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Implementation of PBL Model with Differentiated Learning to Improve Students' Motivation and Cognitive Learning Outcomes on Evolution Material

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ABSTRACT

Each child has their uniqueness and the necessity to choose the correct learning technique so that it can fit all students' demands through differentiated learning by partnering with problem-based learning models to boost students' learning motivation and learning outcomes. This research is Class Action Research, which tries to determine the improvement of learning implementation on students' learning motivation and learning outcomes. The subjects of this study were all students of class XI A2.5 SMA Negeri 1 Krian totaling 35 students. Data collection was carried out using observation, questionnaire, and test procedures, with instruments in the form of observation sheets of learning differentiation with problem-based learning (PBL) models, questionnaire sheets of learning motivation, and learning outcomes test sheets. The results showed that the average learning implementation score in cycle I was 76% with an excellent category, whereas in cycle II it was 93% with a very good category. Student learning motivation before participating in the learning process was in the low category with an average score of 52.93% and after participating in the learning process, the average score of student learning motivation climbed to 76.32 in cycle I with a moderate motivated category and further climbed by 88.55% in the motivated category in cycle II. Students' cognitive learning outcomes in cycle I earned a gain score of 0.54 with a medium category, and in cycle II obtained a gain score of 0.84 with a high category. Based on the results of the study, it can be inferred that there is an increase in motivation and cognitive learning outcomes of students through the implementation of the differentiated learning PBL model on material about evolution.

Keywords : *Differentiated learning, PBL, Evolution, Learning motivation, Learning outcomes*

INTRODUCTION

Education, according to Ki Hadjar Dewantara (KHD), is that each individual is unique. They proceed at their own pace, and students are given the widest possible space to explore, express, and innovate independently and responsibly in terms of instilling the value of Pancasila values through stages, namely habituation, emotional awareness, and discipline. This is also the opinion of Eppard & Rochdi (2017) that children can learn at their own pace and according to their abilities. Each child has the opportunity to study independently and has a certain autonomy in terms of time management. The concept can allow students the freedom to customize their learning skills and processes according to their needs (Pinnelli &

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Fiorucci, 2015). The implementation of independent learning activities through a holistic approach to students by developing all their intellectual, social, emotional, artistic, physical, and spiritual potential in a balanced manner is a form that reflects KHD thinking (Minasar and Susanti, 2023)

Every learner has distinct qualities. They have varied histories, learning preferences, learning styles, hobbies, or learning speeds (Derici & Susanti, 2023). Based on the study above, the researcher wishes to adopt learning that can accommodate all the demands of students, notably through differentiated learning by partnering with problem-based learning models to boost students' learning motivation and learning outcomes. Thus, problem-based learning can be regarded to be the most effective technique for increasing students' cognitive quality and can instill a high level of motivation and capacity for active learning (Lestari, 2022). Other research has also demonstrated that problem-based learning can increase interdisciplinary thinking abilities and biological learning outcomes in the affective, cognitive, and psychomotor domains (Putri & Suwono, 2023).

Based on interviews and observations that have been conducted with the biology teacher of SMAN 1 Krian, in terms of providing material, it cannot be delivered in detail, and only a few varied learning models and methods because of the large amount of material content and not enough time so that it has an impact on the motivation and learning outcomes of students who decline (Susananingsih, 2023). This is supported by the fact that the biology learning outcomes of students in class XI-A2.5 are currently unsatisfactory. Only 28.5% of the total number of students in the class have reached the minimum completeness criteria (MCC=75) set by the school on the previous material exam. The results of the pre-cycle motivation questionnaire data also support the data that the level of motivation possessed by students in class XI-A2.5 is still quite low at 52.93%. That way, the drive and willingness to learn and the learning outcomes of students in class XI-A2.5 still need to be improved. The quality of the teaching and learning process continues to be improved and improved to achieve the best results through differentiated learning with the Problem-Based Learning (PBL) model.

