

# Improving The Critical Thinking Skills by Using the Discovery Learning Model Based on the Ethnoscience of the Patiayam Site

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## Abstract

The purpose of this study was to determine the increase in critical thinking skills of fourth-grade elementary school students using the discovery learning model based on the ethnoscience of the Patiayam site in Jekulo District, Kudus Regency. This study used a quasi-experimental research method with a non-equivalent control group design. The research was conducted at 4 and 5 Bulungcangkring elementary school (experimental group), 2 and 6 Bulungkulon elementary school (control group). Data collection techniques in this study used questionnaires, observation sheets, and also tests. Data analysis techniques used in this study included the Prerequisite Analysis Test, namely the normality test and homogeneity test, then the N-gain test and T-test. The results showed that the effectiveness of discovery learning by N-gain analysis that the control class gets an average of 0.2535, while the experiment class gets an average of 0.5574. Then the result of student learning outcomes in learning using discovery learning model based on the ethnoscience of the Patiayam site in the table above indicating that the experimental class got an average N-gain score of 0.3563, the control class got an average N-gain score of 0,1764. Based on the criteria for the effectiveness of N-gain  $\geq 0.30$ , the discovery learning model based on the ethnoscience of the Patiayam Site is said to improve students' critical thinking skills and learning outcomes. The results of the Independent Samples Test for student learning outcomes show that there is a difference student learning outcomes between the experimental group and the control group in the average result of critical thinking skills with the Sig. (2-tailed)  $0.003 < 0.05$ . These results are also supported by the results of the questionnaire recapitulation statement that student and teacher responses are very positive in implementing learning using the discovery learning model based on the ethnoscience of the Patiayam site.

## Keywords

Discovery learning model, critical thinking skills, ethnoscience

## 1. Introduction

The rapid and complex development of technology, information, and communication marks a new era, namely the era of the industrial revolution 4.0. This has real consequences and impacts in all areas of life. Likewise in the field of education where education must be based on meeting the needs that exist in the future to produce human resources that are innovative, think critically and have superior competence both in soft skills and hard skills so that they can be aligned and even able to compete with human resources from other countries. In dealing with various global issues. As the 21st century skills that that must be mastered in the era of the industrial revolution which are globally described in 4 categories as follows: namely Critical Thinking, Creativity (Creative Thinking Skills), (Anjaniputra, 2020) explain Basic considering is a crucial to students' victory of learning. not as it were does it offer assistance in preparing data gotten through composed and verbal communication, but too it improves the quality of dialect which is created coherently and sensibly.

(Husna, 2019) in his research concluded that "Teachers need to facilitate the development of the students' critical thinking skills by providing relevant activities, which can be embedded within any subject, with some creativity from the teachers". To achieve this, the teacher needs to improve skills that can guide students to improve critical thinking skills (Shofwan et al. 2021). Students' creative and critical thinking abilities can be improved through the use of more varied learning methods, carrying out interesting and fun activities such as inviting more students to do experiments in class or outside the classroom (Nada et al., 2018).

One of the learning models suggested in the 2013 curriculum is the discovery learning model (Fakhrudin & Shofwan, 2019). The Discovery learning model guides students to understand concepts, meanings, and relationships, through an intuitive process to finally conclude (Permendikbud, 2014). Discovery learning was introduced by Jerome Bruner. This model encourages learners to build on past experiences and knowledge, use their intuition, imagination and creativity, and search for new information to discover facts, correlations and new truths. Learning does not equal absorbing what was said or read, but actively seeking for answers and solutions. Therefore, Discovery learning is believed to improve students conceptual understanding, improve student learning outcomes and activities and improve students critical thinking skills in schools compared to conventional methods.

The opinion of Bicknell-Holmes & Hoffman (Castronova, 2002) who said that, "Through exploration and problem solving students create, integrate, and generalize Student driven knowledge, interest based activities which the student determines the sequence and frequency of activities to encourage integration of new knowledge into the learner's existing knowledge base. Moreover, Discovery learning can be facilitated through various strategies, or architectures, in the classroom. This is supported by research (Rudibyani, 2018) which states that Based on effectiveness test and effect size test shows that learning using discovery learning model has been done effectively and has a big influence in improving the thinking skill of elaboration and mastery of student concept.

Based on these studies, the application of discovery learning models in learning can be used as a means of guiding students to find their own concepts and information so that students understand the material more easily because of the meaningful learning process. This is in accordance with the advantages of the discovery learning model, Sari (2017: 61) states that discovery learning has the following advantages: 1) it can improve problem solving skills. 2) Train students to learn independently. 3) Provide reinforcement regarding understanding, memory, and transfer, and can make students active in teaching and learning activities to find the final result. 4) Many provide opportunities for students to be directly involved in learning activities, so that it will generate more motivation to learn and be adapted to their own interests and needs.

