# PHYSICS LEARNING USING INQUIRY-STUDENT TEAM ACHIEVEMENT DIVISION (ISTAD) AND GUIDED INQUIRY MODELS VIEWED BY STUDENTS ACHIEVEMENT MOTIVATION

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**ABSTRACT**

This study aims to determine the differences in learning outcomes of between students that are given the Physics learning models of Inquiry-Student Team Achievement Division (ISTAD) and guided inquiry, between students who have high achievement motivation and low achievement motivation. This study was an experimental study with a 2x2x2 factorial design. The study population was the students of class X of SMAN 1 Toroh Grobogan of academic year 2016/2017. Samples were obtained by cluster random sampling technique consists of two classes, class X IPA 3 is used as an experimental class using ISTAD model and class X IPA 4 as the control class using guided inquiry model. Data collection techniques using test techniques for learning outcomes, and technical questionnaire to obtain the data of students' achievement motivation. Analysis of data using two-way ANOVA. The results showed that: (1) there is a difference between the learning outcomes of students with the ISTAD Physics models and with the physics model of guided inquiry. (2) There are differences in learning outcomes between students who have high achievement motivation and low achievement motivation. (3) There is no interaction between ISTAD and guided inquiry Physics models learning and achievement motivation of students.

## INTRODUCTION

One of the main educational goals is to teach about the nature of science that students should be involved in the investigation and produce a product in the form of facts, concepts, principles, theories, and laws (Zeidan & Jayosi, 2015). The essence of science consists of four elements, namely science as a process, science as a product, science as an attitude and science as an application. The essence of science could be developed, one way to do it is using Physics.

Physics is the science that deals with the discovery and understanding of the fundamental laws that moving matter, energy, space and time. Hence, some students feel scared, and depressed in understanding the concepts and formulas of Physics that are considered to be arduous (Sugiarti, 2005).

Physical Education should be taught according to characteristics of Physics through direct measurement, the use of the experimental method, demonstration, and elaboration of the formula (Subekti & Ariswan, 2016). But in reality, often encountered high school students with learning difficulties on Physics, complained that studying Physics is very difficult.

One model of learning that can help students find the concept and use the process of science is guided inquiry learning model (Yager

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& Akcay, 2010). Guided inquiry learning is based on the context of the problem, determining the problems and the stages of its solution, the teacher guided the students to perform activities by providing the initial questions and lead a discussion (Abdelraheem & Asan, 2006). The inquiry is a way to study scientific issues in the context of real life (McBride, et al., 2004).

Guided inquiry is a learning process which overall activities carried out by students such as planning investigations, making observations, analyzing, interpreting data, suggesting answers, formulating conclusions and communicating; while the teachers acted as motivators that guided and gave good instructions through either a fully procedure or guiding questions during the proceedings (Banchi & Bell, 2008).

Guided inquiry learning, teachers must be able to design a learning method that actively involved students. At the beginning of the learning activities, the teacher gave a lot of guidance then regularly reduced it so that the students could be good investigators and their scientific knowledge could be achieved (Yunus, et al., 2013).

Guided inquiry has been widely applied in the learning process to improve the process and learning outcomes of students. Vlassi's & Karaliota's study (2012) showed that the guided inquiry could improve learning outcomes of students and increase the confidence of teachers in teaching science. Setiawan, et al. research (2016) also showed that the inquiry-based learning is effective to improve the learning outcomes, the enthusiasm of the students in following the activity of the practices, and the attitudes of students in learning process. Meanwhile, the application of CTL guided by guided inquiry model can improve the learning outcomes and students liveliness (Fitriani, et al ., 2016).

Inquiry learning model has been applied in SMA Negeri 1 Toroh Grobogan Regency. However, the acquired learning outcomes of the students are still not optimal. Therefore, it needed to be modified by incorporating inquiry learning model with a student team achievement division (STAD).

STAD consists of five main components, namely a class presentation, study groups, individual tests, score development and group awards (Kordaki, et al., 2012). STAD has been widely implemented in the learning process to improve the learning outcomes of students; it is shown from the results of Tiangtong's & Teemuangsai's research (2013), which indicated that the STAD could improve learning outcomes and collaboration skills among students. These results are also supported by Mahbub Z, et al. research (2016) which indicated that the cooperative learning of STAD assisted by animation media could improve cognitive learning outcomes of students.

