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Effect of Inductive Thinking Learning Model towards the Understanding of Science Concept, Science Process Skills, and Critical Thinking Ability of Junior High Schools

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Abstract

This study aims to determine the effect of inductive thinking learning models on the understanding of science concepts, science process skills and critical thinking abilities of junior high school students. The study population was all eighth grade students of SMP Negeri 1 Masbagik, totaling 318 students. The research sample consisted of 192 students consisting of 6 classes. The research method is quasy experimental with a non equivalent control group design. The experimental group and the control group were randomly determined. Data collection uses a science concept mastery test instrument, a science process skills assessment sheet, and a critical thinking ability test. Hypothesis testing uses the technique of independent sample t test, manova test and regression test. The results showed that: (1) The learning model of inductive thinking influences the understanding of the concept of science; (2) The inductive thinking learning model influences the science process skills; and (3) Inductive thinking learning model influences the critical thinking ability of students of SMPN 1 Masbagik.

Keywords: Understanding of Science concepts; Science Process Skills; Critical Thinking Abilities

Introduction

Science learning in junior high schools is designed and implemented referring to the concept of integrative science, namely processes and products. Science as a process includes scientific process skills and attitudes while science as a product is a collection of knowledge in the form of facts, concepts, principles, theories and others (Kemendikbud RI, Book of Teachers for Class VIII SMP 2014). To improve quality, various innovative learning models can be applied in science learning in junior high schools. One of them is the learning model of Inductive Thinking. The use of Inductive Thinking learning models aims to foster the ability to think, work, and be scientific and be able to communicate them as important aspects of life skills.

Jufri (2013) states, learning in schools is more than just a process to help students in learning. In this case, the teacher must be sure that students are really helped to learn the subject matter and skills demanded by the curriculum. Theoretically, the subject matter is designed so that students learn by

building knowledge and skills based on what has been previously learned and preparing ways to face the challenges to come.

Observation results indicate that the science learning process in junior high schools still uses lecture, question and answer, and assignment methods, learning is still centered on the teacher (teacher centered), consequently students are less motivated in learning and have not found anything interesting from the subject matter of science. Besides the teacher is only guided by existing learning tools, teachers rarely confront students in real conditions, teachers only record a summary of the material while students listen and record the material delivered by the teacher during science learning.

The results of the Joint Semester (USB) Middle School at SMPN 1 Masbagik in the odd semester of the 2017/2018 academic year know that in science subjects the average grade for grade VII is 60, grade VIII is 56, grade IX is 54 with KKM 75, p this means that the average value of USB results in the odd semester of the 2017/2018 academic year is still lower than the KKM score for natural science subjects. This means that students have not been able to understand the science material well. To improve students' mastery of natural science material, a learning process is needed that directs students to find out for themselves the answer to a question or a problem, thus helping them better master the science concept.

Science process skills and critical thinking abilities of students are still very low. This can be seen from the science learning process that has not been carried out to facilitate students in conducting scientific investigations to obtain facts that support the answers to the questions they face. To improve the mastery of science concepts, science process skills, and students' critical thinking skills, learning innovation is needed by applying learning models that develop multi-directional communication, both between students and students and teachers, such learning models are student centered, including learning models Inductive Thinking.

Joice, Weil and Calhoun (2016) explained that the Inductive Thinking learning model was built to strengthen the innate ability of humans to organize information about their environment, categorize concepts and make their world understandable and predictable. Inductive Thinking is a research-based, student-centered science pedagogy and philosophy where students are active in groups and are involved in discovering new things using material that has been designed to directly guide students to rebuild their knowledge.

Inductive thinking that has an emphasis on content and process, thus has to do with understanding and process skills, especially science process skills and critical thinking. The Inductive Thinking Learning Model according to Kartini (2012) has two broad objectives namely to develop mastery of content through the construction of students' own understanding, and to develop and enhance key learning skills such as information processing, oral and written communication, critical thinking, problem solving, metacognition and assessment.

