International Conference on Biology Education, Natural Science, and Technology
Vol. 2 No. 1 (2024)
E-ISSN : 3026-5428

Biology Learning Result of X Grade Senior High School Students through the Implementation of PBL combined with Flipped Classroom

Jhera Cesaria Wardani, Putri Agustina*
[1]Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Surakarta.
Jl. A. Yani Tromol Pos I, Pabelan, Kartasura, Surakarta 57162, Jawa Tengah, Indonesia
*Corresponding Author. E-mail address: pa182@ums.ac.id

KEYWORDS:
flipped classroom, learning outcomes, problem based learning

ABSTRACT

Flipped classroom is a learning method that allows students to learn the material in advance at home according to the assignments given by the teacher. The intent of this study is to discover out whether the flipped classroom-based PBL learning approach impacts biology learning outcomes in class X SMA Negeri 4 Surakarta. This study conducted quasi-experimental research, using a post-test only control group approach. The population comes from class X students of SMA Negeri 4 Surakarta with the sample comprised of two classes generated using the cluster random sampling method, that is, phase E3 as the experimental class and phase E1 as the control class. Assessments, survey questionnaires, and observes are some of the data gathering procedures applied. Data analysis employs statistical techniques that are both descriptive and inference-based. The research results show that 1) The average cognitive learning results in the experimental class were 76.61, whereas the control group had 63.02. 2) The average affective test scores in the experimental class were 72.73, alongside the control class had 67.91. 3) The average results of psychomotor learning section in the experimental group had 67,36 along with the result from control group had 61,11. In accordance with the research findings, it can be inferred that flipped-based PBL learning classrooms influence biology learning outcomes in biotechnology material. Even though it has advantages, implementing flipped classroom learning can also potentially cause several obstacles.

1. INTRODUCTION

Learning is an assortment of change experienced by students, who are able to engage in inventive manners as a result of stimuli and reactions. Learning can also be referred to as a person's process or effort to achieve several kinds of skills, competencies, and attitudes (Salam, 2017). So, learning activities play a very important role in creating experiences that will later become the basis for students' social life. Learning is a way or a process or action that can change someone's learning; in other words, learning is a method that is deliberately carried out or designed so that students learn (Ziraluo, 2021). Learning in education includes many branches of science, including science, such as biology. Biology is the science of life (life science), the phenomena of life processes that interact directly in society (Rustaman, 2016).

The learning model is one of several aspects that determine the success of learning, both internally and externally. The framework for learning is a sequence of activities implemented by the teacher in charge with the aim of conveying lesson material. Learning models frequently emerge using the concepts of learning, psychological and sociological paradigms, systems evaluation, or various other concepts that support them (Khoerunnisa & Aqwal, 2020). Teachers can use various types of learning models in the learning process. Choosing creative and innovative learning models can increase student competence. According to (Fitri, 2022) a learning model is

an approach of instruction that is revealed from its inception to the finish of learning that becomes the frame for implementing an approach, method, strategy, and learning technique.

Problem-based Learning (PBL) is an educational model that is considered to promote student engagement. It is a learning system that relies on a problem faced by students during the process of gaining knowledge (Barokah, 2019). According to (Pramana, Jampel, & Pudjawan, 2020) Problem-based learning is a learning strategy that encourages the students to think critically when tackling current issues. This is related to problem-based learning, which focuses students on being able to solve problems around the students' learning environment.

The characteristics of PBL include three essential elements, namely the existence of a problem, student-centered learning, and learning in small groups (Hotimah, 2020). The goal of the problem-based learning (PBL) method of teaching is to enhance the problem-solving abilities of students and in helping them to gain various experiences and be able to change students behavior, strengthen critical thinking skills and the capacity to address any circumstance.

(Febrita & Harni, 2020). Research (Silvi, Witarsa, & Ananda, 2020) states that the advantages of the PBL approach are that students are encouraged to have the capacity to overcome issues in actual settings. Students can also expand their understanding through learning activities, learning is focused on problems, so that irrelevant information does not need to be reviewed by students.

. Besides the advantages of PBL, there are also several weaknesses of PBL based on (Eskris, 2021). PBL requires quite a long time in preparation for the course of study, and students are less motivated to study when they fail to comprehend the difficulties they're handling. Some students will also experience difficulties if they study independently. Then (Sinmas, Sundaygara, & Pranata, 2019) stated that one of the learning frameworks that can be effectively applied to complement the PBL learning approach is the Flipped Classroom method.

