

Implementation of Problem Based Learning Model in Improving Student Achievement in Physics Subjects at The Vocational High School

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Abstract. This research is a research with quantitative regression method with the aim of knowing the improvement of student achievement by developing problem based learning on energy materials for class X SMK. The research variables are grouped into 2 variables, namely: 1) The independent variable in this study is the Problem Based Learning learning model and 2) The dependent variable in this study is student achievement in Physics. Problem based learning is one of the learning models used in the teaching and learning process, especially in improving student achievement. This model is carried out in small classes, students are given cases to stimulate group discussion. Then the students expressed the results of the search for material related to the case and discussed in groups. The advantages of the problem based learning model include 1) students become more active in finding material or information, 2) students are active in expressing opinions and discussing, 3) the class atmosphere is not boring for students. Based on the results of the analysis carried out in the physics learning process by applying Problem Based Learning, it can be concluded as follows: The application of the Problem Based Learning model can improve student achievement.

Keywords: Learning Model, Learning Achievement, Physics Lesson, Problem Based Learning

1. Introduction

Education is an effort to help students develop all their potential (heart, thought, feeling, and intention, as well as body) to face the future [1]. The learning process occurs because of the interaction between a person and his environment [2–4]. In the learning process is expected to reflect three aspects of learning activities, namely aspects of attitudes, knowledge and skills. The development of a new curriculum, an independent curriculum, in the national education system, seeks to ensure that all three aspects of the national education goals can be implemented in the learning process. The Merdeka Curriculum is a curriculum with diverse intra-curricular learning where the content will be optimized so that students have enough time to explore concepts and strengthen competencies. Teachers have the flexibility to choose various teaching tools so that learning can be adapted to the learning needs and interests of students.

In general, physics is one of the subjects that are considered difficult and disliked by students because physics is usually studied through a mathematical approach. Learning physics is not just understanding mathematics but furthermore students are expected to be able

to understand the concepts contained therein, write them into physical symbols, understand problems and solve them mathematically. This causes students' displeasure with physics lessons to be even greater. Dissatisfaction with physics lessons can be seen from the relatively low average achievement when compared to the average achievements of other subjects.

In learning physics, the ability to understand concepts is an absolute requirement in achieving success in learning physics. For this reason, physics learning must be based on processes, methods and actions. In teacher learning teaching is defined as an effort to organize the environment during learning. Teachers teaching in a learning perspective are teachers providing learning facilities for students to do learning. The subject of learning is students, so the learning that occurs is student-centered and in their activities each individual performs social interaction. Social interaction can be defined as dynamic social relationships. The social relationship in question can be in the form of a relationship between one individual and another, between one group and another, or between groups and individuals. Operationally there are many other factors that affect social interaction in learning.

Based on the problems above, it is necessary to improve the quality of learning by doing various ways. One of them is by developing an existing learning model. Contextual learning is a student-centered learning model and is able to encourage students to construct the knowledge they have acquired through their own mindset. One of the student-centered learning that can be done by teachers to improve student achievement is to apply a problem-based learning model or Problem Based Learning (PBL).

Application of Problem Based Learning (PBL) Model. The energy problem is a very popular problem, widely discussed by people all over the surface of our earth. The energy problem is a problem that really needs to be handled seriously by all parties to be able to overcome the bad effects that occur due to energy, even as much as possible to prevent energy shortages from occurring.

The Problem Based Learning (PBL) learning model has been known since the time of John Dewey. According to Arends, Problem Based Learning (PBL) is a learning model that presents a variety of authentic and meaningful problem situations to students, which can serve as a springboard for investigation and investigation [5]. PBL helps students to develop critical thinking skills and problem solving skills.

Furthermore, problem solving is a process of manipulation of previously owned knowledge. According to [5], the Problem Based Learning (PBL) learning model based on problems has the following characteristics:

- a) Asking questions or problems. Problem-based learning organizes teaching around social issues that are important to students. Students are faced with real-life situations, try to make questions related to problems and allow the emergence of various solutions to solve problems.
- b) Focuses on inter-discipline linkages. Although problem-based learning is centered on certain subjects (natural sciences, mathematics, and social sciences), the problems studied are real to be solved. Students review the problem from various subjects.
- c) Authentic research. Problem-based learning requires students to carry out authentic investigations to find real solutions to real problems. Students must analyze and define problems, then develop hypotheses and make predictions, collect and analyze information, carry out experiments (if needed), and draw conclusions.
- d) Produce products and publish. Problem-based learning requires students to produce certain products in the form of real works or demonstrations that can represent solving the problems they find.