Furthermore, learning with discovery learning models will be more interesting and optimal if it is associated with the environment around students. This is in line with the 2013 curriculum regulations where learning should be linked to the real life of students and implemented with an integrated approach to local wisdom. The benefits of integrating local wisdom around it can be seen from several relevant studies. (Usmeldi & Amini, 2020) concludes from the results of his research that, "Science learning based on local wisdom model can increase students' activity when learning. The implementation of science learning based on local wisdom model can improve student competence". The local-based science wisdom of IPA learning can encourage students to construct and make connections between the knowledge and reality in the environment (Setiawan et al., 2017). (Wilujeng et al., 2019) argued, "the learners will be able to understand the potential in their area even more, so that learners are accustomed to searching, processing, and finding information on their own as well as using the information to solve existing problems in their environment".

Given the many benefits obtained in applying the discovery learning model of learning and also integrating local wisdom or ethnoscience in learning, it is important for schools to apply local wisdom culture-based learning. Researchers are interested in conducting preliminary research in Jekulo Regency. Based on the results of the preliminary research conducted, it was found that the teacher had not applied the ethnoscience-based discovery model effectively in Jekulo district. The results of the questionnaire show that 29% are implementing the discovery learning model, but during the learning process by applying the discovery learning model it is still less effective and efficient. The syntax or discovery learning steps have not been implemented perfectly. This is due to the teacher's lack of understanding of discovery learning syntax. The learning media used have not varied. The surrounding environment has also not been used optimally to direct students to the discovery-based learning process.

Furthermore, in Jekulo sub-district there are several local cultures that should be related to learning materials. One of them is the Patiayam Archeological Site. This site is precisely located in the village Terban, Jekulo sub-district, Kudus district. The large number of fossils found in the Patiayam area is a special attraction for tourists. Patiayam Museum officials said, until now, as many as 7,000 fossils have been collected. The findings consist of 16 species of ancient animals, such as bulls, elephants, antelopes, and ancient marine animals. This collection does not include new fossils found at the Patiayam site because no identification has yet been made (Suara Merdeka.com, 2019). This site has several potentials, including historical, geological, natural tourism and cultural potential.

The application of an integrated learning model with ethnoscience aims to improve 21st century skills, especially critical thinking skills. In addition, students are also expected to be able to hone their ability to think creatively, collaborate, and communicate because they are guided to find concepts independently through a scientific process. Based on descriptions, preliminary research, as well as various theories that find the advantages of discovery learning models, researchers are interested in conducting research to determine the increase in critical thinking skills of fourth grade elementary school students by using the discovery learning model based on the ethnoscience of the Patiayam site in Jekulo District, Kudus Regency.

## 2. Literature Review

### 2.1 Model Discovery Learning

Bicknell-Holmes and Hoffman 2000 in (Castronova, 2002) describe the three main attributes of discovery learning as (1) exploring and problem solving to create, integrate, and generalize knowledge, (2) student driven, interest-based activities in which the student determines the sequence and frequency, and (3) activities to encourage integration of new knowledge into the learner's existing knowledge base.

According to (Joolingen, 2009), the discovery learning model is an instrument that supports the process of developing students' cognitive abilities in learning and bridging the student learning environment. This learning is seen as a promising way, especially in the active involvement of students in the teaching and learning process so that the knowledge gained by students is not only transferred by the teacher, but students develop their own knowledge.

Discovery learning is not like traditional classroom learning. It consists of three main attributes (Bicknell- Holmes & Hoffman, 2000): (1) Through exploration and problem-solving students create, integrate, and generalize knowledge. (2) Student driven, interest-based activities which the student determines the sequence and frequency. (3) Activities to encourage the integration of new knowledge into the learner's existing knowledge base.

*Carin and Sund* (Supentangingrum, 2013: 244) explains the advantages of the discovery learning model as follows: 1) Develop intellectual potential. 2) Changing students from having external motivation (extrinsic motivation) to being self-motivated (intrinsic motivation). 3) Students will learn how to learn (learning to how). Children can be actively involved by listening, speaking, reading, seeing and thinking. 4) Maintain memory.

### 2.2 Ethnoscience

Ethnoscience according to (Shidiq AH, 2016: 228) is a study of knowledge systems developed from a local cultural perspective related to the classification of objects and activities based on natural phenomena. Ethnocentric integrated learning is learning that is organized in a system of knowledge from the local culture and wisdom that is owned, related to certain natural phenomena and events.

Holbrook Rannikmae (Ariningtyas, et al, 2017: 187) suggests that one of the characteristics of ethnoscience learning is the development of positive attitudes towards science. Ethnoscience-based learning emphasizes achieving a unified understanding rather than just deep understanding.

