A Learning Design: Integrating Tracker in Level of Inquiry to Enhance Seven Grade Student Science Process Skills and Graph Interpretation

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Abstract. Science process skills are important skills that need to be learned so that students can develop scientific concepts of science. However, the results show that science learning in the classroom has not been well facilitated, on the other hand the result of the research shows that the ability of graphic interpretation of SMP/MTs students is still low. Research using Level of Inquiry (LoI) and the use of tracker programs try to make it a solution. Pre experimental research with design one group pretest-posttest was implemented in 28 students obtained by purvosive sampling using instruments used to test students' graphic abilities is by test of Understanding Graph in Kinematics and to test the skill of science process students are by standard TIPS II test (Test of Integrated Process Skills II). The results of this study show that the <n-gain> of the graphic understanding is 0.53 in the average category, and <n-gain> of the science process skills is 0.70 in the high category. The application of this learning strategy can significantly improve the skills of the science process and understanding of graphs and based on the results of research indicate that this instructional design can be an alternative in improving students' science process skills and graph interpretation in linear motion learning.

INTRODUCTION

The essence of science itself seeks to arouse human interest to increase its knowledge of the universe in which so many things need to be known and solved. So that science is natural phenomena poured in it the form of facts, concepts, principles and laws are tested truth and through a series of activities in scientific methods and put forward the learning process. One of these scientific process skills that need to be trained on students is the science process skills. Science process skills are important for every student as a provision to use scientific methods in developing science and are expected to acquire new knowledge or develop the knowledge they already have, besides it can affect the way of life, how to socialize and face and seek solutions problem indirectly will improve the quality and Standard of living [1,2]. In line with that, the government's expectation as stated in Permendiknas 41 of 2007 on National Education Standard States that learning processes in educational units should be organized with interactive, inspirational, fun, challenging, motivating learners to play an active role, providing sufficient space for initiative, creativity, independence according to students' talents, interests, and physical and psychological development of student [3], In addition to the science process skills that need to be provided to the students is the ability to understand the graph, the advantages of the importance of understanding the graph is to provide easily understood [4]; Arouse the reader's interest in the material presented and can classify and simplify more information from the material presented [5].

In reality students' science process skills fall into the less favorable category if the percentage obtained shows a number less than or equal to 40% [6], and the learning done so far is still oriented to the mastery of the concept alone and has not explored the students' science process skills [7]. On the other hand a general understanding of the graphs of many elementary, middle and high school students still have difficulties in using, interpreting, and understanding graphics or data [8].

To be able to bridge the two things above, this research will use the LoI as a learning strategy that is considered able to improve the skills of the science process with clear stages, while to improve the understanding of the graph itself is done by integrating LoI with Video Tracker Analysis.

METHODS

The method used in this research is pre experimental design in one group pretest-posttest. With this design, the treatment of the subjects was initially pretested to determine the students 'early ability to understand the graphics and the ability of students' science processes on linear motion matter. Furthermore, the treatment of learning using LoI integrated with the software tracker video analysis, after the treatment is given further posttest to measure the increase in understanding of graphics and the ability of science process students. The results of the analysis between pretest and posttest are used to obtain answers to research questionsIn addition to strengthening the answers to research questions, is also supported by a student attitude scale questionnaire, Observation sheet of learning implementation.

In this study using software video tracker version 4.95 to investigate the magnitudes of linier motion as distance, displacement and speed. The learning stages using LoI assisted Tracker video analysis can be seen in Table 1. The learning steps are based on the characteristics of students and teachers who have the ability to operate the software tracker. Before the learning activities carried out the teacher guides students to prepare files used in analyzing, in the form of supporting files such as java, video converter, and sofware tracker, while students are guided to make video footage motion of objects on kinematics linier motion. Video recording uses a high definition DSLR camera with a resolution of 1920 x 1080 pixels. The camera is placed in front of the movement path of the object so that the display covers the whole object widely. Track length information is illustrated to facilitate calibration.

