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The Effect of Problem-Based Learning Models on Improving High School Students' Learning Achievement

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Abstract
This study aims to determine the effectiveness of the problem-based learning (PBL) model in increasing high school student achievement. This research method uses a descriptive method with a quantitative approach. The research instruments that will be used in this research and development are Biology learning achievement tests and assessment rubrics. Data analysis used SPSS 26 software for testing one paired sample t-test The results showed that the treatment of problem-based learning methods in student achievement for biology class was quite effective in increasing student achievement. This learning model emphasizes long-term learning, students are directly involved in various problems and problems of daily life, learning to understand and solve problems in life. Practical, interdisciplinary, and engaging students play a key role in the design, implementation, and reporting of results-oriented (student-centered) activities. In scientific subjects, practices involving students directly are needed. This study supports some of the results of research using the same method in the field of science and technology but contrasts with the results of research using the same method in the field of linguistics.

Keywords: Problem-Based Learning; Learning Achievement, High School Student

1. Introduction

State why the problem deserves new research. For basic research, the statement about importance might involve the need to resolve any inconsistency in the results of past work and/or extend the reach of a theoretical formulation. For applied research, this might involve the need to solve a social problem or treat a psychological disorder. When research is driven by the desire to resolve controversial issues, all sides of the debate should be represented in balanced measure in the introduction. Avoid animosity and ad hominem arguments in presenting the controversy. Conclude the statement of the problem in the introduction with a brief but formal statement of the purpose of the research that summarizes the material preceding it. Literature reviews as well as theoretical and methodological articles, also clearly state the reasons that the reported content is important and how the article fits into the cumulative understanding of the field.

Formal education is increasingly needed. This is due to the fact that the family environment is not able to introduce children to the world of science which is growing rapidly, however, the problems that occur in the world of education today are very complex in terms of relevance, quality, quantity, and others. In terms of quality, for example, many consider that the quality of our education is very low so efforts are needed to improve it (Abror, 2021; Ermayani, 2021; Yanti et al., 2021). As per the Law of the Republic of Indonesia (UUD) No. 20 of 2003 on the National Education System, the position of an educational teacher is a professional position. reflects that Indonesian education aims to develop students' potential to become almighty, creative, independent God-fearing, and trusting human beings and to become responsible and fulfilling democratic citizens. One of human rights, namely the right to education. On that basis, Indonesia implements the principles of democratic education both horizontally (everyone has the right to education access) and vertically (everyone has the right to the highest education according to ability) (Dzurrahmi et al., 2021; Hadiyanto et al., 2021; Ivan, 2021).

Education is a necessity for people all over the world. The learning process in this century is integrated between literacy, knowledge, skills, attitudes, and adaptation to changing technologies. New learning model need to be overhauled to meet the needs of the 21st century with the change in psychology, thinking patterns, and action models in other contexts of educational and learning performance (Irianto, 2017).

Teachers are the key and at the same time the spearhead of educational attainment and renewal, therefore teachers are in the middle of regulating, guiding, directing, and educating to achieve educational goals. The low quality of learning cannot be separated from the ability of teachers to carry out classroom learning (Aisiyah, 2021; Hadiyanto et al., 2021; Hasanah et al., 2021). But in reality, the learning process that the teacher brings in nowadays is still not running optimally, especially in mathematics. Often what happens in schools, learning mathematics is only oriented to mastery of the material as evidenced by learning outcomes in certain competencies. The teacher assumes that the task of teaching is to transfer information, knowledge, and books, the task of students is to receive, remember, and memorize information according to what is said. This is also done by the teacher every day so that students feel bored in receiving learning and finally students are lazy in learning. And rarely do teachers equip students with problem-solving in long-term life (M et al., 2021; Nursita, 2021; Rosyada et al., 2021).

