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Implementation of Problem-Based Learning Model based on Differentiated Learning to Improve Science Literacy Skills and Student Activities

Virlya Citra Dewi[1*], Nur Kuswanti[1], Bambang Prijono[2]
[1]PPG Prajabatan Biologi, Universitas Negeri Surabaya, Surabaya, Indonesia
[2]Guru Biologi, SMAN 1 Sidoarjo, Sidoarjo, Country.

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ABSTRACT

Scientific literacy skills are a person's ability to understand and construct scientific concepts so that they can apply them scientifically to respond to environmental issues and solve their problems. This skill is essential to train students so that students are more involved and active in learning. The low level of scientific literacy skills and student activity is a problem that is often faced by Indonesian teachers. This study aims to improve scientific literacy skills and student activity through problem-based learning based on a differentiated learning approach. This type of research is Classroom Action Research (CAR), which consists of four stages: planning, action, observation, and reflection. Data collection techniques in this study are observation and tests. The research instrument was an observation sheet to determine student learning activities, while a test sheet was used to determine students' literacy skills. Based on the study's results, it showed an increase in scientific literacy skills and student activity in each cycle. This can be seen from the N-gain value of the first cycle (0.63) and the second cycle (0.71), and the average of student activity in the first cycle (70.32%) and the second cycle (88.44%). Thus, it can be concluded that the implementation of problem-based learning based on a differentiated learning approach can improve scientific literacy skills and student activity.

Keywords: *Problem-based learning, Differentiation learning, Scientific literacy, Student activity.*

INTRODUCTION

Science is a series of knowledge obtained through an assessment process and can be accepted by the human mind (Wulandari, 2018). Science is also defined as a discipline related to the structure and procedures of the physical, social, and natural world to be the main component in encouraging student creativity and innovation through identification and exploration activities (Alpert, 2018; Rusilowati et al., 2016). The essence of science learning is not just remembering or understanding a concept, but instead creating direct and meaningful learning experiences for students. Science learning allows students to search, process, and discover knowledge for themselves to make it easier to apply (Tala & Vesterinen, 2015; Fitriyati et al., 2017). As a result, science learning becomes very important (Ahied et al., 2020).

In science learning, primarily through scientific literacy, students are trained to solve problems (Afriana et al., 2016). Scientific literacy consists of knowledge, interpretation, and understanding of scientific concepts, methods, or processes that a person can use to make decisions regarding personal, societal, cultural, or economic problems (Dani, 2009; Glaze,

***Correspondence:**
Virlya Citra Dewi, PPG Prajabatan, Universitas Negeri Surabaya, Surabaya, Indonesia.
✉ email : virlyacitradewi@gmail.com

2018). Quality science education aims to produce scientifically literate students with the long-term goal of creating responsible citizens equipped with relevant scientific knowledge and skills (Kumar et. al., 2023). The scientific literacy skills mentioned are one of the various types of skills that can answer the demands of education in the 21st century. These skills include life and career skills, technology or information media skills, as well as learning and innovation skills which are divided into critical thinking, problem-solving, communication, collaboration, and creativity. Emphasis on these skills needs to be done to lead students to be trained and have thinking and learning skills so that they can compete in the global era. This skill is one of the main needs and is important for students to train more effectively (Udompong et al., 2013, Setiawan et al, 2017, Qibtiyah et al., 2023).

The reality based on the results of researchers' observations, several schools still have difficulty training scientific literacy skills effectively. One of them is at SMAN 1 Sidoarjo. Interviews with several students showed that learning at school met the specified learning outcomes, but was less interesting. Learning in schools tends not to link concepts with phenomena in the surrounding community, there is a lack of interaction and there is still a lack of enrichment for practicing 21st century scientific literacy skills. Students are less able to discover concepts themselves, connecting the information obtained with everyday problems (Sutisna et al., 2016). This is in line with research conducted by Suparya et.al (2022), Yusmar & Fadilah (2023). Other research also shows the low level of students' scientific literacy skills (Fuadi et al., 2020; Utama et al., 2019; Rahmadani et al., 2018, Fakhriyah et al., 2016).

