The impact of implementing of INSTAD model toward student’s mathematics learning outcome for 5th grade elementary school students

A Syamsuddin*
Magister of Elementary Education, Postgradute Program, Universitas Muhammadiyah Makassar, Jl. Sultan Alauddin No. 259, Indonesia

*agustan@unismuh.ac.id

Abstract. This research paper aims to identify the process and results of the implementation of the Inquiry-Student Team Achievement Division (INSTAD) learning model, find out students’ learning outcomes and identify the effect of the implementation of the INSTAD model on students’ learning outcomes in mathematics learning. This type of research is a quasi-experimental study with nonequivalent control group design. This study involved 60 elementary students. The instrument used is a test of learning outcomes which consists of 10 items. Students’ learning outcomes were analyzed using the t-test formula through of SPSS 20.0 for Windows. The results of descriptive analysis and hypothesis testing revealed differences significantly in learning outcomes between the experimental class and control class, it was indicated by the results of using the t-test on students’ learning outcomes obtained that H0 was rejected because the value of t-count > t-table (4.340> 1.99547) and p value (0.000 <0.05 = α). Based on the value of post-test learning outcomes in the experimental class is an average score of 78.3 while for the average score of the control class is 71.0 and the average N-gain of the experimental class is 0.49, while the N-gain of the control class is 0.22. It can be concluded that the point of N-gain of experimental class is greater than point of the control class. It can be said that the use of the INSTAD learning model has a positive effect on improving students’ mathematics learning outcomes.

1. Introduction
Several concepts and new perceptions about the teaching and learning process in schools have emerged and developed along with the rapid development of science and technology [1]. Teacher is the dominant factor that determines the quality of learning. The quality of good learning will produce good learning outcomes too. One of the demands of teachers is being able to choose the right learning model because of the different abilities of students [2]. The implementation of learning that has been carried out by a teacher in communicating or explaining subject matter is a conventional method that tends to be unidirectional. In this situation, students tend to be passive because the learning is teacher-centered. Therefore, there needs to be a model in learning mathematics which can facilitate and encourage students.

Guided inquiry is a learning model that helps students understand, interpret a problem and build new knowledge [3,4]. The model helps students find concepts [5]. In addition, the model helps students determine problems and the stages of solving them [6]. Inquiry strategy is a series of learning activities...
that emphasize critical and analytical thinking processes to look for and find the answers to a problem and draw conclusions independently [7-9]. It can be said that inquiry is a series of strategy activities that emphasize the process of thinking critically and analytically to find a solution toward a problem in question. While guided inquiry is a process in which all activities are carried out by students such as investigative planning, observing, analyzing, interpret data, propose answers, form conclusions and communicate, while educators or teachers act as motivators who direct and provide guidance through both complete procedures and directional questions during the inquiry process.

As a consequence, guided inquiry learning based on the context of the problem, determining the problem and the stages of its solution, the teacher guides the students to do activities by giving initial questions and directing in a discussion. Guided inquiry has been widely applied in the learning process to improve the learning process and students’s learning outcomes. The results showed that the guided inquiry can improve student learning outcomes indicated by the posttest value higher than the value of the pretest and it can also increase the confidence of educators in teaching and learning process [10,11].

Guided inquiry learning model has been applied in on of the elementary schools in Makassar, but the learning outcomes obtained by students are still poor. Therefore, improvements need to be made to improve the quality of the process and results in learning mathematics by modifying the learning model and combining the inquiry with the student team achievement division (STAD) model. STAD consists of five main components, namely class presentations, group learning, individual tests, development scores, and group awards [12]. STAD has been widely implemented in the learning process to improve student’s learning outcome, this is shown from the results of the research by Tiangtong & Teemuangsai [13], which showed that STAD can improve student’s learning outcomes and the ability of collaboration between the students.

INSTAD learning model is a combination of syntax between STAD cooperative model and guided inquiry syntax. Most of the inquiry syntax is included in the group work stage in the STAD learning syntax, whereas before the individual evaluation and group awards stages, the STAD learning model is included in the stage of repetition of inquiry learning.

Thus INSTAD learning strategies can be said as inquiry activities in group work [14]. INSTAD model contains two strengths needed in the learning, namely the advantages of guided inquiry as learning that can activate the students in scientific inquiry and STAD activities that direct learners independently with their groups in order to achieve common goals as well as provide rewards to groups that are expected to be able to increase motivation students [15].

Erina & Kuswanto stated that the integration of the guided inquiry and STAD learning model, called the Inquiry-Student Team Achievement Division (INSTAD) learning model, is to produce a new syntax which can guide and demand students in conducting investigations in group work [15].