Nowadays we need a learning model that can be realized if there is a shift in mindset, mental patterns, and patterns of action in various contexts of implementing the education and learning process. To become an educator who has the right strategy for the future (visionary) and is oriented towards the future, what must be understood is: changes in the conditions of students, views of students, profiles of students in the future, students' needs to adapt to changes, selection of suitable learning models and methods, creating learning conditions that support the selection and procurement of learning evaluation tools that are appropriate and contextual, and the quality of educators who are constantly improving (Gusty et. al., 2020).

In accordance with Regulation No. 22, 2016 of the Ministry of National Education on Standards of Primary and Secondary Education, the learning process in the educational unit is interactive, fun, challenging, and communicative, inspires, and influences students to actively participate, more creatively, promote initiative move, and independence through students' abilities, interests, talents, and psychological and physical development.

One of the problems facing the educational world today is poor learning. During the learning process, students are less motivated to develop intelligence. Therefore, to support this learning, it is almost obligatory to use a learning model that is appropriate to the conditions of the students in the school. The appropriate learning model is a problem-based learning model (PBL) (Susanto, 2014).

At present, a learning approach is urgently needed that is by the stages of students' intellectual development and can provide meaning for students. Learning does not always have to be done in the classroom, sometimes learning can also be done outside, in the surrounding environment, and in the open. Outside learning or in the surrounding

environment allows students to directly experience the concepts being studied and can develop students' logical reasoning. This is because learning material is summarized into activities that are close to students' experiences in their daily lives so that they become meaningful.

The learning process in schools today has a main problem, one of which is the low receptivity of students. Noticeably in the student's academic results who are always paid great attention by the school. This achievement is of course the result of classical conditioning. Based on observations in high schools, the authors gathered information from interviews with biology teachers that students have difficulty in learning to understand the subject of biology because, in the process of students, teachers present material that is not optimal. question due to limited time during the COVID-19 pandemic. What we mean here is less optimal: teachers rarely use subject-appropriate learning models for students, teachers only teach biological concepts and theories through teacher-centered activities, students do not actively participate in activities, and do not allow students to develop their thinking processes.

The learning this method, teachers have not fully developed their abilities, so most students do not have the necessary personal skills to demonstrate that they are engaged in further learning, which reduces students' learning motivation and leads to poor learning results. Solving educational problems with the current conditions in the field, the government has carried out various reforms, including conducting training, training and improving teacher competence, procurement of books and learning tools, etc. Therefore, teachers look forward to being prepared to improve the standard of education by choosing and using learning models according to student characteristics, basic competencies, learning objectives to be achieved and the material to be taught (Abror, 2021; Ivan, 2021; Munawwir & Nur Hanip, 2021).

The problem-based learning model (PBL) that uses the environment plays a good role in the learning process, as it can help students understand the learning material, and make decisions about the content, the environment, and the environment. learning opportunities, for students indoors and outdoors. classroom and can help define dynamic learning contexts that are constantly updated. In addition, Problem-based learning is a concept of learning that helps teachers link the teaching material to real-life situations and stimulate students to associate knowledge and application, utilization in daily life as a member of family and community (Kuo et al., 2021; Syamina et al., 2021). This PBL concept is expected to make better the learning outcomes and will be more purposeful to students.

The learning process occurs naturally in the form of student activities and experiences rather than the basic concept of knowledge transfer from teacher to student. A learning strategy is much more important than an outcome. Achievement motivation is a psychophysiological condition present in students that encourages them to perform certain activities in order to achieve a certain goal (Alifia & Pradipta, 2021; Fitriati et al., 2021; Nurwahidah et al., 2021). In addition, achievement motivation is the most important thing in a teaching and learning process, because achievement motivation is the encouragement or driving force of individuals in achieving success, and student behavior will be directed in behaving in accordance with abilities in the development of knowledge and skills, and achievement motivation considered as one of the most important variables in determining whether educational goals are achieved, especially if the individual concerned does have abilities that are not so encouraging, then without motivation it is difficult to expect good learning outcomes (Nurwanti, 2021; Susana et al., 2021; Wijayanti et al., 2021).