The learning model of STAD is a syntax blending between STAD cooperative models with the syntax of guided inquiry. Most of the syntax of inquiry is included in the group work phase in the syntax of STAD, whereas before the evaluation phase of individual and group awards, STAD learning model is included in the repetition stage inquiry learning. Thus, ISTAD learning strategy can be regarded as the activities of inquiry in the group work (Prayitno, 2010).

ISTAD contains two power needed for physics learning, they are the excess guided inquiry as a learning process to enable students in the activities of scientific investigation and STAD directing students to learn independently with their group in order to achieve common goals and by giving rewards to the outstanding group is expected to increase students' motivation (Erina & Kuswanto, 2015).

Results of research by Abdullah & Shariff (2008) showed that the inquiry learning guided by cooperative learning is more effective in increasing the students understanding of the concept, while research by Bilgin (2009) showed that students using guided inquiry learning assisted by cooperative learning have a better understanding of concepts and attitudes. Thus, ISTAD application can be used as a solution to increase the students learning outcomes of Physics.

The success of Physics learning is influenced by various factors, one of which is the motivation. McDonald in Syaiful Bahri (2003: 114), stated that motivation is an energy change within the person characterized by effective arousal and anticipatory goal reactions. These changes of energy in a person's self is in the form of a real activity which is a physical activity. In the process of learning, motivation is very necessary because someone who did not have the motivation to learn, would not be possible to do the learning activities so that the students learning achievement would not also be good.

Achievement motivation is the encouragement related to the achievement that is the desire of a person to master the obstacles and maintain a competitive, high-quality work through hard efforts to exceed past deeds and outperform others (Lindgren, 1976: 67).

Achievement motivation can provide a very substantial contribution to the efforts of students to obtain optimal learning results. It is by the opinion of McClelland (1987), achievement

motivation is an urge or desire to do everything as best as possible, not to gain social respect or prestige, but to achieve personal fulfillment in themselves. Besides, McClelland also stated that individuals who have high achievement motivation, when faced with complex tasks tend to do well. If he completed a complex task, it would make him more enthusiastic to accomplish the harder task better than before.

It is reinforced by the results of research by Sujarwo (2011) that the achievement motivation affected the acquisition of learning outcomes. Students who have high achievement motivation obtain better learning outcomes than the students who have low achievement motivation.

## METHODS

The study was conducted in SMA Negeri 1 Toroh Grobogan Regency, which addressed on Jl. Raya Purwodadi-Solo km 07 Sindurejo village, Toroh Subdistrict, Grobogan Regency, Central Java, in the first semester of 2016/2017. As for the timing of the research, it started from the formulating of the proposal to a research report, beginning in July 2016 until March 2017.

This research uses quasi-experimental methods on the basis that this study sought to determine the effect of one variable to another variable and take samples of two classes.

This study is an experiment with a 2x2x2 factorial design. Two-way ANOVA was examining the influence of the main factors and interaction factors by classifying variables into two models; they are ISTAD and guided inquiry learning. A moderator variable is the achievement motivation which is categorized into two, namely achievement motivation high and low categories.

The population in this study were all students of class X IPA SMA Negeri 1 Toroh, Grobogan Regency of 2016/2017 academic year consisting of four classes with the number of students 40 per class. Sampling was done by cluster random sampling then obtained two classes as samples treated differently. Sampling was done randomly, and then computed the mean difference of the population. The data used is the value of Middle Semester Exam (UTS) of the odd semester of the academic year 2016/2017. The statistical test used was t-test (two-tailed). Calculations were performed using SPSS 20. Results of statistical tests using t-test acquired one class as the experimental class, which is class X IPA 3 by using ISTAD model and class X IPA 4 as a control class using guided inquiry learning model.

Data collection techniques in this study are using: (1) the documentation technique to determine the early ability of students. The obtained data of prior knowledge is the value of Middle Semester Exam (UTS), (2) the questionnaire technique with Likert scale to determine the level of achievement motivation of students in learning physics, which are divided into high and low categories, (3) the test technique to determine the learning outcomes of knowledge, (4) the observation technique is used for observation of attitudes and skills of students during the learning process.