### 2.3 Critical Thinking Skills

The Directorate General of Primary and Secondary Education (2017: 6-7) explains the meaning of critical thinking as follows: (1) Using various types of thinking / reasoning or reasons, both inductive and deductive, appropriately and according to the situation. (2) Understanding the interconnection between one concept and another in a subject, and the relationship between concepts between a subject and other subject. (3) Conducting judgments and making decisions effectively in processing data and using arguments. (4) Testing results and establishing connections between information and arguments. (5) Processing and interpreting the information obtained from the initial conclusions and testing it through the best analysis. (6) Making solutions to various non-routine problems, either in a general way or in their own way. (7) Using his/ her abilities to try to solve the problem. (8) Arranging and disclosing, analyzing, and solving a problem.

Facione (Haryani, 2011: 124) suggests indicators or characteristics of critical thinking skills as follows: (1) Interpretation, namely the ability to understand, explain and give meaning to data or information, (2) Analysis, namely

the ability to identify relationships from information used to express thoughts or opinions, (3) Evaluation, namely the ability to test the truth of information used in expressing thoughts or opinions, (4) Inference, namely the ability to identify and obtain the elements needed to make a reasonable conclusion, (5) Explanation, namely the ability to explain or state the results of thoughts based on evidence, methodology, and context. (6) Self-regulation, namely a person's ability to regulate his thinking.

### 3. Methods

This study uses a Quasi-Experimental research method with a non-equivalent control group design. The approach used in this research is a quantitative descriptive approach. The research subjects in this study were students of 4 and 5 Bulungcangkring elementary school as an experimental class with 42 students and 2 and 6 Bulungkulon elementary school as a control class with 26 students.

#### 3.1. The Data Collection Technique

Data collection techniques in this study uses questionnaires, observation sheets, and also tests. The research instrument used in this study was a test of learning outcomes and the results of students' critical thinking skills as well as a questionnaire about the teacher's and students' responses to the application of the discovery learning model based on the ethnoscience of the patiyam site.

#### 3.2. The Data Analysis Technique

The data analysis technique used in this research includes the Prerequisite Analysis Test, namely the normality test and homogeneity test, then the t-test and the N-gain test. The following will explain in detail the data analysis carried out.

#### 3.3. Test Prerequisite Analysis

The average similarity test is carried out to determine the initial ability of the experimental and control class students. The initial abilities of students in the experimental class and control class are the same or there is no significant difference. The initial data used were derived from the initial test values before the treatment. The prerequisite analysis test includes normality and homogeneity tests. The normality test is carried out to determine whether the sample is normally distributed or not. To test for normality in research, the researcher will process the data using the test Kolmogorov-Smirnov assisted by SPSS 24. Decision-making and concluding are taken at a significance level of 5%. If the value is more than 0.05, the data is normally distributed, but if the value is less than 0.05, it is interpreted that it is not normally distributed.

The homogeneity test using Levene's test statistics Test and with a significant level of 5%. If the significance is more than 0.05, it can be concluded that the variance is the same (homogeneous), but if the significance is less than 0.05, the variance is different (not homogeneous). The data in this study are in the form of qualitative data and quantitative data. The data collection techniques use questionnaires, tests, observation, interviews, and documentation. Data analysis of the effectiveness of the discovery learning model based on the ethnoscience of the Patiyam obtained through data analysis on the improvement of student learning outcomes and data on students' critical thinking skills. The data analysis technique is as follows.

#### 3.4. Analysis of Data on the Improvement of Students' Learning Outcomes and Critical Thinking Ability

The experimental data analyzed are pretest and posttest data. The pretest and posttest data from the control group and the experimental group are analyzed using the N-gain formula:

$$N - gain < g > = \frac{Skor\ posttest - Skor\ pretest}{Skor\ maksimum - Skor\ pretest}$$

### 3.5. T-Test

independent sample t-test was conducted to determine whether there were differences in the learning outcomes of the following control and experimental groups. Whether there is a difference in learning outcomes in the control and experimental groups is indicated by the Sig. (2 tailed). If the value is Sig. (2-tailed) >  $\alpha = 0.05$  then H0 is accepted. Conversely, if Sig. (2-tailed) <  $\alpha = 0.05$  then H1 is accepted.

### 3.6. Analysis of Teacher and Student Response Data

Teacher response questionnaires were given to teachers in the experimental class at the end of the meeting. The teacher response questionnaire contains 10 closed question items with yes or no answers. The data obtained were processed with the following formula.

$$\text{Teacher response percentage} = \frac{\text{number of positive responses}}{\text{number of questions items}} \times 100 \%$$

The Discovery learning model based on Patiayam Site ethnosience is said to be effective if the teacher's response is in the percentage range of 75 % to 100% with very good criteria.