Nahdi (2018) argues that problem-based learning (PBL) is a learning innovation because, in PBM, students' thinking skills are enhanced through a group or group work process. systematically, so that students can empower, refine, test, and grow. their ability to continuously reflect. On that basis, there should be a thorough study of what and how problem-based teaching should be applied in the learning process in order to provide information, especially for teachers, about learning. work through the problem. Furthermore, Trianto (2014) argues that the problem-based learning model is a learning model.

Problem-based learning (PBL) is a learning model with an approach in which students learn from real problems so that they can acquire their own knowledge, develop skills, and have higher expectations, empowering students and boosting their self-confidence (Hosnan, 2014). A distinctive feature of this model is the use of real-world problems as what students must learn not only to acquire knowledge and awareness but also to practice and improve their critical thinking, problem-solving skills, and independent skills.

Problem-based learning (PBL) is a learning form modeled after constructivism, oriented towards the student learning process (student-centered learning). PBL (Problem-Based Learning) is a learning model that focuses on presenting a problem (real or simulated) to students, after which students are challenged to find a solution through a series of research and Investigations based on theories, concepts, and principles that students have learned from different scientific fields (multiple perspectives). Issues become the focal point, stimulating and directing the learning process. While teachers become facilitators and guides (Sari and Siregar, 2019).

The problem-based learning model (PBL) using the environment will play a good role in the learning process, as it can help students understand the learning material, and make decisions about the substance content, the environment. and learning opportunities, for students indoors and outdoors. outside the classroom and can help establish dynamic learning contexts (Schwartz, 2013). Problem-based learning (PBL) is an "active learning" method of teaching that uses complex real-world problems as a vehicle for teaching student concepts and principles, as opposed to passive, spoon-based rote learning based on teacher-designed lectures and didactic instruction typical of traditional curricula (Liu et al., 2019).

PBL stimulates students to recognize their knowledge capacity and skills and implement them in new circumstances or to combine and use prior knowledge and principles to achieve specific goals (Yaquinuddin, 2013), which distinguishes PBL from other student-centered approaches, such as project-based learning based on surveys and cases. Initially, PBL was designed to develop teaching methods for medical students (Goodnough, 2006). Since then, PBL has been used in many fields (nursing, medical, dental, pharmaceutical, pediatric, physical diagnostics, and even pharmacology) (Gao et al., 2016; Huang, Zheng, Li, & Yu, 2013; Imran et al., 2015; Kong, Qin, Chu, Mou, and Gao, 2014; Wang et al., 2016; Chu et al., 2016) and at all levels of university and higher education (Miller, 2003; Zhang et al., 2015).

Problem-based learning has been known since the time of John Dewey and is now starting to be accepted as a holistic approach to learning by providing students with authentic and meaningful problem situations that I can point out. opportunity to discover (Umanailo et al., 2019). Basically, mathematics, as a structured and systematic science, implies that mathematical concepts and principles are related. Therefore, when learning mathematics to gain meaningful understanding, students must have a range of mathematical associations, that is the ability to relate mathematical concepts between concepts within mathematics itself and relate mathematical concepts to concepts in other fields (Ruspiani, 2000).

Research by Ramadhani et al. (2019) examined the effectiveness of using the LMS-Google classroom-based reversible problem-based learning model during math learning at SMA Negeri Medan, North Sumatra, in Indonesia. This study was a semi-experimental study with a pre-trial and post-trial control group design. The sample for this study included 62 high school students from two schools. Research results were analyzed using SPSS 25.0 software with a two-way ANOVA test and LSD test. Based on analytical testing, we know that the average math performance of students who followed the Google Classroom LMS-based reverse problem-solving learning model significantly increased compared to conventional learning. The results of the study sheets also show that the students in grade II feel interested, motivated, and enthusiastic to participate in class learning. Digital learning with LMS-Google Classroom-based flip-flop learning provides a new experience for high school students by engaging in math learning in and out of the classroom.