Instruments used are in the form of syllabi, lesson plans and data collection instruments are in the form of tests and observation sheet. The test instrument is used to measure the results of a test study of knowledge. It used a multiple choice test for questions of knowledge. Observation sheet is used to measure the learning outcomes of attitudes and skills when learning process took place.

Instrument validation test is performed by an expert before tested, including lecturers and education practitioners. After testing the instrument of learning outcomes of knowledge, testing the validity, reliability, level of difficulty and test of distinguishing problems are performed using QUESS program.

The test of data normality is using the Kolmogorov-Smirnov test; the homogeneity test is using Bartlett test. Hypotheses are tested using univariate ANOVA test aided with SPSS 20 software.

## RESULTS AND DISCUSSIONS

The data of students learning outcomes is obtained from students test results of circular motion material that is given after receiving treatment. The data of students learning outcomes is presented in Table 1 for the overall data research class, Table 2 for the data of ISTAD class learning outcomes and Table 3 for the data on the guided inquiry class. The following learning outcomes data presented in Table 1.

**Table 1.** The Description of Students Learning Outcomes Data

| Class | Sum of Data | Highest Score | Lowes Score | Average | (SD) |
|---|---|---|---|---|---|
| ISTAD | 40 | 93.5 | 68 | 81,12 | 6.63 |
| Guided inquiry | 39 | 83 | 61.5 | 74.56 | 5.34 |

Table 1. is the description of the students

learning outcomes data in both of the experimental classes. Based on Table 1. it showed that the highest score of students in ISTAD class is 93.5, a bit higher than the highest score in guided inquiry class that is equal to 83. The lowest score on ISTAD class is 68 which is higher than the lowest score of guided inquiry class that is 61.5. The average of learning outcomes in ISTAD class is 81.12, and the average of learning outcomes in guided inquiry class is 74.56.

Table 1 also showed that the students learning outcomes in ISTAD class are higher than guided inquiry to. The difference in learning outcomes scores between these two classes is 6.56. The highest scores between these two classes have the difference value of 10.5, the highest score of ISTAD class is higher than the highest score of guided inquiry class. The lowest score of guided inquiry class is lower than the lowest score of ISTAD class with the odds of 6.5.

The frequency distribution of learning outcomes of ISTAD class and guided inquiry class is described in Table 2 and Table 3.

**Table 2.** The Frequency Distribution of Students Learning Outcomes of ISTAD Class

| Interval | Middle point | Absolute frequency | Relative frequency % |
|---|---|---|---|
| 60-64 | 62 | 0 | 0 |
| 65-69 | 67 | 2 | 5 |
| 70-74 | 72 | 4 | 10 |
| 75-79 | 77 | 10 | 25 |
| 80-84 | 82 | 9 | 22.5 |
| 85-89 | 87 | 10 | 25 |
| 90-94 | 92 | 5 | 12,5 |
| 95-99 | 97 | 0 | 0 |
| Total | | 40 | 100 |

The frequency distribution of scores in Table 2 is divided into eight classes or interval of values. The highest class is in the interval of 75-79 and 85-89 with the number of students who score at the interval as much as 10 students, or approximately 25% of students, as well as the smallest frequency in the 65-69 interval, is 5% with the number of students as much as 2 student.

The frequency distribution of scores in Table 3 is divided into eight classes or interval of values. The highest class is in the interval of 75-79 with the number of students who score at the interval as much as 17 students, or approximately 43.59% students, as well as the smallest frequency in the interval 60-64, is 2.56% with the number of students as much as 1 student.

**Table 3.** The Frequency Distribution of Students Learning Outcomes ofGuided Inquiry Class

| Interval | Middle point | Absolute frequency | Relative frequency % |
|---|---|---|---|
| 60-64 | 62 | 1 | 2.56 |
| 65-69 | 67 | 7 | 17.95 |
| 70-74 | 72 | 7 | 17.95 |
| 75-79 | 77 | 17 | 43.59 |
| 80-84 | 82 | 7 | 17.95 |
| 85-89 | 87 | 0 | 0 |
| 90-94 | 92 | 0 | 0 |
| 95-99 | 97 | 0 | 0 |
| Total | | 39 | 100 |

The students' achievement motivation data is obtained from motivation questionnaire in the form of a checklist with the Likert scale that is given to the students. The achievement motivation questionnaires are given to the experimental class with ISTAD learning model and control class that used guided inquiry model. The student's achievement motivation is categorized into two, high and low. Students are considered to have a high achievement motivation if the achievement motivation score is more than or equal to the average score of all samples. Students are categorized as having low achievement motivation if the achievement motivation score is below the average score of all samples. The student's achievement motivation data of high capability category is presented in Table 4.

