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An Analysis of Problem-Based Learning Activities in Improving Students' Critical Thinking Skills and Intrapersonal Intelligence

Ghaida Nisa [1]✉, Sarwi Sarwi[2], Bambang Subali[2]

[1.] SDN Tandang 04 Semarang, Indonesia
[2.] Pascasarjana Universitas Negeri Semarang, Indonesia

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Abstract

Environmental-based learning is important for science learning in elementary school. It also refers to the concrete stage of students' thinking skills in elementary school. The use of problem-based learning model based on ethnoscience needs to be developed as a holistic learning process. This research sought to analyze the use of problem-based learning model on students' critical thinking skills and intrapersonal intelligence. This research employed mixed methods with a concurrent embedded research design. It took place in Babalan Elementary School and Kedungmutih Elementary School, located in Demak Regency. The research samples consisted of 96 fourth grade elementary school students. The data were collected through test, observation, and questionnaire techniques. The regression results revealed that there were significant differences in student activities using problem-based learning on their critical thinking skills. Based on the results of simple regression, it was found that ($p = 0.00$) < ($\propto = 0.05$); meaning that student activities in using problem-based learning affect critical thinking skills. The critical thinking skills affected students' intrapersonal intelligence, as shown by the results of the sig (2-tailed) regression test of 0.00 < 0.05; meaning that critical thinking skills affect intrapersonal intelligence.

✉ Correspondence address:
Jl. Gemah Jaya Barat 1 No 3 Kedungmundu, Tembalang, Semarang
E-mail: ghaidanisa02@gmail.com

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INTRODUCTION

The 21st century has brought significant changes, in which all aspects of life, including education, have changed to form highly competitive human beings. An effort made by the Indonesian government in preparing the next generation to be able to compete in the 21st century and adapt to the development of science and technology is through education (Nisa et al., 2019). Education becomes the spearhead of changes in human resources to keep up with the ever-changing times.

The government implements the 2013 curriculum oriented to required 21st century skills. Subjects are no longer separate, but rather thematically integrated into each subject matter. The scientific approach requires students to apply scientific methods in their learning process, such as conducting observations and experiments to meet the learning objectives which are to understand concepts in the surrounding environment and their implementation in everyday life. The 21st century skills developed in schools include collaboration, communication, critical thinking skills, and creativity. Critical thinking skills serve as the basis for students' thinking skills (Boyaci et al., 2016). The concept of critical thinking requires the involvement of students in the knowledge construction process through deep reflection and thought (Saleh et al., 2020). Curiosity and asking questions are the characteristics needed in critical thinking.

Critical thinking skills should be developed within science learning in elementary school. Teachers need to master critical thinking skills to understand what must be taught and evaluated (Hamdu et al., 2020). Science introduces the natural environment and natural resources in its vicinity. Science learning increases students' awareness of participating in utilizing, maintaining, and preserving their surrounding environment (Sari et al., 2020). Studying the natural environment packages science learning more concretely to students. These are In line with environmental-based ethnoscience learning which can develop life skills based on empowerment and local potential in each region (Alim et al., 2020). Ethnoscience is a science learning developed from certain natural events with the perspective of local culture and organized local wisdom (Yuliana et al., 2017). Ethnoscience learning is very relevant to be implemented in science learning in elementary school.

Babalan Village, Wedung District, in Demak is located on the coast of the Java Sea. This geographical situation provides the potential to produce national salt. Most of the land is used for salt production, and a large part of the population makes a living as salt farmers. This can be used as a source of science learning. The local wisdom used in this research was the process of producing salt.

Science learning provides a learning experience that requires meaning for life skills in solving problems related to the environment. The active problem-based learning model has positively affected students' academic achievement and attitudes towards science learning (Tandongan et al., 2017). One of the learning models that are expected to trigger critical thinking skills is the problem-based learning model as it involves students in learning to solve problems and encourages students to learn contextual concepts (Malmia et al., 2019).