The Flipped Classroom is an educational strategy in which students examine learning materials at home prior class, directed by the teacher's assignments. Before discussing new subjects in class, the teacher provides assignments for students to familiarize themselves with the material utilizing a variety of learning materials (Agustini, 2021). In pursuance of (Maolidah, Ruhimat, & Dewi, 2017) this type of learning style makes the most of learning resources that students can access online as part of their learning in the classroom. Thus, the flipped teaching technique is an instructional strategy that employs a blended learning approach by reversing the conventional classroom dynamic and delivering educational content outside the traditional classroom setting. (Most are carried out online) (Susanti & Hamama Pitra, 2019).

The ultimate purpose of classroom learning activities is to produce outcomes that promote learning. Academic results may be enhanced by various deliberate attempts carried out systematically, resulting to beneficial changes that are then referred to as the learning process (Rusnawati, 2020). In research (Wardana & Sagoro, 2019) These results may be examined using tools such as learning outcome evaluation items; an improvement in learning outcomes can be demonstrated through comparing the mean results from learning to the percent of student learning fulfillment in pre-research and all subsequent cycles.

The teaching and learning process consists of cognitive, affective, and psychomotor aspects, which are used as guidelines for assessing student learning outcomes. These three factors will demonstrate students accomplishments while absorbing knowledge. According to Bloom (Sudjana, 2006) learning outcomes can be classified into three main groups: cognitive, affective, and psychomotor. The cognitive field encompasses mental (brain) behavior (Ismail M. I., 2021). As for opinion (Huliatunisa, 2022) in his book states that the cognitive area relates to memory or knowledge and intellectual abilities and skills in the cognitive area. There are six levels of mental functions, ranging from the lowest domain to the most complex dimension. The emotive domain essentially refers to beliefs and principles (Suryadi, 2020). Zainal (2014) states that the area of affect cannot be examined in the same way that the cognitive field can. This is because aptitudes measured in the domain of affect involve acquiring (paying attention), reacting, embracing,

coordinating, and valuing qualities. The psychomotor domain is pertain to the ability to respond once the students obtain specific learning encounters; this learning outcome is a continuation stage of affective learning outcomes, which only appear in students' tendencies to behave (Widodo, 2021).

This study was excuted in SMA Negeri 4 Surakarta. Based on preliminary research (Mahardika, 2021), learning at SMA Negeri 4 Surakarta emphasizes on mastering the contents, so the learning method applied is the lecture method. Student learning outcomes are not optimal because students' enthusiasm and urge to learn are insufficient. In order to enhance the quality of education, consider using a learning paradigm such as exploratory learning, problems-based instruction, or contextual education.

The main objective of this study is to discover how the PBL learning paradigm, in conjunction with a flipped classroom, affects biology learning results in class X at SMA Negeri 4 Surakarta.

2. MATERIALS AND METHODS

2.1. Type of Research and Research Design

2.1.1. Type of Research

This is quasi-experimental research. The study's dependent variable is Biology learning outcomes. Meanwhile, the independent variable is the learning model.

2.1.2. Research Design

The research design applied to this study is a post-test only control group. In this approach, both the experimental and control classes are submitted to a posttest, however only the group classified as experimental is treated, hence the design was arranged as follows:

Table 1 Posttest Only Control Group Design

Class	Treatment	*Post-test*
E	X	P1
K	Y	P1

Information:
E = Experimental Class
K = Control Class
P1 = Post-test
X = The treatment uses a PBL learning model combined with Flipped Classroom
Y = Treatment without using the PBL learning model combined with Flipped Classroom

2.2. Place and Time of Research

2.2.1. Place of Research

The study was performed in class X of SMA Negeri 4 Surakarta throughout the 2023/2024 term of study.

2.2.2. Time of Research

The research was carried out in February to May 2024.

2.3. Population, Sample, and Sampling

2.3.1. Population

The population involved was X grade of SMA Negeri 4 Surakarta for the 2023-2024 academic year which consists of 11 classes, there are approximately 36 students in each of the classes, for a total of 396 students.

2.3.2. Sample

The study's sample consisted of students in E1 and E3 classes at SMA Negeri 4 Surakarta. Phase E1 is the control group, and Phase E3 is the experimental group.

2.3.3. Sampling

This study applied cluster random sampling. Cluster random sampling is a research tool of the source of large quantities of data. Cluster random sampling was adopted as a sampling strategy since the data gathered was regular and identical; samples were consequently selected at random.

Table 2. Research Sample for Class X SMA Negeri 4 Surakarta for the 2023/2024 Academic Year

No	Class	Amount		Total
		Male	Female	
1	Phase E1	19	17	36
2	Phase E3	20	16	36
Total		**39**	**33**	**72**

2.4. Data and Data Sources

Table 3 Data and Data Sources

No	Data	Data Source	Data Collection Technique	Instrument
1	Cognitive learning outcomes	Student	Test	Question sheet
2	Affective learning outcomes	Student	Questionnaire	questionnaire sheet
3	Psychomotor learning outcomes	Student	Observation	observation sheet

2.5. Data Collection Techniques

Data about studies on the implementation of Problem-Based Learning with Flipped Classroom was collected through observation, questionnaires, and interviews.