**Table 4.** The Description of Students Achievement Motivation Data

| Learning Model | S | Average | | The Number of Students | | Cut off |
|---|---|---|---|---|---|---|
| | | High | Low | High | Low | |
| Guided inquiry | 39 | 4,37 | 3,67 | 19 | 20 | 4,02 |
| ISTAD | 40 | 4,33 | 3,73 | 27 | 13 | |

The student's achievement motivation scores in Table 4 are categorized into the criteria of high and low averages. The total average is accumulated from both classes. Grouping the categories of high and low achievement motivation is based on the total average of the score which is 4.02, so this score is used as a cut-off or the limit of the average score. If the students have an

average score more than or equal to the cutoff, then the achievement motivation of the students is categorized as high. If the students have an average score less than 4.02, then the achievement motivation of the students is categorized as low.

The average score of high achievement motivation for ISTAD class and guided inquiry class based on Table 2 has a difference of 0.04. The average score of high achievement motivation guided inquiry class is higher than the average score of ISTAD class. However, the number of students who have high achievement motivation for ISTAD class is more than guided inquiry class. The average score of low achievement motivation for ISTAD class and guided inquiry class based on Table 2 has a difference of 0.06. The average score of low achievement motivation for guided inquiry class is lower than the average score of ISTAD class. Also, the number of students who have low achievement motivation for ISTAD class is less than guided inquiry class. From Table 2 it can be concluded that the achievement motivation of students for the class that has been given ISTAD learning model is better than the class that has been given guided inquiry learning model.

The frequency distribution of high achievement motivation is described in Table 5, and Table 6 presented the frequency distribution of low achievement motivation.

**Table 5.** The Frequency Distribution ofHigh Achievement Motivation

| Class Interval | Frequency | |
| --- | --- | --- |
| | Absolute | Relative % |
| 181-195 | 22 | 47,83 |
| 196-210 | 21 | 45,65 |
| 211-225 | 3 | 6,52 |
| Total | 46 | 100 |

The frequency distribution that is being presented in Table 5 showed that the greatest frequency of high achievement motivation lies in the interval of 181-195 and the smallest frequency of high achievement motivation is in the interval of 211-225. The percentage difference between the high and low achievement motivation is 39.13%.

The frequency distribution that is being presented in Table 6 showed that the biggest frequency of low achievement motivation is in the interval of 166-180 about 69.70%, and the smallest frequency of low achievement motivation is in the interval of 135-150 about 9.09%.

**Table 6.** The Frequency Distribution of Low Achievement Motivation

| Class Interval | Frequency | |
| --- | --- | --- |
| | Absolute | Relative % |
| 135-150 | 3 | 9.09 |
| 151-165 | 7 | 21.21 |
| 166-180 | 23 | 69.70 |
| Total | 33 | 100 |

Based on the prerequisite test analysis that has been done, it was concluded that a random sample of data observations came from a normally distributed population and homogeneous. The conclusion indicated that the prerequisite test analysis for ANOVA test had been met. Thus the hypothesis test analysis using ANOVA technique can be resumed. ANOVA test was performed using univariate ANOVA aided by SPSS 20, with a significance level of 5%. Hypothesis test results are summarized in Table 7.

**Table 7.** Hypothesis Test Results Summary

| Hypothesis Test | Sig. | Final Score Sig. | Conclusion |
| --- | --- | --- | --- |
| Learning Process | 0.000 | 0.00<0.05 | $H_0$ rejected |
| Achievement Motivation | 0.000 | 0.00<0.05 | $H_0$ rejected |
| Learning model– Achievement motivation | 0.635 | 0.635>0.05 | $H_0$ accepted |

Based on the data in Table 7, it can be concluded about hypothesis testing as follows:

The first hypothesis related to the influence of the learning model to the students learning outcomes. The hypothesis testing is aimed to determine the differences in learning outcomes between students who get ISTAD learning model as an experimental class and guided inquiry learning model as the control class. The results of data analysis obtained significance value 0.000 <0.05, thus $H_{0A}$ is rejected, and $H_{1A}$ is accepted. The analysis results showed the differences in the results between students who get ISTAD model and guided inquiry model in learning Physics.