Differentiated learning is an effort to adapt classroom learning to the learning requirements of each individual. According to several researchers, differentiated learning is learning carried out by teachers to accommodate all learning requirements related to learning readiness, interests, and learning profiles of students in the classroom (Herwina, 2021; Faiz et al., 2022; Farid et al., 2022; Naibaho, 2023). In implementing differentiated learning, teachers must think about meaningful and fun actions because differentiated learning is not just learning by providing different actions or treatments in class or learning that only groups students based on ability (Faiz et al., 2022; Siagian et al., 2022; Miqwati et al., 2022; Mahfudz, 2023).

Differentiated learning is also defined as a form of effort to identify appropriate teaching methods based on the talents, potential, and learning styles of diverse learners (Morgan, 2014; Wahyuni, 2022; Bendriyanti et al., 2022). Teachers provide facilities to learners according to their needs because each learner has different characteristics that cannot be treated the same way (Pratiwi et al., 2022). Three main types of differentiated learning strategies: (1) material, (2) process, and (3) product differentiation. Students' readiness, interests, and learning profiles are used to differentiate content. Tiered activities, creation of diverse activities, and grouping of students based on readiness, aptitude, and interest are all used to conduct the differentiation process (Marlina, 2019; Siagian et al., 2022; Khomsanah et al., 2023; Yani et al., 2023).

Problem-based learning (PBL) is one of the student-centered learning models that requires the skills and sensitivity of students to solve environmental problems (Latifah & Hanik, 2023). Many studies have shown the benefits of using problem-based learning methodology. One of the characteristics of PBL is that problems are presented and are not expected to have a single answer or single solution. This provides a very broad opportunity

for learners to explore their potential (Hadi et al., 2022). Learners have freedom according to their nature indifferent or differentiated ways.

Based on this description, the importance of selecting learning models and methods with the right consideration to achieve certain goals, especially overcoming the problems of motivation and learning outcomes of students. Researchers are interested in knowing more about the collaboration of the application of differentiated learning with PBL models. This study aims to determine the increase in motivation and cognitive learning outcomes of class XI students of SMAN 1 Krian in the 2022/2023 academic year in evolution material through the implementation of differentiated learning with the Problem-Based Learning model. The results of this study are expected to be useful for students, teachers, and SMAN 1 Krian school, especially in the field of biology learning, and also for teachers in other schools who experience the same problems.

Based on this description, the significance of selecting learning models and approaches with care to achieve certain goals, particularly overcoming student motivation and learning outcomes. Researchers are eager to learn more about the integration of differentiated learning models with PBL models. The purpose of this study is to examine the increase in motivation and cognitive learning outcomes of SMAN 1 Krian class XI students in the 2022/2023 academic year in evolutionary content by implementing differentiated learning with the Problem-Based Learning methodology. The findings of this study are intended to be beneficial to students, teachers, and SMAN 1 Krian school, particularly in the subject of biology learning, and to teachers in other schools that face similar problems.

METHODS

This type of research is Classroom Action Research (CAR). The research was conducted in 2 cycles, in which each cycle consisted of 3 meetings. The research model applied is the research developed by Arikunto (2013) that each cycle consists of four stages of activities, namely the stages of planning, implementation, observation, and reflection. The independent variable in this study is differentiated learning with the Problem-Based Learning (PBL) model, and the dependent variable is the learning motivation and cognitive learning outcomes of students. Learning outcomes in this study are the learning outcomes of students in biology subjects, especially on evolution material, which is analyzed based on the scores from pretests and posttests at the end of each cycle given by the teacher after following the product differentiation learning process with the PBL model. This research was conducted at SMAN 1 Krian on the research subjects of class XI-A2.5 students with a total of 35 people. The research was conducted during PPL II, February - April 2023.