2.6. Research Procedure

Researchers are required to carry out stages in carrying out research activities. These stages include preparation, implementation, and data processing.

2.7. Data Analysis Technique

In this study data was analyzed using both descriptive and inferential statistic. Specifically, data analysis of post-test outcomes from the experimental and control classes. The data was analyzed afterwards to determine the impact of the Problem-Based Learning model with Flipped Classroom on the biology learning outcomes of class X SMA Negeri 4 Surakarta.

2.7.1. Descriptive Statistical Analysis

A descriptive statistical approach is used to offer a fundamental overview of the features of student learning outcomes in the experimental and control groups. This data analysis can be calculated using SPSS Statistics 25; the data analysed is learning outcome data, which is first compared with the student learning outcome criteria as follows:

Table 4 Categorization of Students' Biology Learning Outcomes

Value Interval	Predicate	Information
93-100	A	Very Good
84-92	B	Good
75-83	C	Enough
67-74	D	Less
≤ 66	E	Very Less

Source: (Kemendikbud, 2017)

2.7.2. Quantitative Analysis

The analysis of quantitative data was conducted in two stages, namely, testing prerequisites for analysis and hypothesis testing. Normality and homogeneity tests are utilized in precondition assessments. Apply one-way ANOVA for assessing the hypothesis.

3. RESULTS AND DISCUSSION

3.1.Results

The goal of this study is to examine whether PBL with flipped classrooms influences biology learning outcomes in class X at SMA Negeri 4 Surakarta in the school year 2023/2024. This research was performed during three meetings on Biotechnology material. In the experimental setting, treatment was distributed to execute the PBL with a flipped classroom model utilizing Google Classroom as a virtual educational platform and learning videos; in contrast, the control class used conventional methods of learning supported by PowerPoint media. The findings of the study can be explained as follows.

3.1.1. Cognitive Learning Outcomes

Details on cognitive learning outcomes were acquired from posttest results on Biotechnology material. A description of cognitive learning outcome data is presented in Tables 5 and 6.

Table 5. Cognitive Learning Outcomes of Class 10 Students at SMA Negeri 4 Surakarta for the 2023/2024 Academic Year Through the Application of PBL with Flipped Classroom Learning Model

No.	Class	N	KKM	$\bar{x}$	S	S^2	X_{max}	Xmin
1.	Experimental	36	75	76.61	16.59	266.62	100	33
2.	Control	36	75	63.02	8.52	32.63	93	33

Table 6. Frequency of Cognitive Learning Outcomes

Category	Class Experimental	Class Control
Very Good	55.55%	22.22%
Good	38.90%	52.78%
Enough	5.55%	25%
Not Enough	-	-

Based on Table 5, a normality test was performed. The normality test utilizes the Kolmogorov-Smirnov and Shapiro-Wilk tests (Table 7).

Table 7 Normality Test

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Learning Outcomes	Class Experimental	.150	36	.040	.926	36	.019
	Class Control	.097	36	.200*	.940	36	.052

a. Lilliefors Significance Correction

Based on the normality test table previously, the df value (degrees of freedom) for the experimental and control classes is 36, indicating that the Shapiro-Wilk technique is adequate for addressing data normality in this study. Then, The output result is Sig. for the experimental category of 0.019 and Sig. for the control category of 0.052. Because the value of Sig. for both groups is higher (>) than 0.05, it may be maintained that the learning outcomes of the experimental and control classes are typically distributed as data.

The analysis prerequisite test is then continued with a homogeneity test (Table 8). Following to the findings of the homogeneity, the relevance value is 0.420 (more than 0.05), and the data provided is homogeneous and may be used for analysis of difference tests or ANOVA.

Table 8 Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Learning Outcomes	Based on Mean	.659	1	70	.420
	Based on Median	.636	1	70	.428
	Based on Median and with adjusted df	.636	1	69,990	.428
	Based on trimmed mean	.681	1	70	.412

Hypothesis testing was carried out using one-way ANOVA (Table 9).

Table 9 One Way ANOVA

C Learning Outcomes					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3321.125	1	3321.125	10.740	.002
Within Groups	21645.528	70	309.222		
Total	**24966.653**	**71**			

Significant provisions (Sig.) < 0,05 according to the ANOVA table previously, the values p-value (Sig.) is 0,002 < 0,05. Thus, the test decision contradicts H0, which states that there is a substantial disparity in outcomes for learning between the control and experimental classes.