- e) Collaboration. Problem-based learning is characterized by students working together, most often forming pairs in small groups. Working together provides motivation to continue in more complex assignments and enhances the development of social skills.

Table 1. Steps of the Problem Based Learning (PBL) Learning Model

Phase	Teacher Behavior
Phase-1 Student orientation to the problem	The teacher explains the learning objectives, explains the logistics needed, proposes phenomena or stories to bring up problems, motivates students to be involved in solving problems selected
Phase-2 Organizing students for learning	The teacher helps students define and organize learning tasks related to the problem.
Phase-3 Guiding individual and group investigations	The teacher encourages students to collect appropriate information, carry out experiments, to get explanations of problem solving.
Phase-4 Develop and present the work	The teacher assists students in planning and preparing appropriate works such as reports, videos, models and helps them with various assignments with their friends.
Phase-5 Analyze and evaluate the problem-solving process	The teacher helps students reflect or evaluate their investigations into the processes they use.

1.1 Phase 1: Orientation of students to problems.

Educators explain what the learning objectives are, how the learning process will be carried out, and motivate students to be involved in problem solving activities that can be selected. In one learning model should be able to answer all the basic competencies to be achieved. Therefore, the Problem Based Learning model can be implemented in more than one meeting. Learning meetings are adjusted to the number of basic competencies to be achieved.

Early childhood students can be given problem orientation by presenting a problem that they need to solve well. For example, problems in the theme of loving can be inserted learning objectives containing literacy. Learners can be directed to solve the problem of how to care for a cat. With equipment that is easily available, students in groups can be asked to determine and make the best cat cage design so that the cat lives comfortably. The role of the educator directs the strengths and weaknesses when students design a cat cage. When students carry out activities to design cat dwellings, there is literacy in the form of scientific literacy, where students learn the principles of building buildings. There is also technological literacy, where educators accompany students to access videos about cat habits when living in their cages. There is also engineering and artistic literacy, where students with their creativity can create cat house designs that have the same principles as cat houses in general, although with different manufacturing techniques. Although early childhood is not familiar with mathematical formulas, early childhood can be introduced to mathematical principles in the form of a solid building which means having an adequate building framework. The task of educators is to connect abstract concepts to become more concrete to early childhood students through interactive communication.

Problem orientation to students at higher education levels is certainly not much different from PAUD. Educators at any level of education should always ask what learning objectives need to be achieved by students. The learning objectives must contain literacy which is adjusted to the level of cognitive, affective, and psychomotor development of students. The desired output that can be achieved by high school students should be more complex than the output of elementary school [6]. The higher the level of education, the learning objectives (output) will be more complex.

You can study the following examples of problem orientation for students at the high school level. If the approach you apply is embedded, then you can choose one discipline/subject as the parent of several subjects (referring to literacy) as a child embedded in the parent. Simply put, the subject label is one but at the same time includes two or more subjects embedded in it. For example, the sub-topic of Biology is "digestive system" but in Biology is embedded ICT (technology literacy), mathematics (mathematical literacy), cultural arts lessons (art literacy). In the sub-topic "digestive system", scientific literacy can contain about how to prevent digestive system disorders; his technological literacy can be in the form of food processing technology practices using microorganisms and fermenters or allowing for virtual discussions with professors at universities; his engineering/technical literacy can be in the form of designing fermentor/incubator activities to optimize yeast development; his artistic literacy can be adapted to the local potential of herbal plants around his residence; and mathematical literacy can be in the form of calculating the speed of the fermentation process to the temperature of the fermenter.

Educators can convey problem orientation by motivating students to be enthusiastic and ready to learn. For example, by asking students to guess what might happen to the problem given by the teacher. Educators can also connect the learning objectives to be achieved with past learning objectives. This method makes student orientation to the problem more important and challenging to solve.

1.2 Phase 2: Organizing students

Educators help students define and organize learning tasks related to the problem (setting topics and assignments). The definition of the problem must meet the criteria of being authentic, clear, easy to understand, broad according to learning objectives, and useful. For example, at the high school level, students are grouped heterogeneously, each group discussing the nutrients needed by the body and how to test for nutrients in foodstuffs. Students are asked to determine the roles of each student. Some are looking for materials, some are diligent in observing experiments, some are connecting with technology as a medium of information, and some are reminding them to carry out any problem solving activities.

1.3 Phase 3: Guiding individual and group investigations.

Educators help students to collect appropriate information, experiments to obtain explanations and problem solving, data collection, hypotheses, and problem solving. Educators act as facilitators who encourage each student to find solutions from technological ways, think critically, and utilize creativity. Educators also play a role in encouraging students educatively if there are indications of boredom and despair in the problem solving process.