The theory of multiple intelligences has received less attention in the world of education. Whereas the intelligence underlies the learning process experienced by students. Multiple intelligences owned by students greatly affect their learning outcomes. The multiple intelligences consist of verbal-linguistic, logical-mathematical, visual-spatial, physical-kinesthetic, musical-rhythmic, intrapersonal, interpersonal, and naturalist intelligences. A learning model is needed that triggers both critical thinking skills and intrapersonal intelligence. Intelligence is important for shaping attitude by understanding oneself and improving oneself to be better (Azid et al., 2016). This is in line with a person's intrapersonal intelligence which leads to adaptive attitude. With intrapersonal intelligence, students feel empathy and care about their environment. Students who have intrapersonal intelligence are also able to solve

problems better. This ability of recognizing oneself is getting less attention at the moment, while this aspect of intrapersonal intelligence is important to foster self-confidence in students.

A specific problem that occurs in science learning is that students are not encouraged to seek and construct their own knowledge but are more required to memorize the concepts provided by the teacher (Martaida et al., 2017). Lack of support for students in a variety of learning activities results in their critical thinking skills being sub-optimal. This statement is supported by the learning outcomes of fourth graders during the 2018/2019 academic year at two elementary schools in Demak Regency, Central Java, Indonesia. Over there, science scores were still low, science learning activities did not involve scientific attitudes through observations, experiments, and various activities outside the classroom.

Based on observation that have been made, there were low science learning outcomes in Basic Competence 3.4 (K.D 3.4) about connecting force and motion with various events in the surrounding environment. The previous data also showed that the classical average score obtained was 67.16, with the highest score being 84 and the lowest score being 43, with a Minimum Criteria Completeness (KKM) of 70. Out of 96 fourth grade students, only 36 students (38%) achieved the KKM while 60 students (62%) did not reach the KKM. From the results of item analysis, students were able to answer items correctly with a percentage of 85% on easy questions or in the C1 classification (understanding). Items with C4 classification (analyzing) only had 25% of students answering correctly. These data served as consideration for evaluation, proving that the students are lacking in critical thinking and solving problem. Furthermore, according to the results of observation and interview, it was found that science learning in said classes rarely conducted experiments as learning activity.

To strengthen the science learning process to be able to solve problems in the environment, there is a scientific approach. In this approach, it is necessary to apply a problem-based learning model and be able to solve problems by triggering critical thinking skills, intrapersonal, and interpersonal intelligence. Science learning is expected to provide a learning experience that requires honing for life skills in solving problems in the environment, learning about the nature where the students live, and producing a sense of concern for their surrounding environment. The problem-based learning model offers several advantages, including: 1) encouraging students to have problem solving skills; 2) helping students to construct their own knowledge; 3) facilitating scientific activities; 4) enabling students to assess their learning progress; 5) helping students to obtain the ability to communicate. This learning model encourages students to be active in the learning process and students can answer open-ended questions that identify students' concept construction through science and technology learning in elementary school. It also provides students with experience to develop critical thinking skills for solving various problems.

The problem-based learning model in this research is different from the problem-based learning model conducted by other researchers. The problem-based learning conducted by the researchers was based on ethnoscience in the area where students live with natural resources that produce salt. Learning based on local wisdom can foster a sense of pride of their own region, as stated in theme 8 ‘the place where I live’ in grade 4. Students can learn the uniqueness of each region to enrich the repertoire of Indonesian culture.

This research sought to analyze the implementation of problem-based learning model on students' critical thinking skills and intrapersonal intelligence. This research is expected to provide benefits to the knowledge base, especially the implementation of problem-based learning model based on ethnoscience related to producing salt in coastal region.

METHODS

This research employed mixed methods with a concurrent embedded design. This design combines quantitative and qualitative methods at

the same time, but the weights of the methods are different. Here, the researchers tried to find out the activities and the learning process using problem-based learning model on the basis of ethnoscience and paying attention to critical thinking skills and intrapersonal intelligence. The first stage was to observe the local culture. The second stage was the implementation of learning using a problem-based learning model. Before the implementation process, a pretest was carried out. It was complimented by a posttest administered at the end of learning. Furthermore, some samples were interviewed to obtain more detailed information. The following research flow was used in this research, as presented in Figure 1.