Further research by Palupi et al. (2020) compared the effectiveness of guided learning (GIL) and problem-based learning (PBL). Some previous studies have implemented the GIL model in limited fields, such as science. Similar to the PBL learning design, previous research focusing on the application of the GIL model often aimed to compare it with traditional learning models. A sample of 162 students was selected by the multistage sampling method. Data in the form of students' explanatory writing test scores were analyzed using a one-way ANOVA. These results confirm that the GIL model is considered to be more effective than the PBL for narrative text because the student's age-specific activity still requires teacher-centered instruction to create text. This. In terms of conditions, the PBL model cannot be effective for narrative writing activities because this model focuses more on students' problem-solving abilities.

Silalahi's research (2021) examines the effectiveness of the cooperative problem-based learning (CPBL) model in static learning. The research method of the experimental class is experimental, in which the experimental class applies the CPBL model and the control class applies the conventional model. A simple random sample is taken for the experimental and control groups. The tool used is a test of academic achievement. The results show that the learning outcomes of students in the experimental group are better than those in the control group. Therefore, the learning outcomes of students under the CPBL model show an increase in static learning of very good quality. It is drawn to a close that applying the CPBL model is more sufficient than conventional learning.

Having that description in mind, the PBL or problem-based learning model by Ramadhani et al. (2019) and Silalahi (2021) has research gaps that can be found through some of the results of previous studies, their research is more effective in improving students' academic performance. Meanwhile, according to Palupi et al. (2020), the PBL model is not effective in increasing student achievement. Therefore, this study focuses on the level of validity and practicality of the Problem-based learning (PBL) model in improving high school student achievement in biology subjects using the pre and post-test t-test methods and then the n-gain method.

2. Method

This study using the quantitative descriptive research with a pre-experimental research type using a one-group pre-test-post-test design (Creswell, 2010). Following the research procedure used there are three stages, namely: (1) the preparation stage; (2) the implementation stage; and (3) the analysis stage. At the preparatory stage, what was done was observing the students who were the subject of the research. In this activity what is observed is the learning achievement of students. This research focuses on developing a Problem-based learning model to improve high school student achievement in biology subjects. This study examined the results of an assessment of biology learning achievement before and after applying a problem-based learning method using a one-group pretest-posttest design method.

The instrument that will be used in this study is a biology learning achievement test and an assessment rubric: In other words, biology learning achievement tests are used to measure a student's ability after participating in the learning process. The test is carried out with multiple choice questions in the number of 50 questions based on the test grid that has been given, the value range ranges from 0-100 with a score of 2 to 1 correct question. Data analysis used SPSS 26 software for testing one paired sample t-test.

3. Results and Discussion

Biology Output Standard Tests are used to assess students' abilities after going through the learning process. The student biology performance test used is a multiple choice test built from the construction of indicators to assess the level of achievement of identified basic skills, following that uses a benchmarked reference assessment (PAP) that is geared toward a student's level of proficiency. of all materials examined, so the scores obtained reflect the student's level of performance in biology. The stages of developing a test to test the skills of assessing learning

outcomes in biology are: (1) define test frameworks based on performance indicators of basic skills; (2) compile the tests; and (3) define grading guidelines. The test is carried out with multiple choice questions in the number of 50 questions based on the test grid that has been given, the value range ranges from 0-100 with a score of 2 to 1 correct question.

The following in table 1, data is presented regarding the minimum, maximum, and average values in the pre-test and post-test after implementing the PBL method.