1.4 Phase 4, Develop and present the work

educators assisting students in planning and preparing appropriate works such as reports and demonstrations. For example on the theme of "digestive system", activities that can be carried out can be in the form of students discussing in groups to conclude the content of food

substances found in the results of the practicum. The results of the practicum can be presented in the form of posters or videos that can be seen by every student.

1.5 Phase 5, Analyzing and evaluating the problem solving process

Educators help students to reflect or evaluate their investigations and the processes used. Ideally, the Problem Based Learning learning model can be applied to achieve all the basic competencies to be achieved, in terms of knowledge, skills, and attitudes. Of course, the basic competencies achieved are not only one so that the application of Problem Based Learning allows more than one meeting to occur. For example, phase 1 and phase 2 can be applied at the 1st meeting, phase 3 and phase 4 may require two further meetings, and phase 5 can be applied at the 5th meeting. The ultimate goal of applying the Problem Based Learning learning model is the achievement of basic competencies, in this case competencies related to the field of . So that learning can run smoothly through the application of Problem Based Learning, educators need to make lesson plan correctly.

Winkel defines "achievement is evidence of achievable business success" [7]. Achievement is the result achieved by students as a result of their lessons which include cognitive, affective and psychomotor aspects after following the teaching and learning process. Learning achievement is the result obtained by students from their learning efforts. Student achievement can be seen from the numbers or scores obtained by students compared to other students' scores or scores. In this study, a learning achievement test will be used, especially in the cognitive domain, as stated by Blom who divides it into six cognitive aspects, namely knowledge, comprehension, application, analysis, synthesis, evaluation.

Learning achievement is a real ability (actual ability) achieved by individuals or students in learning. The definition of achievement above emphasizes the results achieved from an activity that has been carried out or created by way of tenacity of work, both individually and in groups in certain fields of activity and is pleasing to the heart. Based on the opinions above, it can be concluded that learning achievement is the result obtained by someone who can be known as a learning outcome by using a test or evaluation, and is usually indicated by a test score. Thus, in the educational process in schools, learning activities are the most basic activities, this means that the success or failure of what students achieve depends on the learning process experienced by students.

Gronlund in Saifuddin Azwar, suggests that the preparation of achievement tests formulates several basic principles in measuring achievement as follows: achievement tests must: measure learning outcomes that have been clearly defined in accordance with instructional objectives, measure a representative sample of learning outcomes and from the material covered by the program instructional or teaching, contains items with the most suitable type to measure the desired learning outcomes, designed in such a way as to suit the intended use of the results, the reliability of achievement tests must be sought as high as possible and the measurement results must be interpreted with caution, can be used to improve students' learning [8]. With the understanding and understanding of achievement tests more proportionally in the sense of something that is expected to be able to take advantage of the results as much as possible.

In preparing the achievement test, determining the format and type of items to be used includes considerations, namely the nature of learning outcomes must measure learning outcomes directly, the quality of items that may be made such as multiple-choice items will produce the best quality items in the sense that they will have a good measurement function. more effective than other type items. Multiple-choice items that are carefully designed by taking into account the limitations of the test content and written according to the purpose of

measuring according to a high level of competence will have the widest variation in the level of mastery, ranging from the simplest to the highest. The best type of item is the one that best fits the test material, the level of competence to be revealed and the education level of the student to be tested. The test planner must be able to determine the type of item that fits the test being made.

Considerations in determining the type of item used in the learning achievement test have advantages and disadvantages. The advantages of the multiple-choice type are that it is comprehensive because in a short test time it can contain more items, checking answers and scoring is easy and fast, the use of answer sheets makes the test efficient and cost-effective, the quality of items can be analyzed empirically, has high objectivity and generally has reliability. satisfactory. The disadvantages are that it is difficult to make and takes a lot of time and effort, it is not easy to write to express a high level of competence and there is a possibility that the correct answer is solely due to guesswork. The multiple choice type item writing consists of one statement sentence or question sentence called stem and several answer choices called alternatives or options. One of these alternatives is the answer key, while the other alternatives are answers called distractors. The preparation of the multiple-choice test has several criteria including: the question sentence must be firm and clear, the statement in the form of a positive sentence is not allowed to use the word no or except, the distractor must be balanced, each item stands alone, the sentence length of each item is balanced and uses dots. at the end of the sentence.