Based on the above opinion it can be said that the inductive thinking learning model is part of the learning model of searching and finding new information which is process oriented to facilitate the implementation of the learning process. Thus the Inductive Thinking learning model has an emphasis on processes and content related to the application of concept understanding, science process skills, and critical thinking. The learning model of Inductive Thinking is important to apply because in its learning activities Inductive Thinking works in team form so that activities can be used to develop understanding and questions, problem solving and individual responsibilities.

According to Huda (2017) that the learning model of Inductive Thinking is an elaboration of 3 learning syntaxes, namely the formation of concepts consisting of identifying data or problems, making categories, interpreting data with conclusions, and applying by making hypotheses and making

predictions. The application of the Inductive Thinking learning model will lead students to work in groups, look for data and problems as well as make categories, make conclusions and answer carefully designed questions so as to produce a concept or a true picture of the study.

Method

This study aims to determine the effect of inductive thinking learning models on understanding concepts, science process skills, and critical thinking skills. This type of research is a quasy experiment using the nonequivalent control group design as shown in Table 1

Table 1: Research Design

Group	Pretest	Treatment	Posttest
E	O1	X_1	O2
K	O3	-	O4

(Source: Sugiyono, 2014)

Information :

E: Experiment Class
K: Control Class
O1: Experiment Class Test
O2: Experiment Class Posttes
O3: Pretest Control Class
O4: Control Class Posttes

The research activity begins with a pretest both to the experimental class and to the control class. In the experimental class applied inductive thinking learning models and control classes with conventional learning models. After getting different treatments, both classes were given posttests regarding conceptual understanding, science process skills and critical thinking skills.

The population of this study was all students of class VIII of SMPN 1 Masbagik, East Lombok Regency in the 2018/2019 Academic Year consisting of 10 classes or 318 people. The sampling technique in this study uses simple random sampling technique. From ten population classes randomly selected 6 sample classes. The six classes were randomly selected again three classes became the experimental class and three classes became the control class.

Data collection is done using test techniques. Concept Understanding Test to measure indicators of concept comprehension namely (1) translation (2) interpretation (interpretation) and (3) initial extrapolation (Bloom 1956). Science process skills tests are used to measure indicators of process skills that are observing, grouping (identifying), predicting (predicting), hypothesizing, planning an experiment, using tools / materials, applying concepts, interpreting results and communicating. (Rustaman, 2005). Critical thinking skills test measures indicators of critical thinking skills that refer to the indicators of critical thinking skills Ennis, (1985) include (1) providing a simple explanation, (2) building basic skills, (3) concluding, (4) giving an explanation (5) arranging strategy and tactics.

Data analysis techniques in this study are Independent Sample t Test and manova test and regression by first doing the data normality test and homogeneity test. Normality test uses Lilliefors (Kolmogorov-Smirnov compatibility test) which is processed with SPSS 19 software for windows. With the criteria if Sig. (2-tailed)> 0.05 then the data is normally distributed. Homogeneity test in this study

uses the Lavene Test and the Box's M. Test The Lavene Test aims to find out the data on each dependent variable having homogeneous or not variance-covariance. Box's M Test aims to find out the data on all variables together whether or not homogeneous variance is covariance. Decision criteria if Sig. > 0.05 then homogeneous data or vice versa. Data processing using SPSS 19 software.

Hypothesis testing of each dependent variable uses the Independent Sample t Test, with the criteria if t count> t table Ho is rejected at the significance level of 0.05 or vice versa, while to test the effect of independent variables on the dependent variable simultaneously manova test is used with the criteria if the number Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root show significance (Sig)> 0.05, then H_0 is accepted and if the significance number (Sig) <0.05, then H_0 is rejected. Calculations using SPSS 19 software for windows.