Erina & Kuswanto implemented the INSTAD model in physics learning in high school to find out the effect of the INSTAD learning model on: (1) students' science process skills, (2) students' cognitive learning outcomes, and 3) student’s science processes and student’s learning outcomes. The results of Erina & Kuswanto’s research find out that (1) there is a significant influence of INSTAD to improve science process skills of students; (2) there is a significant effect of INSTAD to improve student’s cognitive learning outcomes; (3) there is a significant influence of INSTAD to improve science process skills and cognitive learning outcomes of students simultaneously [15].

Based on explanation above, Abdullah & Shariff stated that inquiry learning guided by cooperative learning is more effective in improving students' conceptual understanding. Thus, the implementation of INSTAD model can be used as a solution in improving students' mathematics learning outcomes. The success of mathematics learning is not only influenced by approaches and learning models but also influenced by internal factors of students. In this study, the students' problem-solving abilities were observed. It is expected that the using of the INSTAD learning model in the process of learning mathematics will attract the interest of students to actively participate in learning activities so that it will improve the ability of students to solve problems [16].

Related to explanation before, Erina & Kuswanto’s research described about the effect of INSTAD Model in physic learning in high school. They had found that the INSTAD learning model is a form of
innovation in learning to improve student’s science process skills and student’s cognitive learning outcomes. Different from Erina & Kuswanto’s research, in this research paper will be discussed about the implementation of INSTAD learning models in learning mathematics and its effects on students' mathematics learning outcomes for elementary school. Besides that, this research paper will investigate the process and results of the implementation of the INSTAD model in mathematics learning. 

The procedure or steps of the INSTAD learning model used in this research paper refers to the stages of learning based on the learning steps that have been prepared by Prayitno [14]. The steps are as follows, (1) teacher presentation, (2) inquiry work in the STAD group, (3) presentation of inquiry work, (4) individual tests, and (5) group award. The following steps are the results of combining between the STAD inquiry and cooperative which are presented in detail in the following Table 1.

| Steps                          | Activities                                |
|--------------------------------|-------------------------------------------|
| Step 1 Teacher presentation    | Establishment of heterogeneous groups     |
| Step 2 Inquiry work in the STAD group | Teacher presentation               |
|                                | Formulating a problem                    |
|                                | Developing hypotheses                    |
|                                | Designing experiments                    |
|                                | Testing hypotheses and analyzing data   |
|                                | Making induction                         |
| Step 3 presentation of inquiry work (repetition) | Presentation of results |
| Step 4 Individual tests       | Individual tests                         |
| Step 5 Group award            | Award of group progress                  |

2. Method

This research is a type of quasi-experimental research using nonequivalent control group design. This research was carried out at SD in Makassar involving 60 students as research sample. In this study two classes of mathematics learning activities were determined, namely classes that used the INSTAD model (experimental class) and used non-INSTAD learning models (control class). For collecting the data, the initial data collection was carried out through a pretest. This was done to get an overview of the student’s initial learning outcomes in the experimental class and the control class. This test was carried out before the experimental and control classes received the subject matter with the treatment of the INSTAD learning model and the non-INSTAD (lecture) model. Furthermore, carrying out learning activities directly by using the INSTAD and non-INSTAD learning model (lectures). Finally, final data collection through posttest.

The instruments used in this study are: (a) problem sheet: questions are given to each student in the form of multiple choice questions in twice (pretest and posttest); (b) Observation sheet: it is used to determine student’s activities during learning mathematics process include student activities in discussing in groups, asking questions and answering questions correctly and implementing the model by the teacher.

Data analysis techniques used in this study are descriptive and inferential statistical analysis. The data analyzed is the score of the pretest and posttest results by looking at the increase in score before and after the treatment by comparing the score of N gain of the experimental class and the control class. In this study, the data that will be tested for normality and homogeneity is the gain of learning outcomes of mathematics in the research subjects. Lei Bao stated that n gain is an increase in the results of the pretest and posttest calculated using the normalized increase in average analysis (average normalized gain) [17].
By using the category of the average normalized gain which created by Hake [18], the high and low normalized gain (N-gain) can be classified as follows in Table 2.

**Table 2. Categorization of gain value.**

| Interval of Gain (g) | Category  |
|----------------------|-----------|
| g ≥ 0.7              | High      |
| 0.3 ≤ g < 0.7        | Medium    |
| g < 0.3              | Low       |

Furthermore, it is also used independent sample t-test with \( \alpha = 0.05 \) to test the research hypothesis by using software of SPSS 20.

3. **Result and discussion**

The results of this research paper are described respectively; (1) the student’s mathematics learning outcome; and (2) the impact of the implementation of the INSTAD learning model toward students’ mathematics learning outcomes.

3.1. **The student’s mathematics learning outcome**

In this research paper, student’s learning outcome is described in the following Table 3.