[9]provides an understanding of learning achievement, namely "the results achieved by someone in an effort to learn as stated in the report card [9]." Furthermore, state that learning achievement is a proof of learning success or a student's ability to carry out learning activities according to the weight achieved [7]. Based on the above understanding, it can be explained that learning achievement is the level of humanity possessed by students in accepting, rejecting and assessing the information obtained in the teaching and learning process. A person's learning achievement is in accordance with the level of success of something in studying the subject matter expressed in the form of grades or report cards for each field of study after experiencing the teaching and learning process. Student achievement can be known after an evaluation is held. The results of the evaluation can show the high or low student achievement.

Understanding learning achievement, namely learning is a need for everyone, because by learning a person can understand or master something so that his abilities can be improved. According to Winkel, learning in humans can be formulated as a mental or psychic activity that takes place in active interaction with the environment, which results in changes in knowledge and attitude values [7]. Based on this opinion, it can be concluded that learning achievement is formulated as a mental or psychic activity, mastery of knowledge and learning skills possessed by students and is operationalized in the form of indicators in the form of report cards.

Measurement of Learning Achievement, according to Arikunto, measurement of learning achievement can be done in various ways by giving a test that has a function, namely to measure students' abilities and the success of teaching programs. The test is divided into 3 kinds [6]:

1. Diagnostic test is a test used to find out the weaknesses of students so that they can provide the right treatment.
2. Formative tests are to determine the extent to which students have formed after following a certain program and this test is used at the end of the lesson.

3. The summative test is a test that is carried out after the end of giving a group of programs or a larger program and is carried out at the end of each semester.

According to Sudjana, learning achievement can be divided into 3 levels, namely [10]:

1. High learning achievement, with a value or score above the average obtained from the results of the learning evaluation, so that knowing the value or score students can be declared successful in achieving the goals of education.
2. Moderate learning achievement, the average value or score that can be obtained by studying evaluation or examinations obtained by students so that by knowing the scores obtained, students can be said to be successful and achieve educational goals.
3. Low learning achievement, value or score below the average obtained from the results of research or exams, with the results of these scores it can be said that the student failed in his studies and failed in his educational goals.

Based on the description above, it can be concluded that the measurement of learning achievement can be done by giving a test that has a function to measure students' abilities and the success of teaching programs and evaluate student learning outcomes by looking at the results of students' final test scores.

Factors Affecting Learning Achievement, [11] stated in detail about the factors that influence learning achievement, among others, namely:

1. Factors originating from outside the individual, including: non-social factors such as air conditions, study time, the tools used for learning, and social factors, such as the atmosphere in the family, noisy sounds around the study area, and so on.
2. Factors that come from within the individual which include: physiological aspects, namely physical conditions or health in general and certain physiological functions, especially the functions of the five senses, psychological aspects, such as emotional intelligence, attitudes, memory, is the individual's ability to fully control existence as a whole.

To achieve good learning achievement, there are many factors that need to be considered, because in the world of education there are not a few students who experience failure. There are students who have a strong drive to excel and the opportunity to improve achievement, but in reality the resulting achievements are below their abilities.

In general, the learning achievement displayed by students has a close relationship with the level of intelligence possessed by students. According to Winkle, the essence of intelligence is the ability to set and maintain a goal, to make an adjustment in order to achieve that goal and to assess one's self critically and objectively [7]. This level of intelligence greatly affects the learning achievement of a student, where students who have a high level of intelligence have a greater opportunity to achieve higher learning achievement. On the other hand, students who have low intelligence levels are also expected to have low learning achievements. However, it is not impossible if students with low intelligence levels have high learning achievements, and vice versa.

Curriculum and teaching methods include materials and how to provide these materials to students. More interactive learning methods are needed to foster student interest and participation in learning activities. Sarlito Wirawan said that the most important factor was the teacher factor [12]. If the teacher teaches wisely, firmly, has high discipline, is flexible and is able to make students happy about the lesson, then student learning achievement will tend to be high, at least the student is not bored in following the lesson.

Based on the opinion above, it can be concluded that learning success or achievement is strongly influenced by two factors, namely internal factors and external factors. Internal factors include the condition of individuals who study, both physically and psychologically,

while external factors include environmental conditions of family, school, community, including the material being studied. These factors interact with each other

2. Method

This research is a quantitative regression method with the aim of knowing the improvement of student achievement by developing problem based learning on energy materials for class X SMK. The research variables are grouped into 2 variables, namely: 1) The independent variable in this study is the Problem Based Learning learning model and 2) The dependent variable in this study is student achievement in Physics.