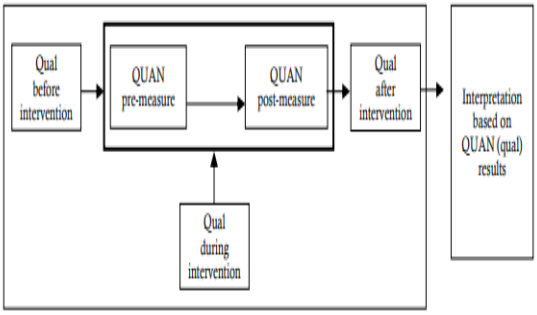


Figure 1. Concurrent embedded design.

The research population involved fourth grade elementary school students in Wedung District, Demak Regency during the 2018/2019 academic year. Sampling was done with purposive sampling technique. The research subjects were 53 students in the fourth grade of Babalan Elementary School and 43 students of Kedungmutih Elementary School.

The data collection techniques used in this research consisted of 1) tests to determine students' critical thinking skills, 2) observation to find out students' activities during learning, 3) questionnaire to determine their intrapersonal intelligence, and 4) interview to find out more details about intrapersonal intelligence.

The analysis used were the n-gain test and simple regression test. Qualitative data were collected during the implementation process and after the implementation process. The analytical techniques used in qualitative data included data reduction, data presentation, and conclusion drawing. Data reduction was election process data, simplification of written records in the field. Data presentation was by compiling a collection of information required for drawing conclusion. Drawing conclusion was carried out by considering the results of quantitative and qualitative analysis.

RESULTS AND DISCUSSION

In the planning stage, the researchers planned learning using ethnoscience-based teaching materials, the learning model used was problem-based learning and it was necessary to prepare learning tools and research instruments that would be used. The learning tools were in the form of lesson plan, syllabus, ethnoscience-based evaluation questions. The research instruments were in the form of questionnaire, pretest and posttest questions, interview guidelines, and observation sheet.

During the implementation stage, problem-based learning model based on ethnoscience was held 3 times for the theme 'the place where I live' with the sub-theme 'the uniqueness of the place where I live'. At the third meeting, the students studied outside the classroom by visiting a salt-producing factory in the nearby location. This implementation stage was done through with several steps.

a. Stage 1, Orienting students to the problem. The teacher prepares the students to be ready to accept the material with a positive learning atmosphere.
b. Stage 2, Organizing students to learn. The teacher helps students to define and organize learning tasks related to the problem.
c. Stage 3, Directing individual and group investigations. At this stage, students look for solutions to existing problems, by doing learning outside the classroom, visiting the salt factory
d. Stage 4, Developing and presenting the work. The teacher helps students in planning and preparing reports and facilitates them to share assignments with their friends.

e. Stage 5, Analyzing and evaluating the problem solving process. The teacher helps students to reflect or evaluate their investigations and the processes they just used.

Critical Thinking Skills

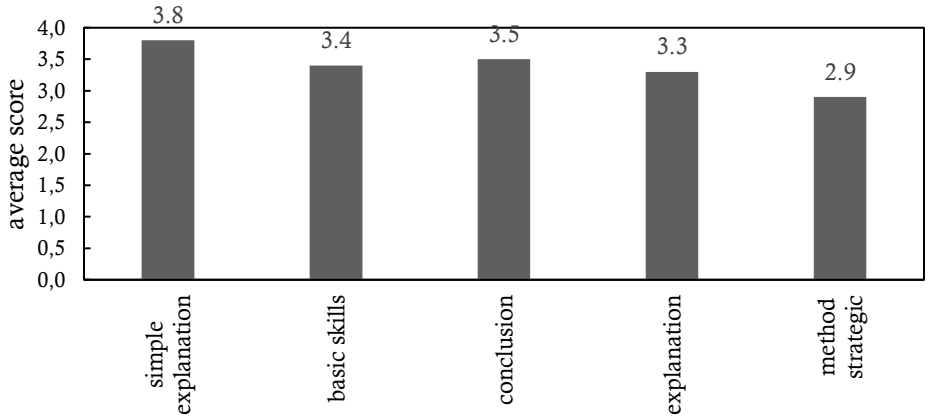
This research measured students' critical thinking skills after learning using problem-based learning model based on ethnoscience. Before the implementation of problem-based learning, the students were assigned to pretest. After the implementation of problem-based learning, the students were given posttest. The pretest and posttest questions were designed based on the indicators of critical thinking skills: 1) providing simple explanations, 2) building basic skills, 3) drawing conclusions, 4) making elaborate explanations, and 5) taking strategic steps. The type of assessment was multiple choice with reasoning that gave the students space to write down the causal reasons for their answers.