## 4. Results and Discussion

This research is the application of discovery learning model based on Patiayam site ethnosience to improve critical thinking skills and student learning outcomes. The study was conducted in four elementary schools in Jekulo District, Kudus Regency. In the control group, the teacher applied the conventional learning model. Explanatory learning materials with lectures, questions and answers, and assignments. In the experimental group, the teacher applies a discovery learning model based on the Patiayam site ethnosience. During the learning process students are guided to find material concepts independently based on the syntax of the discovery learning model design. The design of the discovery learning model based on the ethnosience of the Patiayam site as a whole is presented in Figure 1.

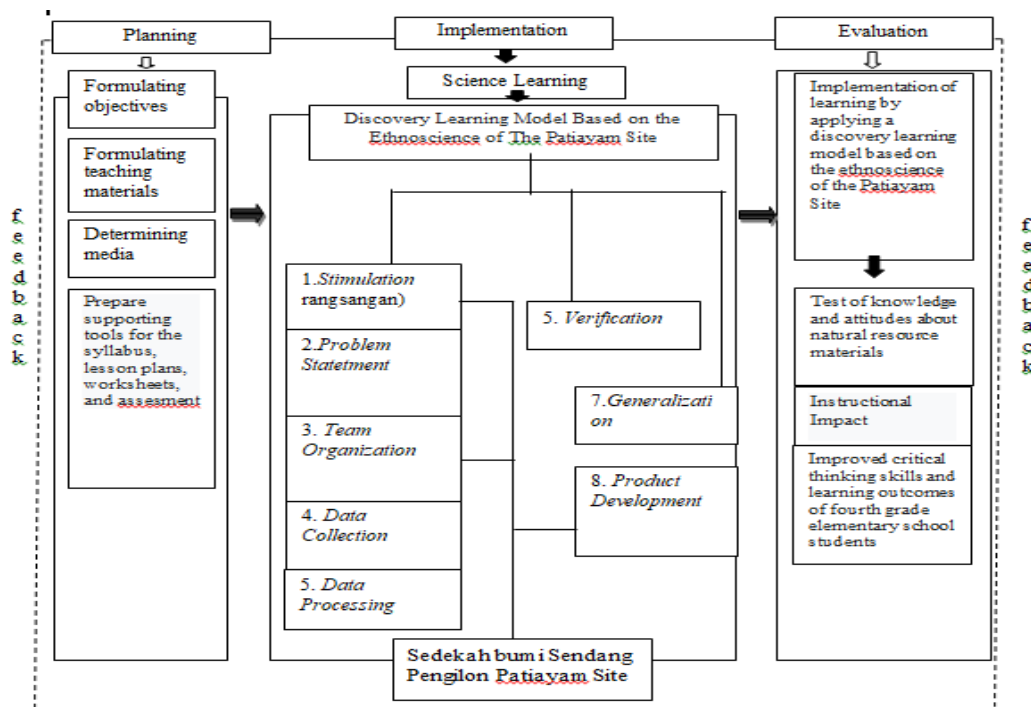


Figure 1. The Discovery Learning Model Based on the Ethnosience of the Patiayam Site

Based on figure 1 above the, before implementing the model the teacher first carries out planning activities so that the designed results can be optimal. The planning activities carried out by the teacher include formulating objectives, formulating materials, determining media, and compiling learning support devices. The next activity is the implementation of learning activities by applying the discovery learning model.

Application of the the discovery learning model based on the ethnoscience of the Patiayam site in 4<sup>th</sup> grade science learning theme 4 about "Various Jobs". Basic competencies 3.8 "Explaining the importance of balancing and preserving natural resources in the environment." and 4.8 "Conducting activities to conserve natural resources with the people in their environment." which is carried out based on the syntax contained in the book development of learning model. Learning consists of initial activities, core activities, and closings. In the first lesson, was carried *pre-test* out to determine students' mastery of the material.

The meeting begins preliminaries. In this activity the teacher makes apperception by presenting a learning video that can be downloaded by scanning a barcode or via the provided link. Teachers and students ask questions about the natural state of the Patiayam Site in the video and explain why. The class is divided into groups. Each group consisted of 4 students who were selected heterogeneously. The teacher conveys the competencies to be achieved.

The next step, the core activities. In the core activity using learning model syntax *discovery* based on the ethnoscience of the Patiayam Site.

