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Analysis of Students' Critical and Creative Thinking Skills on the Application of A Problem-Based Learning Model Contained with Etno-Science (Etno-PBL)

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Abstract

The learning process in schools is considered not to focus on real-life problems that require critical and creative thinking skills from students. In addition, the learning carried out did not pay attention to the local culture that developed in the area. Therefore, this study aims to analyze students' critical and creative thinking skills after applying a problem-based learning model that contains ethnoscience. This study uses a mixed method with a sequential explanatory strategy. This research was conducted on students of class X MIPA SMAK Santo Thomas Aquinas Bengkayang, West Kalimantan, for the academic year 2021/2022. Test the validity of quantitative data and qualitative data using a concurrent triangulation strategy which was carried out at the same time. The results showed that the average score of critical and creative thinking skills was 77.7 and 75.9, respectively, with high levels, while the N-gain values were 0.57 (medium) and 0.72 (high). The conclusion is that ethnoscience-based problem-based chemistry learning in this study is effective in developing students' critical thinking and creative thinking skills.

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INTRODUCTION

Indonesia is a country whose people have a lot of cultural diversity, local technology, and noble values that need to be instilled and socialized to students through the learning process (Khoiriyah & Husamah, 2018). The learning process in schools is considered not to focus on real-life problems that require critical and creative thinking skills from students. In addition, the learning carried out did not focus on the problems of local culture that developed in the area. Therefore, this study aims to analyze students' critical and creative thinking skills after applying a problem-based learning model that contains ethnoscience (Ulger, 2018); (Thomas, 2009); (Purba et al., 2017).

Meaningful learning is obtained by students naturally through their own experiences. Education in schools should create a more meaningful learning atmosphere, not only theoretical / rote learning, but how to make students create their own learning experiences. Education in schools is more about the development of science and technology, not about education oriented towards nature and the environment. This is in accordance with the results of interviews and observations conducted at SMAK Santo Thomas Aquinas Bengkayang in West Kalimantan.

The results of preliminary observations at SMAK Santo Thomas Aquinas Bengkayang, West Kalimantan, showed that chemistry learning in general was still teacher-centered. Students tend to accept the teacher's explanation without knowing the meaning of the lesson. For example, in learning, chemistry is studied as a product and tends to memorize concepts, theories, and laws. Students do not practice higher-order thinking such as critical and creative thinking. Finally, students have difficulty answering questions about social problems. It is difficult to apply these concepts in everyday life to solve various problems that arise.

Given the importance of critical and creative thinking skills for everyone, it is very important to develop learning programs that can improve students' critical and creative thinking skills. Problem-based learning is one of the learning programs that are considered effective in improving critical thinking and creative thinking skills (Temuningsih et al., 2017); (Thomas, 2009); (Sudarmin, Zahro, et al., 2019); (Ariyatun &Octavianelis, 2020). Problem-based learning as one of the alternative learning that is student-centered has been developed recently. (Orozco & Yangco, 2016) stated that problem-based learning provides an alternative for education so that students' critical thinking skills can develop.

Through this description, the success of the learning process in schools is strongly influenced by the cultural background of the students or the community where the school is located (Ramadanti & Supardi, 2020); (Savery, 2006). Therefore, an educational breakthrough is needed that combines culture with science or commonly called ethnoscience (Savitri & Sudarmin, 2016; Sumarni et al., 2022). Ethnoscience encourages teachers and educators to teach science based on culture, community wisdom, and social problems. The form of ethnography makes it easy to recognize processes, methods, methods and content through educational processes that are culturally developed in everyday life (Sudarmin et al., 2018). Cultural knowledge such as fairy tales, songs, games, traditional houses, traditional rituals, local production, natural use is one form of the ethnoscience education system (Wati, 2021); (Sudarmin et al., 2019). In the learning process with an ethnographic approach, students no longer see cross-cultural knowledge that needs to be studied, but cultural and regional wisdom that already exists and is recognized in everyday life (Parmin, 2015; Ramadanti & Supardi, 2020).