3.1.2. Affective Learning Outcomes

Questionnaires assessing students' creative thinking abilities provided data regarding affective learning outcomes. Tables 10 and 11 describe affective learning outcome data.

Table 10. Affective Learning Outcomes of Class 10 Students at SMA Negeri 4 Surakarta for the 2023/2024 Academic Year Through the Application of PBL with Flipped Classroom Learning Model

No.	Class	N	KKM	$\bar{x}$	S	S^2	X_{max}	X_{min}
1.	Experimental	36	75	72.63	8.59	73.86	98.33	58.33
2.	Control	36	75	67.91	5.59	31.32	83.33	58.33

Table 11. Frequency of Affective Learning Outcomes

Category	Class Experimental	Class Control
Very Good	33,33%	2,78%
Good	66,67%	97,22%
Enough	-	-
Not Enough	-	-

3.1.3. Psychomotor Learning Outcomes

Data on psychomotor learning outcomes were gathered through observations on attitude assessments. Tables 12 and 13 describe the psychomotor learning outcome data.

Table 12. Psychomotor Learning Outcomes of Class 10 Students at SMA Negeri 4 Surakarta for the 2023/2024 Academic Year Through the Application of PBL with Flipped Classroom Learning Model

No.	Class	N	KKM	$\bar{x}$	S	S^2	X_{max}	X_{min}
1.	Experimental	36	75	67.36	12.5	156.25	91.67	41.67
2.	Control	36	75	61.11	12.78	162.69	83.33	41.67

Table 13. Frequency of Psychomotor Learning Outcomes

Category	Class Experimental	Class Control
Very Good	33.33%	25%
Good	61.11%	63.89%
Enough	5.56%	11.11
Not Enough	-	-

3.2. Discussion

The deployment of the flipped classroom-based PBL learning technique has been explored in two classes: experimental and control. This study contains two variables: the independent variable and the dependent variable. The independent variable in the current research is the flipped classroom-based PBL learning approach, featuring the use of a web-based educational tool called Google Classroom. The dependent variable in this research inquiry is learning outcomes, which are assessed using cognitive, psychomotor, and affective measures. The findings and discussion of the study may be interpreted as follows.

3.2.1. Cognitive Learning Outcomes

Cognitive learning outcomes are a form of understanding that must be possessed by students who are actively participating in the learning programs, this will help students comprehend the learning content and improve their knowledge, resulting in improved cognitive learning achievements. Cognitive learning outcomes are an indicator of students' level of mastery about the subjects they have studied or their understanding of a particular topic in learning activities in the context of understanding or theory related to knowledge, and the enhancement of cognitive competencies that include recalling and recognizing of facts, operational patterns, and ideas in developing students' intellectual skills and competencies (Lestari & Irawati, 2020).

Data on student learning outcomes in cognitive section for class 10 at SMA Negeri 4 Surakarta in year of study 2023-2024 were obtained from post-test results. Based on the previously mentioned analyzed data results, the experimental class had higher average on the cognitive learning outcomes compared to the control class; this can be seen in Table 5. The experimental class averaged grades is 76.61, following by the mean in the control class was 63.02. The gap between the average scores of the experimental class and the control class is quite significants, which is 13.59, so from this average value, the treatment of problem-based learning methods based on the flipped classroom influences the learning result afterwards. This aligns with previous research from (Putri, Masruhim, & Widiyowati, 2021) titled *The Effect of Flipped Classroom Model Towards Student's Learning Outcomes.* According to the subject of the buffer solution, this research results show that average points in the control class was 76.62 beside the experimental class was 76.62.

The frequency of cognitive learning outcomes can be categorized into four categories: excellent, good, enough, and not enough. In table 6, The occurences of cognitive learning outcomes observed in the first category, namely the outstanding category in the experimental class, has a percentage of 55.55%, and for the control group, the result show of 22.22%. The sound category of the control class has a higher number in 52.78%, while for the control class, it is 38.90%. The next category is simply an experimental class that only has a percentage of 5.55%, the control class has a 25% in this category. However in the last category, both the experimental and control sections had the same results that is 0%. Therefore, the experimental students get more of cognitive learning outcomes than of the control class.

Statistical test is required to assess if the differences between averages of the two classes is significant or not. Before determining the type of test to use, first off, all prerequisite tests are analyzed with normality and homogeneity tests. The normality test determines whether the data is regularly distributed or not. The Saphiro-Wilk test is suitable for normality testing. The criteria used is if value Sig. > 0.05, and the material is typically distributed. The normality test results obtained values Sig. The data is usually distributed in 0.019 for experimental classes and 0.052 for the control area. This result is in accordance with previous research by (Ismail S., 2022). It is known that the Sig value is 0.158 for the experimental group different from the control group that had 0.455, therefore because the Sig value for both groups > 0,05, it can be interpreted that the *Shapiro Wilk* normality test result has shown as normally distributed data.