The first stage is the planning stage. The planning stage was carried out before cycle 1 and cycle 2. In the planning stage of cycle 1, the activities carried out were preparing teaching modules, observation sheets, and evaluation materials (tests). Then re-planning was carried out in cycle 2, by considering the results of the first cycle reflection. The activities for preparing teaching modules contain steps or learning processes with product differentiation using the PBL model. Then, proceed with the preparation of observation sheets for the implementation of teacher learning and evaluation materials or tests with questions that will be asked at the end of each lesson in the cycle.

The second stage is the implementation stage. This stage begins with conducting a cognitive diagnostic test (pretest) and giving a questionnaire or motivation questionnaire to students, which aims to determine the initial condition of the class. Then, the learning style mapping of students is carried out based on the results of the learning style test that has been given. After that, the treatment is carried out through the implementation of differentiated learning integrated with the PBL learning model. The activities of students in each cycle are

discussing problem-solving and creation based on learning styles as a form of problem-solving results of evolution material, then presented in front of the class. Each product differentiation work is presented at the end of the cycle meeting.

The next stage is the observation stage. This stage was carried out simultaneously with the implementation of the action. The data collected at this stage contains the implementation of PBL, the results of the motivation questionnaire, and the post-test at the end of each cycle based on the actions and plans that have been made. Data collection was carried out with the aid of observation instruments developed by researchers. In carrying out observation and evaluation, the teacher does not have to work alone. In this observation stage, the teacher can be assisted by outside observers (peers or experts). With the presence of other people in this research, the CAR carried out becomes collaborative.

The last stage in this research is the reflection stage. This stage is carried out at the end of each cycle to evaluate everything that has been done in the implementation action. This stage aims to identify the weaknesses of Cycle I and improve teachers' performance at the Cycle II stage. Cycle II teachers motivate students more, attract attention with minigames, and provide stabilization of important concepts so that students do not have misconceptions about the material. In cycle II the teacher also held a practicum on evolution material. The purpose of the practicum itself is that students can analyze problems more easily in the environment, and they can strengthen their understanding of the concepts. So, in cycle II, it is expected that the motivation and learning outcomes of students will increase. The advantage of each cycle, the teacher begins the teaching and learning process by showing interesting slides and videos to trigger problems. The shortcomings of cycle I are caused by the efficiency of time that is not maximized. Too much time is spent on showing videos, and students are not accustomed to PBL model differentiation learning.

Data collection techniques were carried out through test and non-test methods. The test method used in this study aims to determine the cognitive learning outcomes of students in each cycle of research implementation. Meanwhile, non-test methods in the form of learning implementation observation sheets were applied to determine activity activities during the differentiation learning process with the PBL model and learning motivation questionnaires in each research implementation cycle. The data instruments were the motivation questionnaire, implementation observation sheet, and test questions. In filling out the instrument, the implementation observation sheet was assisted by external observers (peers or experts).

Data analysis techniques used quantitative analysis and qualitative analysis. Quantitative analysis is applied in testing learning outcomes through pretests and posttests. Furthermore, it analyzes the value with the calculation of the normalized Gain Score (gain-score). This Gain Score is calculated by the formula developed by Hake as follows:

$$\text{N-Gain} = \frac{Spostest - Spretest}{\text{Smax score} - \text{Spretest}}$$

With N-gain value criteria:

Table 1. N-Gain Score Criterion

N-Gain Score Criterion	
N-Gain > 0,70	High
0,30 ≤ N-gain ≤ 0,70	Medium
N- Gain < 0,30	Low

Descriptive qualitative analysis was carried out to see the implementation of the learning process activities of students and teachers by applying product differentiation learning with the PBL model during the learning process. The analysis uses a classical formula by dividing

the number of scores obtained during the implementation of the learning process activities by the total or maximum score multiplied by one hundred percent so that the percentage of implementation results is obtained.