The ethnoscience approach can be integrated into various learning models, one of which is Problem Based Learning (PBL). This learning model is a learner-centered, collaborative, and emphasizes application of scientific knowledge, creativity, and problem solving based on unique knowledge. The original knowledge that will be integrated can be in the form of language, customs, culture, morals, and techniques created by certain people or people who have scientific knowledge (Rudibyani, 2019; Savery, 2006); (Sumarni et al., 2022). (Thaniah & Diliarosta, 2020); (Khoiri et al., 2018); (Sudarmin et al., 2020); (Ariyatun et al., 2020). Therefore, in this study, critical and creative thinking skills were analyzed after the application of the PBL model with ethnoscience on redox material. The results of the study are expected to provide information about the profile of critical and creative future students.

METODOLOGY

This study uses a mixed method with a sequential explanatory strategy, where the qualitative and quantitative data obtained are analyzed separately, then combined to obtain conclusions. Quantitative data in the form of tests of critical and creative thinking skills. Qualitative data in the form of interviews, observations and implementation of problem-based chemistry learning with ethnoscience content.

As research subjects, 102 students were selected based on the purposive sampling technique, namely the determination of the sample with certain considerations. The data analysis technique used concurrent triangulation strategy to test the validity of quantitative and qualitative data. Then compare the two data to see if there is any convergence, difference, or combination. This strategy mixes data when the survey reaches the interpretation and discussion stages. Mixing is done by combining two survey datasets into one, or by combining or comparing the results of two datasets side by side in a discussion.

RESULT AND DISCUSSION

The purpose of this study was to descriptively analyze students' critical and creative thinking skills after the application of the problem-based learning model containing ethnoscience. The research data was obtained from the results of critical and creative thinking skills tests in the form of description questions. After the test results are obtained then analyzed and categorized based on the criteria.

3.1 Critical Thinking Skills

The students' critical thinking skills in this study were measured using a critical thinking test of redox reaction material which was tested by peer-verified and tested for validity and reliability. Critical thinking skills measured in this study include asking basic questions and solving and organizing strategies and tactics. Obtaining critical thinking ability research data on every aspect of critical thinking ability calculates the level of achievement of test results for each indicator and compares the scores obtained by each student with the maximum and average critical thinking skills obtained by doing. The performance of each indicator is determined. Next, we analyzed the results of the critical thinking test for each aspect of critical thinking skills. The results of the analysis of the average critical thinking skills of students in each aspect are summarized briefly in Figure 1.

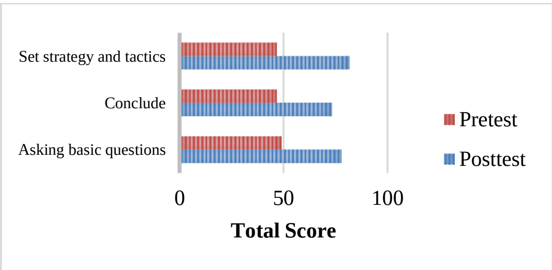

Figure 1. Average score of critical thinking skills

The highest average score of the students' critical thinking skills test is shown in Figure 1. Proving that aspects of managing strategies and tactics obtained the highest average score at the time of the posttest. And the lowest score on the concluded aspect. Meanwhile, the distribution of critical thinking ability levels in brief, the distribution of the criteria for critical thinking skills is presented in Table 1.

Table 1. Criteria for Critical Thinking Skills

Competency Level	Interval	Number of Students
Height	66,6 < p ≤ 100	28
Moderate	33,3 < p ≤ 66,6	62
Low	0 < p ≤ 33,3	12