Table 1. Descriptive Statistics result for Pre-test and Post-test

Criteria	*Pre-test*	*Pos-test*
Min	32	56
Max	84	100
Average	55.65	77.55

As you can see based on the table, in the pre-test column the minimum value is 32, while in the post-test column the minimum value is 56. The maximum value in the pre-test column is 84, while in the post-test column the maximum value is 100. Furthermore, the average value obtained an average value in the pre-test of 55.65, and in the post-test column obtained an average value of 77.55. Based on the descriptive analysis that was carried out in the pre-test and post-test groups, it can be concluded that the post-test scores have a higher average than the pre-test scores. This indicates that the problem-based learning method is effective in improving students' biology learning ability.

However, this is not the only effect of the problem-based learning model method in this study. It is necessary to look at the significance of the effect based on the pre-test and post-test data. Analysis was performed using SPSS 26 software using the paired sample t-test method. The SPSS analysis output shown in the following table.

Table 2: Paired Samples Correlations

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre & Post	40	.880	.000

The table above describes the relationship between pre-test and post-test data. Concluded from the SPSS results, the significance value (sig.) is found to be 0.000, which is under 0.05, which means that the data between the pre-test and post-test have a relationship. The correlation value is 0.88 (between the range 0-1), so it can be said that the correlation between the two data is very close. This is reasonable because it is one paired sample, which means that the respondents (students) who are tested on the pre-test and post-test are the same students.

Furthermore, there is an output that explains the effect of the PBL model on student achievement which is presented in table 3 below.

Table 3: Paired Samples Test

Paired Samples Test

Paired Differences							
			95% Confidence Interval of the Difference				
Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)

Pair 1	Pre - Post	-21.90000	7.37216	1.16564	-24.25773	-19.54227	-18.788	39	.000

Table 3 indicates the effect of the PBL method on student achievement in biology class. This influence can be seen based on the significance value (sig.). The significance value shown in the table states that it is 0.000, which means it is below 0.05. This indicates that there is an influence between student achievement before and after the PBL learning method is used. Overall, on the sample t-test and descriptive analysis, it can be concluded that the PBL learning method is effective for increasing student achievement in biology lessons. This research does not stop here, a follow-up analysis, namely the analysis of how to do it, is carried out to see how effective the PBL learning method is.

In addition, in this study, the N-Gain Score test was administered to determine improvement in student achievement in biology. The trial in this study was a group pre-test and post-test, which is an experimental study design. The N-Gain test is performed by counting the dissimilarity between the value of pre-test and post-test.

Table 4: N-Gain Category

Limitation	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Middle
$g < 0,3$	Low

Source: Meltzer (2003)

Table 4 shows that the grade of n-gain limit level is divided into 3 categories, namely low if the n-gain value is less than 0.3 or 30%. Average if the n-gain value is between 30 and 70% and high if the n-gain value is greater than 0.7 or greater than 70%.

Table 5: Category of N-Gain Improvement Interpretation

Category Interpretation of N-Gain Effectiveness	
Percentage (%)	Interpretation
< 40	Not Increasing
40 - 50	Less Increase
56 - 75	Enough Increase
>76	Increase

Source: Hake (1999)

In addition, Table 5 explains the type of explanation for the increase in n-gain. It includes four types of implementations according to Hake (1999). The interpretation category did not increase if the ratio was less than 40%, that is the intervention or control did not yield a significant increase compared to before and after the trial. The latter has less of an increase if the percentage increase n is between 40 and 50%, which means that the treatment or control did not improve results from the pre-test to the post-test. In addition, the third category, if it falls between 51 and 75%, is classified as moderately increased, meaning that treatment or control increases enough for pre-test to post-test results. Finally, 76% or more were classified as "increasing," meaning that the treatment or control was increasing between the pre-test and post-test results.