Usmadi (2020), in his research, stated that if the data group maintains as a normal distribution, then the homogeneity test may be applied. Based on Table 7, the significance value (Sig) based on the mean for the learning outcome variable is 0.420. Since the value of Sig (0.420) is greater than 0.05, it can be concluded that the variance of learning outcome data in both the experimental class and the control class is homogeneous. This is align with previous research from (Wijayanto, Sukestiyarno, Wijayanti, & Pujiastuti, 2022), and the homogeneity test results obtained values Sig. = 0.384 > α = 0,05, which can be interpreted as meaning that the collected information comes from a population that shares the same/homogeneous variance. Prerequisite analysis result has shown that it can be informed that the data is usually distributed and the data is homogeneous, so it passess the parameter for further testing, thereby is the one-way ANOVA test. As mentioned from the table 8 before, the one-way ANOVA test result show the value Sig. 0.002 < 0.05. As this implies, it is possible to infer that the hypothesis was rejected, indicating that there are variations in learning outcomes between the comparison group and trial classes. These findings are in accordance with research by Nisya & Nindiasari (2023) result of the one-way ANOVA test has shown value Sig. 0.21 < 0.05. Then it could potentially presented that H0 is rejected, implying that there is a difference in the mean score of numeracy ability between courses given with the Flipped Classroom model, which has been integrated with Problem-based Learning, and classes delivered using the Problem-based Learning model. This research is reinforced by the results of descriptive statistics analysis data shown in Table 5, this is indicate that the average score of the experimental class which is 76.61 is higher than the control class that is 63.02.

In research, Rusnawati (2020) stated that students from SMKN 1 Negara have higher study outcomes when the flipped classroom learning model was implemented. The condition can happen because students are more impressed by being active in participating in learning, so students think it is easier to comprehends the course content provided through the flipped classroom learning model. This statement was confirmed by the opinion (Mirlanda et al., 2020) that optimizing learning activities in class by exchanging ideas and practicing allows students to train and hone their reasoning, which can be interpreted indirectly as students practicing making choices and drawing conclusions in a way that is appropriate and of course makes sense.

3.2.2. Affective Learning Outcomes

Affective learning outcomes assess student capabilities that relies on thoughts, sensations, and reactions rather than logical reasoning. This particular type of evaluation was directly related to attitudes among students and desires, encompassing self-assurance, dedication, courtesy, integrity, self-control, collaboration, and other distinctive features. it is understandable that affective assessment focuses on measuring learning outcomes, which is related to character cultivation so that the teacher could implement the evaluation finding to enhances the studying system and maximize an already good learning system (Akbar et al., 2021).

Data from affective student learning outputs were obtained from the survey answer on students' inventive thinking capacity. According to the results of descriptive data analysis, the mean score of effective learning outputs for the experimental class were more significants than the average scores from the control class; this result has shown in Table 8. The experimental class has average grades of 72.63, while the control section has an average value of 67.91. The difference of average scores between the two research classes were relatively small that is at 4,72; this is different from the achieved cognitive learning outcomes of 13.59. Next, the maximum score in the experimental class is 98.33, and the maximum value for the control class is 83.88. So, the maximum value for the experimental class more significants than the control class. For the lowest scores, both of the class have the same value, which is 58.83 for experimental and controls. This is in accordance with research Rizaldi's (2022) the fundamental overview data on students' affective learning outcomes, which could be mentioned as the Mean or average score obtained; there is an increase in the value in the class being tried (Experimental), mean gain of 77.93 and the control group is 70.45.

The amount of frequency of affective study outcomes is categorized into four categories: excellent, good, enough, and not enough. In Table 4.7, the total amounts of affective learning outcomes for the first category, namely perfect for the experimental section, has a percentage of 33.33%, however for the control class, it has a percentage of 2.78%. Move to the second category, namely good for the experimental class, has a percentage of 66,67%, following by the control class that has a percentage of 97.22%. The third category is enough, and the fourth category is not enough; both of the research classes have the same percentage, which is 0%. Therefore, the experimental class outperformed the control class in affective learning sections.

According to research (Pratiwi et al., 2017), Effective learning outcomes show positive values when implementing the flipped classroom learning model. This situation occurs because students feel confident about taking part in learning in class. After all, they already have the material for learning in advance. Besides that, the flipped classroom learning model also helps students to learn independently because it requires them to manage their own time. This can teach them to have an orderly attitude towards the rules and be committed to carrying out the tasks given by the teacher (Fatimah et al., 2022). In research, Fatimah (2022) states that when implementing the flipped classroom learning model, student learning initiative increases by 30%, which means students can carry out learning activities independently without influence from other people.