This research is related to the level of cognition that can be achieved by students. The evaluation description is as follows: 1) Low level. If the student can only solve the problem by performing a one-Step procedure; Remember facts, important terms, or concepts to identify points of information from graphs or tables. 2) Medium level, if students can only solve problems related to the use and application of conceptual knowledge to explain or explain phenomena, solve problems, organize data, interpret or use data Choose an appropriate procedure that includes two or more steps to do it. 3) High level, if students ask questions in a series of steps to analyze complex information and data, synthesize or assess evidence, justify reasons from various sources, make plans, or solve problems. Problem-based chemistry learning with an ethnoscience approach is said to be successful if it meets the requirements for success in the completeness of critical thinking skills test results, namely if there is a difference in the average score of students' critical thinking skills before and after the application of learning. Hypothesis testing using a one sample T-test with the help of the SPSS program with the results of the t test output obtained a sig value has a value of -19,680 < -1,98326 so that Ho is rejected and Ha is accepted, then there are differences in the results of the critical thinking skills test between before and after the application of learning problem-based chemistry with an ethnoscience approach. Meanwhile, the magnitude of the increase in students' critical thinking skills is obtained from the calculation of the N-gain formula (g) by comparing the pretest and posttest scores. From the calculation results obtained the average value of the pretest results of 47.76 and the average posttest results of 77.6 so that it has a value of g = 0.57 in the medium category. While the acquisition of the N-gain category for each individual is summarized in Figure 2.

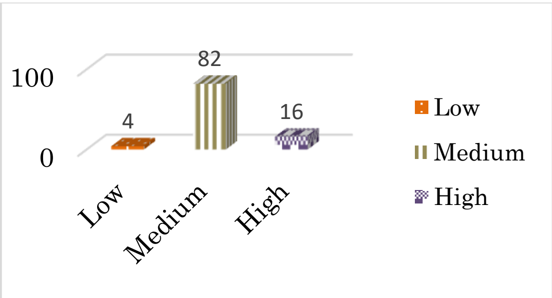

Figure 2. N-Gain per individual critical thinking skills

Figure 2. shows that there are 4 students who experience an increase in critical thinking skills in the high category. While in the medium category there were 82 students and in the low category there were 16 students who experienced an increase in critical thinking skills in redox reaction material. This result is also in accordance with the results of critical thinking observations made by observers during the learning process. The ability of a critical thinker can be measured by several visible features. Indicators of critical thinking skills in this study include students' ability to give brief explanations, set strategies and tactics, and draw conclusions. Evaluation of students' critical thinking skills is used to improve the learning process. One of them is the use of free-form question tests and student response-based assessments. Testing critical thinking skills includes questioning skills, causality of events, and results-enhancing skills. The students' critical thinking skills in this study were developed through activities designed to build their own knowledge, learned from learning activities such as discussions and problem solving exercises. In the experimental class, the formation of an experimental class helps students solve problems in understanding the material. Students are given the

opportunity to discuss while solving learning problems. Enables students to easily develop and practice communication skills and learn to organize problem-solving tasks in life contexts. These results are similar to research (Izzah et al., 2020; Orozco & Yangco, 2016; Yusuf et al., 2020) that problem based learning can improve students' conceptual understanding and develop critical thinking skills.

3.2 Creative Thinking Skills

The indicators of students' creative thinking skills measured in this study include: fluency (think fluently), flexibility (think flexible), elaboration (think in detail), and originality (think original). The results of the analysis of the average creative thinking skills of students in each aspect are briefly summarized and presented in Figure 3.

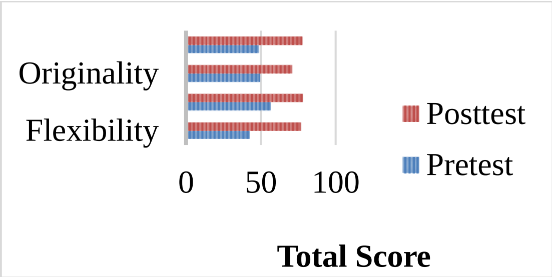

Figure 3. Average score of creative thinking skills

The indicators of students' creative thinking skills measured in this study include: fluency (think fluently), flexibility (think flexible), elaboration (think in detail), and originality (think original). The results of the analysis of the average creative thinking skills of students in each aspect are briefly summarized and presented in Figure 3.

Table 2. Criteria for Creative Thinking Skills

No	Competency Level	Interval	Number of Students
1	Hight	$66,6 < p \leq 100$	29
2	Moderate	$33,3 < p \leq 66,6$	63
3	Low	$0 < p \leq 33,3$	10

Overall, the average score of creative thinking skills of students in class XI SMAK Santo Thomas Aquinas Bengkayang West Kalimantan got 75.92 in the high category. While the magnitude of the increase in students' creative thinking skills is obtained from the calculation of the N-gain (g) formula, namely by comparing the pretest and posttest scores. From the calculation results, the average value of the pretest results is 39.8 and the average posttest results is 75.07 so that it has a g value of 0.72 in the high category. While the acquisition of the N-gain category for each individual is summarized in Figure 4.