To find out the increase in the average value of students at the pretest and posttest, an N-gain analysis was carried out on the understanding of concepts, science process skills and critical thinking skills using equations:

$$\text{N-gain (\%)} = \frac{\text{posttes score} - \text{pre test score}}{\text{Maximum score} - \text{Pretest score}} \times 100\%$$

N-Gain acquisition data is interpreted with the criteria according to the following Table.

Table 2. Criteria for Increasing N-Gain

Percentage *(%)*	Interpretation
< 40	ineffective
40 – 55	Not effective
56 – 75	enough effective
> 76	Effective

(Source: Hake, 1999)

Results and Discussion

Decryption of Research Results

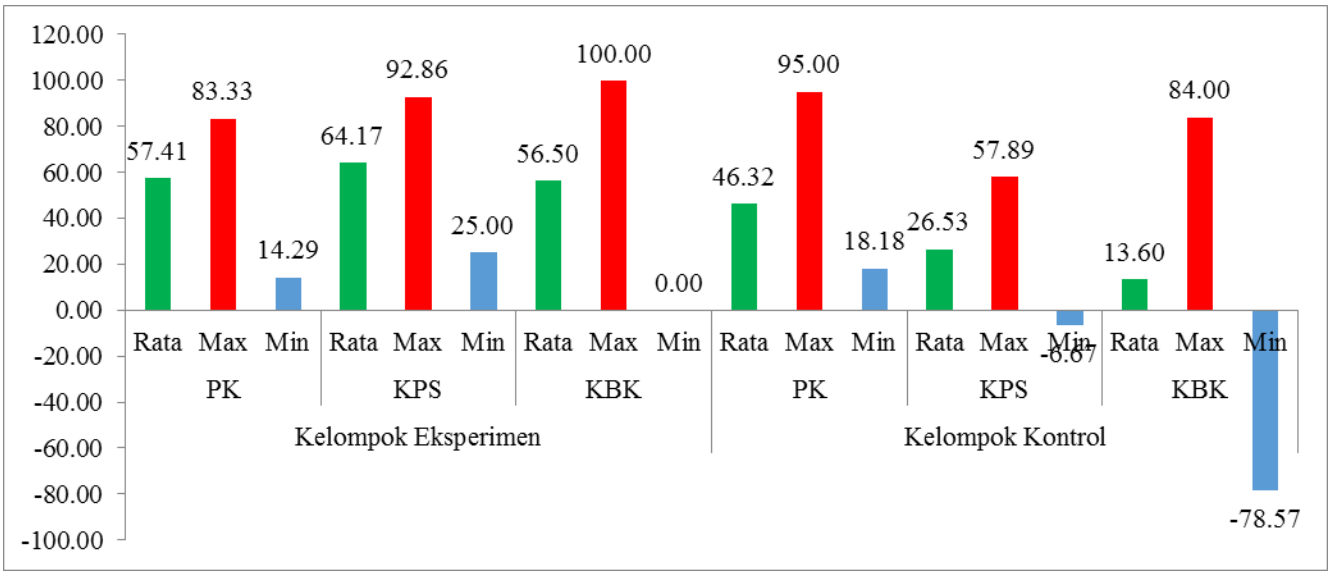

Figure: Description of the Experiment and Control data group

Information:

PK: Understanding the concept of science
KPS: Science Process Skills
KBK: Critical Thinking Ability

From the picture above shows the results of the calculation of the value of N-Gain on concept understanding in the experimental group the highest value was 83.33 and the lowest was 14.29 with an average of 57.41, in the control group the highest value was 95.00 and the lowest was 18.18 with an average average 46.32. Likewise, the science process skills variable in the experimental group obtained the highest score of 92.86 and the lowest of 25.00 with an average of 64.17. In the control group the highest value of 57.89 the lowest -6.67 with an average of 26.53. The value of critical thinking skills for the highest experimental group is 100.00, 00.00 and the average is 56.50, while in the control group, the highest value is 84.00 and the lowest is -78.57, with an average of 13.60. From the above facts it can be said that the experimental group applying the Inductive Thinking learning model has an average value that is higher than the control group applying the conventional learning model.