The results of classroom observations also show that students still have difficulty recognizing and evaluating explanations of various phenomena. Students' skills in analyzing and evaluating data, arguments, or statements, to draw appropriate conclusions, are also still lacking. This can be seen from the very low achievement of students in answering scientific literacy questions, namely N gain of 0.28. Observed student activity also showed an average of 48.15%. This problem results in students appearing less critical in analyzing a problem and less learning activity. In fact, the Independent Curriculum requires students to be more active, creative, critical, and innovative in learning in class. This statement emphasizes that biology learning needs to be designed with an approach that raises problems related to students' lives (Bahri et al., 2018) to increase understanding of biology and prevent the emergence of misconceptions. This was revealed by Fiteriani & Baharudin (2017), that learning in schools places too much emphasis on memorization of every teaching material provided.

Learning that has minimal activities and only emphasizes memorization certainly does not support students in developing and building knowledge. Learning activities that are only teacher-centered will not train skills or other student-centered activities. Even scientific literacy skills that are part of the bill for 21st-century learning will not be trained. This non-contextual learning is the cause of students' low scientific literacy skills (Fuadi et al., 2020). The obstacles to achieving scientific literacy above are also influenced by the abstractness of science concepts which makes teachers constrained in delivering the material, resulting in stagnation in students' cognitive development and having an impact on the learning process or outcomes (Moodley & Gaigher, 2019).

The solution to this problem is to implement a student-centered learning model and encourage them to construct their understanding. One learning model that can be used is problem-based learning (PBL). Through this learning, it is hoped that students will become more interested in learning, and be able to improve their scientific literacy skills through the problem-solving process. The problems presented must also be linked to everyday life because, through real problems, students will obtain meaningful learning to improve their understanding and learning outcomes (Triani et al., 2018). Problem-solving ability is the highest learning outcome because it requires students' cognitive development to be able to study, analyze, and create meaningful solutions (Indriwati et al., 2019; Agnafia, 2019).

Levels of the learning process using problem-based learning include problem orientation, organizing students in investigations, guiding students in investigations, optimizing and displaying investigation results, to analyzing and evaluating the problem-solving process (Arends, 2008). Through PBL, students have the opportunity to examine or critically review contextual problems in daily life related to scientific concepts up to the phase of creating solutions (Ariyana et al, 2019; Jenah et al., 2022). Students activate the knowledge they have gained by discussing problems in groups so that various assumptions about the problems they face emerge. PBL presents complex activities in the problem-solving process, thereby increasing high-level cognitive involvement (Loyens et al., 2015). Activities carried out by students in stages of problem-based learning is also in accordance with scientific literacy activities, and can certainly increase student activity during learning.

It is hoped that students' scientific literacy skills and activities will increase with the teacher's ability to facilitate students with different characters. Differentiated learning is one solution to accommodate various different student learning models. Differentiated learning can be implemented with strategies to differentiate content, processes, and products (Kusuma, 2022). In this learning, the teacher as facilitator designs material according to students' wishes, interests, or learning styles (Gusteti & Neviyarni, 2022). The principle of differentiated learning in the independent curriculum is not only gaining understanding and learning experience but also efforts to form a Pancasila student profile (Martanti et al., 2021). Differentiated learning has been proven to be effective in the classroom (Suwartiningsih, 2021; Minuriyah et al., 2022).

Intermediate modifications problem-based learning with a differentiated learning approach is considered suitable because it can provide an alternative division of work groups based on learning styles. It is hoped that the problem-solving process will become more effective, so as to increase students' scientific literacy activities and skills. This statement is supported by Minasari & Susanti (2023), is that through the implementation of problem-based learning based on differentiated learning, student activity and learning outcomes increase. Previous research has also proven its effectiveness problem based learning in improving scientific literacy skills (Yew & Goh, 2016; Hüttel & Gnaur, 2017; Nurtanto et al., 2020; Azizah et al., 2021), as well as student activities (Suginem, 2021; Estarini, 2023). The research results from Noma et al. (2016) also show that through the application of PBL to environmental change material, higher-order thinking skills can be trained.

