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The Difference in Critical Thinking and Learning Outcome Using Problem Based Learning Asissted with Sasirangan Ethnoscience Student Worksheet

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Abstract*—Critical thinking is one of the higher order thinking skills. It can be developed with sasirangan as South Borneos' culture that translating real science to scientific science or ethnoscience. This study aims to find (1) the difference in critical thinking skill, (2) difference in learning outcome, and (3) students' respon. This study used a quasi-experimental method with nonequivalent control group design. The samples were 69 students from XI IPA 2 and XI IPA 3 SMAN 1 Banjarmasin. Data collecting techniques were tested for critical thinking skill, test for knowledge learning outcome, observation, questionnaire, and documentation. The data has been analyzed by using descriptive and inferential analysis. The results are (1) there is significant difference in critical thinking skill, (2) there is significant difference in knowledge learning outcome, and average value of attitude and skill learning outcome of the experimental class had better result than the control class, and (3) students are responding positively to the practice of Problem Based Learning model assisted with sasirangan ethnoscience student worksheet on colloid material.

***Index terms*—Problem Based Learning, ethnoscience, sasirangan, critical thinking skill, learning outcome, colloid**

I. INTRODUCTION

Education is a fundamental requirement that should be owned by every human being. Along with the rapid advances in technology and information that also have an impact on the world of education, the educational curriculum in Indonesia demonstrate its progression. Based on Minister of Education and Culture Regulation No.22 in 2016 [1], the 2013 curriculum currently requires teachers to apply learning that guides students to have 4C competencies. One of these is critical thinking skills. Critical thinking is reasonable and reflective thought, focusing on deciding what must be believed or done by analyzing information and ideas carefully and logically from various perspectives [2].

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Critical thinking skills can be developed by applying the learning patterns that make students more active, in the form of student centered which make students construct their own knowledge of learning concepts by actively searching for and sorting out the information needed according to learning material, including from the environment and daily life. One of the aspects of life that can be associated with the process of learning chemistry in schools is the aspect of local culture. It is based on the Minister of Education and Culture Regulation No. 70 in 2013 [3], which states the curriculum is rooted in the culture and nation of Indonesia.

However, based on the experience during the teaching practice in school, teachers have not utilized the potential of local culture as a source of learning so that the learning provided by the teacher is separated from the environment where the students reside. As a result, the students tend to be passive, receive the information conveyed by the teacher, and do not know the relationship between learning chemistry and local culture.

To overcome this problem, Problem Based Learning assisted with sasirangan ethnoscience student worksheet is applied. Problem Based Learning is a learning model that uses real problems in the environment as a basis for gaining knowledge and concepts through critical thinking skills and solve problems [17]. The etnoscience study was the original transforming science activities (knowledge developing in society) that became science scientific [4]. Application of chemical learning with etnoscience can be done by assigning students to to make observations related to the habits that exist in society.

The ethnoscience of South Kalimantan people is certainly different from other etnoscience in the region of Indonesia. One of the unique cultures of South Kalimantan that still exists today is sasirangan. It is a cloth that is still close to students because it is used as a school uniform worn by students at least once a week. In chemical learning material, there are two aspects of sasirangan which can be related to colloidal material, namely sasirangan coloring agents and waste produced.

The integration of sasirangan as a typical cloth from South Kalimantan into chemistry learning materials is expected to increase the insight into the local culture, transform indigenous knowledge of the community, and understand the relationship of local culture including aspects of daily life with chemical learning materials. At the end, students are ecpexted to become more active and be able to develop their critical thinking skills.

Based on previous studies, Problem Based Learning with etnoscience can improve students' critical thinking skills in reproductive system material [8]. It is also supported by Atmojo who stated that in learning the ethnoscience approach, students were actively involved in learning so that they had a better understanding than students who studied conventionally [13].

From this description, the researchers are interested in conducting this study to find the differences in critical thinking skills, the differences in learning outcomes, and students' responses using the Problem Based Learning assisted with sasirangan ethnoscience student worksheet in colloidal material in class XI IPA SMAN 1 Banjarmasin.

II. METHOD

A. Research Design

This study employed a quasi-experimentalresearch design with pretest-posttest nonequivalent control group design. It involved one experimental class and one control class. The experimental class and the control class were given a pre-test before learning and post-test at the end of the lesson. The pre-test aims to determine the students' initial ability before applying the treatment. After the learning process, a final test (post-test) was given to determine the achievement of learning outcomes after being given treatment in both classes.

