Achievement of learning outcome after implemented physical modules based on problem based learning

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Abstract. Implementation of Problem Based Learning (PBL) modules can grow the students' thinking skills to solve the problems in daily life and equip the students into higher education levels. The purpose of this research is to know the achievement of learning outcome after implementation physics module based on PBL in Newton's Law of Gravity. This research method use the experimental method with posttest only group design. To know the achievement of student learning outcomes was analyzed using t test through application of SPSS 18. Based on research result, it is found that the average of student learning outcomes after applying physics module based on PBL has reached the minimal exhaustiveness criteria. In addition, students' scientific attitudes also improved at each meeting. Presentation activities which contained at learning sync are also able to practice speaking skills and broaden their knowledge. Looking at some shortcomings during the study, it is suggested the issues raised into learning should be a problem close to the life of students so that, the students are more active and enthusiastic in following the learning of physics.

1. Introduction
In general, the implementation of physics learning that occurs in schools shows that students tend to be lazy to think. In addition, in answering questions they simply memorize and quote from the book so that their mastery of the concept is less developed. This means that they have not yet developed scientific thinking skills [1]. The application of PBL in the learning process can benefit students with high performance to the lowest so as to reduce the gaps in achievement of learning outcomes [2]. The learning process will run maximally if supported by decent learning facilities and quality. The main facility most frequently used is teaching materials. The teaching materials in question are books, modules, worksheets, handouts etc in both print and electronic versions. The module is a teaching material that suits the demands of the curriculum by considering the needs of the students. In other words, although classroom time is reduced, modules can have a positive effect on student performance on conceptual tests and discussion processes [3]. There are several advantages in the application of module in learning that is focus on individual ability of each student, the control of the learning result must be achieved by looking at the competency standard in the module, and the students can know the relation between the learning with the result obtained through curriculum relevance. The students who use the module and complete the task within it can help them to take lessons and improve information during learning consistently with pre-lecture priming [4].
Problem-based learning is a series of learning activities that emphasize the process of solving problems faced scientifically [5]. By applying the PBL model in the learning process, students do not just listen, record and memorize the subject matter, but with PBL students are expected to actively think, communicate, search and process data, and conclude. With the learning process, students are directed to think using the scientific method. The PBL syntax are five main stages to be presented in Table 1 below [6]:

| learning phase                  | student activity                                              |
|---------------------------------|---------------------------------------------------------------|
| phase 1 problem orientation.    | observe the pictures of daily phenomenon and answer the questions which available in the module. |
| phase 2 organize the students to learn | the student discuss in group that consist of 4-5 student |
| phase 3 independent and group investigation | the students solving the problems that have been presented in the module by group discussions |
| phase 4 presentation (problem solving) | the students present the results of the discussion with the group in front of the class. |
| phase 5 analyz and evaluate of problem-solving | students with teacher conducting reflection based on discussion result |

The module applied in this research is a Problem Based Learning (PBL) module because the field of physics is concerned with how to figure out and understand nature systematically, so that physics is not just a mastery of a collection of knowledge in the form of facts, concepts, principles only But also a process of discovery. The Graduate Competency Standard (SKL) for physics subjects is: conducting experiments, including formulating problems, filing and testing hypotheses, determining variables, designing and assembling instruments, collecting, processing and interpreting data, draw conclusions, and communicate experimental results orally and in writing [7]. The material contained in the module is Newton's law of gravity because it contains an adequate conceptual analysis to practice student problem-solving skills. Through this PBL module, students are expected to be able to use and develop the ability to solve problems with various forms of settlement strategies. In addition, the application of PBL-based physics module is expected to improve student learning outcomes.

Problem based learning can improve the ability to understand and remember the meaning of words and physics terms on the concepts and questions given so that the student's knowledge (cognitive) automatically increase [8]. So, the goal to be achieved from this research is to know the achievement of physics module based onPBL in Newton's Law of gravity materialon the result of student learning outcome in X degree senior high school. Newton’s Law of gravity is chosen because it contains many applications applied in technology both on earth and in space so students need to understand in depth. Because this research uses experiments, the initial hypothesis (H₀) used is the result of learning after applying the PBL-based physics module equal to the determined by minimal exhaustiveness criteria value. While the final hypothesis (H₁) used is the result of learning after the applied PBL-based physics module exceeds the established minimal exhaustiveness criteria value.