The results of the n-gain analysis on the experimental classes related to the pre-test and post-test values are shown in the following table:

Table 6: N-Gain Analysis Results

Number	Pre-test	Post-test	Difference	Ideal Score (100-pre)	N-gain	% N-gain
1	58	70	12	42	0.29	29%
2	82	90	8	18	0.44	44%
3	34	66	32	66	0.48	48%
4	64	96	32	36	0.89	89%
5	64	80	16	36	0.44	44%
6	52	68	16	48	0.33	33%
7	80	96	16	20	0.80	80%
8	48	76	28	52	0.54	54%
9	38	60	22	62	0.35	35%
10	36	62	26	64	0.41	41%
11	74	100	26	26	1.00	100%
12	74	94	20	26	0.77	77%
13	54	86	32	46	0.70	70%
14	44	62	18	56	0.32	32%
15	66	84	18	34	0.53	53%
16	52	78	26	48	0.54	54%
17	54	70	16	46	0.35	35%
18	54	78	24	46	0.52	52%
19	78	98	20	22	0.91	91%
20	34	62	28	66	0.42	42%
21	32	64	32	68	0.47	47%
22	60	74	14	40	0.35	35%
23	62	92	30	38	0.79	79%
24	46	70	24	54	0.44	44%
25	42	56	14	58	0.24	24%
26	74	96	22	26	0.85	85%
27	54	68	14	46	0.30	30%
28	58	68	10	42	0.24	24%
29	42	68	26	58	0.45	45%
30	32	66	34	68	0.50	50%
31	42	72	30	58	0.52	52%
32	40	68	28	60	0.47	47%
33	52	86	34	48	0.71	71%
34	84	100	16	16	1.00	100%
35	34	62	28	66	0.42	42%
36	82	92	10	18	0.56	56%
37	74	98	24	26	0.92	92%
38	62	78	16	38	0.42	42%
39	58	76	18	42	0.43	43%
40	56	72	16	44	0.36	36%
Average					0.54	54%

The table above showed that the average posttest scores were higher than the pretest scores. This indicates that children in the experimental class tended to improve their scores by correcting their mistakes through problem-

based learning. The mean N gain in the test class in this study was 54%, which was classified as moderate, and for effectiveness, it was included in the moderate gain category. This means that the use of problem-based teaching methods is quite effective in improving the learning efficiency of high school students in Biology.

Problem-based learning is a type of learning model in which students engage in an activity (project) to create a product. Student involvement begins with planning, designing, implementing, and communicating the results of activities in the form of products and performance reports. This learning model focuses on a long-term learning process in which students are directly involved in a variety of everyday life problems and learn to understand and solve related problems, be they industrial or practical, and engaging students as key actors in the design, implementation, and communication of the results of the activities (student focus). In scientific subjects, practices involving students directly are needed. With science and technology practices that have been implemented, it can make students better understand the real situation in science and technology learning which is not only based on theory. Biology lessons are no exception, for example, there is practice regarding organ systems through the torso. Thus students will increasingly understand how the condition of organ systems in humans, not just imagining it.

Problem-based learning (PBL) models help students find meaning in lessons by connecting academic material to the context of their daily lives (Firdaus et al., 2021; Putri and Taqiudin, 2021; Yulia Sari, 2021). They build meaningful relationships and create meaning by engaging in independent learning, working collaboratively, thinking critically and creatively, communicating with others, achieving high standards, and engaging with others. engage in learning tasks. Yennita and Zukmadini, 2021). As described by Elaine B. Johnson (2002). an educational process that work towards to help students understand what they are learning by relating the subject matter to everyday life situations, i.e., the personal and social contexts of individuals, societies, and cultures. To achieve this goal, the system consists of the following eight elements: making meaningful connections, doing meaningful work, self-study, collaboration, critical and creative thinking, personal development, high standards, and the use of authentic assessment.

If the problem-based learning method is implemented correctly it will make students better understand the real conditions of a subject. Indirectly it will attract the attention of students to increase their interest in learning more deeply. Thus, the problem-based learning method can empirically improve student achievement in the context of this study, namely science-based subjects, namely biology subjects.