Independent Sample t Test in this study to examine the effect of independent variables on each dependent variable. The test results can be seen in the following table:

Tabel : Independent Samples t Test

Variable		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Understanding the Concept of Science	Equal variances assumed	4.785	180	0,000	-11,538	2,411	16,296	6,780
Science Process Skills	Equal variances assumed	10,560	180	0,000	-28,296	2,679	-33,584	-23,009
Critical thinking	Equal variances assumed	2,237	180	0,027	-7,076	3,164	-13.320	-0,833

Independent Sample t Test results on variables. The concept of understanding variable has a tcount of 4.785 and a ttable at a significance level of 0.05 of 1.973 means tcount> ttable. Thus it can be concluded that H0 is rejected and H1 is accepted, meaning that there is an influence of the Inductive Thinking learning model on concept understanding.

The science process skill variable has a t-test value of 10.560 and a ttable at a significant level of 0.05 of 1.973, meaning a t-count> t-table. Thus it can be concluded that H0 is rejected and H1 is accepted, meaning that there is an influence of Inductive Thinking learning models on science process skills. The tcount for the critical thinking ability variable is 2.237 and the ttable at a significant level of 0.05 is 1.973, meaning tcount> ttable, it can be concluded that H0 is rejected and H1 is accepted, meaning that there is an influence of the Inductive Thinking learning model on critical thinking skills.

On the results of the manova test that tests the effect of independent variables on the dependent variable can be seen in the following table.

Table 3: Multivariate Test Results

Effect		Value	F	Hypothesis df	Error df	Sig.
Learning Model	Pillai's Trace	0,335	46,525[a]	3.000	178.000	.000
	Wilks' Lambda	0,665	29,955[a]	3.000	178.000	.000
	Hotelling's Trace	0,505	29,955[a]	3.000	178.000	.000
	Roy's Largest Root	0,505	29,955[a]	3.000	178.000	.000

Based on Table 3 above, the Sig. tested by Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root procedures all show 0,000, meaning that the Sig value <0.05 according to the criteria above can be concluded that H0 is rejected and H1 is accepted, meaning that there is a simultaneous influence on the Inductive Thinking learning model understanding of concepts, science process skills, and critical thinking skills.

The Effect of Inductive Thinking Learning Models on Understanding Concepts

The results of data analysis show that there is an influence of inductive thinking learning models on concept understanding. This influence is caused by the application of inductive thinking models that lead students to more easily understand the learning material because it is taught through teamwork or groups in solving problems and problems provided by the teacher. This is consistent with the statement put forward by Prayogi et al., (2010) that learning in teams enables students to develop their reasoning at a higher level, because the discussion takes place in the division of roles in groups, making learning more interesting and helping the collaboration between members resulting in the growth of student activity in learning. Besides learning with inductive thinking models can actively encourage students to explore their own knowledge so that students can become individuals who are independent, active, and skilled in solving problems based on information and knowledge obtained (Siswono, 2013). Thus the learning model can encourage the activeness of students to explore their knowledge independently in solving problems in the concepts being studied.

The strengths of the inductive thinking learning model can be seen from the readiness of students in the learning process, and the results achieved with the parameters of achieving learning objectives and the distribution of student knowledge. In applying the Inductive Thinking learning model at the end of each teacher's learning requires students to read the learning material to be learned at the next meeting. Thus students who have studied the material first will find it easier to find concepts, so the understanding of the concepts in the material being learned is getting stronger. In addition, the concepts found received confirmation from the team or group, even from the teacher.

The Effect of Inductive Thinking learning models on Science Process Skills

Based on the results of data analysis shows that there is an influence of inductive thinking learning models on science process skills. This is caused by the experimental group applying the inductive thinking learning model conducting experiments or practicum. By conducting experiments students experience firsthand the process that they learn so that they are really focused on what is being done or learned. Science process skills can be developed through direct experience because students can better appreciate the process or activity that is being carried out (Rustaman 2005).