Environmental change material is suitable for practicing scientific literacy skills which are classified as high-level thinking. This material is closely related to students' lives. This also applies to ecosystem material, material that has broad coverage and is close to the students' environment (Anfa et al., 2016). This material can be taught through the environment around students so that students are trained to observe a phenomenon, evaluate, test, design scientific investigations, and interpret data, results or evidence scientifically. Learning that is close to the student's environment and contextual will tend to be more meaningful and stored in the student's long-term memory (Qibtiyah et al., 2023).

Several sub-chapters in ecosystem material can also be taught through practical activities that require students to analyze and evaluate data, to draw conclusions. For example, in the biogeochemical cycle subchapter, students are asked to confirm the importance of the existence of plants in helping the biogeochemical cycle through practical activities. The practicum activities in question can be carried out on based learning problem-based learning, where students collaborate with each other to solve problems. Likewise with environmental change material, the problems of which are very close to students' lives. This material is very suitable for raising problems and presenting them through problem-based learning based on differentiated learning. The problem of low scientific literacy skills and student activity needs to be immediately addressed through learning in these two materials because it is important to create student-centered learning and prepare them to compete globally in the 21st century.

Based on this background, the aim of this research is to implement problem-based learning based on differentiated learning to train students' scientific literacy skills and activities.

METHODS

Method and Model

The method used in this research is classroom action research, using a qualitative approach. The sample involved was 36 student of X-9 at SMAN 1 Sidoarjo. This research was conducted because of the low level of scientific literacy skills and student activity in Biology learning activities. The problems found are then determined by a follow-up plan by implementing a student-centered learning model, thereby improving scientific literacy skills and activities. Problem-based Learning based on a differentiated learning approach, is the model taken by researchers because it is considered an appropriate alternative, and supports the independent curriculum bill.

Two learning cycles were implemented in this research, with 4 stages in each cycle. The activity stages in question include planning, action, observation, and reflection (Arikunto, 2013). The scheme of the classroom action research cycle implemented by the researcher is presented in Figure 1.

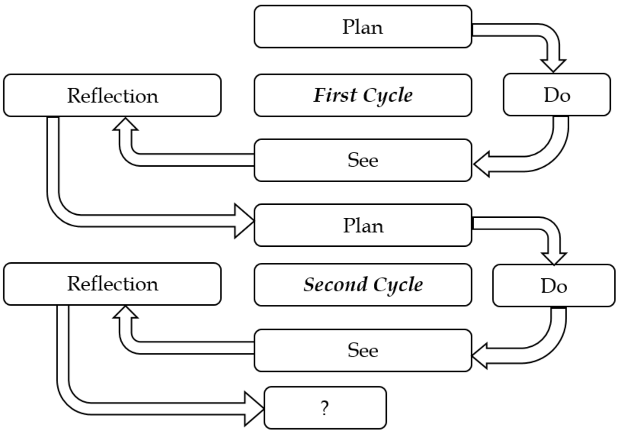

Figure 1. Scheme of the PTK Research Cycle

Activities in Planning

Planning activities are solutions or follow-ups to problems found by researchers. The activities carried out include creating action plans for conducting learning that can improve students' scientific literacy skills and activities. At this stage, the researcher determines the research schedule, compiles the learning tools, prepares all the necessities used for each meeting, and prepares an observation sheet for the implementation of the learning. The learning tools prepared are problem problem-based learning in cycle I and integrated with a differentiated learning approach in cycle II. Researchers also held discussions with experts and colleagues in preparing these planning activities.