The population of the study was the XI grade students of SMA Negeri 1 Banjarmasin in the 2017/2018 school year. The samples of this study were the XI IPA 2 class of 35 students in the experimental class using the Problem Based Learning model assisted with sasirangan ethnoscience student worksheet, and XI IPA 3 of 38 students in the control class using the expository model. The samples were taken by purposive sampling technique by consideration of the time equation for learning colloidal material and learning outcomes that were not significantly different in the two classes.

B. Data Collection

The data were collected using test and non-test techniques. The test technique functions to find the critical thinking skills and learning outcome knowledge in the form of multiple choice and description. The non-test technique is in the form of observation sheet to find out the learning outcomes of students 'attitudes and skills that are filled in by observers during the study, questionnaires on students' responses to the applied learning, and documentation of relevant things to the study.

C. Data Analysis

The analytical technique used was inferential and descriptive. The t-test used in inferential analysis needs to fulfill the requirements for normality and homogeneity test. The normality test used the Liliefors test, while homogenity test used Fisher's test. The t-test aims to find out whether or not there is a difference produced between groups using Problem Based Learning assisted with sasirangan ethnoscience student worksheet and groups using the expository model. Also, also used N-gain which is categorized as high, medium, and low with the aim of knowing the quality of the increase in the dependent variable, and product moment correlation to determine the direction and strength of the two variables.

III. RESULTS AND DISCUSSION

The results of the study are in the form of data on critical thinking skills, learning outcomes of knowledge obtained through pre-test and post-test, attitudes, skills, and responses of students. Data from the results of tests of critical thinking skills and knowledge learning outcomes were analyzed descriptively based on N-gain values and analyzed inferentially through normality test, homogenity test, and t-test. The attitudes, skills and response questionnaire learning outcomes were analyzed descriptively by percentage techniques.

A. Critical Thinking Skill

TABLE I. AVERAGE OF CRITICAL THINKING SKILL

Value	Experiment Class		Control Class	
	Pre-test	Post-test	Pre-test	Post-test
Highest	10,00	64,00	8,00	59,00
Lowest	33,00	96,00	30,00	96,00
Average	**22,46**	**83,97**	**19,18**	**75,63**

Table 1 shows the average value; the experimental class obtained an average post-test value that is 83.97 (very critical), while the average post-test value of the control class is 75.63 (critical). The differences occur because of the application of different learning models that influence the value achieved.

TABLE II. THE RESULT OF T-TEST CRITICAL THINKING SKILL

Result	Class	Db	$\bar{X}$	SD^2	t_{count}	t_{table} (5%)
Pretest	Experiment	71	22.46	58.84	1.98	1.99
	Control		19.18	37.07		
Post-test	Experiment	71	83.97	72.44	3.94	1.99
	Control		75.63	87.32		

Based on Table 2, the experimental and control classes obtained the $t_{count} < t_{table}$ (1.98<1.99), and that is not significant before being treated. After being given different treatment you may see the $t_{count} > t_{table}$(3.94 >1.99) and it changes to significant.

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TABLE III. N-GAIN INTERPRETATION OF CRIITICAL THINKING SKILL

Class	*Mean of N-gain*	Category
Experiment	0,80	High
Control	0,70	Medium

Based on Table 3, the experimental class has an average N-gain of critical thinking skills in the high category after getting colloidal material learning with Problem Based Learning assisted with sasirangan etnoscience student worksheet, while the control class is on the medium category.

B. Learning Outcome

TABLE IV. AVERAGE OF KNOWLEDGE LEARNING OUTCOME

Value	Experiment		Control	
	Pre-test	*Post-test*	*Pre-test*	*Post-test*
Highest	20,00	60,00	20,00	50,00
Lowest	70,00	100,00	60,00	100,00
Average	**42,00**	**86,29**	**36,84**	**78,16**

Table 4 shows the average value, the experimental class obtained an average post-test value of 86.29 (good), while the average post-test value of the control class is 78.16 (enough). The differences occur due to the application of different learning models thus affecting the value achieved.

TABLE V. STUDENTS COMPLETENESS STANDARDS

Value	Experiment	Control	Result
< 75	6	16	Non complete
≥ 75	29	22	Complete

The data in Table 5 shows that the number of students who achieved learning completeness and changed in the form of percentages. For the experimental class is 83% while in the control class is 58%.