1. *stimulation*. At this stage, students observe a picture of the earth alms ceremony at Sendang Pengilon. Teacher asks various questions to students in the
2. *problem identification*. At this stage, students answer the questions contained in worksheet 1, according to their previous knowledge which is then summed up into hypotheses or temporary answers.
3. *team organization*. In this stage the teacher appoints the group leader and assigns assignments to each member in the data / information collection process. Information gathering can be through reading reference books, conducting interviews with competent sources, and, if necessary, observing the environment. Then the teacher ensures that each student in the group has understood the assignment that has been given by the group leader.
4. *data collection*. At this stage students are guided to re-read reference books, conduct interviews with competent sources (teachers at school), and make observations in the surrounding environment. In accordance with the task given by the group leader. Then write down the results on a worksheet.
5. *data processing*. In the data processing stage students collect various information that has been obtained, then compare the hypotheses with the answers that have been obtained after making observations, interviews, and reading references. By marking relevant answers/ information.
6. *verification*. In this stage students observe, sort and conclude the correct answer in the worksheet
7. *generalization*. Students write conclusions on worksheet 5 about efforts to balance and conserve natural resources.
8. *product development*. At the product development stage, students witnessed a demonstration of how to conserve natural resources that could be easily practiced by students. Demonstrations can be done by planting plants or planting in pots (tabulampot) in the neighborhood around the school. Then the students practiced natural resource conservation activities by planting fruit in pots (tabulampot) in the surrounding environment.

The next activity is the closing activity. In this activity the teacher and students conclude the material together, then work on practice questions. Furthermore, to find out whether there is an increase in students critical thinking skills and learning outcomes in the experimental and control classes, it is necessary to test the hypothesis. Before the hypothesis test is carried out, it is first tested the normality and homogeneity of the variance of the test results. The normality test was performed using the Kolmogorov-Smirnov test assisted by SPSS 23. The significance level used was  $\alpha = 0.05$ . The normality test on the student learning outcomes of the control class and the experimental class is presented in table 1 below.

Table 1. Normality Test Results of Student Learning Outcomes

<b>Normality Test Results</b>							
	Class	Kolmogorov-Smirnova			Shapiro-Walk		
		Statistics	Df	Sig.	Statistics	Df	Sig.
Student learning outcome	Pre-test Experiment	.125	42	.098	.930	42	.013
	Post-test Experiment	.132	42	.062	.974	42	.456
	Pre-test controls	.098	26	.200 *	.955	26	.298

	Post-test controls	.139	26	.200 *	.963	26	.447
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Table 1 above is the result of the normality test calculation to determine if the two samples are normally distributed or not. Based on the table above, the sample data has a significant value of 0.05. That is, the significance value of the experimental class normality test data is 0.200 in the initial and final learning. The control class, 0.092 in early learning and 0.200 in late learning.  $P > 0.05$  so it was decided that the residual data has a normal distribution or  $H_0$  is accepted and  $H_a$  rejects means that the second sample is normally distributed and meets the requirements for the Independent Sample Test stage.

After the normality test, homogeneity test was carried out. The homogeneity test was used to determine whether there was a similarity in variance between the experimental class and the control class. Homogeneity test was carried out using Levene's test with the help of SPSS 23.

The results of the homogeneity test of students' critical thinking abilities can be seen in table 2 below.

Table 2. Homogeneity Test Result of Students' Critical Thinking Ability

<b>Test of Homogeneity of Variances</b>			
<i>Critical Thinking</i>			
Levene Statistics	df1	df2	Sig.
.127	3	132	.944

Based on table 2 above, it shows that the variance of the score is 0.944 at the significance level = 0.05. Thus the calculated score is greater than 0.05. This proves that the experimental class and the control class come from the same variance class. The homogeneity test of student learning outcomes data is listed in the following table 3.

Table 3. Homogeneity Test Results of Student Learning Outcomes

<b>Test of Homogeneity of Variances</b>			
<i>Student learning outcomes</i>			
Levene Statistics	df1	df2	Sig.
.692	1	66	.409

Table 3 shows that the results of the homogeneity test of learning outcomes obtained by the variance score (Sig.) is 0.409. Thus, the calculated score is greater than = 0.05 ( $p > 0.05$ ) so that  $H_0$  is accepted. This proves that the experimental class and the control class come from the same variance class.

Furthermore, the increase in students' critical thinking skills and student learning outcomes were analyzed using a normalized average gain. Recapitulation of analysis results Get on the critical thinking skills listed in the following table 4.

Table 4. Recapitulation of the Results of the Gain Analysis on Critical Thinking Skills

Class	Average (%)		<i>N-gain</i>	Explanation
	Early Learning	Final Learning		
Experiment	56,47	79,17	0,4869	medium
Control	59,50	68,87	0,1981	Low

Table 4 shows that the increase in students' critical thinking skills in the experimental class is 0.4869 and is in the medium category. In the control class, the increase is 0.1981 and is in a low category. Thus the increase is higher in the experimental class. Based on the criteria for the effectiveness of  $N\text{-gain} \geq 0.30$ , the discovery learning model based on the ethnoscience of the Patiayam Site is said to improve students' critical thinking skills. Then performed of  $N\text{-gain}$  analysis of student learning outcomes in learning using the discovery learning model based on the ethnoscience of the Patiayam site. The calculation results can be seen in the following table.

table 5. Results of the Gain Score Test for Student Learning Outcomes.

