
Improvement of Student Achievement Through Problem Based Differentiated Learning

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Abstract. Learning needs to accommodate the diversity of students through innovative selection of strategies or learning models that are oriented towards an independent learning curriculum. The learning model that can be applied is through differentiated problem based learning (PBL) which can meet students' learning needs. This study aims to determine the increase in student learning outcomes using a differentiated PBL model. This research uses a type of qualitative research with a descriptive approach. Sampling was carried out using the purposive sampling technique, namely the technique of determining the sample with certain considerations. Data collection techniques using tests and observation sheets. Data analysis techniques used the normality test and paired sample t-test and used the formula on the observation sheet. The results showed that learning using the differentiation model with PBL increased significantly by 83.75 and the learning process took place effectively by 78.

Keywords: Learning Outcomes, Differentiation Models, Learning, Problem Based Learning

Introduction

The success of a country in facing the industrial revolution 4.0 is also determined by the quality of educators such as teachers. Teachers are required to master skills, and the ability to adapt to new technologies and global challenges. In this situation, every educational institution must prepare a new orientation and literacy in the field of education. Old literacy that relies on reading, writing, and mathematics must be strengthened by preparing for a new literacy, namely data literacy, technology, and human resources (Gausdal & Makarova, 2017). Data literacy is the ability to read, analyze and use information from data in the digital world. While human resource literacy is the ability to interact well, not rigid, and with character (Hermann et al., 2016).

Learning innovation towards a new paradigm is expected to be able to solve problems entering the 40's industrial revolution era. Innovative learning activities create a class atmosphere that is not rigid and not monotonous. Students are invited to discuss, interact and dialogue more so that they can develop their own scientific concepts and principles (Susetyo, 2019).

Carry out differentiated learning according to the concept of independent curriculum, that is, learning that meets the learning needs of students (Lestarinigrum, 2022; Zhu et al., 2016). The teacher facilitates students according to their needs, because each student has different characteristics, so they cannot be given the same treatment. In carrying out differentiated learning, the teacher must think about meaningful actions that will be taken later, because Differentiated learning does not mean giving each student a different

treatment or activity and learning in isolation between smart and unskilled students (Kinshuk et al., 2016).

Differentiated learning has the following characteristics: 1) focuses on the main concepts and principles of the subject matter. 2) Evaluation of student learning readiness and progress is accommodated in the curriculum. 3) There are flexible student groupings, and 4) Students become active explorers (McTighe & Brown, 2005). Several empirical studies focusing on differentiation learning are described (Tulbure, 2011) mean: 1) Differentiating instruction on personal learning styles leads to an increase in the level of learning outcomes, 2) Differentiating instructional strategies on learning styles do not affect learning levels, 3) Lack of compatibility between learning styles and didactic strategies motivates and makes the studying process flexible.

In differential learning, problem based learning (PBL) models can help students better understand differential concepts and apply their knowledge to solve real-world problems related to differential calculus. (Tawfik & Lilly, 2015). PBL is a set of learning activities that emphasizes the process of scientifically adapting to the problems encountered, instilling in students the habit of always striving to overcome the problems they face (Tsybulsky & Muchnik-Rozanov, 2019; Yamin et al., 2020).

At SMP Al-Irsyad in class VIIB, they already use the independent curriculum, so it is recommended to do differentiation learning. Although this learning is not new, the application of teaching and learning activities is still rarely done. On the other hand, differential learning with PBL is still not very popular and specific elements are not embedded by teachers. Therefore, the application of this learning strategy cannot be optimally implemented.

Based on previous research, differentiation learning strategies are efforts that can be made to improve student learning outcomes by using a heterogeneous cognitive approach to students. Problem-laden differentiation learning strategy is a method used to balance students' abilities in digesting lessons, managing emotions, and ways of communicating, including the ability to develop different interests and talents of students (Hadi et al., 2022). Other studies have stated that the application of differentiated learning through the PBL model in learning Mathematics in class VIII SMP Negeri X can improve student learning outcomes and student learning activities. The implementation of differentiation learning through the PBL model has increased. The average percentage of completeness of student learning outcomes in cycle I was 92%, increasing to 96% in cycle II. While the percentage of student learning activities in cycle I reached 90.25%, an increase of 92% in cycle II (Muslimin et al., 2022).