Subjects were students of class VII 2016/2017 forces on one Islamic junior high school in East Lombok, which is currently studying the kinematics of rectilinear motion of matter. Number of research subjects totaling 28 students, with sampling technique that is purposive sampling. This technique is used on the basis of determining samples with certain considerations, Which is to considering students who are technologically literate in terms of operating electronic devices for making videos. For the purposes of data collection, has been in translation standardized test TUG-K (Test of Understanding Graph in Kinematics) amounted to 20 multiple choice questions [9], while testing the science process skills using standardized tests TIPS II (Test of Integrated Process Skills II) amounted to 36 multiple choice questions [10].

TABEL 1. Learning Sequence Level of Inquiry (LoI) with Tracker

LoI cycle	Subject	Day	LoI		Tracker Integrated
1	Motion quantities	1	*Discovery Learning*		-
			Intractive Demonstration	√	teacher introduces the use of tracker when conducting an motion investigation
			Inquiry Lesson		-
			Inquiry Lab	√	teachers and students use the tracker when conducting investigations
2	Motion with constant velocity	2	*Discovery Learning*		-
			Intractive Demonstration	√	teacher introduces the use of tracker when conducting an motion investigation
			Inquiry Lesson		-
			Inquiry Laboratory	√	teachers and students use the tracker when conducting investigations
3	Motion with constant acceleration	3	*Discovery Learning*		-
			Intractive Demonstration	√	teacher introduces the use of tracker when conducting an motion investigation
			Inquiry Lesson		-
			Inquiry Lab	√	teachers and students use the tracker when conducting investigations

Use of standard TUG-K interpretation test and TIPS II science skill test, Based on the consideration of the degree of validity and reliability presented in Table 2 below.

TABEL 2. Level Validity and reliability of standard science process skills tests and graph interpretation

No.	Type of Test	Level		Category
		Validity	Reliability	
1	TIPS II	0,76	0,86	High
2	TUG-K	0,79	0,83	High

The implementation of a study is said to be more effective if it yields an average N-gain value greater than the initial test score [11]. N-gain is used to determine the improvement of science process skills and understanding of the charts using the criteria proposed by Hake [12] as shown in Equation (1) and the obtained N-gain values are categorized by the criteria presented in Table 3, Where the ideal maximum score for the test is 100. Improving all aspects can be seen from the increase in the average percentage value of each aspect.

$$< g >= \frac{<S_{post}> - <S_{pre}>}{S_{m\,ideal} - <S_{pre}>} \quad (1)$$

TABLE 3. *N-gain* Average criteria

Value	Criteria
<g> ≥ 0,7	High
0,3 ≤ <g> < 0,7	Medium
<g> < 0,3	Low

RESULT AND DISCUSSION

Science process skills improvement of student's show in Table 4 that there in high category. The improvement in each all out can we see in Figure 1.

TABLE 4. Gain normalized of student's science process skills

Class	<pre-test>	<post-tes>	<g>
Experiment	40,77	82,40	(0,703) High

Improvement of aspect can be seen from the increase in the average percentage the value of each aspect can be seen in Figure 1.