The use of questionnaires or polls in this study aims to determine the learning motivation of students in learning biology about evolution. The data analysis technique was carried out using descriptive qualitative analysis. Guidelines for assessing motivation instruments after obtaining scores were calculated using the classical formula. The number of scores achieved is divided by the maximum number of scores, then multiplied by one hundred percent. Then, the results of the percentage level of motivation of students in the class are obtained.

Based on the formula above, the percentage data of learning implementation and motivation level of each descriptor were obtained classically. The percentage data is presented in the form of the following table :

Table 2. Score Criteria

Score (%)	Criterion
80 – 100	Good
60-79	Enough
40-59	Less
≤ 40	Bad

RESULTS AND DISCUSSION

Results

Initial Study Results

Pre-test activities are carried out to reflect the initial cognitive abilities and competencies of students. The pretest is carried out through the quizizz platform, so that the test results can be displayed immediately to determine the ability and cognitive competence and learning readiness of each student. The pretest contains 20 questions about evolution. For more details about the pretest results can be seen in the following table.

Table 3. List of frequency distributions Pretest Class XI-A2.5

No.	Score	Frequency	Average
1.	11-20	5	38
2.	21-30	8	
3.	31-40	11	
4.	41-50	4	
5.	51-60	5	
6.	61-70	2	
Number of learners		35	

Based on the results of the pretest, it was found that out of 35 students, 4 students scored 15, 1 student scored 20, 3 students scored 25, 5 students scored 30, 5 students scored 35, 6 students scored 40, 2 students scored 45, 2 students scored 50, 3 students scored 55, 2 students scored 60, 1 student scored 65, and 1 student scored 70. By getting an average class score of 38. All students in class XI A2.5 did not reach the learning completeness of the MCC score. These results, prove that the initial cognitive abilities and competencies of students in class XI A2.5 are still relatively low because they do not meet the school's MCC, which is 75. Students'

learning readiness in facing new chapters, especially the evolution chapter, is still low. This is also influenced by the motivation and interest of each student towards learning biology.

The next activity is learning style mapping. A week before the implementation of the teaching module with differentiated learning-based teaching with the PBL model, the researcher conducted a non-cognitive diagnostic test to identify the learning styles of students using Google form, and the link was shared through the class WhatsApp group. The results of the responses were used as a tool to map learners according to their learning needs. Based on the results of the questionnaire, it can be concluded that the learning styles of students in class XI-A2.5 SMA Negeri 1 Krian are very diverse. Then the researcher divides learners into several groups based on learning styles and makes diverse learning product assignments such as posters, infographics, recordings, videos, podcasts, and role-playing dramas to enable learners to explore the results of learning material products according to their learning styles. The results of the learners' learning style questionnaire can be seen in Figure 1.

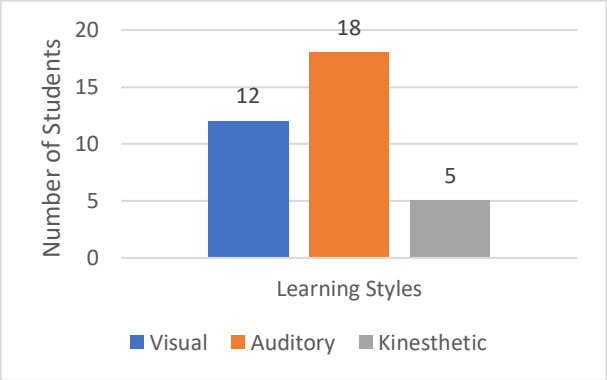

Figure 1. Learning Styles of Class XI-A2.5 Students

Based on these results, there are various kinds of learning styles owned by class XI-A2.5 SMA Negeri 1 Krian. The auditory learning style dominates the class with 18 children, while the visual learning style is 12 children and the kinesthetic learning style is only 5 children. In its application, the visual learning style group will be asked to present infographics or posters, the auditory learning style group will present podcasts and the kinesthetic learning style group will present video dramas or role plays about problems in evolution. In mapping the learning needs of students and preparing teaching modules, differentiated learning is appropriate and very supportive regarding learning styles, learning abilities, and learning readiness in students. This is in line with the opinion of Faiz et al., (2022) that the purpose of differentiated education is to provide learning opportunities to learners more naturally and effectively, it is necessary to map the willingness and need to learn.