The initial stage of parametric statistical analysis was to test the normality of both pretest and posttest data. The results of normality tests, using the Kolmogorov-Smirnov formula, are presented in Table 1.

Table 1. Results of the Pretest and Posttest Data Normality Test

Statistic Test	SD1	SD2
Pretest Mean Score	61.32	57.90
Sig. (2-tailed) pretest	0.102	0.358
Posttest Mean Score	86.03	84.53
Sig. (2-tailed) posttest	0.124	0.577

The criteria for testing the normality of data using SPSS is if Sig > 0.005, then the data are normally distributed. Meanwhile If Sig < 0.005, then the data are not normally distributed. Table 1 states that Sig > 0.005 were obtained in pretest and posttest, then the data can be declared normally distributed. The pretest and posttest learning outcomes data were stated to be normally distributed. Table 1 also states that the average pretest score for both classes was below the KKM, while the average posttest score has reached the KKM. There was an increase in the score between the pretest and posttest. The results of the pretest and posttest of the five indicators of critical thinking skills are presented in detail in Figure 2.



The results obtained as shown in Figure 2 are that the students mastered simple explanation indicator with an average of 3.8. The students mastered the basic skills indicator with an average of 3.4. They mastered the drawing conclusion indicator with an average of 3.5. They mastered the elaborate explanation indicator with an average of 3.3. They mastered the strategic step indicator with an average of 2.9. Of the five indicators, the most mastered by the students was

providing simple explanations. The students had been able to make a definition of science in simple sentences. The least mastered indicator was taking strategic steps. Students have not been able to determine the strategic steps taken to develop alternative problem solving. Further observations are needed to determine strategic steps.

After that, the homogeneity test was carried out using ANOVA on SPSS to see whether the data were homogeneous or not. The results of homogeneity tests on pretest and posttest scores, as obtained through the Levene test are presented in Table 2.

Table 2. Homogenity Test Result

Data	Statistic Test	Sig.
Pretest	Levene Test	0.181
Posttest		0.278

The criteria for testing the homogeneity of data using SPSS is if Sig > 0.005, then the data are declared homogeneous. Otherwise, if Sig < 0.005, then the data are not homogeneous. Table 2 states that the pretest and posttest obtained Sig> 0.005, meaning that the data were declared homogeneous. The data on critical thinking skills were be obtained from the results of student tests that have been compiled. After the data were checked for normality and homogeneity, the n-gain test to determine the category of improvement before and after the implementation of the problem-based learning model was performed. The level of effectiveness of problem-based learning model is based on the <g> score criterion. The results of the n-gain test are presented in Table 3.

Table 3. N-Gain Test Result

Statistic Test	SD1	SD2
Pretest	61.32	57.90
Posttest	86.03	84.53
<g>	0.64	0.62
Level	medium	medium

Based on Table 3, it shows that both SD1 and SD2 classes had moderate n-gain scores. This means that there is an increase in critical thinking skills after the implementation of problem-based learning model. Although it is not included in the high category, it can be a consideration for the use of problem-based learning in improving critical thinking skills. There was an increase in score from before and after learning was conducted using problem-based learning model on the basis of ethnoscience. This might be influenced by the previous learning patterns, so it would take time and habituation for students to get used to active learning and hone their critical thinking skills.

Also from Table 3, the results of moderate n-gain increase did not reach high category because it would require habituation over a long period of time in getting students to think critically. Critical thinking skills require practice and patience (Snyder et al., 2008). Activities provided in problem-based learning model are more appropriate and effective means of achieving critical thinking skill indicators.

Ethnoscience-based learning provides varied learning activities to students that they do not merely listen to lectures from teachers and do questions afterwards (Arfianawati et al., 2016). With various activities available such as observing, organizing learning, conducting investigations, presenting results, and evaluating problem solving processes, this learning model can leave a pleasant impression for students in their learning. The problem-based learning model can create a conducive, active, creative, and fun learning environment and shape the students' personality for the better.

