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Physics Learning Using Direct Instruction Model Assisted by Plickers Application to Measure Problem Solving Ability

Mardhiyyatin Naqiyah*, Jumadi, Insih Wilujeng

Physics Education, Postgraduate Program, Yogyakarta State University, Karangmalang, Yogyakarta, Indonesia

*mardhiyyatinnaqiyah.2017@student.uny.ac.id

Abstract. This was a quantitative research that aims to know the effectiveness of physics learning by using direct instruction model assisted by Plickers application, knowing the problem solving ability of learners after being taught using direct instruction model assisted by Plickers application, and knowing the percentage of learners achievement for each problem solving indicators. The subjects of the study were the students of class XI MIA 1 SMA Negeri 1 Sayegan consisting of 32 students and selected using purposive method. Data was collected by using a test instrument in the form of a reasonable multiple choice which presented in the Plickers application. The results showed that learning by using direct instruction model assisted by application of Plickers was effectively used in physics learning process in terms of KKM (minimal completeness criteria) achievement. In addition, the average score of students' problem solving ability was 85.00 with details of 27 students scored the high category and 5 students were in the medium category. Furthermore, the percentage of each problem solving indicator was in the high category and only one indicator experienced the medium category with a percentage of 73%.

1. Introduction

Physics is one of the disciplines of science that has a very crucial role in developing knowledge and technology. This requires humans to continuously improve the latest science and innovation related to physics. The same thing applies to students who are required to have a better understanding regarding physical material. Hence, the role of the teacher is very important to design a learning that is more focused on mastering the concept of physics. Therefore, the role of the teacher is not only teaching, but also to ensure that the learning process is optimally applied so that the learning objectives can be achieved well.

Based on Permendikbud No. 22 of 2016 concerning process standards in elementary and secondary school level learning, it is recommended to use problem solving based learning as one of the approaches to learning in order to encourage students' ability to produce individual and/or group work [1].

In addition, Permendikbud No. 22 of 2016 concerning process standards for elementary and secondary school level learning also suggests that the learning process should contain the application of information and communication technology that is systematically integrated, and effective in accordance with the situation and conditions. This means that technology acts as a medium that indirectly helps the learning process become more focused on students. Therefore, the integration of technology in the learning process is very important to conduct.

In line with the recommendations in the problem solving process, one of the problems in physics learning that is still often found in the field is the learning process that is still oriented to results and completing the material so that thinking skills become less applied [2]. In addition, learning in the classroom is more directed at mastering the concept regardless of the physical problem solving abilities that lead to the difficulties of students in facing complex problems [3].

[1] found that the problem that often occurs in the learning process is the lack of problem solving skills in students, especially in contextual questions, whereas problem solving skills need to be developed for students to be able to keep up with the times.

Based on several facts from previous research, it was found that students' physical problem solving abilities were still in the sufficient category. This is mostly due to the difficulty of students in understanding the problem so that it is difficult for them to make a solution plan to solve it [4]. In addition, students are emphasized on mathematical formulas and operations so that they lack the opportunity to be responsible for their opinions and answers, whereas giving more opportunities in problem solving processes can help students to gain experience in solving physical problems [3].

According to the results of the observations conducted at SMA Negeri 1 Sayegan, it was found that the stages of learning were only focused on making the students memorize the formula, without any further understanding of the concept, so that the physics problem-solving ability became less applied. Furthermore, the learning process that is implemented is still teacher-centered which eventually lead students to be less active in the learning process.

Regardless of the problem that has been mentioned before, another problem that was also found was the lack of utilization of technology that made the learning process monotonous. This will eventually makes the focus of students easily distracted by things that are not related to physics learning. Furthermore, learning using online media is very rarely done in physics learning, so that the usual learning process becomes less interactive.

The phenomenon found is in line with the research conducted by [5] which reveals that classroom learning which is generally used emphasizes more on quantitative aspects, for example in equations or mathematical processes, compared to qualitative analysis that is able to help develop the ability to choose the concepts and principles that are most suitable to be used in solving a particular problem. Therefore, a learning model is needed that can guide students in identifying concepts, understanding their use, and planning solutions in written form before solving the problem [5].

One of the learning models that can be applied to help students in training their problem solving abilities is a direct learning model (direct instruction). It is because direct learning models can involve students directly in learning to understand the steps to solve problems through structured information and training [6].