The results are consistent with the research by Erina & Kuswanto (2015) which showed that there is a significant influence of ISTAD learning model in improving students learning outcomes in Physics and line with the research by Iswandari, et al. (2013) stated that ISTAD significantly affected the science process skills and students

learning outcomes in biology.

The research by Nurhidayati, et al. (2015) also showed that the combined STAD combined with guided inquiry method could increase the activity and learning outcomes of students with a very high percentage.

The students who got ISTAD learning model obtained higher learning outcomes in the aspects of knowledge compared with the students who got a guided inquiry learning model. The average of learning outcomes of knowledge at ISTAD class is 81.13, while the average of learning outcomes in guided inquiry class is 74.56.

The second hypothesis is related to the differences in learning outcomes based on students achievement motivation. The testing of this hypothesis is aimed to determine the differences in learning outcomes between students who have high achievement motivation and students who have low achievement motivation. The results of data analysis obtained significance value 0.000 <0.05, thus $H_{0A}$ is rejected, and $H_{1A}$ is accepted. The analysis results indicated that there are differences in learning outcomes between students who have high and low achievement motivation. High achievement motivation and low achievement motivation is categorized based on the cut-off score of 4.02.

The average score of high achievement motivation in the experimental class is 4.33, lower than the control class which is 4.37. There is a difference of 0.04. However, the number of students who have high achievement motivation in the experimental class is more than the control class. In the experimental group, the number of students who have high achievement motivation was 27 students, while the control class only 19 students.

The average score of the low achievement motivation in the experimental class is equal to 3.73, higher than the control class of 3.67. The number of students who have low achievement motivation in the control class is also more than the experimental class. At control class, the number of students who have low achievement motivation was 20, while the experimental class is 13 students.

These results are consistent with the research conducted by Sugiyanto (2009), stated that achievement motivation contributed to the students' academic achievement positively and significantly. The research conducted by Sukimarwati, et al. (2013) also stated that the achievement motivation gave influences on students' achievements and in line with Wiratama's research (2014) that indicated that there are differences in learning outcomes of students who have high and low achievement motivation.

The third hypothesis is related to the interaction between learning model and students achievement motivation. The testing of this hypothesis is aimed to understand the interaction between ISTAD and guided inquiry learning models with students achievement motivation. Based on the testing results, it is concluded that there is no interaction between ISTAD and guided inquiry learning models with students achievement motivation. It is influenced by several factors.

First, the learning outcomes of knowledge between methods of learning and achievement motivation are stand-alone and unrelated. Students who have high or low achievement motivation did not provide the interaction of the learning models. Students who have high achievement motivation if treated with any model will have good learning outcomes. Conversely, students who have low achievement motivation will have diminished learning outcomes if treated with any model.

Second, on the learning outcomes, the interaction attitude between learning model and achievement motivation did not give a significant effect because students who have high and low achievement motivation followed the learning process well from the beginning to the end.

Third, on the result of learning skills, students have a natural reaction in participating in learning activities to prepare a presentation, equipment, and materials in the lab, and do pay attention to the lab work. Students who have high and low achievement motivation equally gave good responses. Thus, it can be concluded that there is no interaction between the models of learning and achievement motivation on learning outcomes' aspects of knowledge, attitudes, and skills. Students who have high and low achievement motivation will be equally able to cope well.

## CONCLUSION

The results of this study can be concluded that: 1) there is a difference between students learning outcomes that were given ISTAD learning model and guided inquiry learning model in learning Physics. ISTAD learning model provided better learning outcomes than guided inquiry learning model. 2) there are differences in learning outcomes between students who have high and low achievement motivation. The students who have high achievement motivation got better learning outcomes compared to the students who have low achievement motivation. 3) there is no

interaction between ISTAD and guided inquiry learning models with students achievement motivation. Learning models and achievement motivation are different, so if given a different learning model, students who have high achievement motivation will get better learning outcomes than students who have low achievement motivation.

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