This research made some observations to students' activities during the implementation of problem-based learning with the indicators: 1) the activeness of students in finding learning materials through group discussion; 2) the activeness of students in formulating problems; 3) the activeness of students in finding alternative problem solving; 4) the activeness of students in presenting the results of group work; 5) the activeness of students in analyzing and evaluating alternative problem solving. The following is the average result of each indicator of their activeness in problem-based learning (as shown in Figure 3).

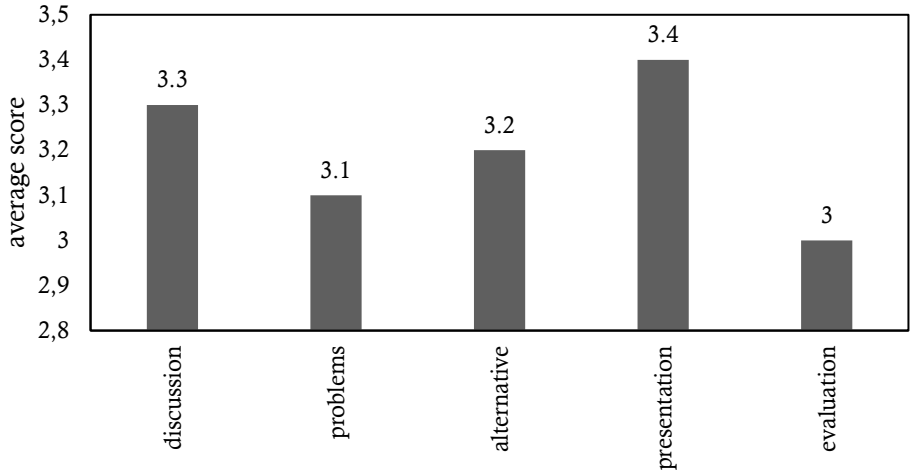


Figure 3. PBL activity Indicator

Figure 3 shows that the average score of activeness of students in finding learning materials through group discussions was 3.3. Students were more interested in learning by group discussion than learning individually. In addition, learning in groups improves relationship among students. The average score of activeness of students in formulating problems was 3.1. Problem solving skills reflect critical thinking skills (Sulardi et al., 2017). In practice, students were given everyday problems related to science, such as the force used to spin a windmill on a salt field plot. Students were able to analyze problems existing in the material or in the environment.

The average score of activeness of students in finding alternative problem solving was 3.1. Students were accustomed to finding alternative solutions to problems by providing them opportunities to express their opinions, to think critically. Its implementation was to provide a solution for producing salt during rainy season. The average score of activeness of students in presenting the results of group work was 3.4. Presenting the results of discussion has provided the students chance to hone their public speaking skill. The average score of analyzing and evaluating alternative problem solving was 3. The highest indicator was in presenting the results of group work, students were able to present the results of their discussions well. The lowest indicator was in analyzing and evaluating alternative problem solving. This happened because students did not develop the ability to evaluate alternative problem solving. Students tended to have fractional answers to problems in general. They received information globally and could not expand the results of problem solving. They were hesitant to express different opinion from their friends. This required self-confidence to cultivate the courage to express opinions.

Practical learning of everyday concepts fosters good student character (Sarwi et al., 2016). The implementation of problem-based learning brings positive impacts on students, such as getting used to applying scientific attitude, telling the truth, and having the courage to express opinions. The learning activities can shape their attitude. The problem-based learning model affects their critical thinking skills, which was tested using a simple regression test. The results of the simple regression test are presented in Table 4.

Table 4. Regression Test Results

Data PBL activities on critical thinking skills	R Square	Sig.
Babalan class	0.590	0.00
Kedungmutih class	0.594	0.00

The criteria of simple regression test using SPSS is by paying attention to r-table with n = 96 and significant level of 5%. It obtained a score of

0.202. If Sig > 0.202, then the data are declared to have no effect. If Sig < 0.202, then the data are declared to have effect. Based on Table 4, the class in Babalan Elementary School obtained an R-Square of 0.590, meaning that the activities in problem-based learning affect their critical thinking skills by 59%, the rest is influenced by other variables that are not discussed in this research. While the class in Kedungmutih Elementary School had an R-Square of 0.594, meaning that the activities in problem-based learning affect their critical thinking skills by 59.4%, while the rest is influenced by other variables that are not discussed here. Based on the results of simple regression analysis, it can be concluded that problem-based learning has a positive effect on students' critical thinking skills in science learning.