In addition, one of the methods that is suitable for investigating problem solving is interviewing which allows students to tell their thinking processes when trying to solve problems [7]. In line with this statement, the stages in the direct instruction learning model allow students to express their opinions regarding the reasons for choosing the answers given. Thus, students' problem solving abilities can be more trained and not limited to the use of equations.

Furthermore, the use of technology in learning is highly recommended so that the learning process can occur in a more effective and efficient way, especially in terms of evaluation or assessment. One educational application that can be used is Plickers. Plickers provides a system for managing quizzes for tests or evaluations, the results of which can be seen directly. This application makes the process of answering questions more interactive because they are packaged differently by using internet and smartphone networks. In the process, students are given a card to answer the questions displayed. This application can also be accessed for free, making it easier for teachers to use it [8].

The use of a direct learning model in measuring problem solving abilities has previously been conducted by several researchers. A research found that direct teaching was effective in improving problem solving abilities [9]. In addition, the use of the Plickers application as a medium in the learning evaluation process is consistent with the research conducted by [8] which found that the use of the application of Plicker has a positive impact on the learning process.

Based on several explanations that have been described, it is necessary to innovate physics learning by using direct instruction learning models assisted by the Plickers application. The use of direct learning models that utilize online-based applications is expected to have a positive effect on students' achievement, especially on problem solving abilities.

Furthermore, this study will highlight whether or not the use of direct instruction learning models based on the Plickers application is effectively used in physics learning in terms of minimum completeness criteria (KKM). In addition, it will also measure students' physical problem solving abilities after applying direct instruction learning models assisted by the Plickers application, as well as the percentage of students' achievement on each indicator of problem solving ability.

2. Method

This is a pre-experimental research aiming in measuring problem solving ability of student after being taught in learning using the direct instruction model assisted by the Plickers application. The research design used was a one-shot case study as illustrated by Figure 1[10].
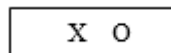
$$\boxed{X \quad O}$$

Figure 1. One-shot case study design

X   : treatment in the form of learning by using the direct instruction model assisted by Plickers application.

O   : measurement of physics problem solving abilities after learning

The research subjects were students of class XI MIA 2 of SMA Negeri 1 Sayegan in the 2017/2018 school year consisting of 32 students. The subjects of this study were selected using purposive sampling method. Data collection was conducted on 30 April 2018 by implementing learning in class XI MIA 2 and evaluating at the end of learning by utilizing the Plickers application.

The study began by designing subject specific pedagogic (SSP) that will be used in the learning process. The SSP that was developed was based on basic competencies related to the material of optical equipment, especially in the sub-material of cameras and microscopes. The development of this SSP is guided directly by expert lecturers so that it has gone through several stages of revision.

The instrument used in this research is a reasoned multiple choice test. Question items are presented using the Plickers application while still writing down the problem in the place provided. This problem solving was then analyzed using Excel 2013 and SPSS.

The analysis used in explaining the data obtained is descriptive analysis. This descriptive analysis is displayed in the form of averages, standard deviations, maximum scores, minimum scores and variances. In addition, the effectiveness of the learning process was analyzed by using one sample t-test by comparing the results obtained with the minimum completeness criteria (KKM).

The maximum score of students was obtained from four indicators, which were: (1) describing variables known to the problem, (2) determining equations that are suitable for solving problems, (3) substituting known values into equations, and (4) evaluating solution. The acquisition of the maximum score of students will be categorized based on the assessment guidelines adapted from [11] in Table 1.

Table 1. Problem Solving Ability Categories.

Score	Category
20 -29	High
10 - 19	Medium
0 - 9	Low

Furthermore, the average percentage of each problem solving indicator will be categorized into four sections based on the guidelines adapted from [12] in Table 2

Table 2. Percentage Categories of Problem Solving Ability Indicators.

Percentage	Category
$t > 75\%$	High
$50\% < t \leq 75\%$	Medium
$25\% < t \leq 50\%$	Low
$t \leq 25\%$	Very Low

Note: t = percentage of each indicator

3. Result and discussion

Analysis related to the effectiveness of the learning process using direct instruction learning model assisted by Plickers application was analyzed using SPSS with one-sample T-test technique with a significance level of $\alpha = 0.05$. The testing hypothesis is as follows:

H0: physics learning using direct instruction model assisted by Plickers application is not effective according to the achievement of learning outcomes.

H1: physics learning using direct instruction model assisted by Plickers application is effective according to the achievement of learning outcomes.

The results of the analysis show a significance value of 0.006. Because the significance value obtained is smaller than the value of $\alpha = 0.05$, then H0 is rejected. This means that learning direct instruction models assisted by the Plickers application are effectively applied in the learning process.