Table 5. Gain Score Test for Student Learning Outcomes.

Class	Average		N-gain	Explanation
	Early Learning	Final Learning		
Experiment	71,52	82,62	0,3563	medium
Control	71,12	76,77	0,1764	low

Table 5 above shows the results of the N-gain test of student learning outcomes in learning using the ethnosciences-based discovery learning model on the Patiayam site. Gain score average 0.1764 with low category. Thus the increase is higher in the experimental class. Criteria Based on the effectiveness of N-gain 0.30, the discovery learning model based on the Patiayam site ethnosciences is said to be able to improve student learning outcomes.

After that was done Furthermore, the test was conducted on the differences in students' critical thinking abilities from the control class and the experimental class. The results of the Independent Sample Test for students' critical thinking skills are listed in the following table 6.

Table 6. Independent Samples Test

Independent Samples Test (Students Critical Thinking Skills)										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
N-Gain_Skor	Equal variances assumed	.021	.885	-10.135	82	.000	-7.262	.717	-8.687	-5.836
	Equal variances not assumed			-10.135	81.997	.000	-7.262	.717	-8.687	-5.836

Table 6 above shows the results of the Independent Samples Test to see the differences in student learning outcomes between the control group and the experimental group. Based on the calculation, it shows that there is a difference in the average results of critical thinking skills with the results of Sig. (2-tails)  $0.000 < 0.05$ . This shows that there is an average difference in learning critical thinking skills between the experimental group and the control group.

Besides, testing was also carried out to see differences in student learning outcomes in the experimental class and the control class. The results of the Independent Sample Test student learning outcomes can be seen in the following table 7.

Table 7. Independent Samples Test of Student Learning Outcomes

Independent Samples (Student Learning Outcomes Test)										
		Levene's Test for Equality of Variances		T-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Ngain	Equal variances assumed	.692	.409	3.802	66	.000	5.850	1.538	2.778	8.921
	Equal variances not assumed			3.923	58.387	.000	5.850	1.491	2.865	8.834



The results of the Independent Samples Test for student learning outcomes in table 7 above show that there is a difference in the average result of critical thinking skills with the Sig. (2-tailed)  $0.003 < 0.05$ . This shows that there is a difference in the average student learning outcomes between the experimental group and the control group to strengthen research. A survey of teachers and students was also conducted to determine the positive response of teachers and students after the implementation was carried out. Retrieval of data through questionnaires. The questionnaire was given to teachers and grade IV students. Based on the questionnaire filled out by 42 students, it was stated that the results of the recapitulation of the positive response of the students were 88.00% and belonged to the good category. Thus, the discovery learning model based on the ethnoscience of the Patiayam site can be used by students to improve learning outcomes and critical thinking skills.

Questionnaires were also given to grade IV teachers to find out a positive response to the application of the discovery learning model based on the ethnoscience of the Patiayam site. Based on the results of the recapitulation of teacher responses, it can be seen that the positive responses given by the teacher are at the percentage level of 90.0% in the very good category. Thus, it can be concluded that the discovery learning model based on the ethnoscience of the Patiayam site can help teachers in the learning process as an effort to improve student learning outcomes and critical thinking skills.

#### 4.1 Discussion

This research was conducted to know the improvement of critical thinking skills and learning outcomes of fourth-grade elementary school students using the discovery learning model based on the ethnoscience of the Patiayam site in Jekulo District, Kudus Regency. Students' critical thinking skills through the application of discovery learning based on the ethnoscience of the Patiayam Site were obtained through observation. The observed aspects include 8 indicators of students' critical thinking skills in learning, including 1) students can understand data or information, 2) students can explain data or information, 3) students can give meaning to data or information, 4) students can identify relationships from information used to express thoughts or opinions, 5) students can test the truth of the information used in expressing thoughts or opinions, 6) students can identify and obtain the elements needed to make a reasonable conclusion, 7) students can explain or state the results of thoughts based on evidence, methodology, and context, 8) students can assess something based on certain criteria.