An active learning supports students to learn to deal with complexity and places learning in a practical context (Mann et al., 2021). Practices are needed in learning so that students understand the concepts they are learning for real-life purposes. This practical learning gives students long-term impression and engraved them in their memory. The complexity in the learning process is summarized in the syntax of the problem-based learning model based on ethnoscience. Thus, complexity motivates students in their critical thinking skills.

Critical thinking is systematically based on intellectual criteria in learning activities to solve problems, consider assumptions, draw conclusions, and identifying implications (Vieira et al., 2016). In problem-based learning, the students are involved in observing, questioning, reasoning, and communicating activities to trigger critical thinking. There are many science concepts that can be taught in elementary school that require critical thinking skills, for the learning be meaningful for the students.

Interpersonal Intelligence

Intrapersonal intelligence is the ability to recognize oneself. Intrapersonal intelligence affects self-control based on the goals to be achieved (Park et al., 2017). The learning process paying attention to multiple intelligences can activate students' intelligence to carry out their tasks optimally (Candrawan et al., 2017). The implementation of learning process paying attention to multiple intelligences has solutions to maximize and develop intelligence according to their fields and overcome students' deficiencies (Pratiwi et al., 2018). It can also maximize the learning process in a meaningful way.

In this research, the intrapersonal intelligence data collection was done using questionnaire with some indicators: 1) knowing yourself, 2) knowing what you want, and 3) knowing what is important. The results of the intrapersonal intelligence questionnaire are presented in Figure 4.

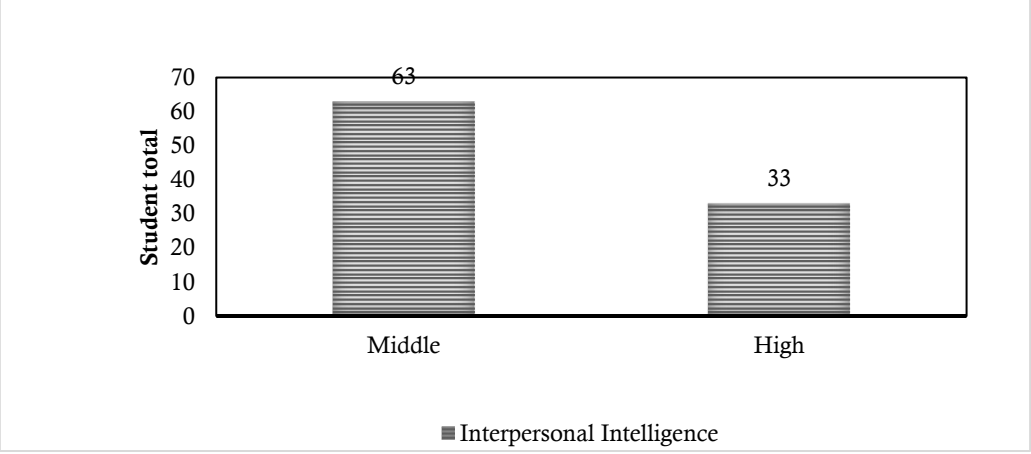


Figure 4. Intrapersonal intelligence questionnaire

Based on Figure 4, 63 students had moderate intrapersonal intelligence and 33 students had high intrapersonal intelligence. There were no students who had low intrapersonal intelligence, indicating that the students recognized their potential. The percentage between students who had high and those who had moderate intrapersonal intelligence was very different. Only 30% of students were able to develop their intrapersonal intelligence well. Based on the results of the questionnaire, the weak or low indicator was in knowing yourself, with details of awareness, recognizing own feelings, skills for expressing thoughts, high self-assessment, self-reliance, and maximizing own potential. For the indicator of knowing what is important, the students were able to describe important things in themselves.

This research conducted a simple regression test to analyze the relationship between critical thinking skills and intrapersonal intelligence. The result of simple regression test for problem-based learning activities with intrapersonal intelligence is shown in Table 5.