Activities in Implementation

The implementation stage was carried out by researchers according to the learning plan that had been prepared, namely implementing a PBL model based on a differentiated approach during the learning process. At this stage, colleagues act as observers for the researcher. Learning activities in implementing this classroom action are carried out in two cycles. The number of meetings in each cycle is three meetings. In cycle I the teaching material is the ecosystem, while in cycle II the teaching material is environmental change and waste recycling. The implementation of learning is carried out in accordance with previously prepared plans.

Activities in Observation

The observation stage was carried out to obtain data related to scientific literacy skills and student activities during learning. Data collection was carried out through student pretest-posttest results which were adjusted to scientific literacy indicators. Observations of student activities during learning are adapted to research instruments. Observations were carried out by tutor teachers assisted by colleagues, as observers. The instruments prepared by previous researchers have also been consulted with experts.

Activities of Reflection

At this stage, researchers must observe and analyze the actions that have been carried out, carefully and thoroughly. Evaluation activities for obstacles, challenges, or obstacles that occur during the learning process are also carried out at this stage. This aims to obtain material for consideration in determining follow-up plans in the next cycle. Decision-making regarding follow-up plans must be carried out carefully to obtain the expected research results. Reflection activities are carried out together with tutor teachers and field supervisors.

Research Subject

The subjects of this research were students in X-9 of SMAN 1 Sidorajo for the 2022/2023 academic year. The number of students is 36, with 20 female students and 16 male students. The research subjects are known to be 15-16 years old. Students' learning style backgrounds are categorized into visual, auditory, and kinesthetic. These categories are needed to support differentiated learning. Preliminary study activities were carried out in February, and research was carried out from April to May.

Data Collection Instrument

Data collection techniques in this research are tests and observations. Tests are used to collect data on students' scientific literacy skills after implementation of problem based learning based on a differentiated approach. In this research, the instruments used were written tests in the form of pretest and posttest, as well as observer observation sheets. The scientific literacy skills test is composed of 3 indicators. These three indicators were then developed into 15 questions in cycle I and 20 questions in cycle II are presented in Table 1.

Table 1. Science Literacy Skills Test Grid

Indicators about scientific literacy skills	Question number	
	First Cycle	Second Cycle
Explain scientific phenomena	1.2.3.9.14	1.2.3.7.14.15.18
Evaluating and designing scientific investigations	7.8.10.11.15	8.9.11.12.16.19.20
Interpreting scientific data and evidence	4.5.6.12.13	4.5.6.10.13.14.17

Observations were carried out to determine student activities during the Biology learning process in X-9 at SMAN 1 Sidoarjo. Observers observe every ongoing event and record it according to the instruments provided. This is intended to assess the level of student activity during the learning process. Observations are focused on observing student learning activities with indicators: providing attention, cooperation, and social relationships, expressing opinions, solving problems, and discipline. The format of this assessment is a rating scale which is made in the form of a score of 1-4, to be analyzed later.

Technical Data Analysis

Increasing students' scientific literacy before and after learning is obtained from the pretest and posttest students' results on ecosystem material. This increase is known through N-Gain analysis and then compared with the categories created by Hake (1999). Learning is categorized as good if the normalized N-Gain score obtained is greater than 0.4. The following are the N gain scoring criteria according to Hake (2014): low ($g < 0.30$), medium ($0.30 \leq g \leq 0.7$), and high ($g > 0.70$). Student activity data obtained by observers during learning is analyzed by calculating the gain for each indicator and dividing the results by the maximum gain (Anas, 2006). The results obtained are then categorized according to the criteria for student learning completeness. These categories are very high with a range of 81%-100%, high, range 61%-80%, medium: 41%-60%, low: 21%-40%, and very low if ≤ 21% (Amir & Sartika, 2017).