The results of the researcher's observation of learning motivation at Pre-Cycle during learning showed a lack of enthusiasm for learning biology. This is supported by the results of giving motivation questionnaires to students. The questionnaire was distributed in the form of physical paper and filled in directly by students at that time. The questionnaire consists of 20 questions, including representing six indicators of motivation. For more details about the results of students' motivation can be seen in the following Table 4

Table 4. Results of the Precycle Learning Motivation Questionnaire

No	Indicator	Result (%)	Category
1.	There is a desire and desire to succeed	38.86	Unmotivated
2.	There is encouragement and need in learning	54.48	Less Motivated
3.	The existence of future values and aspirations	52.57	Less Motivated

4.	There is an appreciation in learning	54.86	Less Motivated
5.	There are interesting activities in learning	49.94	Less Motivated
6.	The existence of a conducive learning environment	66.86	Moderately Motivated
	Average	52.93	Less Motivated

Based on the table above, the learning motivation of class XI-A2.5 before the action reached an average percentage of 52.93% in the less motivated category. This can be seen from the results of each indicator in Table 4, which have not yet reached the motivated category (≥ 80%), especially the indicator of the desire and willingness to succeed, which reached a percentage of 38.86% in the unmotivated category. The low motivation to learn biology before the action was due to the lack of implementation of differentiated learning with the PBL model on the material about evolution. It was also supported by the low percentage value of the desire and willingness to succeed indicator because students were dominantly passive in group discussions. They have not actively asked the teacher about material that has not been understood, and they have not been active and easily give up when doing assignments.

Implementation of PBL Learning

Research on the application of differentiated learning with the Problem-Based Learning model in class XI A2.5 SMA Negeri 1 Krian in the even semester of the 2022/2023 academic year was carried out in 2 cycles. During its implementation, it involved two observers who were other subject teachers to assess the PBL learning implementation score using the implementation observation sheet. The results of the comparison of the implementation of differentiated learning with the PBL model can be seen in the following Table 5.

Table 5. Result of Comparison of Differentiated Learning Implementation with PBL Model

No	Observed aspects	Percentage (%)	
		Cycle 1	Cycle 2
1.	Student orientation to the problem	80	100
2.	Organizing students to learn	75	90
3.	Guiding and investigating individuals or groups	70	90
4.	Develop and present work	70	90
5.	Analyze and evaluate the problem-solving process	85	95
	Average	76	93
	Category	Enough	Good

Based on Table 5, there is an increase in the average percentage of differentiated learning implementation with the PBL model from cycle I 76% to cycle II 93%. This is supported by an increase in each aspect of learning implementation, especially in the first aspect (orientation of students to the problem), the third aspect (guiding & individual / group investigations), and the fourth aspect (developing and presenting work) which has the largest difference in increase of 20%. These aspects have increased because there are differences in activities in Cycle I and Cycle II. Cycle I activities were only discussions related to problem-solving and creation, while in cycle II there were practical activities integrated with the PBL model and making work on the results of problem-solving. Creation is based on their learning style so that it can increase students' interest in learning and the achievement of PBL learning implementation indicators. The final results in cycle II, show that differentiated learning with the PBL model succeeded in exceeding the research success indicator (≥ 80%). In the implementation, students were more enthusiastic and active in learning because the activity

was new to them and the creation of active interaction between components, namely teachers, students, and learning media.