The simple regression test obtained sig (2-tailed) of 0.00 <0.05. Having an R-Square of 0.432 means that the problem-based learning activities affects intrapersonal intelligence by 43.2%, the rest is influenced by other variables that are not discussed in this research. Based on the above data, the students' critical thinking skills affect their intrapersonal intelligence. There needs to be critical thinking skills to recognize yourself and the ability to manage yourself.

Qualitatively, the fourth-grade students' intrapersonal intelligence can be explained from the result of interviews. The following is a description of students' intrapersonal intelligence: 1. Student BA-5 (the student with a high intrapersonal intelligence questionnaire score). The interviews were conducted to collect data, and students felt they knew their skills in the field of science. This happens because the students knew the alternatives to producing salt during rainy season. The following is the interview excerpt with a student who got high category intrapersonal intelligence:

Q : "How will you react when your friends give you advice?"

S : "If the advice is sound, I listen and do it, if the advice is not good, I let it pass by"

Q : “If you were to choose between studying in group or individually, which one? What is the reason?”

S : "Studying alone, because when studying group, I end up doing all by myself, my friends don't want to help."

Q : “Do you know any events/information in your neighborhood?”

S : "I'm currently harvesting salt, I'm helping my uncle."

Based on the interview with student BA-5, it is known that he recognized his own feelings, had the skills to express his opinion, had an attitude of independence, and maximized his potential. He expressed his opinion about his preference to study independently rather than in group, indicating an attitude of independence in himself. This was triggered by the knowledge of personal goals that would be achieved through the way he chose. He understood what he wanted from himself; he was able to express what he felt well through what he experienced. His self-confidence grew well and was adaptive to his environment. He knew what was happening in the environment and was directly involved in said activities. 2. Student KM-32 (the student with moderate intrapersonal intelligence questionnaire score). The following is the interview excerpt with the student who had moderate intrapersonal intelligence:

Q : "How will you react when your friends give you advice?"

S: "I listen to them"

Q : “If you were to choose between studying in group or individually, which one? What is the reason??”

S : "Studying together, so that our task can be completed quickly."

Q : “Do you know any events/information in your neighborhood?”

S : "I don't know, sometimes I know from my parents."

Based on the results of the interview, student KM-32 had not yet clearly identified his

own feelings, what he wanted, he tended to take the average decisions taken by other students. His self-assessment was still low by not knowing the goals to be achieved. He also was not able to be adaptive to his environment. It appeared that KM-32 did not know what was happening to his environment. He tended to follow the majority vote agreement from others, without knowing himself and what he wanted. Students in general are not able to create their own learning style and imitate the learning styles of other students (Fadloli et al., 2021). It can be seen from this subject who generally did not dare to express his opinions honestly.

Activities that are in accordance with intrapersonal intelligence are role playing, making strategies in cooperation, working cooperatively, reflecting on the development and achievement on oneself, doing own tasks, and setting own goals (Hidayah et al., 2018). Learning is carried out in groups so that students have the chance to practice interacting with friends and their environment.

This refers to intrapersonal intelligence that involves self-management, which can increase the speed of the learning process (Jouzdani et al., 2016). The problem-based learning activities provide stimulus for students to recognize themselves and the environment through observing existing problems to find problem solving. This is synergistic with intrapersonal intelligence to know one's own strengths and weaknesses. Strong intrapersonal will improve critical thinking skills, this is proven by the achievement of students in carrying out learning very well. Students who have strong intrapersonal intelligence can master the material for themselves without always being directed by others (Hidayah et al., 2018).

CONCLUSION

The conclusion drawn from this research is that the increase in critical thinking skills after learning using problem-based learning based on ethnoscience with n-gain scores of 0.64 and 0.62 are in the medium category. Based on the results of simple regression, it is found that ($p = 0.00$) < ($\propto = 0.05$); meaning that the students' activities in problem-based learning affect critical thinking skills. Critical thinking skills affect intrapersonal intelligence as shown by the results of the regression test with a sig (2-tailed) of $0.00 < 0.05$. The students' activities in problem-based learning model provide a stimulus for students to recognize themselves and the environment through observing the existing problems to find solutions for said problems.

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