3.2.3. Psychomotor Learning Outcomes

Psychomotor learning outcomes are aspects of learning outcomes related to the use of basic skills and physical movements. Psychomotor aspects play a vital role in human life. This ability is developed through learning and practice. The psychomotor domain is also related to skills (keterampilan) of a manual or motor nature (Neno, 2023). According to Sugiarti (2018), a student's psychomotor abilities are closely related to skill abilities, which can be seen through practical or experimental activities. It could be potentially inferred that the psychomotor domain is the domain connected to skills (keterampilan) or the capacity to respond when someone obtains or perceived a certain phase of learning (Fathurrahman, 2020).

Data on psychomotor student learning outcomes were obtained from the output of attitude assessment observations. Depend on the previous results of descriptive data analysis in Table 9, it shows that the average score of experimental class students is higher on this section; this is in accordance with cognitive learning outcomes and affective learning outcomes. Based from the result of experimental class, the average effective learning outcomes are 67.36, meanwhile the control class only has 61.11 as their average score. Hence, there is some distinction between the experimental and the control classes that is 6.25. Furthermore, the maximum score for psychomotor learning outcomes is also greater than the control class, with the maximum score in the experimental class being 91.67, but for the control class only has 83.33 points. For the minimum value, there are some traits in common between the experimental and the control classes, which is 41.67.

Table 9 also displays the frequency of psychomotor learning outcomes; in this table, there are four categories of evaluations result by psychomotor learning outcomes that can be mentioned as very good, good, enough, and not enough. The first category is outstanding; the experimental results obtained have a percentage of 33.33%, while for the control class, it has a percentage of 25%. The second category, which is good, obtained the percentage of the experimental class at 61,11% and for the control class at 63.89%. For the third category, it is enough to obtain the respective percentage of results for the both research classes, which are 5.56% in experimental and 11.11% for the control group. The last score from this category by both classes performed the same percentage, which is 0%. As a result of the study this learning outcome occur more frequently in the experimental class than in the control class.

The control class demonstrade inferior outcome in learning from psychomotor domain than those of the experimental. This can be considering that the control class only uses non-PBL learning models. This metodhology demand students to merely write down and pay attention to the teacher's explanation, which results in students lacking skills in the learning process and finding it difficult to achieve optimal learning success. The non-PBL learning model emphasizes teacher-centered learning. Besides that, the psychomotor skills that appear in learning using this model do very little to develop students' psychomotor skills.

They are referring to research (Hamid & Effendi, 2019) that shows that the flipped classroom learning model influences the outputs of learning in students during the psychomotor domain. However, this is different from research findings (Rahma et al., 2023), where the flipped classroom learning model does not influence psychomotor learning outcomes. External factors or internal factors can cause this incident. Students' habits can influence internal student learning outcomes at home, in addition there is an abundance on student learning outcomes and their willingness to learning for the time ahead. Neighborhood environment, school, and family also have an impact on external influences.

4. CONCLUSIONS

The main findings of this research and statistical tests carried out can be informed that flipped classroom-based PBL learning influences biology learning outcomes in biotechnology material. This effect is caused by the PBL with Flipped Classroom learning process, which gives

students more time to understand the lesson material, as well as the existence of online learning media, which allows students to learn independently. Typically, flipped classroom learning contains with both outside and inside activities in class. These two activities are equally important and must run well to obtain maximum results. Although it has more significant advantages, the application of flipped classroom learning may also additionally present some several obstacles. The teacher's role is vital in overcoming existing obstacles for the successful implementation of PBL with Flipped Classroom learning.

5. ACKNOWLEDGMENTS

I wish to express my gratitude to my supervisor who has provided guidance throughout the research process and the completition of this present paper. I would certainly wish to appreciate all parties who contributed until the end of this research.

6. REFERENCES

Agustini, M. (2021). Meningkatkan Aktivitas Dan Hasil Belajar Siswa Menggunakan Model Flipped Classroom Melalui Aplikasi Google Classroom. *Indonesian Journal of Education Development*, 280-289.

Akbar, I. T., Sahlan, H., & Purwanto, H. (2021). Problematika Penilaian Afektif Pada Mata Pelajaran Pendidikan Agama Islam. *As-Sunniyyah Journal Ilmiah Mahasiswa*, 1-11.

Barokah, S. L. (2019). Penerepan Model Pembelajaran Problem Based Learning Berbantuan Media Quiziz Untuk Meningkatkan Hasil Belajar Sosiologi (Lintas Minat) Materi Interaksi Sosial Bagi Peserta Didik Kelas X MIPA 4 SMA N 1 Bawang Tahun Pelajaran 2020/2021. *Habitus: Jurnal Pendidikan Sosiologi dan Antropologi*, 173-186.