2. Methods
This research used experimental method with post-test only group design. Post test results of students obtained after applying physics modules based on PBL in Newton’s Law of gravity were analyzed and then compared with the applicable minimal exhaustiveness criteria. This research was conducted at SMA N 2 Kudus. The subjects of this study were students of class X MIA 1 amount 32 students. Data of student knowledge obtained from multiple choice test method as many as 25 questions. Data analysis technique used is one sample t test. The result of post-test of student, then analyzed by one sample t test, because only take from one sample then compare with minimal exhaustiveness criteria.
which is valid that is 70. As for student attitude and skill data obtained by observation then write result on observation sheet available.

3. Result and Discussion

3.1. Learning implementation

The module applied in this research is PBL-based physics module which consists of 3 learning activities. The learning activities (KP) contained in this module are KP 1 (Newton Gravity Style), KP 2 (Field Gravity Newton), KP 3 (Kepler Law). Learning activities are adapted to the PBL syntax. This learning process tends to be student-centered. The study was conducted 5 times meeting by applying 5 PBL syntax in each meeting.

In the problem orientation stage, students recognize problems and answer some questions to explore students’ curiosity before proceeding further to the core of learning. Followed by organizing the students to work in groups and then do the discussion. Discussion here leads the students to perform activities ranging from observations to find solutions to the problems given. After the investigation process is complete, the students proceed to the presentation stage. At this stage students have the opportunity to exchange opinions and argue each other to convey the results obtained from each group. The last stage is to do reflection and evaluation at the end of learning. The achievement criteria for each learning stage with PBL model can be seen in Table 2. For the problem orientation stage, student learning organization and learning evaluation belong to good category. While at the stage of the investigation of the group there are some students who are still difficulties because the portion of students' thinking ability in one group there are uneven so that those who are in a group with low ability can not be the maximum in conducting the investigation. In addition, their thinking patterns are also limited because their level of curiosity is still low. In the course of presentation the results are also included in the medium category because students are still not used to appear in front of the class and do question and answer independently. So the teacher should motivate them to be more confident and give reinforcement to the students who dare to actively express their opinions.

| Table 2. Criteria for achieving pbl syntax |
|------------------------------------------|
| learning phase                          | category |
| problem orientation.                    | good      |
| organize the students to learn           | good      |
| self and group investigation             | medium    |
| presentation of the work (problem solving)| medium   |
| analysis and evaluation of problem-solving| good     |

The application of PBL model in learning can be applied if supported constructivist learning environment. Learning environment in question is the suitability of the topic, cognitive flexibility, information resources, dynamic modeling, komunikatifan and contextuality of presentation [9]. In this research that causes less maximal application of PBL model is one of less optimal learning environment that is cause communication among student.

3.2. Student Knowledge

The first measurement of learning outcomes is student knowledge. In general, students have mastered all the indicators of learning that are delivered. But there are still some indicators of learning that have not been achieved that is on the indicators to analyze the application of Newton's gravitational force on the motion of satellite circulation. There are some students who still do not understand in the section describing the satellite release process, calculating the speed of satellites orbiting the earth and calculating the speed of the satellite off. Students still assume that the speed of satellite offsets must be greatest, when the required take-off speed is the smallest so that satellites can be retained in orbit and remain within the reach of the earth's gravitational forces. Meanwhile, in distinguishing the calculation of freelance speed and speed of orbits of students still have not maximized the equation used. This
indicates that the application of physics module in this research is still not fully successful, but that
does not mean this research failed. This can be proved in the final evaluation result of the study
reveals that at the end of the learning has been tested in the form of multiple choice as many as 25
questions where the problem has been adjusted with the indicators of learning that have been applied
during the study. From the results obtained, the average student score is 71.13 with the highest score
of 80 and the lowest of 64.

Based on the results of data processing with SPSS 18, it is known that the students’ learning
outcomes have been normally distributed so as to test the hypothesis of the achievement of this PBL
module using one sample Kolmogorov-Smirnov Test. Of 32 students, normality test results obtained
standard deviation value of 4.626. Since this value is smaller than the average, the average value is a
reflection of the overall student learning outcome representation. In addition, the Kolmogorov-
Smirnov Z value obtained by 1.167 is greater than Z table, the initial hypothesis is rejected and the
significance level is 0.131 which means that the data is normally distributed because the value is more
than 0.05. Because the data obtained has been normally distributed then it can be continued to analyze
with one sample t test. The use of one sample t-test is done because it is analyzed only the student's
post test section with a sample of 1 class. Results obtained by this student compared with KKM that is
equal to 70. The results obtained from the test one sample t-test is the value of t arithmetic shows
1.376 with degrees of freedom 31 (N-1) which means that t arithmetic c> t table then Ho is rejected and
Ha accepted. This means the learning outcomes achieved by students after the applied PBL-based
physics modules exceed the established KKM scores.

