Students’ ability in solving physics-analysis problem through the TAI type cooperative learning model

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Abstract. This study aims to determine students' learning ability in completing the questions of Physics-analysis through the TAI type cooperative learning model. The research design used was pre-experimental design of The One Group Pretest-Posttest Design. The research subjects consisted of 30 first-level students (15 years old). The data was the students' problem solving and collected through the instrument which is in the form of an essay tests that have been validated by two experts in the field of Physics. The responses were then assessed using the assessment rubric and then processed using the SPSS program to get the results of paired sample t-test analysis. The results of t-test calculations was t= -24.475, p < 0.00. The results showed that there were differences in students' learning abilities to solving the physics-analysis problems during the pre-test and post-test, so the use of this learning model could improve the ability of students in solving the analysis problem of physics in the motion concept in physics lesson.

1. Introduction

Physics is one of the disciplines of science. Science education is also one of the branches of science that is studied in the level of junior high to high school in the Department of Science. An understanding of the nature of the science is critical point behaviour in achieving scientific literacy as well as everyday and scientific activities are influenced by the views of people concerned with the nature of Physics in Science [1]. Physics lesson is known as lesson that has a relatively high level of difficulty. It requires solving physics problems using knowledge in solving questions or an related problems with physics. The ability to solve problems is a thought process in which a person will use the knowledge and understanding they learn to fulfil their thinking skills [2-4]. In the teaching process and learning of physics, capacity of problem solving can be known through the completion of the questions that require students to think critically for having ability to solving the analysis questions [5].

The high and low ability of students in completing questions in the form of analysis can be seen from the stages of students in solving a problem, such as the difficulty of students analyzing the problem, writing the formula to be used according to the request, operating the calculation and checking the answers to questions [6,7]. One of the things that causes many students to not be able to solve the problem related to problems is because of the lack of attention of the teacher in teaching
questions in the form of problem solving or analysis problems in questions[4]. In this case, students usually have difficulties in implementing steps to resolve the problem correctly, thus ability to solve Physics problem by the student less developed [8].

2. Literature review

The success of students' ability to solve analysis problems is because students are still having difficulty understanding the questions or problems. Most of the questions given are only about the concept of the application without involving questions in the form of analysis. Another problem that causes students difficulties in solving problems is because in the learning process the teacher still tends to apply conventional learning models. This causes students not to have freedom and freedom to develop their abilities. Thus, it is known that the cause semester final replay value per Basic-Competency (BC) obtained by the students are still in under the Minimum Completion Criteria (MCC). In line with this, the reality in the field of the implementation of learning Physics is still presented in the form of a Science book with a concept in the form of "ready to use", "finished" and "right". But in essence, if the teacher does not understand the nature of scientific knowledge and only teaches it to students only to what is called "ready to use", this can lead to misunderstandings about Science. Therefore, the teacher's confidence in the Science concept in Physics must have been based on a good understanding of Physics and expertise in solving Science problem. This is because teacher must be teach students to have problem solving skills that involved the application of concept [9]. By this case, Science teachers also need to have the good skills, much knowledge, and interests in remake the changes in the teaching and learning process in the classroom[10].

Referring to this, teacher understanding is the main thing that is most needed in teaching. In addition, the teacher's strategy must also be appropriate in delivering lessons, especially in choosing the learning model to be used. On the other hand, field studies prove that students are still not able to solve questions in the form of analysis. Therefore, there needs to be a learning model that can be developed to motivate students. In this case, motivation can increasing the student’s academic ability as the main factor to get an achievement in lesson. In the other side, students also can increase their critical thinking skills, so that students will be more competent in construct ideas in studying and have the problem solving skills [11]. With regard to this, learning using cooperative type models can be used as an effective alternative to improve the quality of students' understanding [12]. In this case, it is also necessary to develop an intensive learning model in accordance with existing learning models in order to achieve learning processes and objectives, and to improve students' overall thinking ability [13,14]. In the other side, teachers also can increasing the ability of students’ critical thinking by make a planning and preparation in learning process involves the good pedagogical, determining the outcome by learning process, demonstrating the student’s knowledge, many kind of study resources, create coherent learning and realization of student assessments[10].