Before being given to students, the instrument is first calculated the level of validity and reliability. This calculation is done using SPSS and obtained results as in Table 3

Table 3. Validity and Reliability of Instruments

No	r Count Value	r Table Value	Information
1	0.805	0.349	Valid
2	0.543	0.349	Valid
3	0.643	0.349	Valid
4	0.703	0.349	Valid
5	0.806	0.349	Valid
6	0.784	0.349	Valid
7	0.653	0.349	Valid
Reliability		0.801	Reliable

The r table value used was 0.349 based on the number of samples which consist of 32 at a significance level of 5%. Based on the data shown in Table 3, the r count value for all items was bigger than the r table value. Thus, it can be concluded that the instrument used is valid. In addition, the reliability value is seen in the Alpha Cronbach value and it appears that the alpha value obtained was bigger than the r table value. Hence, it can be concluded that the instrument used is reliable. In addition, the instruments used were also validated by two expert lecturers and declared eligible for use in the study. Furthermore, to interpret the problem solving abilities of students, descriptive analysis was conducted using SPSS and the results obtained as shown in Table 4.

Table 4. Descriptive Analysis of Problem Solving Ability Tests

Statistic	Statistical Value
Sample	32
Maximum Score	100
Minimum Score	60
Ideal Score	100
Average	85.00
Standard Deviation	11.46
Variant	131.35

Table 4 shows that from the ideal score of 100, the maximum score obtained by students was 100 and the minimum score was 60 with an average of 85.00. This score was obtained by adding each student's score for each indicator which is then multiplied by the score of the question. The average value was above the KKM value and it supported the results obtained at the level of effectiveness of this learning process.

The results obtained were inseparable from the class control carried out by the teacher which made student were competing to answer the questions during the learning process and more enthusiastic in the process of answering questions using the Plickers application. The achievement of the students was then categorized based on the criteria in Table 1. The results of the groupings are illustrated in Figure 2.
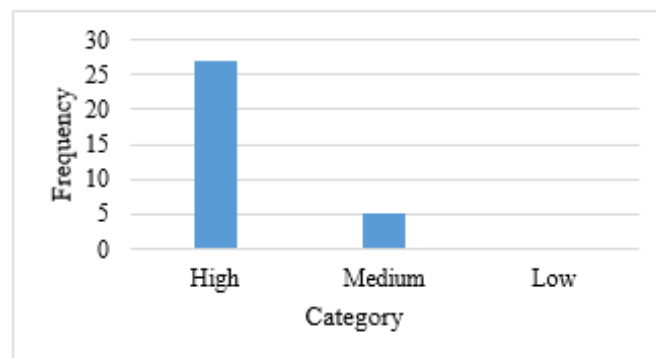

Figure 2. Graph of Problem Solving Abilities Achievement

Figure 2 shows the final results obtained by students, where out of 32 people there were no students in the low category, five students scored the medium category, and the rest scored the high category. Furthermore, the percentage analysis of each indicator shows that one indicator was in the medium category, while the other three indicators were in the high category as shown in Table 5.

Table 5. Percentage of Problem Solving's Indicators

Problem Solving's Indicators	Percentage	Category
Describing variables known to the problem	88%	High
Determining equations that are suitable for solving problems	82%	High
Substituting known values into equations	73%	Medium
Evaluating solution	78%	High

Table 5 shows that only the ability to substitute the values known to the equation rank the medium category. This was probably because some students do not know the similarities used for cases with

similar solutions. In the microscope material, a similar resolution case was to determine the magnification of the microscope for accommodate and not accommodate eyes

The results obtained were in accordance with the results of research conducted by [13] that there were significant differences in students' problem solving abilities after being given treatment compared to conventional learning methods. In addition, the findings of this study were also in line with the research conducted by [14] which provides treatment in the form of interviews with students regarding the answers given after conducting the test. It was found that training explicitly in solving physical problems can help students to acquire the skills needed

4. Conclusions

Based on the data processed and the discussion that has been presented, it can be concluded that.

- Physics learning using direct instruction model assisted by Plickers application was effectively applied in terms of the achievement of KKM (minimal completeness criteria)
- After learning physics by using the direct instruction model assisted by the Plickers application, students' average score of problem solving ability was 85.00 with details of 27 people in the high category, 5 people in the medium category, and no students in the category low
- Percentage of each indicator of problem solving ability was in the high category. However, there was one indicator that scored medium category with a percentage of 73

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