Optimalization of student’s learning outcomes and learning activities in physics using open ended model

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Abstract. This study aims to optimize the learning outcomes and physics learning activities of senior high boarding school in Banda Aceh, Indonesia on the subject of Newton's law about gravitation using an open-ended learning model. The study was conducted by involving 29 students of grade 11th. Data collected include data of learning result, data of observation result of student activity, and student response questionnaire data. The data collected is then analyzed using descriptive and quantitative statistics. Based on the results of processing and data analysis shows that the results of learning and physics learning activities of senior high boarding school in Banda Aceh, Indonesia has been optimal.

1. Introduction
In the learning activities at school, teachers are not only required to master the teaching materials, but also expected to know the characteristics of the students because each student has a difference in learning activities and problem solving. With regard to problem solving activities, learning needs to be designed so as to accommodate the diversity of student characteristics so that they can develop optimally according to their potential [1]. The failure of the teacher to convey the subject matter is not only because he lacks the mastery, but it can be because he does not know how to teach certain subject matter properly and correctly.

According to Yulianti [2] in the context of physics learning at school, students learn not only how to understand the physics concept but are also expected to develop the skills to ask questions, make explanations, and test explanations and rewrite them using their own language.

According to Popov [3], there are several solutions to address current physics education issues, including (1) teachers need to identify each student's individual abilities and challenge him in the proper way, (2) teachers need to have the ability to explain physics in different ways when meeting with students of different characteristics, and (3) teachers who convey the desire to learn have often lessons relate to reality, and they engage students in challenging discussions and show how theoretical knowledge can be used in practice.

Furthermore, it is said that successful learning depends on two-way communication and discussion between teacher and students. Therefore, if students are aware of their ability to learn then they can also plan lessons with teachers. However, the increased desire to learn does not automatically lead to students achieving better academic performance, but the development and progress in the field of interest will give potential to increase students' desire to learn. Increased desire to learn can create opportunities to achieve better learning outcomes in physics [3].
The outdoor physics approach broadly uses open-ended authentic problems, and hence, it is necessary to classify problems and find suitable problem-solving strategies for open-ended problems. All of problems can be classified with three variables; data, method and goal. The fewer variables that are known to the solver the more open the problem will be [3,4] and therefore, open-ended problems will have a variety of solutions and options of different solving methods are possible. Problem solving can be seen an essential part of physics learning and usually students solve problems, where most of the problems are constructed with the aim to find a suitable formula and then apply given numerical values into that formula [5].

Based on the results of interviews with several teachers and students in high school shows that during physics learning activities in school students tend to be passive. At the time the learning activities are ongoing students only pay attention to the explanation of teachers and have not asked or responded many questions and have not been involved in the learning process, consequently the students are less active and creative in solving problems given teachers.

One of the alternative activities that can be done to improve the process of physics learning is to use a learning model that provides an opportunity for students to develop their mindset in solving a problem. The processes undertaken by the student in selecting, organizing and integrating new knowledge, behaviors and ideas will influence his motivation and attitudes [6].

To optimize the process and the results of physics learning in students, it is necessary to use open-ended learning model. Open ended learning model can be used in physics learning because it can help students think creatively and support the understanding of physics concepts, and this model of learning gives individuals the freedom to develop different ways and problem-solving strategies according to their respective abilities [7].

Furthermore, the open ended learning model is a learning that presents a problem that has method or the correct solution more than one [8]. According to Takahashi [9], the open ended problem is a matter of having multiple solutions or settlement strategies. In addition, the use of open questions can stimulate creativity, original thinking skills, and innovation in learning [10], while the advantage of using open-ended problems is to encourage students to develop creativity and think analytically [11]. Meanwhile, according to Nohda [12], one of the objectives of open matter in learning physics is to encourage students' creative activities in solving problems.

According to Takahashi [9], there are some benefits of using open-ended questions in learning, among others (1) students become active in expressing their ideas, (2) students have more opportunities to comprehensively use their knowledge and skills, (3) students have rich experience in the process of finding and receiving approval from other students of their ideas. In studying physics, open questions can be given to students early in the learning process. Furthermore, the learning process is developed based on the variations of answers that appear. In this way, students have experience in finding something during the problem-solving process.

2. Method
This action research was conducted on students of grade 11st senior high boarding school in Banda Aceh, Indonesia involving 29 students as subjects and the object is open ended learning on Newton's law about gravitation.

Techniques used to collect data in this study are using test questions, student activity observation sheets, and student response questionnaires. The data obtained during this research is processed using descriptive and quantitative statistics.

The stages for this study began by preparing the test set for Newton's law about gravitation, student activity observation sheets, and student response questionnaires.
3. Result and discussion

3.1. Implementation of lesson plan
Based on the result of the observer's evaluation during the learning process, there was an increase of the average percentage of lesson plan implementation, from cycle I of 72.92%, second cycle was 84.75% and cycle III was 95.50% (see table 1). Increasing the implementation of the lesson plan is possible because the teacher is very concerned about each step listed in the lesson plan that he has designed and seeks to improve it for each cycle. Increasing the implementation of this lesson plan shows that physics learning activities for Newton's law subject about gravitation are highly optimized.