Cooperative learning is one method that can be applied to support students’ thinking abilities because the ongoing learning process is student-centered. This learning method assigns students to form small groups in the classroom and other learning environments, or anywhere as long as they are within the scope that can help them to learn together [15]. By learning methods, students will not only have the knowledge, but also the experience gained through the utilization of information, and is expected to be a producer, an innovator in a field, have a constructive thinking and critical, have high creativity, and able to be the one who innovative with the aim of training themselves as independent individuals [16].

In this regard, a review of the cooperative type TAI learning model which is a merger between the study groups to learn individually and specifically for the Mathematics learning at the high-grade students can use to help students on problems solving in learning [17].

Referring to this, note also that the cooperative model type TAI is not only used in the Mathematics lesson, but used also for the other lessons like Physics lesson, this is because the Physics also has a Mathematics content and use mathematics in solving problems that are mathematical. By this case, TAI type Cooperative learning model can be used in Physiscs. With the existence of the TAI type
Cooperative learning model, it is expected that students' ability to solve various forms of questions that they feel will also increase [5].

Research on the model of Cooperative Learning type TAI has also been done by [18] with results showing that with the high degree of independence will bring enormous impact on student learning, where the results of student learning will be remembered well, whereas when the level of independence decreases, student learning outcomes will also decrease. The independent level is inseparable from the Self-Efficacy within a person in which it will help to determine a decision, efforts to grow and progress, persistence and perseverance in the face of difficulties or problems, as well as the degree of anxiety or calmness they experience when maintaining obligations that cover their lives, so that they can produce predetermined goals [19].

3. Method
This research was conducted data in High School. This research uses experimental design with pre-test and post-test techniques. The experiment was conducted to see the level of students' ability to solve Physics questions before and after using the TAI type cooperative learning model. The sample selection was based on criteria such as the class that gets the exams score in under Minimum Completion Criteria (MCC) there are 30 students (15 years old) at the concept of Motion. This research was conducted using one sample class with experimental research design, that was The One Group Pretest-Posttest Design, as shown in table 1:

| Table 1. Design of The Research |
|---------------------------------|
| Pre-test | Treatment | Post-test |
| O₁       | X         | O₂        |

Collecting data in this study using a test instrument in the form of an essay about the form already validated by two validators who have expertise in the field of Physics. This test was given during the pre-test and post-test with the number of questions as many as 5 items. Research data in the form problem solving by the students were then assessed using the assessment rubric. Data obtained from tests were analyzed using quantitative statistics in the form of t-test types of paired samples. This was done to compare the two groups, the pre-experimental and post-experimental groups [13]. By this way, the different about the before and after intervention can be seen clearly. The data was then processed using the Statistical Package for Social Sciences (SPSS) program, namely IBM SPSS 23. In this case, to achieved mastery learning students individually, then the score of correct answers students must achieve amounted ≥ 70 or above the Minimum Completion Criteria (MCC) provisions.

For the test of students' abilities used paired sample t-test through the SPSS program with two-way (2-tailed) testing on the basis of decision significant and not significant. In processing the analysis of data, it was necessary to determine the number of student scores. The student ability test assessment rubric is shown in table 2 as follows:
| No | Stage                  | Rated Aspect                                      | Score Terms                                                                 |
|----|------------------------|--------------------------------------------------|-----------------------------------------------------------------------------|
|    |                        |                                                  | 1                             | 2                             | 3                             | 4                             |
| 1  | Question analysis      | Write the amount known, the unit, and the amount asked | If the student cannot write down the amount known, the unit, and the amount asked | If the student only writes the amount known, but does not write down the unit and the quantity asked | If students only write down the amount known and the magnitude asked, but do not write the unit | If the student only writes the known quantity and unit, the amount that is asked but is not in accordance with the request for the question. |
| 2  | Transfers the question | Write down the formula in accordance with the amount to be used in accordance with the request for the question | If students cannot write the formula to be used in accordance with the question request | If students can write a formula but it is not in accordance with the question request | If students can write a formula but the amount used is still a lot inappropriate | If students can write the formula according to the request, the amount is not quite right (almost close to right). |
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4. Calculation operation

Substituting the data into the form of operation of the calculations that have been obtained, then performing a careful, systematic, and exact calculation of the unit