Furthermore, learning research is differentiated with the PBL model, in the implementation of independent curriculum learning in class VII which has just been implemented at SMP Negeri 2 Telukjambe Timur, Karawang Regency, West Java Province since the beginning of the 2022/2023 school year. The results of this study showed that the average student learning interest increased by 0.8 points, the average individual formative assessment results increased by 21 points, and the average group work results increased by 14 points. In conclusion, this research was successful in increasing students' interest in learning through differentiated learning with the PBL model in social studies lessons in Class VII G of SMP Negeri 2 Telukjambe Timur (Sumarni, 2023).

Independent curriculum is a syllabus that aims to hone children's interests and talents from an early age by focusing on essential material, character development, and student competencies. Independent learning also involves self determined conditions in fulfilling the goals, methods, materials, and evaluation of learning for both teachers and students. With this, it can be seen that the learning process in the independent learning curriculum is more directed to the needs of students (student-center) whereas previously the concept

of learning was still centered on teachers or educators (Basham et al., 2016; Indarta et al., 2022). The merdeka Learning curriculum is present as an answer to the intense competition for human resources globally in the 21st century. There are three major competencies in the 21st century, namely the competence to think, act and live in the world. Thinking competence includes critical thinking, creative, and problem solving. Acting competencies include communication, collaboration, digital, and technology literacy. While the competence to live in the world includes initiative, self-direction, global understanding, and social responsibility (Putriani & Hudaidah, 2021; van Laar et al., 2017).

Differentiated learning refers to the variety of services provided by the different characteristics of the knowledge participants. When students arrive at school, they differ widely in abilities, experiences, aptitudes, interests, language, culture, learning styles, and many other factors. The success of differentiated learning can be seen from the process and learning outcomes. Parameters of differentiated learning success include students feeling comfortable in the learning process, improving hard skills and soft skills, students are able to reflect on their abilities from the beginning, process, and end of learning. As a result, it is unfair if the teacher only provides the subject matter and grades students in the same way for all learners in the class. Teachers must pay attention to student differences and provide services that meet student needs (Wahyuningsari et al., 2022). Other research states that differentiation learning is successful in applying students' motivation, academic achievement, attitudes, and perceptions (Chen & Chen, 2018).

The application of PBL is not easy to do. Because the nature of PBL is the use of "problems" in the learning process. Through this learning, students are able to think creatively, so they can solve the problems they face in everyday life. This learning can improve their critical thinking skills. Students come up with ideas and implement development ideas about the potential of their own region, which can be translated into student activities or activities, both through the presentation of written text and pictures, as well as through real activities, encouraging students to realize the map of the advantages of their own regional potential. The teacher's ability to design differentiated learning is also very necessary to improve students' critical thinking skills. Therefore researchers are very interested in researching differentiation learning with PBL to support students' critical thinking skills in the 4.0 era. The purpose of this study is to discover that differential learning includes PBL that supports the learning outcomes of SMP Al-Irshad students in the 2022/2023 academic year.

Methods

This study uses a qualitative descriptive method that seeks to describe phenomena that occur in a real, realistic, actual, real way (Rukajat, 2018). The research design uses a one-group pretest-posttest format with one class observed at the pretest stage (O1) = before proceeding to the learning treatment using the learning method that has been made, (X) = treatment and posttest, (O2) = posttest.

The population used in this study were all 30 students of class VII SMP Al-Irshad. Meanwhile, the sample used was class VIIB, which consisted of 15 students. The sampling method is purposive sampling with the selection of certain criteria that are applied based on research objectives or research problems. Data collection techniques through pre-test and post-test observations. So that the details are described in the following research instruments.