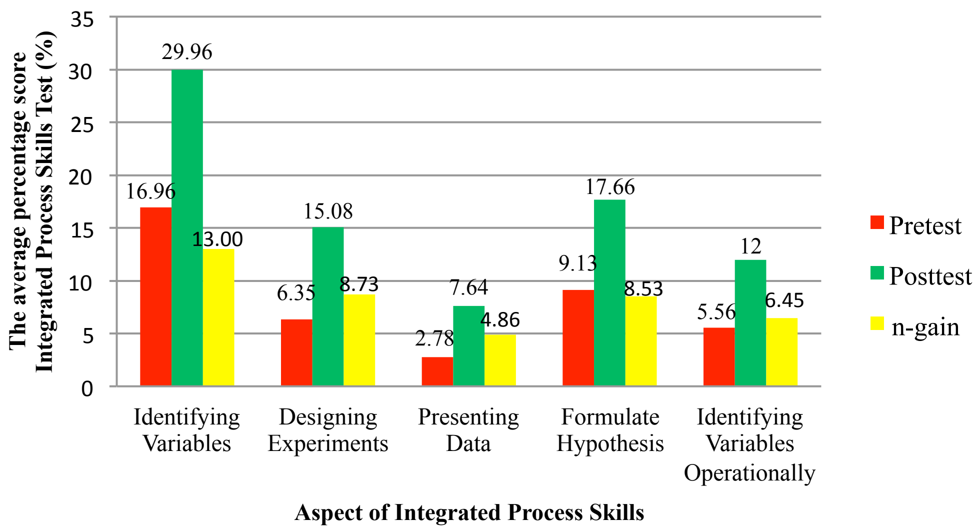

FIGURE 1. Graph Improvement of All Aspect in Integrated Process Skills

Based on the graph above, it can be seen that the results of the students' process skills on the competency aspects of integrated process skills have increased in the five aspects. For the aspect of identifying the variables on posttest increased by 29.96% from 16.96% in pretest with an increase value in this aspect of 13% which made it the highest increase in the five aspects in the integrated process skills. An improvement in that aspect when reviewing the average learning outcomes between teachers and student responses from the overall cycle undertaken shows that 90.2% In the criteria almost all the activities of teachers implemented in membelajarkan this aspect, and 83% in the criteria almost all the activities of students implemented to learning this aspect. With the results of this improvement is defined as at the time of implementation is done by the teacher, students are given emphasis-emphasis the purpose so that students are able to identify variables. The first ability students have to possess in the skills of the process of science is the aspect of formulating hypotheses that are high-level skills, Where to achieve the ability to formulate a hypothesis takes a longer time and consistent to learning. It certainly begins with students having the ability to identify, predict, interpret, experiment, and communicate experimental results so that the transmission of knowledge in the learning activities can be effectively implemented [13]. As for the aspects of presenting data on posttest increased by 7.64% from 2.78% in pretest with an increase value in this aspect of 4.86% which makes it the lowest increase. The low percentage increase from this aspect is caused by the not yet maximal students responding from the activities that study this aspect, the students' assumptions on the learning are still relatively new and require time to adjust. These findings are reinforced by previous research that found that low student process science skills are caused by several factors including low scientific background, lack of laboratory infrastructure [14], School administration has not initiated contextual learning and requires a change in student learning habits from the lessons that are usually applied in the classroom [15].

Graph interpretation improvement of student's show in Table 5 that there in average category. And Improvement of aspect can be seen from the increase in the average percentage the value of each aspect show in Figure 2.

TABLE 5. Gain normalized of student's Graph Interpretation

Class	<pre-test>	<post-tes>	<g>
Experiment	23,04	63,21	(0,53) Average

Basically understanding graphs something new for the students at my place of research, especially on the teaching system is still using conventional teaching (lectures). So when associating with the results of his research is still in the average category.