Eskris, Y. (2021). Meta Analisis Pengaruh Model Discovery Learning dan Problem Based Learning terhadap Kemampuan Berfikir Kritis Peserta didik Kelas V SD. *Jurnal Pendidikan Guru Sekolah Dasar*, 43-52.

Fathurrahman, F. (2020). Pengembangan Rubrik Penilaian Aspek Psikomotorik Pembelajaran Atletik Start Jongkok Untuk Tingkat Sekolah Menengah Atas. *Skripsi Sarjana, Universitas Negeri Yogyakarta*.

Fatimah, D., Kantun, S., & Herllindawati, D. (2022). Pengaruh Model Pembelajaran Flipped Classroom Terhadap Kemandirian dan Hasil Belajar Siswa. *PANDITA: Interdisciplinary Journal of Public Affairs, 5*, 1-12.

Febrita, l., & Harni, H. (2020). Model Problem Based Learning dalam Pembelajaran Tematik Terpadu terhadap Berfikir Kritis Siswa di Kelas IV SD. *Jurnal Pendidikan Tambusai*, 1619-1633.

Fitri, D. M. (2022). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Kritis Siswa Pada Pembelajaran Biologi. *ALVEOLI: Jurnal Pendidikan Biologi*, 41-52.

Hamid, A., & Effendi, H. (2019). Flipped Classroom Sebagai Alternatif Pembelajaran Pada Mata Pelajaran Dasar Listrik dan Elektronika. *JTEV (Jurnal Teknik Elektro dan Vokasional), V*(1), 81-86.

Hotimah, H. (2020). Penerapan Metode Pembelajaran Problem Based Learing Dalam Meningkatkan Kemampuan Bercerita Pada Siswa Sekolah Dasar. *Jurnal Edukasi*, 5-11.

Huliatunisa, Y. (2022). *Dasar Pengembangan Kurikulum Sekolah Dasar.* Sukabumi: CV Jejak, anggota IKAPI.

Ismail, M. I. (2021). *Evaluasi Pembelajaran.* Depok: PT. RajaGrafindo Persada.

Ismail, S. (2022). Pengaruh Penggunaan Model Pembelajaran Berbasis Proyek "Project Based Learning" Terhadap Hasil Belajar Fisika Peserta Didik Kelas X IPA SMA Negeri 35 Halmahera Selatan Pada Konsep Gerak Lurus. *Jurnal Ilmiah Wahana Pendidikan*, 256-269.

Khoerunnisa, P., & Aqwal, S. M. (2020). Analisis Model-Model Pembelajaran. *Fondatia : Jurnal Pendidikan Dasar*, 1-27.

Lestari, D. G., & Irawati, H. (2020). Literature Review: Peningkatan Hasil Belajar Kognitif Dan Motivasi Siswa Pada Materi Biologi Melalui Model Pembelajaran Guided Inquiry. *Bioma*, 51-59.

Mahardika, W. (2021). Peningkatan Hasil Belajar Futsal Melalui Pendekatan Bermain Pada Siswa Kelas X SMA Negeri 4 Surakarta Tahun Ajaran 2019/2020. *Jurnal Ilmiah Mitra Swara Ganesha*, 11-18.

Maolidah, I. S., Ruhimat, T., & Dewi, L. (2017). Efektivitas Penerapan Model Pembelajaran Flipped Classroom Pada Peningkatan Kemampuan Berpikir Kritis Siswa. *EDUTCEHNOLOGIA*, 160-170.

Mirlanda, E., Nindiasari, H., & Syamsuri. (2020). Pengaruh Pembelajaran Flipped Classroom Terhadap Kemampuan Penalaran Matematis Ditinjau Dari Gaya Kognitif Siswa. *Prima: Jurnal Pendidikan Matematika, 4*(1), 11-21.

Neno, K. J. (2023). Analisis Kecerdasan Psikomotorik Mahasiswa PPL Progam Studi Pendidikan Informatika Dalam Manajemen Pembelajaran TIK Di Sekolah. *HINEF : Jurnal Rumpun Ilmu Pendidikan, 2*(1), 17-21.

Nisya, K., & Nindiasari, H. (2023). Penerapan Flipped Classroom Diintegrasikan Dengan Problem Based Learning Terhadap Kemampuan Numerasi Siwa SMA. *Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika dan Statistika*, 327-335.

Pramana, M. W., Jampel, I. N., & Pudjawan, K. (2020). Meningkatkan Hasil Belajar Biologi Melalui E-Modul Berbasis Problem Based Learning. *Jurnal EDUTECH Universitas Pendidikan Ganesha*, 17-32.