**Table 3. Students’s mathematics learning outcome.**

| Control group | Value Classification and Category |
|---------------|----------------------------------|
|               | Pretest | Posttest | F | % | F | % |
|               | 3       | 6        | 10 | 20 | 2 | 6.67 |
|               | 2       | 6.67     | 6 | 20 | 2 | 6.67 |
|               | 8       | 2.67     | 8 | 22.67 | 9 | 30 |
|               | 7       | 23.3     | 6 | 20 | 6 | 20 |
|               | 10      | 33.3     | 4 | 13.3 | 9 | 30 |
|               | 30      | 100      | 30 | 100 | 30 | 100 |

3.2. **Description of student’s learning outcomes before being treated**

Pretest was done in the experimental and control class to find out the ability of the student’s initial learning outcomes. Based on the results of the analysis of the pretest showed that the experimental and control classes have an initial ability that is not significantly different. In the experimental class, the scores of student’s learning outcomes with an average of 62.0 and the control class with an average of 61.6. Both of them are in the low category. The data shows that the student’s initial learning outcomes for two classes before participating in learning are in the low category. This indicates that the distribution of experimental and control class data is not different with the average difference of 0.4. The small mean difference shows that the initial ability of both classes is equivalent. The equality of the pretest value of the two classes had also been proven through the independent samples t-test at a 95% significance level.

3.3. **Description of student’s learning outcomes after being treated**

The test questions for students’ learning outcomes for the posttest are the same as the pretest therefore there is no bias between the pretest and posttest. The highest score of the experimental class were 100 and the lowest was 60. Meanwhile, for the control class the highest scores were 90 and the lowest score were 40. The average posttest scores were 78.33 and 71.00, both of which were included in the medium
category. The largest percentage of the experimental class is 30% including height and very high categories. In contrast to the control class, the posttest results were 20% including high and very high categories and 22.67% including medium. This showed that the students’s learning outcomes of the experimental class had a large increase when compared to the pretest, while the increase of control class that occurred was not too significant. In addition, Table 3 indicates that the distribution of posttest data for experimental and control classes is different. Likewise based on the average score of the experimental and control classes obtained a difference of 7.3. The difference in mean score shows that the INSTAD learning model is influential to improve student’s learning outcomes.

Based on the description above, it can be concluded that the students’s learning outcomes in the experimental class are higher than the control class. When it is viewed from the average pretest of the control and experimental classes have almost the same score, but the posttest results show that the experimental class is better than the control class. This is evidenced by the comparison of the frequency distribution of learning outcomes between the experimental classes taught using the INSTAD model higher than the learning outcomes of students from the control class taught using direct learning model.

3.4. The impact of the implementation of the INSTAD learning model toward student’s mathematics learning outcomes

To determine the impact of INSTAD learning model on improving student’s learning outcomes, a comparison of the average learning outcomes or N gain is obtained. N gain statistics analysis can be seen in Table 4 below.

| Class   | Total | Maximum | Minimum | Average |
|---------|-------|---------|---------|---------|
| Experimental | 30    | 1.00    | 0.25    | 0.49    |
| Control   | 30    | 0.80    | 0.00    | 0.22    |

Based on Table 4, it is known that the score of the average of the N gain of the experimental class learning outcomes is 0.49 and the score of the average of the N gain of the control class is 0.22. By using the categorization of gain value in the Table 2., it can be said that N gain of experimental class learning outcomes is in the high category while N gain of control class learning outcomes is in the medium category.

The scores obtained from the research results (pretest, posttest, and N gain) were analyzed using hypothesis testing with the help of SPSS 20.00 for Windows. Hypothesis testing in this research uses independent samples t-test. The result of t test output N gain from student’s learning outcomes obtained 4.702 with 58 degrees of freedom and a significance value of 0.000. Based on the results obtained it is clear that the value of $t_{\text{obt}} > t_{\text{table}}$ (4.702 > 1.99547) and P value (0.000 < 0.05) or significance <0.05; it means that there are differences in learning outcomes between the experimental and control classes. The findings of this study indicate that learning with the INSTAD model influences the learning outcomes of students.

Based on the description above, it can be stated that the students’s learning outcomes in the experimental class is higher than the control class. If seen from the average pretest of the control class and the experiment, it has almost the same value, but the posttest results show the experimental class is better than the control class. This is evidenced by the comparison of the frequency distribution of students’s learning outcomes between the experimental classes taught by using the INSTAD model higher than the students’s learning outcomes from the control class taught by using the lecture model.

4. Conclusion

The difference in the use of approaches in learning will certainly have a different impact on improving student’s learning outcomes. Learning by using the INSTAD learning model provides direct experience to students. The students are given the opportunity to formulate problems and make hypotheses on
problems that have been formulated during the learning process while direct learning (conventional) which is not student-centered, rarely gives students the opportunity to construct their own understanding of the subject matter presented by the teacher. As a consequence, the implementation of the INSTAD learning model is one way to familiarize students to build their own knowledge, practice working or solving problem which can increase students’s learning outcomes.

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