RESULTS AND DISCUSSION

Results

Preliminary Study Results

It is hoped that the problem of low scientific literacy skills and student activities in X-9 at SMAN 1 Sidoarjo can be improved through the implementation of the problem-based learning model. The effectiveness of learning is seen if there is an increase in students' scientific literacy skills with an N-Gain score ≥ 0.3. The pretest and posttest questions used to determine the level of students' scientific literacy skills were in the form of 15 essay questions in cycle I and 20 questions in cycle II, with indicators of scientific literacy. The scientific literacy indicators used in this research are (a) explaining/describing scientific phenomena (recognizing, creating, and evaluating explanations related to various phenomena), (b) evaluating and designing scientific investigations (describing or giving an assessment of a scientific investigation and offering ways to answering questions scientifically) and (c) interpreting data or scientific evidence (analyzing and evaluating data, statements and arguments in various depictions and drawing appropriate conclusions), as well as providing solutions by applying existing concepts to solve problems). The level of students' scientific literacy skills is obtained by analyzing the test scores obtained for each individual and for each scientific literacy indicator.

Table 2. Students' Science Literacy Skills in Pre-cycle

No	Parameters	Pra-cycle	
		Pretest	Postest
1	Number of students	36	36
2	Means	66	75.36
3	Median	67	73
4	Modus	67	73
5	Minimum	53	60
6	Maximum	73	93
7	Range	20	30
8	N-gain	0.28	
9	Category	Low	

The table above shows the results of the pretest and posttest scientific literacy skills tests during the research implementation cycle. Based on the table above, the N-gain value is 0.28 in the low category. The class median value still has not reached the KKM. This shows the low literacy skills of students in this class. In fact, it is very important to train these skills to prepare students for the 21st century. Based on this data, researchers then carried out data analysis to determine follow-up plans related to problems in the classroom.

Another problem found by researchers was the low level of student activity during learning. Students tend to be quiet and not actively involved in class. The majority of students also seem to have difficulty conveying their ideas or thoughts. Students' ability to solve problems is low. The results of student activities are proof of the importance of this research. The data is presented in Table 3.

Table 3. Student Activities during Pre-cycle

Meeting	**Indicator**				
	Pay attention	**Cooperation and social relations**	**Forming an opinion**	**Solve the problem**	**Discipline**
1	55.56%	41.67%	34.02%	40.27%	49.31%
2	58.33%	48.61%	38.19%	41.67%	52.08%
3	58.33%	52.08%	47.92%	48.61%	55.56%
Average			48.15%		

Based on the table above, it is known that student activity at the para-cycle stage is only 48.15%. This means that more than half of the students in the class are less active in learning. Students' ability to carry out collaboration is also still low, even though this is important to train to support an independent curriculum. Models, approaches, media and teacher skills in designing learning are things that need to be evaluated to support the creation of active and student-centered classes. Preparing learning plans also needs to pay attention to student characteristics, to create a comfortable and enjoyable class.

Analysis of Students' Scientific Literacy

The research was carried out in 2 cycles. Each cycle consists of 3 meetings with ecosystem material and 3 further meetings with environmental change material. The pretest and posttest were carried out twice, at the beginning and end of each cycle. The average score of students' pretest and posttest scores can be used to see the increase in their scientific literacy skills because the analysis of learning outcomes data uses the degree of increase in N-Gain. Analysis of students' learning outcomes and scientific literacy skills is presented in Table 4.

Table 4. Students' Science Literacy Skills

No	Parameters	First Cycle		Second Cycle	
		Pretest	Pretest	Postest	Postest
1	Number of students	36	36	36	36
2	Means	64.41	86.53	57.22	87.5
3	Median	67	87	55	85
4	Modus	67	87	50	85
5	Minimum	53	80	45	80
6	Maximum	80	93	70	95
7	Range	27	13	25	15
8	N-gain	0.63		0.71	
9	Category	Average		High	

The table above shows the results of the pretest and posttest scientific literacy skills tests in the two learning cycles. Based on the table above, the N-gain value was obtained at 0.63 in the medium category in cycle I, and 0.71 in the high category in cycle II. This shows an increase in students' literacy skills and activities that occur after learning with problem-based learning based on a differentiated learning approach. The increase in student skills is because students are starting to be trained and accustomed to dealing with problem-based questions. Students also become more skilled in knowledge and scientific steps in analyzing cases found in everyday life.