Students' Learning Motivation

In line with the implementation of differentiated learning with the PBL model in class XI A2.5, the results of the learning motivation questionnaire were obtained. According to Uno (2017), there are two types of learning motivation, namely intrinsic (internal) and extrinsic (environmental), which have six indicators. Learning motivation in Class XI A2.5 was measured through a questionnaire sheet distributed at the end of each cycle. The questionnaire consists of 20 questions related to indicators of intrinsic and extrinsic motivation. The recapitulation of students' learning motivation per cycle is as follows:

Tabel 6. Results of the Learning Motivation Questionnaire

No	Indicators	Percentage (%)	
		Cycle 1	Cycle 2
1.	There is a desire and desire to succeed	53.33	91.09
2.	There is encouragement and need in learning	80.10	90.00
3.	The existence of future values and aspirations	80.29	86.57
4.	There is an appreciation in learning	75.71	84.86
5.	There are interesting activities in learning	82.51	90.10
6.	The existence of a conducive learning environment	86.00	88.67
	Average	76.32	88.55
	Category	Moderately Motivated	Motivated

Based on Table 4 and Table 6, the learning motivation of class XI-A2.5 attained an average percentage of 52.93% in the unmotivated category in the pre-cycle, while in cycle 1 it got a fairly motivated category with a percentage of 76.32%. The score then further increased in cycle II with a percentage of 88.55% in the motivated category because it had attained a score of more than 80%. This increase was supported by changes in the results of aspects of intrinsic and extrinsic factors of motivation in cycle I to cycle II. The final results of the intrinsic motivation aspects include 1) The existence of desire and willingness to succeed reached a percentage of 91.09%; 2) The existence of encouragement and needs in learning reached a percentage of 90%; and 3) The existence of future hopes and ideals reached a percentage of 86.57%, after calculating the data, the total average value of intrinsic factors was 89.22%. Meanwhile, the final results on extrinsic factors consisting of three other aspects, namely 1) The existence of rewards in learning reached a percentage of 84.86%; 2) The existence of interesting activities in learning reached a percentage of 90.10%; and 3) The existence of a conducive learning environment reached a percentage of 88.67%, after calculating the data, the total average value of extrinsic factors was 87.87%. From the above data, it can be concluded that 89.22%> 87.87%, which implies that intrinsic factors have a greater influence on students in class XI-A2.5 SMA Negeri 1 Krian than extrinsic factors.

Cognitive Learning Outcomes

Based on the results of data collection analysis during the learning process, data on cognitive learning outcomes were acquired. The collecting of this data through pre-tests during the pre-cycle and post-tests at the end of each cycle. The following is a recapitulation of the cognitive learning results of students per cycle while using differentiated learning with the PBL model:

Tabel 7. Cognitive Learning Outcomes

Criteria	Cycle 1		Cycle 2	
	Pretest	Posttest	Pretest	Posttest
Average	38	72.5	38	91
Highest Score	70	90	70	100
Lowest Score	15	55	15	70
Completion	0%	57.14%	0%	91.42%
N-Gain	0.54		0.84	
Category	Medium		High	

Based on the table above, it can be seen that there is an increase after the use of differentiated learning with the PBL model. In Cycle I, 57.14% of learning completeness was reached, and the N-gain score was 0.54 with a moderate category. Then, there was a rise in the second cycle with a post-test completeness value of 91.42% and an N-gain score of 0.84 with a high category since it had reached an N-gain score of more than 0.7 and learning completeness of more than 75%. From these results, there was a considerable increase in N-Gain from cycle I to cycle II by 0.30. The table also shows that the average score of each cycle has increased from pre-cycle of 38 to cycle I of 72.5 and increased to 91 in cycle II. Thus, it can be demonstrated that there is an increase in interest and motivation in studying evolution, which has an impact on their learning results. The rise in interest was generated by the practicum activities in cycle II and the adaptation of students to differentiated learning with PBL models that explore evolution.