TABLE VI. THE RESULT OF T-TEST KNOWLEDGE LEARNING OUTCOME

Result	Class	Db	$\bar{X}$	SD^2	t_{count}	t_{table} (5%)
Pretest	Experiment	71	42.00	175.29	1.74	1.99
	Control		36.84	135.70		
Post-test	Experiment	71	86.29	176.97	2.45	1.99
	Control		78.16	215.43		

Based on Table 6, the experimental class and the control class obtained $t_{count} < t_{table}$ (1.74 < 1.99) before being treated. After being given different treatment, the result is $t_{hitung} > t_{tabel}$ (2.45 > 1.99).

TABLE VII. N-GAIN INTERPRETATION OF KNOWLEDGE LEARNING OUTCOME

Class	*Mean of N-gain*	Category
Experiment	0,77	High
Control	0,65	Medium

Based on Table 7, the experimental class has an average N-gain knowledge learning outcomes with a high category, while the control class is in the medium category.

TABLE VIII. ATTITUDE LEARNING OUTCOME

Observed Aspects	Average	
	Experiment Class	Control Class
Curioss	85,4	80,3
Responsibility	86,8	80,9
Coooperation	85	81,9
Average	85.71	81.03
Category	**Very Good**	**Good**

The data in Table 8 shows that the experimental class has attitudinal learning outcomes from each meeting higher with a very good category than the control class in the good category. It indicates that the attitude in learning colloidal material on the application of the Problem Based Learning model assisted with sasirangan ethnoscience student worksheet is better than the expository learning.

TABLE IX. SKILL LEARNING OUTCOME

Observed Aspects	Average Value	
	Experiment Class	Control Class
1	80.00	71.05
2	81.07	72.04
3	88.57	83.55
4	86.43	76.97
5	89.29	81.58
6	85.71	80.26
Average	84.59	71.05
Category	**Very Skilled**	**Skilled**

In the results of the skills, the observed aspects are how to make a solution, filter, illuminate the solution, stir the solution, pipette the solution and grind the ingredients. The data in Table 9 shows the experimental class is in the category of very skilled and control classes in skilled categories.

C. Response

TABLE X. STUDENTS RESPONSE

Class	Control	Result
Experiment	42.02	Very agree
Control	40.07	Agree

Table 10 shows that the experimental class gives a very agreeable response to the application of the Problem Based Learning model assisted with sasirangan ethnoscience student worksheet compared to the control class with expository learning.

The difference in the results obtained in the two classes is because of the different treatment is given. The critical thinking skills measured consisted of 10 indicators referring to the Ennis indicator, namely considering source creativity, deducing and considering deduction, defining terms and considering definitions, analyzing arguments, asking and answering questions, focusing questions, inducing and considering the results of induction, making and determine the results of consideration and decide on an action.

A. Critical Thinking Skill

The students' critical thinking skills in this study were trained through the Problem Based Learning model assisted with sasirangan etnoscience student worksheet which took place in two meetings through daily life problem related to colloidal material presented on student worksheet or the investigation process in the form of conducting experiments. The use of the Problem Based Learning model assisted with sasirangan etnoscience student worksheet consists of five learning stages namely problem orientation, organizational learning, individual and group investigations, developing and presenting work, and analysts and evaluation of problem solving processes, which in this study begins with etnoscience.

During the ethnoscience stage, the students were given the opportunity to recognize sasirangan ethnoscience in a discourse about the sense of ethnoscience and the making of sasirangan, which were presented in the form of pictures and information in the student worksheet, starting with making a pattern to drying the cloth that is documented directly from the place of craftsmen sasirangan. Giving pictures is intended for students to better understand about the manufacturing process and even determine the materials and tools used. Students are then asked to fill in a table that contains original science and scientific science to deepen the understanding of chemistry sasirangan ethnoscience.

The answer shows that the students have been able to explain the meaning of sasirangan in original science in the form of the use of sasirangan and scientific knowledge in the form of territory and patterns used, but have not shown the characteristics of sasirangan regarding syllaby and line patterns that distinguish Javanese batik. As for the materials for making sasirangan, the original science part of the answer is written in Banjar language which signifies the students' initial knowledge as a South Kalimantan community, while in scientific science the answer is in the form of scientific names and chemical formulas. It indicates that the students have trained their critical thinking skills, that is considering source credibility by collecting information from various sources such as books and the internet and choosing the most relevant scientific science answers. Something similar is found in sasirangan waste where students write direct discharges into rivers in original science and chemical processing in scientific sciences.