If students cannot substitute the data into the form of operation the calculations that have been obtained, and have not been able to perform calculations carefully, systematically, and exactly the unit

If students can only substitute the data into the form of operation the calculations that have been obtained, are able to do calculations but have not been careful because the value of the amount entered into the equation is still not correct (confused)

If students can only substitute the data into the form of operation the calculation has been obtained, then do the calculations carefully but the unit is not written in the calculation operation

If students can only substitute the data into the form of operation the calculations have been obtained, then do the calculations carefully but the units used are still not right

4 Checking

Checking the answers is in accordance with what was asked for the writing of the formula, unit writing and calculation operations

If students do not check the answers that are in accordance with what is asked, writing formulas and unit writing

If students only check whether the answer is appropriate, but do not check the writing of formula and unit writing

If students only check whether the answer is appropriate, check the writing of the formula, but do not check unit writing

If students only check whether the answer is appropriate, check the formula and unit writing but do not check how the calculation operation steps

4. Findings

4.1 Results

This study aims to determine whether the use of the TAI type learning model can improve students' ability to solve analysis questions in the field of Physics at Banda Aceh State High School. Analysis of findings shows that it can improve students' ability to solve Physics analysis questions in the concept of Motion at Banda Aceh State High School. Table 3 shows the mean, standard deviation, t-test value of the variable, and the results of the research hypothesis at the pre-test and post-test. This shows that there are differences in the results of the tests carried out in the study sample as shown below:
Table 3. Results of t- test samples paired in the pre-test and post-test using the TAI type Cooperative Learning Model

| No. | Test   | Mean  | S. D  | T    | Df   | Sig.  | H₀  |
|-----|--------|-------|-------|------|------|-------|-----|
| 1   | Pre-test | 50.30 | 9.237 | ~    | 24.475 | 29.00 | 0.000 | Rejected |
| 2   | Post-test | 83.73 | 5.464 |      |       |       |     |

4.2. Discussions

The aims of this study were to investigate whether the use of cooperative learning models the type of TAI can improve students' ability to solve Physics analysis questions in the concept of Motion. Based on the results of data analysis, it was known that the cooperative learning model the type of TAI can improve students' ability to solve Physics analysis questions in the concept of Motion. Furthermore, after calculating the t-test for the two tests the results were -24.475 which causes H₀ rejected with Sig. amounting to 0,000 < 0.05. This shows that there were significant differences between students’ abilities at the pre-test and post-test. Therefore, the use of the cooperative type TAI learning model can improve students' ability to solve Physics analysis questions in the concept of Motion.

The author agrees that the results of the research carried out by the researcher are in accordance with the research previously which states that the use of cooperative learning type TAI will make it easier for students, where students who are unable to solve questions of physics analysis will be assisted by other students who have the ability to solve the problem. It mean can be in the form of assistance for students who have difficulty in understanding lesson, make a help for students to improve their problem solving skills, and have more harmony in living together on the basis of each other mutual respect [5]. As well as states that students will be more effective to learn when to do an approach to teaching that is more precise, the teacher not only gives exercises alone or formulas but must emphasize students in understanding concepts that are taught, allowing students to learn and solve analysis problems[7].

Improving student learning outcomes is caused by students being able to analyze questions, transform questions, perform calculation operations and check answers [6,7]. From some of the assessment criteria, students are required to be able to resolve the matter in accordance with the analysis of Physics completion steps.

The steps in completing the analysis questions are not only trained to mention the quantities that are known and asked, but also trained to be able to analyze the questions, mention the quantities that are known and asked, and be able to perform the calculation operations correctly. With the resolution of this problem, students will be more active in solving physical analysis questions [20].

5. Conclusion

The TAI type cooperative learning model in one way in the learning process to improve students’ ability to think critically, having the problem solving, and completing Physics questions in the form of concept analysis. In addition, motivation is also very important in the learning process involving this cooperative learning model, where one of the main factors also depends on the teachers. The way that the teachers can develop an intensive learning model, make a planning and preparation in learning process involves the good pedagogical, much knowledge, and students’ assessment. The implementation of the TAI type cooperative learning model needs to be expanded for greater support of the practicality and effectiveness learning in school.

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