Discussion

The problem of poor levels of motivation and learning outcomes for biology learning for students in class XI A2.5 at SMA Negeri 1 Krian is the basis for this implementation project. This is also assisted by a lack of diverse learning models and approaches. Based on this, the researcher uses differentiated learning in conjunction with PBL learning models in the following chapter, which is about evolution. There are numerous stages in differentiated learning activities that pay attention to students' input, readiness, and interest, including assessment, learning, and reflection (Marlina & Solehun, 2021). Conducting a pre-test, evaluating students' learning needs, and sending a learning motivation questionnaire are examples of preparatory activities prior to implementation or pre-cycle.

The results of the pre-cycle activities are the fundamental reference and initial data before implementation. The results of learning style mapping are implemented into differentiated learning, especially product differentiation collaborated with PBL learning, where in the synthesis, there are learning steps in developing and presenting the results or work of a problem. This is in line with the opinion of Sarie, (2022) which states that PBL learning models are very effective and support differentiated learning, particularly in product differentiation. Differentiated learning can be done using three strategies, including content, process, and product differentiation Wahyuni (2022). Herwina (2021) revealed that product differentiation is a form in which students comprehend what is taught by the teacher. Learning products enable teachers to assess learners' skills. Product differentiation is carried out is granting freedom to each group to present their learning outcomes according to their interests and abilities.

The results of the pre-test and motivation questionnaire in the pre-cycle were still categorized as low because they were triggered by learning difficulties and low interest in learning biology. This is in line with the statement of Rahmayani & Amalia (2020) that learning difficulties and lack of motivation of students when learning can also arise because the

learning model used by the teacher is not varied and does not provide opportunities for students to be more active in learning with their own ideas. Thus, learning innovations must be implemented to solve problems in certain situations and conditions. This learning innovation is a solution that must be designed and implemented by every teacher, maximizing new media and methods so that it can provide something useful for effective and efficient learning implementation (Norhikmah et al., 2022).

With these results, the researcher attempts to implement more varied learning, namely through the application of differentiated learning combined with the PBL model. According to Setiyadi (2019), PBL is an active student learning model that combines new information with cognitive structures previously owned by students (meaningful learning) through group learning activities to find solutions to real-world problems and develop problem-solving skills in a problem with the help of various learning resources. Through PBL, students are required to cultivate higher-order thinking, problem-solving, and intellectual skills (Jayadiningrat & Ati, 2018). The use of a differentiation approach also has a positive impact on maximizing capacity in learning activities based on student learning needs, notably in accommodating the diversity of learning styles of students, including VAK: Visual, Auditory, and Kinesthetic. Differentiated learning itself is a learning strategy that is tailored to the needs of students to facilitate improved learning experiences and a deeper understanding of the subjects taught (Lupita & Hidayat, 2022). Understanding that each individual learns differently depending on their abilities and uniqueness is in accordance with the learning principles promoted by Ki Hajar Dewantara. With this implementation action, students are anticipated to increase their involvement in learning activities to improve student learning outcomes.

The results of these actions are an increase in the level of motivation and learning outcomes of students. It can be seen in Table 4 and Table 6 that the level of motivation in the pre-cycle reached an average percentage of 52.93%, while in cycle 1 it was 76.32% and an increase of 88.55% in cycle II. The increase in the level of motivation is due to the implementation of learning in Cycle II, which is better than Cycle I. This is also supported by the adaptation of participants. This is also supported by the adaptation of students to differentiated learning with the PBL model in Cycle II, so that students are more excited and actively involved in learning. This is in line with the research of Hermayani et al. (2015) that improving the quality and implementation of the learning process resulted in the achievement of higher scores for each aspect. Teachers improve the quality of learning in each cycle through reflection and restructuring for improvement in the next cycle. The better the quality of teacher learning in the classroom, the better the quality of students (Maghfiroh, 2022). These results are also supported by the theory of Sardiman A.M (2018), that in learning activities, motivation is a general driving force within students that encourages learning to achieve learning goals. Learning motivation significantly supports students' learning activities. High learning motivation causes learning to be more enthusiastic and enjoyable, which in turn has a positive impact on student performance (Arianti, 2019).