Many benefits are obtained by involving students in laboratory activities including increasing the meaningfulness of learning, conceptual understanding and understanding of the nature of science Therefore science process skills can be trained from the description of research data, known natural phenomena, and simple equipment that is around students. According to Jufri (2013) the learning process is not merely the activity of conveying and explaining the concepts learned, but involving students to build knowledge and skills, formulate problems through laboratory activities.

The Effect of Inductive Thinking Learning Models on Critical Thinking Ability

The application of inductive thinking learning models influences critical thinking skills. The increased ability of students' critical thinking is caused by the application of inductive thinking learning models that provide opportunities for students to think in solving problems by finding information from various sources and interpreting data so they can make conclusions. The inductive thinking learning model emphasizes students to learn in groups in activities designed to improve mastery of the contents of the subjects and develop abilities in the process of learning, thinking, problem solving, communicating, group work, management and evaluation. Inductive thinking learning involves students in developing information, knowledge, and helps students develop understanding by applying the learning cycle.

The inductive thinking learning model invites students to think through the process of experimentation, and research. The experiments conducted were about the process of human excretion in order to analyze and conclude the results of the experiments so that students have the ability to think critically. In the inductive thinking learning model, students analyze the results of experiments guided with a variety of critical questions that are sequential and continuous, in the end students can make conclusions correctly so that the ability to think critically.

The Effect of Inductive Thinking Learning Models on Concept Understanding, Science Process Skills, and Critical Thinking Abilities

The results of data analysis showed that there was an influence simultaneously on inductive thinking learning models on concept understanding, science process skills, and critical thinking skills. The Inductive Thinking Learning Model is also proven to theoretically influence the understanding of concepts, science process skills, and the ability to think critically in students in learning science.

Inductive Thinking learning model can improve critical thinking skills and improve aspects of hypothesizing, analyzing and concluding. From the various results of the research conducted above it can be concluded that the Inductive Thinking learning model provides positive results for the understanding of concepts, science process skills, and critical thinking abilities. Thus the Inductive Thinking learning model can be applied to science subjects because in this learning process students are trained to construct their own cognitive abilities, provide facilities for students to practice their science process skills and foster creativity in thinking. Thus the concepts learned will be easily understood, then proven through experiments or practicums to build their science process skills and be given the opportunity to assess their performance and think about how to improve.

Conclusion

Based on the results of research and discussion can be concluded as follows.

1. The application of the inductive thinking learning model has a positive and significant effect in increasing the understanding of students' science concepts.The application of the inductive thinking learning model has a positive and significant influence in improving the understanding of the concept of science. This is because the inductive thinking learning model emphasizes the formation of concepts independently by students with the guidance of the teacher, thus giving a deep impression of the concepts learned.

2. The application of the inductive thinking learning model has a positive and significant effect in improving students' science process skills. This happens because in the learning process with the learning model of inductive thinking, students carry out practical activities or experiments in an effort to prove the concepts or theories they have understood.

3. The application of the inductive thinking learning model has a positive and significant effect in increasing students' critical thinking skills. This can be caused by students exploring problems as critical thinking responses, in the form of questions that lead them to identify concepts and understanding of concepts that are built and the application of their knowledge.

Suggestion

Based on the results of this study it is suggested:

1. Research needs to be done with a different subject matter from the subject used for the trials in this study. This is important to uncover other aspects related to student learning outcomes.

2. In the learning process teachers should be able to influence students' critical thinking skills by providing application questions to practice their critical thinking skills with a range of scores that are not too large.

3. The teacher must be careful in managing time such as when to do the practicum or experiment, when to discuss, the formation of concepts, presentations, and application of concepts, so as to conclude at the end of learning.

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