Table 1. Percentage of lesson plan implementation per cycle.

| Activities learning | Cycle I % | Category | Cycle II % | Category | Cycle III % | Category |
|---------------------|-----------|----------|------------|----------|-------------|----------|
| Introduction        | 75.00     | Good     | 91.75      | Very good| 95.75       | Very good|
| Main part           | 68.75     | Good     | 75.00      | Good     | 97.00       | Very good|
| Closing             | 75.00     | Good     | 87.50      | Very good| 93.75       | Very good|
| Average per cycle   | 72.92     | Good     | 84.75      | Very good| 95.50       | Very good|

3.2. Student activity
Student activity data during physics study using open ended learning model can be seen in table 2. During the process of physics learning using open ended learning model, students are given the opportunity to learn through real life activities by presenting the natural phenomenon openly. The form of presentation of this open phenomenon can be done through learning that is oriented to the problem or open matter.

Table 2. Percentage of student activities per cycle.

| No. | Student Activity                              | Observation result (%) |
|-----|-----------------------------------------------|------------------------|
|     |                                               | Cycle I | Cycle II | Cycle III |
| 1   | Hear the teacher's explanation               | 83.3    | 83.3     | 100       |
| 2   | Answer the teacher's question for initial knowledge | 85.7    | 85.7     | 85.7      |
| 3   | Reading (gathering information and so on)     | 80.0    | 85.7     | 92.3      |
| 4   | Perform critical analysis of problem solving | 88.2    | 88.2     | 93.3      |
| 5   | Reviewing and reviewing the issues raised    | 85.7    | 92.8     | 93.3      |
| 6   | Summing up learning                          | 83.3    | 83.3     | 100       |
|     | Average                                       | 84.4    | 86.5     | 94.1      |

There are a number of benefits of using open-ended questions on open ended models, including (1) students participating more actively in learning and expressing their ideas more intensively, (2) students have more opportunities to use their knowledge and skills comprehensively, (3) students have more opportunities to develop their reasoning [13]. Increased student learning activity during the use of open-ended learning model because this model provides an opportunity for students to express ideas and investigating strategies to solve problems, either individually or in groups. Students are encouraged to learn to build, construct and maintain argumentative and reasonable solutions.

3.3. Student learning outcomes
The results of physics learning that students achieve during the course of action using open-ended learning model can be seen in table 3.
Table 3. Learning outcomes achieved by students each cycle.

| Research cycle | The number of students | Classical completeness (%) |
|----------------|------------------------|---------------------------|
|                | Completed | No completed |                      |
| Cycle I        | 10        | 19            | 34.48                 |
| Cycle II       | 19        | 10            | 65.51                 |
| Cycle III      | 26        | 3             | 89.65                 |

The students learning outcomes can be observed through the number of students who achieve learning classical completeness. In the first cycle, the number of students who achieve mastery in the classical reach 34.48% with the category less good, in cycle II, the number of students who reaches the value of classical completeness reached 65.51% with good category and in cycle III, the number of students who achieve the test results above or equal to 75 reached 89.65% with very good category so that in this cycle can be said that learning has been completed in a classical. This shows that the provision of action with the improvement has been able to optimize student learning outcomes from the category of less good to the category very well and expressed in a classical manner.

Students’ learning completeness in class shows that open ended learning model can improve their learning result. This is in accordance with the important characteristic of the open ended model is the flexibility of students to use a number of methods and all possibilities that are considered appropriate to solve problems and improve learning outcomes.

3.4. Students’ response

Students' responses to the learning process can, among other things, be assessed from the aspect of likes, interests, desires, and so on can be seen in table 4, which shows good results. Students who are interested in a particular subject tend to give greater attention to the subject. The form of attention can be seen from the participation of students in learning activities.

Table 4. Percentage of student interest responses.

| No | Aspect                      | Student response |
|----|-----------------------------|------------------|
| 1  | Preferences                 | 100              |
| 2  | Interest                    | 100              |
| 3  | Desire                      | 82.76            |
| 4  | A passion for the subject of physics | 65.52          |
| 5  | Help understand the material | 68.96           |
| 6  | Clarity of concept learned  | 65.52            |
| 7  | Worksheet language          | 75.86            |

Average 84.4 Good

4. Conclusion

Based on data and analysis of research results, it can be concluded that the results of learning and physical learning activities in students for Newton's law of gravitation can already be optimized using open-ended learning model. The implementation of lesson plan is excellent, learning activities are categorized very good, student learning outcomes are very good, and student response is good. Recommendations from the results of this study is open ended learning model can be used and developed for the material or other subject contained in the subject of physics.

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