Analysis of Student Activities

Student activities during learning were also observed. This aims to determine the improvements that occur during learning with problem-based learning based on a differentiated learning approach. Observations were carried out according to the 5 activity indicators that had been determined. Data on increasing student activity is needed to determine the learning model and approach used. The results of observing student activities are presented in Table 5.

Table 5. Student Activities During Learning

Cycle	Meeting	Indicator				
		Pay attention	Cooperation and social relations	Forming an opinion	Solve the problem	**Discipline**
I	1	66.67%	55.56%	63.89%	61.11%	66.67%
	2	72.91%	66.67%	72.91%	72.91%	72.91%
	3	76.38%	72.91%	80.56%	76.38%	76.38%
Average		**70.32%**				
II	4	86.11%	88.89%	83.33%	86.11%	80.56%
	5	90.27%	89.58%	89.58%	91,67%	88.89%
	6	91.67%	90.27%	91.67%	93.75%	89.58%
Average		**88.44%**				

Based on data analysis, it is known that student learning activities have increased classically. This increase occurred in every indicator. The highest percentage of student activity was obtained in the problem-solving indicator, namely 93.75%, while the lowest percentage was in the cooperation and social relations indicator, namely 55.56%. These results prove that problem-based learning based on effective learning is used to increase student activity. In this learning, communication activities become very effective and optimal so that the class is more focused and enjoyable. Forming groups that are tailored to students' learning styles also makes students more enthusiastic and creative in showing their performance.

There are a number of reflections from cycle I learning, namely problem-based learning implemented has been proven to improve students' scientific literacy skills with an N gain of 0.63 (medium category). Several things that need to be improved in the next cycle include students not fully actively participating in discussion activities, so teachers must be more creative in designing fun learning. There are still many students who do not have the skills to solve problems well, requiring teacher accuracy in presenting more real problems to be raised in learning content. A number of students also still feel that learning does not facilitate their learning style. This is the reason for researchers to integrate differentiated learning into PBL in cycle II.

Discussion

Implementation of problem-based learning proven to be able to improve students' scientific literacy skills and activities. This is in line with research that shows the positive impact of PBL on increasing scientific literacy skills (Prastika et al., 2019; Nasution et al., 2019; Aliyana et al., 2019) and student activities (Suginem, 2021; Sukirman & Solikin, 2020; Dewi et al., 2019). The results of learning observations in cycle I obtained an N gain of 0.63 in the medium category. The medium category for the N-gain value of scientific literacy skills is caused by several factors, including the results of analysis during pretest activities and observations during learning that students are not used to working on questions in the form of scientific literacy skills, especially essay questions that require high-level thinking skills. The habit of students being presented with questions in the form of multiple choice or short answers also leads them to answer questions as is and not in accordance with the analysis requested. This is confirmed by the opinion of Gunawan (2016), who states that students will answer questions according to their habits, if the student is used to solving story problems, then he will easily analyze the questions. It is these habits and abilities that need to be trained in students, to improve their skills in relating knowledge to the real-life questions/problems presented (scientific literacy).

The limitations of research in cycle I can be seen from the low achievement of student activity in the problem-solving aspect, namely 52.78%. This is due to students not being used to the questions or problem-based questions provided. Students also have not fully applied science in analyzing problem-solving. Students have not been able to engage in the mastery of thinking and acting using scientific methods to find out and solve problems, known as scientific literacy skills (Huryah et al, 2017). In fact, it is important to train scientific literacy skills for students as early as possible (Yanto et al., 2023). Students' laziness in reading case studies or problems presented in the questions was also suggested to be the cause of their low problem-solving skills scores. Students' different learning styles, but receiving the same treatment, also causes students to feel less comfortable in learning. As a result, students become less focused and feel unfacilitated in class.

