect category and has a more confident statistical analysis than the P value [24]. Thus, the flipped classroom learning model assisted by pre-class quizzes influences student learning outcomes in the biochemistry course on fatty acid metabolism.

In this research, the author is only an observer and provides ideas for learning models to lecturers using the flipped classroom learning model. This research was conducted in 4 meetings where the control and experimental classes used the flipped classroom learning model. Flipped classroom is a learning model that reverses the way of learning in class. In this learning model, the learning material must be studied by students at home before learning begins so that when in class, the lecturer does not explain the lecture material but immediately works on practice questions or other activities such as role plays, debates, presentations, or other methods. The material has been studied previously [25]. The Flipped Classroom Learning Model consists of three steps: Phase 0 (independent study by students), Phase 1 (classroom activity that includes teaching and learning, as well as discussion on assignment), Phase 3 (applying students' skills in projects and other simulation in the classroom); and Phase 3 (measurement of student's understanding at the end of the material delivery) [26].

Before measuring students' understanding at the end of the learning material by conducting a post-test, students were previously given treatment in the experimental class by implementing the flipped classroom learning model assisted by pre-class quizzes. Meanwhile, the flipped classroom learning model was implemented in the control class without

pre-class quizzes. Pre-class quizzes are quizzes at the beginning of learning that determine students' learning readiness and to what extent the students have mastered the material or teaching materials that the lecturer will teach. Pre-class quizzes are given to the experimental class before each lesson, and students can access them via the Kahoot application with 10 to 15 questions at each meeting.

The pre-class quizzes used during the previous research had been discussed first with the lecturer in charge of the biochemistry course. They had been tested for validity and reliability before being given to students at the MIPA faculty at Mataram University. After the biochemistry course ended, the experimental and control classes were given a post-test to measure students' final understanding. The average post-test score in the experimental class was 67, which was higher than the average post-test score in the control class, namely 55. This indicates that the learning model and giving quizzes at the beginning of learning, namely pre-class quizzes with the flipped classroom learning model, is an innovation that can optimize learning outcomes that focus on understanding concepts.

The flipped classroom has been recognized as a teaching trend since it was first introduced in the millennium [27] and later popularized by Bergmann and Sams [28]. This approach increases the quality of time in the classroom since the students must learn before face-to-face meetings with the teacher or mentor [29,30]. During the pandemic, the popularity of flipped classrooms has been increasing, although the success of its implementation is influenced by the pre-pandemic experience of teachers/mentors [15].

Regardless of the learning methods implemented, pre-class quizzes were argued to increase the learning outcomes. Side et al. [31] reported that the quizzes given at the beginning of learning affected the chemistry learning outcomes in South Sulawesi. The low learning outcomes of students in the control class were caused by a lack of readiness to learn because there were no pre-class quizzes or quizzes at the beginning of learning, even though the control and experimental classes used the flipped classroom learning model. Students who know they will be given pre-class quizzes will prepare themselves better at home and have initial knowledge about the material provided by the lecturer before the learning process takes place. Another study by Trisna et al [32] revealed that quizzes at the beginning of learning could improve class readiness and learning outcomes. Having a quiz at the beginning of learning will motivate students to study outside of class by reading books, asking questions, or discussing with classmates or teachers.

The present study combined the flipped classroom and pre-class quizzes, and a clear difference in the learning outcomes between the control and experiment classes was observed. Handing the learning materials to the students before classroom learning in the control class did not effectively increase the student's learning outcome. In contrast, including pre-

class quizzes in the experiment class has successfully increased the learning outcomes. A typical flipped classroom implementation requires at least 80% of students to complete the reading of teaching materials or guides before the classroom [33]. Indeed, the extent to which the students involved the 'flipped' or 'reverse' learning in the control class was not analyzed. The pre-class quizzes served as extra motivation for the students, a result that is similar to a recent report by Zainuddin et al. [34]. The student who is ready to learn tends to understand the prerequisite material and the material that will be taught in class. This will foster motivation to participate in class discussion activities and group discussions actively, making learning more meaningful for the students.

## CONCLUSION

Based on the research results and discussions described, it can be concluded that there is a significant and positive influence of the flipped classroom learning model assisted by pre-class quizzes on student learning outcomes in the biochemistry course on fatty acid metabolism. This was presumably achieved by ensuring the student's preparedness since students must work on quizzes before the classroom.

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