Critical thinking is the most important skill in facing challenges and solving problems of everyday life to welcome the golden generation in the current era. Therefore, teachers are required to be able to design and develop learning that can improve students' critical thinking skills. (Uribe-Enciso et al., 2017) said critical thinking development must be inherent in education as societies need citizens who facilitate their progress. In applying the learning model to improve the critical thinking skills of teachers also need to integrate with the surrounding environment. This will make it easier for students to understand the material being taught. Furthermore (Uribe-Enciso et al., 2017) explained that customarily, instruction has been concerned with the conservation of culture through the transmission of information collected within the advancement of its history. However, this spoon-feeding education has got to alter since understudies ought to acquire knowledge and create aptitudes and competences for life. This cannot be done in case they are not dynamic members of their learning handle; they cannot be introduced in somebody else's encounter and information. They have to be constructed their claim in order to be able to finish their life objectives and dreams. Besides, students must get it they have a place to a local and a worldwide community, and so they have to get to be mindful of the requirements of both their specific and bigger settings:

Surroundings In expansion, understudies ought to be able to see and grasp opportunities for long-term development without disservice to others. Be that as it may, this understanding comes when understudies create basic considering. In addition, discovery learning models also have many advantages that have been proven in various studies. Among them is research conducted by Hanafiah (2012: 79), explaining the advantages of the discovery learning model as follows: 1) helping students to develop readiness and mastery of skills in cognitive processes. 2) Students acquire knowledge individually so that it can be understood and settles in their minds. 3) Can generate motivation and passion for learning of students to study even harder. 4) Provide opportunities to develop and advance according to their respective abilities and interests. 5) Strengthen and increase self-confidence with the process of self-discovery because learning is centered on students with a very limited role for teachers.

The application of the discovery learning model based on the ethnoscience of the Patiayam site in this study is divided into three activities, namely preliminary, core, and closing activities. In the preliminary activity students are asked to

watch a learning video that presents natural conditions on the Patiayam site. The video can be downloaded by scanning the barcode provided. thus, students will be made to ask questions about the material to be studied.

The next activity is the core activity. In the core activity students begin to work with the previously divided groups. Students carry out discovery learning syntax based on the ethnoscience of the Patiayam site step by step. Starting stage *stimulation* (stimulation/ giving stimulation), problem statement (statement/ problem identification), team organization (organizing in groups), data collection (data collection), data processing (data processing), verification (proof), generalization (draw conclusions/ generalizations) , and product development. To facilitate the implementation, each stage is equipped with a worksheet.

The last activity is closing. In this activity students conclude the material as a whole and work on practice questions. In the practice questions arranged are equipped with pictures showing the existence of natural and cultural wealth in the Patiayam Site The results of the research that have been conducted have found that learning by applying this model has a positive effect on the application of the ethnoscience-based discovery learning model on the Patiayam site, including the improvement of students' critical thinking skills. The results of data analysis showed that the increase in students' critical thinking skills in the experimental class was 0.4869 and was in the medium category. In the control class the increase is 0.1981 and is in the low category. Thus the increase is higher in the experimental class. Based on the criteria for the effectiveness of  $N\text{-gain} \geq 0.30$ , the discovery learning model based on the ethnoscience of the Patiayam Site is said to improve students' critical thinking skills.

(Martaida et al., 2017) also found the effect of discovery learning models compared to conventional models. Where the research results found that the first hypothesis test yielded  $t\text{-count} = 2.10$ , and the second hypothesis test yielded  $t\text{-table} = 2.00$  with  $\alpha = 0.05$ . When comparing  $t\text{-count}$  to  $t\text{-table}$  turns,  $t\text{-count} > t\text{-table}$ , it's clear that students who use the discovery learning model have better critical thinking skills than students who use traditional learning methods.  $T\text{-count} = 2.21$  was obtained from the second hypothesis test.

Then performed an N-gain analysis of the learning outcomes of the experimental class students obtained an average score of 71.52 in the early learning and 82.62 in the final learning, the increase in value was 0.3563 in the moderate category. The control class obtained an average score of 71.12 in the early learning and 76.77 in the late learning with an increase of 0.1764 for the low category. Thus the increase is higher in the experimental class. Based on the criteria for the effectiveness of the  $N\text{-gain} \geq 0.30$ , the discovery learning model based on the ethnoscience of the Patiayam Site is said to improve student learning outcomes.

Furthermore, the T test is carried out to test the differences in the results of critical thinking skills and student learning outcomes in the control and experimental groups before and after the trial. The results of the t test for the critical thinking skills of the control and experimental class students showed the value of  $t\text{-count} = -10,135$  with the value of Sig. (2-tailed)  $0.000 < \alpha = 0.05$ . This means that there is a significant difference in the control and experimental classes, namely the score for assessing students' critical thinking skills in the experimental group is higher than the control group. The results of the t test for student learning outcomes posttest scores obtained by  $t\text{-count} = 3.802$  with a Sig. (2-tailed) value of  $0.000 < \alpha = 0.05$ . This means that there is a significant difference in posttest learning outcomes in the control and experimental groups, namely the posttest learning outcomes in the experimental group are higher than the control group. Thus, the discovery learning model based on the Patiayam Site ethnoscience has met the criteria of being effective.