Differentiated learning is an alternative that teachers can choose to accommodate various student learning styles. The teacher integrates differentiated content and product learning in cycle II, to obtain an N gain of 0.71 in the high category. This shows that an increase in literacy skills and student activity occurred after learning with problem-based learning based on a differentiated learning approach. Differentiated learning integrated intoproblem based learning namely content and product differentiation. Content-differentiated learning provides students with the opportunity to obtain material content that is required by certain learning outcomes but is packaged differently according to student's interests and learning styles. Product differentiation can also be a forum for students to show their innovation and creativity in creating solutions to problems according to the material/topics being studied. This modification was carried out to anticipate increasing scientific literacy skills and student activities which were not optimal in cycle I because differences in student characteristics were not yet fully facilitated.

One way to respond to student diversity is to guide the development of student's potential according to their nature by freeing students to learn and freely develop their potential (Yanti et al., 2022). Students with a visual learning style background were presented with pictures and infographics about pollution in East Java, while students with an auditory learning style were presented with videos about pollution in the Sidoarjo River. The opportunity to practice sorting organic and inorganic waste is given to students with a kinesthetic learning style. These different learning activities are then also reinforced by the teacher to avoid misconceptions and are in accordance with the learning objectives.

Learning with problem-based learning based on differentiated learning received better responses and results from cycle I. Students felt that learning facilitated their interests and talents. Faiz et al. (2022) revealed that it is necessary to map students' learning readiness and learning needs to create opportunities for students to learn more efficiently and naturally. Differentiated learning that is integrated by teachers must aim to meet students' needs, and everything that teachers do is a form of meeting students' needs. Therefore, product differentiation is also carried out at the end of the second cycle to obtain results from students' skills according to their learning styles.

Students' scientific literacy skills in the second cycle generally increased. The highest results were obtained on the indicator explaining scientific phenomena. This shows that students are becoming more skilled in predicting and expressing correct reasons, formulating hypotheses, and describing the implications of potential scientific knowledge or concepts for society. These skills teach students how to make assessments related to information or scientific concepts to make it easier to make decisions in daily life (Chen & Osman, 2017), so scientific literacy skills must be trained in students' learning activities.

The second cycle of student activity in this study showed the highest results in problem-solving skills, namely 91.67%. This shows that the majority of students are able to apply their knowledge to the context of the problems they face. Students are also increasingly trained in creating creative ideas or innovations as a form of solution to a problem. These problem-solving skills need to be trained to prepare students to face the 21st century (Hidayat et al., 2017), as explained by Pratiwi et al. (2019) students need to have skills in constructing scientific knowledge or concepts and understanding how to apply them scientifically to address personal or environmental issues. A person's knowledge, interpretation, and understanding regarding scientific concepts, processes, or methods needed for the process of making personal and societal decisions regarding culture or economics, is the core of scientific literacy skills (Sultan et al., 2021).

Problem-based learning which is integrated with differentiated learning, provides opportunities for students to learn according to their learning style so that learning becomes more efficient and meaningful. This learning can also facilitate students to show innovation/creativity in solving problems in a way that suits their learning style. Research limitations can be seen in the differentiated learning approach that is integrated into PBL in cycle II, namely only the differentiation of biological content and products. This is an opportunity for the academic community to continue research related to problems found in class, and make PBL or differentiated learning (content, process, or product) as an alternative solution. Research can also be developed on other materials or subjects.

CONCLUSION

Based on the research results, it can be concluded that the implementation of problem-based learning based on differentiated learning can improve students' scientific literacy skills and activities. The increasing scientific literacy skills of students can be seen from the increase in the N gain value in cycle I (0.63) and cycle II (0.71). The N-gain value shows that students are becoming more skilled in applying science in life as preparation for facing the 21st century. Student activity during learning has also increased in all five indicators. The average student activity was 70.32% in cycle I and 88.44% in cycle II. This proves that the follow-up plan to integrate differentiated learning in the second cycle had a significant effect.

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