Table 1. Research instrument

Data	Data Collection	Technique Source	Instrument
Student learning outcomes	Students	Test	Test sheet
Differentiated learning with Students PBL	Students	Observation	Observation sheet

Furthermore, Data were analyzed using the normality test and the paired-samples t-test. Acquire response data from the observation sheet conducted as an observation of the steps of the learning activity in the learning process. Observation is an assessment scale that will be filled in when the researcher conducts the teaching and learning process. Observations made focused on the main concepts and principles of the subject, assessment of student readiness and development, were embedded in the curriculum, had flexible groupings of students, and became an active explorer.

Assessment in the differentiated learning process has three aspects. Assessment does not only refer to the achievement of criteria determined in accordance with learning objectives. The three aspects include content, process, and product. Rating range definitions and rating weightings can be found in the score interpretation table based on the Likert scale with an assessment score of 4 = very good, 3 = good, 2 = less, and 1 = very less. Furthermore, the score of the student response questionnaire is calculated by using the formula (Pranatawijaya et al., 2019).

Results and Discussion

Learning outcome data obtained from the learning outcomes of VII B grade students on solar system material using differentiated learning with problem based learning outcome data in the form of pretest and posttest scores in the form of multiple choice with a total of 20 questions with an answer score of 1 for correct answers and 0 for wrong answers.

After the learning outcome test data is obtained, then calculations are carried out using the paired sample t test with the aim of determining how much the students learning outcomes have improved. After the pretest and posttest data is obtained, then calculate the average pretest and posttest scores by calculating the normality test. The following are the results of the pretest, posttest, normality test, and paired sample t test values in the Table 2.

Table 2. Learning Outcome Data

type	lowest	highest	average	normality test	paired Samples t test	category
Pretest	5	70	32.5	0.207>0.05	0.000<0.025	Significant Improvement
Posttest	65	100	83.75	0.296>0.05		

Based on the table above, it shows that in the pretest score, the lowest score is 5 and the highest score is 70. In the posttest score, the lowest score is 65 and the highest score is 100. The average value of the pretest was 32.5 while the average value of the posttest was 83.75. In the Shapiro-Wilk normal test, it is known that the sig. value on the pretest and posttest variables is 0.207 and 0.296, so the data distribution is normal and

because the data is normally distributed, the hypothesis test is continued with parametric statistics, namely the paired samples t test. The paired samples t test obtained the output results, the sig valde of 0.000 is greater than 0.025 so that there is a significant difference in average values. To determine can be seen from the Figure 1.

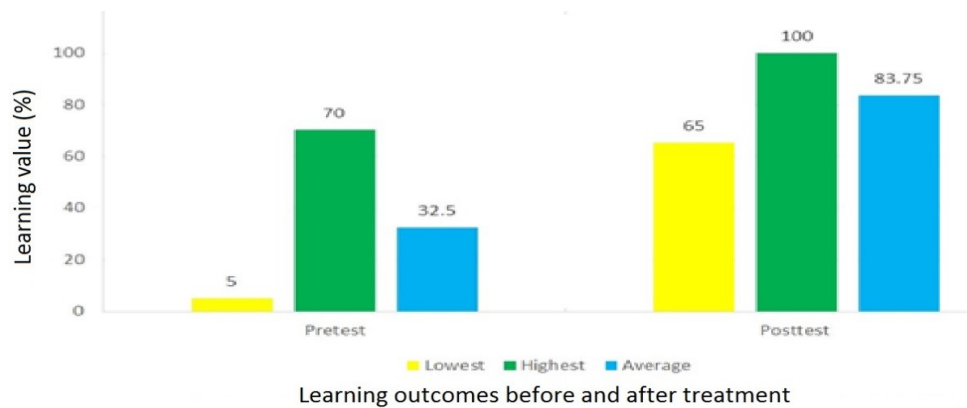


Figure 1. Diagram of Learning Outcomes

The Figure 1 shows that there is an increase in learning outcomes seen from the difference in the average score between the pretest and posttest. The average value of the pretest score is 32.5 and the average value of the posttest score is 83.75.

Observation sheet data obtained from students and teachers of class VIIB on solar system material using a differentiated learning model loaded with problem based learning. The observation sheet is in the form of a sheet containing interactions between teachers and students with a rating scale of 1 to 4. after obtaining the observation sheet data, seen from the results of the observation sheet there are several assessments, namely learning assessment, attitude assessment, psychomotor assessment. Learning assessment air senes lowest score legend entry problem based learning differentiation learning model is carried out in class VIIB SMP Al-Irsyad, then the data is analyzed in the Table 3.