Pratiwi, A., Sahputra, R., & Hadi, L. (2017). Pengaruh Model Flipped Classroom Terhadap Self-Confidence dan Hasil Belajar siswa SMAN 8 Pontianak. *Jurnal Pendidikan dan Pembelajaran, 6*(11), 1-13.

Putri, N. A., Masruhim, M., & Widiyowati, I. I. (2021). The Effect of Flipped Classroom Model Towards Students Learning Outcomes On The Subject Of the Buffer Solution. *Bivalen: Chemical Studies Journal*, 13-16.

Rahma, E. A., Herlambang, A. D., & Rahman, K. (2023). Pengaruh Model Flipped Classroom Pada Mata Pelajaran Pemograman Dasar terhadap Hasil Belajar Siswa Kelas X SMK Negeri 6 Malang. *Jurnal Pengembangan Teknologi Informasi dan Komputer, 7*(5), 2421-2427.

Rizaldi, R. (2022). Analisis Hasil Belajar Fisika Siswa Pada Ranah Afektif Pokok Bahasa Getaran dan Gelombang. *EKSAKTA : Jurnal Penelitian dan Pembelajaran MIPA*, 257-261.

Rusnawati, M. D. (2020). Implementasi Flipped Classroom terhadap Hasil dan Motivasi Belajar Siswa. *Jurnal Ilmiah Pendidikan dan Pembelajaran, 4*(1), 139-150.

Rusnawati, M. D. (2020). Implementasi Flipped Classroom Terhadap Hasil dan Motivasi Belajar Siswa. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 139-150.

Rustaman, N. Y. (2016). Pembelajaran Sains Masa Depan Berbasis STEM Education. Padang: Prosiding Seminar Nasional Biologi Edukasi.

Salam, R. (2017). Model Pembelajaran Inkuiri Sosial Dalam Pembelajaran Ips. *HARMONY: JurnalPembelajaran IPS Dan PkN*, 7-12.

Silvi, F., Witarsa, R., & Ananda, R. (2020). Kajian Literatur tentang Kemampuan Pemecahan Masalah Matematika dengan Model Problem Based Learning Pada Siswa Sekolah Dasar. *Jurnal Pendidikan Tambusai*, 3360-3368.

Sinmas, W. F., Sundaygara, C., & Pranata, K. B. (2019). Pengaruh PBL Berbasis Flipped Class Terhadap Prestasi Ditinjau Dari Motivasi Belajar Siswa. *Rainstek Jurnal Terapan Sains & Teknologi*, 14-20.

Sudjana, N. (2006). *Penilaian Hasil Proses Belajar Mengajar*. Bandung: PT Remaja Rosdakarya Offset.

Sugiarti. (2018). Penilaian Psikomotor Siswa Pada Pembelajaran Fisika Melalui Model Pembelajaran Guided Inquiry. *Journal Of Physics and Science Learning, 2*(1), 78-84.

Suryadi, A. (2020). *Evaluasi Pembelajaran Jilid II.* Sukabumi: CV Jejak, anggota IKAPI.

Susanti, L., & Hamama Pitra, D. (2019). Flipped Classroom Sebagai Strategi Pembelajaran Pada Era Digital. *Health & Medical Journal*, 54-58.

Usmadi. (2020). Pengujian Persyaratan Analisis. *Inovasi Pendidikan*, 50-62.

Wardana, S., & Sagoro, E. M. (2019). Implementasi Gamifikasi Berbantu Media Kahoot Untuk Meningkatkan Aktivitas Bealajar, Motivasi Belajar, dan Hasil Belajar Jurnal Penyesuaian Siswa Kelas X Akuntansi 3 Di SMK Koperasi Yogyakarta Tahun Ajaran 2018/2019 . *Jurnal Pendidikan Akuntansi Indonesia* , 46-57.

Widodo, H. (2021). *Evaluasi Pendidikan.* Yogayakarta: UAD PRESS.

Wijayanto, Z., Sukestiyarno, Y., Wijayanti, K., & Pujiastuti, E. (2022). Pembelajaran Flipped Classroom dalam Meningkatkan Self-Regulated Learning Siswa. *Prosiding Seminar Nasional Pascasarjana Universitas Negeri Semarang*, 1241-1247.

Zainal, V. R., Kamal, H., & Muhammad, N. (2014). *The Economics Of Education.* Jakarta: PT Gramedia Pustaka Utama.

Ziraluo, Y. B. (2021). *Pembelajaran Biologi Implementasi dan Pengembangan (Kedua ed.). (L. Sumiyarti, Ed.).* Lombok Tengah: Forum Pemuda Aswaja.