The increase in learning outcomes is because the discovery learning model makes students play a more active role when participating in the learning process. In addition, the discovery learning method will also train students' ability to solve a problem. So that the effect of discovery learning on student learning outcomes includes cognitive, affective and psychomotor aspects. This is in line with several studies such as (Kamaluddin & Widjajanti, 2019) said that the application of discovery learning models is considered more effective if it is related to ethnoscience. Because the community culture that is inserted into the learning process can have a positive influence on the learning process. Indigenous science teaches learning related to the environment when linked to science (Kurniawan et al., 2019). Furthermore, ethnoscience can also be used as a means to guide students in solving a problem. This is in line with the opinion (Parmin & Fibriana, 2019) that knowledge obtained from analysis of local wisdom can improve students' skills in solving a problem.

In this case, the Patiayam Site in Jekulo District has a culture that can be related to science. The ability of students to solve problems is a critical aspect of thinking that needs to be honed and developed. To recognize critical thinking

skills in students, it needs to be analyzed by applying the right learning model. Tosuncuoglu stated that students who think critically are students who are able to investigate, analyze, accept or reject data, evaluate and draw conclusions. (Tosuncuoglu, 2018). Aspects of critical thinking skills can be seen through the application of the discovery syntax learning model. Sulistiani argues that discovery learning has several advantages, one of which can make students more active in learning because students have to relate new knowledge to the knowledge they embrace to find new concepts. (Sulistiani et al., 2018).

Discovery learning with a scientific approach encourages students to solve problems actively and is able to improve students' critical thinking skills with a scientific approach so that students can build scientific thinking including observing, asking, reasoning, trying, and networking. (Nurcahyo et al., 2018). Discovery learning model is effective in improving students' critical thinking skills on Arrhenius acid-base material, this is indicated by a significant difference between the N-gain value of the control class and the experimental class, where the control class has a greater N-Gain. (Rudibyani, 2018). The same opinion states that the critical thinking skills of students taught by discovery learning are better than students taught by conventional learning (Martaida et al., 2017).

In addition, there are several similar relevant studies on the use of the discovery learning model, critical thinking skills, and ethnosience learning. The results of the research on critical concept understanding and thinking abilities of students who took mathematics learning with the guided discovery method were better than students who took conventional learning in terms of the school level, most of the students showed a positive attitude towards learning mathematics with the guided discovery method (Nurulaen, 2011). The effectiveness of the application of the learning model is seen from the number of students who achieve completeness scores of more than 70%. The two-sample T test shows that the experimental class has a better average learning outcome than the control class. Based on the N-gain analysis, the percentage of students in the experimental class who obtained the "high" category was more than the percentage of students in the control class.

Furthermore, the results of research that have been carried out are also supported by the results of the questionnaire recapitulation of the teacher's responses to the application of the discovery learning model based on the ethnosience of the Patiayam site. Based on the results of the recapitulation of teacher responses, it can be seen that the positive responses given by the teacher are at the percentage level of 90.0% in the very good category. Thus it can be concluded that the discovery learning model based on the ethnosience of the Patiayam site can help teachers in the learning process as an effort to improve student learning outcomes and critical thinking skills. The questionnaire was also given to fourth grade students to find out a positive response to the application of discovery learning based on the ethnosience of the Patiayam Site. Based on the questionnaire filled out by the students, 42 questionnaires stated that the results of the recapitulation of students' positive responses were 88.00% and included in the good category. This is in line with several studies such as (Ahmatika, 2017) where the use of discovery learning models can provide a jolt to students so that students can think fundamentally and in conclusion can illuminate the problem given. This is anticipated to develop student abilities so that in the end they can improve student achievement.

## 5. Conclusion

Based on the results of research conducted using this learning model is effective in improving critical thinking skills as evidenced by the increase in the average score of students' critical thinking skills in the experimental group, namely 0.4869 in the moderate category. It was higher than the control group which only got a score of 0.1981 in the low category. The increase in the average score of student learning outcomes in the experimental group was 0.3563 in the moderate category. It was higher than the control group which was only 0.1764 in the low category. The results of the t-test for critical thinking skills obtained  $t\text{-count} = -10.135$  with a significance level of  $0.000 < \alpha = 0.05$ . The t-test results of student learning outcomes obtained  $t\text{-count} = 3.802$  with a significance level of  $0.000 < \alpha = 0.05$ . This means that there is a significant difference in posttest learning outcomes in the control and experimental groups, namely the posttest learning outcomes in the experimental group are higher than the control group. Thus the discovery learning model based on the ethnosience of the Patiayam site has met the criteria of being effective. The results of the study were also supported by the percentage of positive responses given by the teacher and students, respectively that were 90.0% and 88.00%.

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