Table 3. Observation sheet result

observation sheet average	score average	value	description
Learning	3.2	78	Good
Attitude	3	86	Good
Psychomotor	3.25	80.51	Achieving the goal

In the learning outcomes, the average score is 3.2 and has a value of 78 and is classified as good learning to be implemented in learning in accordance with the recommendations for learning models in the independent curriculum.

Attitude assessment aims to measure the development of student attitudes over time, provide opportunities for students to reflect on attitudes, attitude assessment can also provide information to teachers about the effectiveness of learning, to develop the formation of positive student attitudes, improve student attitudes, and help form positive character and morale. The results obtained from the attitude assessment with an average score of 3 and a value of 86 obtained good value results because many students have positive character and morals so that they have a good attitude towards teachers and other students and themselves.

Psychomotor assessment aims to measure students' practical skills, monitor student progress, and encourage active involvement in the learning process. The results obtained from students when presenting the results of the LKPD obtained by conveying it to other students so that data is obtained with an average score of 3.25 and a value of 80.51, which means that students are able to achieve the objectives of the learning that has been done.

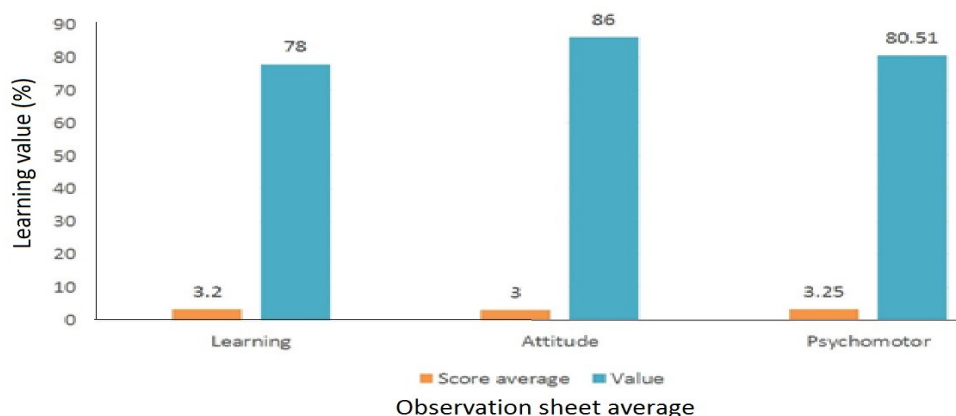


Figure 2. Diagram observation Results

Based on Figure 2, it shows that the observation sheet obtained a good value. From picture and Table 3 it can be seen that each aspect observed for teacher and student activities has a good value so it can be stated that action in learning are carried out using a PBL differentiation model in science subjects on solar system material class VII Al-Irsyad Junior High School in the 2022/2023 academic year is included meets good rank and meets the standards for learning performance, id est at least 70-89 or good studying.

The independent learning curriculum also involves conditions in meeting the learning objectives, methods, materials and evaluations of both teachers and students. With this, it can be seen that the studying process in the independent learning curriculum is more directed towards the needs of students (student-center), where previously the concept of studying was still centered on the teacher or educator (Ningrum & Andriani, 2023).

Differentiated learning foc Legend on the main concepts and principles of academic materials developed, evaluation of student readiness and studying development is accommodated Into the curriculum, there is flexible grouping, and students become active explorers. The application of differentiated learning combined with PBL has advantages, including involving students in learning activities so that the material presented is easy to understand, students can learn independently, students can learn from various sources, so that the material can be understood by students, then students can experience the benefits of science learning directly (Musyadad et al., 2019).

Choosing the right learning model will create effective studying activities so that it can foster students' interest in studying. Every student has a different way of learning. With the use of differentiated learning models with PBL, it is hoped that the implementation of learning that has been carried out by teachers can create an attractive learning atmosphere for students (Sulistiyosari et al., 2022).