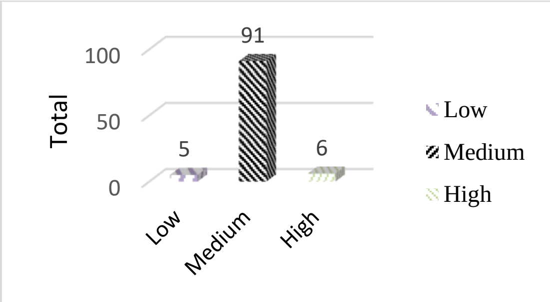

Figure 4. N-Gain per individual creative thinking skills

Problem-based chemistry learning with an ethnoscience approach is said to be successful in improving creative thinking skills, namely if there is a difference in the average score of students' creative thinking skills before and after the application of problem-based learning with an ethnoscience approach. Hypothesis testing using a one sample T-test with the help of the SPSS program with the results of the t test output obtained a sig value has a value of -19,680 < -1,98326 so that Ho is rejected and Ha is accepted, then there are differences in the results of the creative thinking skills test between before and after the application of learning problem-based chemistry with an ethnoscience approach. While the comparison of the increase in students' critical and creative thinking skills after problem-based learning with an ethnoscience approach is described in Figure 5.

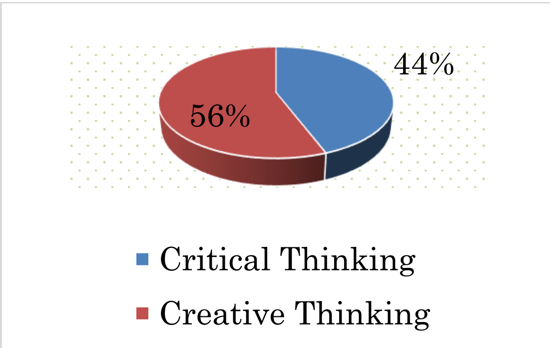

Figure 5. Comparison of the increase in N-Gain

This gain is due to the fact that during learning students are given the opportunity to express their opinion on a problem (Ulger, 2018). The problems given also facilitate students to be actively involved in providing explanations for solving problems they are doing. The active involvement of students is in line with the results of research (Rudibyani, 2019) which argues that critical thinking skills can be developed through learning with active student involvement. Students can also draw conclusions and present them well. (Malau et al., 2021) revealed that with active learning, students will take the initiative to solve problems and be responsible for learning so that they can conclude results that are in accordance with the concept.

Problem-based learning with an ethnoscience approach takes place in five stages. The first step in problem-based learning with an ethnoscience approach is the problem-oriented phase. Train children's thinking skills and interests in following the learning process. After students direct the problem, the next student organizes the problem. In the first process, students develop their literacy skills at the functional stage. The third stage of this learning is inquiry, where the teacher asks students to collect relevant information and conduct experiments to obtain and solve problems. This process is modeled after the question and answer process among group members during the experiment and planning, designing, and conducting surveys. Through this process, strategies and techniques are set in the stage of understanding the material. In the fourth stage, students develop and present student work in the form of activity reports. The design process involves the analysis and interpretation of data. The process of creating a description and the process of designing a solution are described below. This requires the ability to interpret data and information. This description of student work takes into account the increase in students' literacy skills at the conceptual level. The final step in this study is to analyze and evaluate the problem solving process. Students reflect and draw conclusions through a process of discussion between friends. This phase focuses on evidence-based discussion and communication of information to draw conclusions and assess deficiencies during ongoing research.

CONCLUSION

Problem-based chemistry learning with an ethnoscience approach in this study went well so that it was able to develop students' critical thinking and creative thinking skills. The ethnoscience approach in problem-based learning emphasizes that students must be active in learning activities by integrating the cultural context or local wisdom. This is able to encourage students to learn more actively and more meaningfully so that students' critical and creative thinking skills are high because students understand the concept as a whole and maximally.

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