Associated with previous research, this study supports the results of research by Ramadhani et. al. (2019), and Silalahi (2021), but is contrary to research by Palupi et. al. (2020). Research Ramadhani et. al. (2019) stated that the average learning outcomes of students who were taught using the Flipped-Problem-based learning model based on the Google Classroom LMS experienced a significant increase compared to conventional learning. The results of the questionnaire in learning also showed that class II high school students felt enthusiastic, motivated and enthusiastic about participating in class learning. Digital-based learning with the Flipped-Problem-based learning model based on LMS-Google Classroom provides a new experience for high school grade II students in participating in mathematics learning both in class and outside the classroom. The learning method used by Ramadhani et. al. (2019) is one of the developments of the problem-based learning method which has an influence on the enthusiasm of high school students. By influencing the enthusiasm of these high school students, they will be able to improve their learning achievement because they feel very enthusiastic about participating in a lesson, so this research supports the results of research by Ramadhani et. al. (2019).

Further research by Palupi et. al. (2020) compared the effectiveness of the Guided Inquiry Learning (GIL) and Problem-Based Learning (PBL) models. Palupi et.al research. al. (2020) the GIL model is considered more effective than PBL for explanatory writing activities because of the concrete operational age of students who still need teacher-centered guidance in producing explanatory texts. Judging from the conditions, the PBL model cannot offer effectiveness for explanatory writing activities, because this model places more emphasis on students' problem solving abilities. PBL model research is less effective in learning related to language areas such as writing

explanations, thus research by Palupi et. al. (2020) cannot be said to be directly opposite to this research because it is necessary to pay attention to several aspects such as research limitations in which fields. This research examines science and technology, especially biology subjects which state that the problem-based learning model is quite effective in increasing student achievement, while research by Palupi et. al. (2020) examines explanatory writing, which is the field of language and literature.

A further research by Silalahi (2021) examined the effectiveness of the cooperative problem-based learning (CPBL) model in static learning. The results show that the learning outcomes of students in the experimental group are better than those in the control group. Therefore, the learning outcomes of students under the CPBL model show an increase in static learning of very good quality. It is concluded that applying the CPBL model is more effective than conventional learning. This is consistent with this study, which found that the APP model is quite effective in improving student achievement because the fields of study are similar, namely science and technology.

Overall it can be concluded that the problem-based learning method can influence student learning achievement to be better (improve) in science-based learning. Thus it can be used as a reference to make the problem-based learning method to improve student achievement.

4. Conclusion

Based on the research findings reviewed, it was concluded that problem-based learning to help students succeed in biology is highly effective in improving student achievement. This learning model emphasizes a long-term learning process in which students learn to engage directly with and understand various problems and problems of everyday life and solve them in a practical, interdisciplinary manner, and involving them as key actors in the design, implementation, and communication of the outcomes of (student-centered) activities. In science subjects, practice that is directly related to the student is necessary.

This study supports several previous studies such as research by Ramadhani et. al. (2019), and Silalahi (2021), but contrary to research by Palupi et. al. (2020). Overall it can be concluded that the problem-based learning method can influence student learning achievement to be better (improve) in science-based learning. Thus it can be used as a reference to make the problem-based learning method to improve student achievement.

5. Suggestions

This research covers the scientific field which is specific to biology subjects. It has obtained support from research results in the same field, namely science, and technology, while there are studies that contradict the results of this research because the fields are different, namely language. Future research can examine science with other subjects such as mathematics, physics, or chemistry to confirm the results of this study. It can also be done for the application of problem-based learning methods to the social aspects of humanities such as history, economics, geography, etc. to broaden and sharpen theories about problem-based learning models.

The problem-based learning method at this time is very important to intensify because this learning method trains students to always think critically and be skilled in solving a problem, besides that learning activities run more conducive and effectively because students are required to be active. This learning method requires students to be active in solving problems and can be used as a provision for the future how a student can think critically in the conditions of the very volatile industrial era 4.0.

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