Based on the results of the calculation of the value of the learning observation sheet, the results of the implementation of teacher and student learning on solar system material using a differentiated learning model with PBL are in a high category. It is known that the teacher and student learning observation sheet obtained a score of 78 (good) which means it is in accordance with learning standards.

Differentiation learning model with PBL on solar system material is an active learning model. With the use of differentiation models loaded with PBL, placing students as the center of learning activities so that students are required to be more active, independent, and understand learning material according to student abilities. According to research (Chen & Chen, 2018) successfully implemented about student motivation, academic achievement, attitudes and perceptions through differentiated learning.

Indicators of successful implementation of differentiated learning can be seen from the implementation of learning that is oriented towards learning interests and student profiles, actively involving students so as to create a pleasant learning environment, and an increase in mastery of knowledge and skills from students after going through learning (Pandina Scot et al., 2008). Students can choose learning methods according to their respective learning styles so that it helps them master the material being taught more optimally so that learning objectives are achieved (Pashler et al., 2008).

Based on the research data on learning outcomes obtained from pretest and posttest scores, the lowest score on the pretest was 5 and the highest score was 70. On the posttest score, the lowest score was 65 and the highest score was 100. The average value of the pretest is 32.5 and the average value of the posttest value is 83.75.

After the data on the results of the pretest and posttest are obtained, then calculations are carried out with the formula with the aim of determining how much the percentage increase in student learning outcomes. With the average pretest and posttest scores, a high percentage of learning improvement is obtained with a percentage value of 158 %. Based on the high percentage value, it can be concluded that there is a high increase in learning outcomes so that it can be stated that learning with a differentiated learning model with PBL is in accordance with what is recommended in the latest curriculum, namely the independent learning curriculum.

The data above is reinforced by research (Burney, 2008; Hadi et al., 2022) differentiated learning strategy is an effort that can be made to improve student learning outcomes by taking a cognitive approach to heterogeneous students. In addition, in research (Mulbar et al., 2018) The learning outcomes of students have increased where the average learning outcomes of students reach individual completeness, namely meeting the KKM set by the school and classical completeness is achieved which is marked by at least 80% of students meeting the KKM, namely 70. This was achieved in Cycle II with the average learning outcomes of students increasing to 81.5 with classical completeness of 86.67%. Then based on the research results (Muslimin et al., 2022) which has been carried out, it can be concluded that the application of differentiated learning through the PBL model in learning mathematics in class VIII SMP Negeri X can improve student learning outcomes and student learning activities. The implementation of differentiated learning through the PBL model has increased. The average percentage of student learning outcomes completeness in cycle I was 92%, increasing to 96% in cycle II.

Based on research using the differentiation model with PBL in learning activities, it has a positive effect on students in terms of learning and student learning outcomes. Reinforced by research research results (Sumarni, 2023) the application of a differentiated learning approach through the PBL model, there has been an increase in student interest and student learning outcomes, and the research is considered "successful". In addition, in research (Herwina, 2021) stated that differentiated learning is able to help students achieve optimal learning outcomes, because the products they will produce are according to their interests. Therefore, the differentiated learning process must provide ample space for students to demonstrate what they have learned.

Based on the calculation of the value of the observation sheet on each indicator, the lowest score is 2 on the score of calmness in class conditions because all discuss with each

other to complete the LKPD given. Almost all scores on the indicators are high because students are very enthusiastic in carrying out learning and always listen to the instructions and material that the teacher provides during learning so that it includes good learning because there is an increase in learning activities that occur.

Attitude assessment with multiple indicators is used as additional data to reinforce learning observations. Get good results in chat. Students can carry out learning with good attitudes by following learning properly, and students reflect good student judgment. In the observational evaluation of student attitudes, students are able to demonstrate good traits according to the attitude sheet evaluation.

Conclusion

The learning outcomes that have been carried out in problem-based differentiated learning have increased significantly by 83.75 and the effective learning process is 78. The development of various learning models in the process of teaching and learning activities is adjusted to the learning material. The application of the problem-based differentiation learning model requires a more mature learning plan so that time is used more effectively. It is hoped that further research can be carried out by measuring critical thinking skills.

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