Motivation can boost the willingness to do an activity. Willingness originates both from within (intrinsic motivation) and from outside the individual (extrinsic motivation) (Suharni, 2021). How strong a person's drive impacts the quality of his conduct, both in the context of learning, working and in later life. The learning process will be successful if it contains student motivation in learning (Firdaus et al., 2020). The results of this study are in line with the research of Aini (2019), which reveals there is an influence of the PBL model on the motivation and learning outcomes of biology class X students of SMAN 1 Ngunut. The results demonstrated that the PBL model might boost students' interest.

The next result is an increase in students' cognitive learning outcomes from cycle I, obtained a gain score of 0.54 with a medium category, and in cycle II, obtained a gain score of 0.84 with a high category. The increase was due to the learning implementation process of

cycle II being better than cycle I. This is in accordance with the improvement in the observation results of the implementation of PBL learning. This is in accordance with the increase in observation results of PBL learning implementation in Table 5. In cycle II the teacher also motivated students and attracted their attention by conducting a PBL-based practicum on evolution. The purpose of the practicum itself is so that students can analyze problems in the environment more easily and they can strengthen concept understanding in students (Khairadi, 2020). So, in cycle II, the motivation of students increased, and learning outcomes also increased. Motivation has an impact on the success of students in learning. During the learning process, motivation can trigger students to actively conduct learning activities so that changes in behavior occur toward achieving goals in the form of high learning outcomes (Suharni, 2021).

The increase in student learning outcomes is because PBL learning steps increase competence in problem-solving, and it can improve students' cognitive learning outcomes. This is in line with Margetson's opinion (in Haryanti, 2017) that the PBL model is better than other learning models because the model strengthens the development of students' lifelong learning skills in an open, reflective, critical and active mindset and encourages successful problem solving, communication, teamwork, and interpersonal skills. This is supported by the results of Mahmud's research (2022), which concluded that there was an increase in student activity and learning outcomes after applying the PBL learning model. As for the support of the research results of Chasanah et al., (2019), the application of PBL can also improve learning outcomes and spur the motivation of students to participate in learning because they realize the benefits of problem-solving. This statement is reinforced by Minasari and Susanti's research, (2023), which states that the application of a differentiated-based PBL learning model affects changes in students' attitudes towards learning, and the level of enthusiasm of students in seeking information also increases.

Thus, from the results of research that has been conducted in class XI A2.5 at SMA Negeri 1 Krian Sidoarjo, it is known that differentiation learning with PBL models can increase learning motivation, especially intrinsic motivation and learning outcomes, especially on learning material about evolution. Differentiation learning that is employed is limited to product differentiation. Product differentiation is carried out based on the learning styles of students, including auditory, visual, and kinesthetic. The activity collaborates problem-solving and creation. Problem-solving is able to develop learners' critical thinking skills, and product differentiation is able to develop creative thinking skills and collaboration between learners.

CONCLUSION

Based on the results of the data analysis conducted, it can be concluded that there is an increase in motivation and cognitive learning outcomes of class XI students of SMAN 1 Krian in the 2022/2023 academic year about evolution through the implementation of differentiated learning with the PBL model. There is evidence of an increase in the implementation of PBL learning from cycle I by 76% to cycle II by 93%, and the level of learning motivation increases from pre-cycle with a percentage of 52.93% to cycle I with a percentage of 76.32% to cycle II with a percentage of 88.55% with a well-motivated category, as well as the cognitive learning outcomes of students from cycle I obtained a gain score of 0.54 with a medium category and in cycle II obtained a gain score of 0.84 with a high category. The increase in gain score occurred significantly by 0.30. Thus, teachers can apply this learning to better facilitate students' learning needs and overcome problems related to motivation and learning outcomes.

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