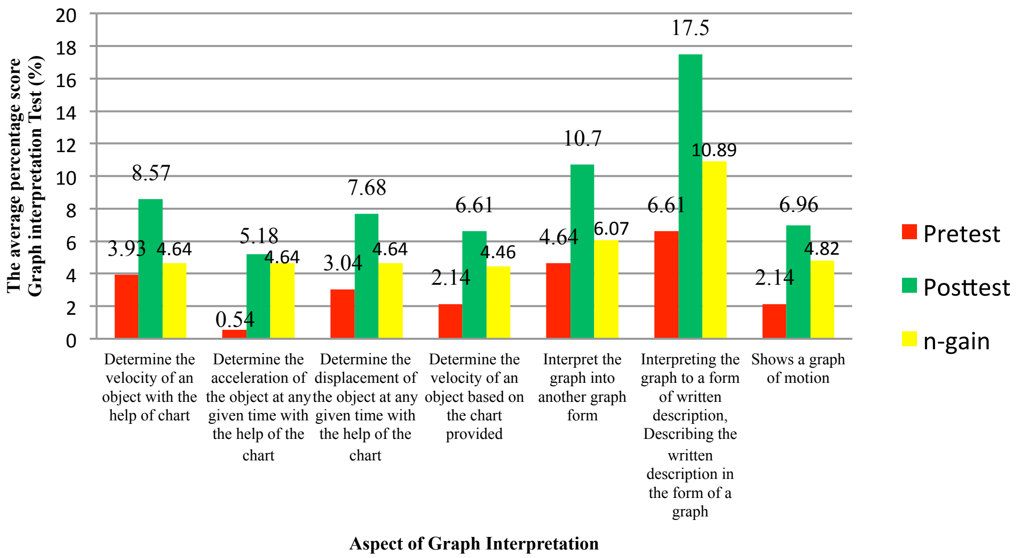

FIGURE 2. Graph Improvement of All Aspect in Graph Interpretation

Figure 2 shows some aspects of the understanding graphs. of these aspects affect a significant improvement between pretest to posttest. The highest increase in aspect is the interpreting graphs in written form as well as written descriptions depict in graphic form. This yield increase due to the student's level of knowledge to be able to answer with that type is not too complex, in line with that the researcher believes that the lack of ability to do student graphics literacy will have an impact on understanding the concept of kinematics, whereas students are required proficient in interpreting the graph and able to convey to others both in oral and written form [3], as well as answering previous findings stating that students are not able to re-reveal in their own words related to the various information contained in the graph and they are also difficulties in understanding the kinematics graph [16].

Different viewpoints, that the least increase aspect is the determinant aspect of the acceleration of an object at a time with the help of the graph. The low analysis of the results is due to the lessons learned when the student response at that time is still lacking and the teacher has a challenge in providing tricks that can make students quickly understand this aspect. Time constraints are also a very influential factor in this study, the teacher takes his time to explain the previous concept resulting from the lack of response from students. This finding is also reinforced by previous research which states that high school and college students are still weak and have difficulty in understanding the graph [17,18]. But the role of software tracker in general is very helpful for students in understanding the concept of motion, but still not maximal in helping students to fully understand this aspect. This is due to the lack of time to trained students tracker software, this is believed by the findings in previous research which states that the weakness of learning using VBL (video based laboratory) namely anlysis video tracker on the topic of kinematics linear motion one of them is required a special time before learning to train students in preparing, using, and trained the use of equipment in the form of cameras, measuring instruments and set the motion of objects to fit the expected [19].

Result of this study shows that the implementation of level of inquiry strategies improve the science process skills with clear stages so it is able to bridge in order to better identify student's inquiry learning and gradually was able to leave teaching to the conventional model (lectures). These findings are in line with previous studies that the levels of inquiry learning model can significantly improve the science process skills of students [20,21]. With using levels of inquiry students are given the opportunity to be actively involved in the activities of scientific investigation so that they can develop the skill of their intellectual processes. For enhance understanding of the graph it self is done by integrating the Level of Inquiry (LoI) with Tracker video analysis. These findings are in line with previous studies that to bridge in order to better identify student's learning inquiry and have gradually been able to leave the teachings of the conventional model (lectures) [22]; Learning activities using an analytical tracker video analysis useful experience for students in developing thinking skills, leading to the common mindset of scientists [16].

CONCLUSION

Implementation of the levels of inquiry strategy with tracker video analysis can significantly improve the science process skills and graph interpretation. This research is empirical evidence that support eirlier studies, and may provide additional information for developers research to conduct further research related to the study, because it is still very wide to hold the development of level of inquiry learning strategy with tracker video analysis. A challange for teacher is to integrate the activities of inquiry with the tracker, that is necessary to train the students to be able to bring expected propositions.

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