After the analysis prerequisites are fulfilled, namely normality and homogeneity, then hypothesis testing is carried out. Hypothesis testing is done to find out whether the proposed hypothesis is rejected or not. To test the hypothesis, regression analysis was used to study the form of the relationship between one independent variable and one dependent variable. The hypothesis to be tested is formulated in the null hypothesis (H_0) and the alternative hypothesis (H_a). The hypothesis is as follows H_a : Learning Problem Based Learning model can improve student achievement. and H_0 : Problem Based Learning model cannot improve student achievement.

3. Result & Discussion

Model provides opportunities for all students to be active in the learning process, moreover to solve the problems provided in the learning process. This of course has an influence on student physics learning outcomes which can be proven by an average score above the KKM.

Problem based learning is one of the learning models used in the teaching and learning process, especially in improving student achievement. This model is carried out in small classes, students are given cases to stimulate group discussion. Then the students expressed the results of the search for material related to the case and discussed in groups. The advantages of the problem based learning model include 1) students become more active in finding material or information, 2) students are active in expressing opinions and discussing, 3) the class atmosphere is not boring for students.

In the small class trial analysis, the results showed that the research instruments, namely the evaluation of learning achievement and student worksheets, were valid and reliable. This indicates that the instrument can be used on a wide-scale trial. While the analysis of the small-scale difference test shows the growth of student achievement before and after learning. The growth is not the same in each indicator. In trial 1, the highest growth was in the ability to cooperate and discipline, this happened because in the LKS the thermometric nature of the material required many activities that required group collaboration in a work team. Meanwhile, discipline increases because the LKS also demands accuracy in reading measuring instruments that have to do with discipline in the use of tools.

Learning in the experimental class uses a learning based learning model that is guided using LKS, the results of the percentage calculation show that student achievement is better than in the control class. This is in accordance with Sukamto's opinion that one of the goals of providing LKS is to enable students to carry out teaching and learning activities to find and manage their own learning outcomes that need to be mastered [10]. Suwardi stated that the advantage of using LKS is that it provides opportunities for students who have more ability to learn faster and allows teachers to devote more attention to students whose abilities are lower

than the class average [11]. The theory reinforces that the use of worksheets in learning can control student activities so as to reduce student activities that are not in accordance with learning activities. Students are busy with the task of doing LKS so that the opportunity for silence and other inappropriate activities can be minimized. LKS guides students to understand the concepts being studied in a coherent manner in the worksheets.

The results of the analysis show that the growth of students' soft skills in the experimental class is 56% while in the control class it is 38%. The growth of students' soft skills, especially communication skills and collaboration skills will be more effective if implemented in learning with practicum or experimental methods, this is in accordance with Wiyanto who stated that the important role of practicum is as a vehicle for developing communication skills, analyzing data and skills to work together in teams. [12].

There are several obstacles that arise in the development of problem based learning learning models in the field. These constraints are important things to know for teachers and other researchers who will use the learning model. Learning constraints will be felt more if it has entered the large-scale stage, with the number of students more than 20. In the learning process the teacher will have difficulty controlling student activities in a large classroom, for that we need a companion teacher to participate in supervising students. The advantage of the learning process through problem based learning for students is that students are enthusiastic about participating in the learning process and express pleasure in carrying out physics practicum in class, although there are those who state that physics practicum should be in a physics laboratory. The obstacle in making worksheets that can improve student learning achievement is that it requires careful thinking so that it is in accordance with the evaluation used so that it requires patience so that the concepts that we will convey can be effectively understood by students. The worksheets used in the experimental class have been tested in small classes so that they have undergone improvements. Improvements are carried out according to input from students consisting of commands that are difficult to understand or are typos. The costs incurred to duplicate LKS are also not small, especially if the LKS requires a lot of sheets. The obstacle in making physics worksheets carried out in class is that the teacher must understand the characteristics of students, namely students who already understand the concepts of physics that will be used for practice so that the learning process can run smoothly without many questions from students.

4. Conclusion

Based on the results of the analysis carried out in the physics learning process by applying Problem Based Learning, it can be concluded as follows: The application of the Problem Based Learning model can improve student achievement.

Acknowledgement

Appreciation and thanks to the supervisors and suggestions from various parties, so that this article can be completed. For that the author would like to thank Dr. Basukiyatno, M.pd. as the Head of the Pedagogical Masters Program at Pancasakti University, Tegal, Dr. Burhan Eko Purwanto, M. Hum. as Advisor I, Dr. Muntoha Nasucha, M.Pd. as Advisor II. All of the Lecturers of the Master of Pedagogy Study Program UPS Tegal, Fellow students of class 3 MP UPS Tegal, My beloved family at home, especially my wife, all those who have helped from the beginning to the end of the preparation of this article.

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