Application of problem based learning can improve students' ability to solve problems, increase
student activity in learning, and improve student learning outcomes [10]. The fulfillment of
intellectual needs of students can be known through positive responses given students after learning to
use PBL-based Physics module [11]. In addition, significant differences in learning outcomes after
module use also indicate that students can construct their knowledge through PBL activities and can
solve the problems presented during posttest

3.3. Student Attitude
As a scientific being, the ability is enhanced not only in the aspect of knowledge alone but also the
scientific attitude aspect must also be possessed. Observations on the students' scientific attitude were
observed during 4 meetings in the learning process. The types of scientific attitudes observed consist
of 6 indicators of judgment, namely honesty in speech, modesty in behaving to friends and teachers,
responsibility for tasks given, cooperation in discussion, tolerance to friends and the environment, and
confidence in making decisions. Student attitude observation results are shown in Figure 1.

![Figure 1. Observation of student’s attitude](image-url)

Based on the picture above, it can be seen that there is an increase in student attitudes at each
meeting. Scientific attitude that is expected to emerge in learning science is truthful to the fact,
because in this condition students are trained to use the scientific method in solving problems, so it is
not easy to believe in something that is uncertain the truth [12]. The condition of honesty of students at
the beginning of learning is still relatively low because some students are still seen to look to the friends next to him and some even open HP to seek clues when asked to perform independent activities such as working on the problem. But with direction and reinforcement, this does not last long, in the next meeting they begin to understand the process of learning honestly so that will get meaning useful for them. The second point is the courtesy of students to friends and teachers. Since the beginning it already looks pretty good because of the habits that are done in schools such as shaking hands when meeting with teachers or older people and greeted among family members at school. Furthermore, the attitude of responsibility to the task has improved quite well because the teachers begin to apply the discipline of time in completing the task. Beyond the task during the learning process, it seems that in this school also apply a very strict discipline attitude and also prepare sanctions that are educational for those who violate. The attitude of student responsibility can be familiarized by self-discipline bring the results of student discussion and come on time, then students will have a high responsibility attitude [13]. Meanwhile, for the attitude of cooperation and tolerance in the discussion has increased because every time the meeting, they are accustomed to face the conditions of dissent in the discussion. Increased tolerance occurs because students are getting used to differences of opinion in the group so that the attitude of student tolerance is increasing [14]. Furthermore, students' self-confidence has also improved. This attitude can be seen from the change in the way of speech, the way of conveying and the order of the sentences that are arranged indicate that with a calm nature will produce a high confidence. Having self-esteem is considered capable of improving students' learning motivation so that it will generate learning spirit to achieve maximum learning result [15].

3.4. Student Skills
In addition to observing attitudes, teachers also observe student skills. Skills here centre on data presentation activities. The data presentation stage is part of the learning model that is integrated into the module. There are several points observed: the ability to communicate, the systematics of the delivery of opinions, insights on the topic of discussion, courage in acting, enthusiasm to expose the results of discussion, as well as the appearance and gesture in speaking in front of the class. The result of observation of student skill during 4 times meeting shown in Figure 2.

![Figure 2. Observation of student’s skill](image)

Student-centered physics learning is never separated from the skills of communicating and expressing opinions. In the syntax of learning this time, there is a presentation stage of the work done through the presentation of the results of the discussion. At the beginning of the meeting, the students still feel awkward to express their opinions because they are not confident in the results of their thinking. Presentation and discussion activities can provide an opportunity for students to improve their verbal communication skills. Not only communicate with teachers, but with peers so they will know the characteristics and abilities that vary [16]. Through the presentation activities, students are also trained
to develop insights as they will gain new information from various opinions given in the forum. Over time, students are encouraged to cultivate their knowledge so that the insights they have will develop. In addition, they were also asked to add some references to scientific knowledge. Enthusiastic students also experience improvement because the teacher gives its own points for students who enthusiastically argue voluntarily. Another advantage gained after applying problem-based learning is that students are more enthusiastic and courageous in presenting results. Based on the chart above, after going through 2 meetings, students start accustomed to dare to argue. So, problembased learning can improve the attitude and scientific skills of students such as courage, curiosity and enthusiasm in discussion.

4. Conclusion
Based on the results and discussion, it can be concluded that the achievement of student learning outcomes after the applied PBL-based physics module has reached KKM, but there are still some learning indicators that have not been mastered by students due to lack of attention of some students and limited time during the learning process. This module can also improve scientific attitudes and practice students' speaking skills quite well by seeing the progress of student observations from the first to last meeting. Therefore, the application of PBL-based learning modules like this is highly recommended in physics learning.

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