In the problem orientation stage, the students observe real problems as concrete problems and are close to their personal daily lives (personalization) that are most effective for Problem Based Learning model [5]. The problem was given in the form of a discourse about the disposal of waste into the river by sasirangan craftsmen. In learning organizations, the students are asked to formulate the problem in discourse and make hypotheses from problem formulations as exercises in developing critical thinking skills, namely giving simple explanations with indicators asking and answering questions and focusing questions. It can be seen from the students' activities in identifying the problem of disposal of waste sasirangan and then turning it into the "what and how" question, which is an indicator of asking questions and answering questions. The hypothesis presented "with color deletion" is included in the indicator focusing on the question where students identify the best answers the problem of waste disposal.

Hartini, Kusasi, & Iriani [6] stated that formulating the problem and answering the question made students use their knowledge to specify the formulation of the problem that had been proposed from various point of view so that more relevant problem formulations were obtained, then can imagine and appreciate the scope and various alternative problem solutions. In addition, the students are trained to focus on the questions, and their mind is more focused on knowing the main points of an event, the issues, and problems that occur [7].

The next stage is an investigation that gives the students the opportunity to gather information in groups in various ways including conducting experiments to determine the distribution system and the nature of colloids as well as experiments using sasirangan waste and activated carbon. The column of lab tools and materials is deliberately left blank so that the students who actively build their knowledge according to constructivism theory based on the work procedures given. During conducting the experiments, critical thinking skills are managing strategies and tactics that are trained in determining actions during observation through interaction between group members, all in understanding work procedures, sharing stages of work procedures, ensuring smooth practice, and observing experimental results. Also, the students get the opportunity of studying independently, reducing the dependency of teachers presence and got the ease in learning every competency that must be mastered.

The students then develop and present their work by answering questions in the student worksheet and presenting the results of group discussions related to the results of research and data analysis. At this stage, the students are trained to communicate the results of the discussion in front of the class. Other students can respond in the form of questions, suggestions, or improvements which will then be responded to by the presentation group by considering, rejecting, or accepting the opinions of others to fit the group's opinions, and reducing the understanding between them and other students, so that students' critical thinking skills are honed.

The last stage is analyzing and evaluating the problem solving process presented by each group or on all learning activities that have been carried out by clarifying, so that students can find out whether the answers that have been done are correct or still need improvement. In addition, clarification aims to form concepts in the minds of students. Students also make conclusions in which the students' critical thinking skills can be developed as long as the students get a series of investigative experiences and draw conclusions based on that [5]

Based on the results of the t-test calculation for the post-test, there are significant differences in critical thinking skills in both classes. The research findings are obtained in accordance with Arfianawati, Sudarmin, & Sumarni [12] that there is a significant difference in improving critical thinking skills using learning models based on ethnoscience, because it relates chemistry is learning with aspects of local culture that are close to the student life; thus, helping the students to understand chemistry learning.

The syntax contained in Problem Based Learning namely individual or group investigations also affects students' critical thinking skills. Temuningsih, Peniati, & Marianti [8] state that investigations on Problem Based Learning with ethnoscience approaches provide opportunities for students to experience real cultural phenomena in a society related to learning material. It makes the students more critical to filter information through interaction with others.

The influence of Problem Based Learning on critical thinking skills is also inseparable from the media used to improve critical thinking skills in learning. The use of student worksheet in learning can help students develop critical thinking skills through the process of formulating problems supported by the use of pictures, as well as the process of making temporary answers where students are trained to be able to solve problems and answer questions clearly and logically.

B. Learning Outcome

The difference in learning outcome knowledge between the experimental class students who have an achievement of 83% KKM and the control class students that have a KKM achievement of 58% is also inseparable from the treatment given. This difference is because the control class was not given the sasirangan ethnoscience treatment as in the experimental class. On sub-material properties of colloids, the experimental class was given problems related to colloidal properties of sasirangan. The students in this experimental class were more active in finding answers that make their understanding more developed. However, in the control class, the sub-material of colloidal properties is only obtained from the teacher's explanation. Therefore, the students became passive and easily forgot the material in which ultimately affects the the learning outcome. A similar opinion was conveyed by Fitriani, Widiyatmoko, & Khusniati [9] that learning involves students in making their discoveries and relating them to real life concepts, which provide learning more meaningful experiences and will be firmly embedded in the student's mind.

The results obtained are also in line with the research conducted by Puspita, Suciati, & Maridi [15] showing that learning with the Problem Based Learning model can provide positive interactions on the learning outcomes of knowledge in environmental pollution material. It is because the material presented was not just given to students. Students were given the opportunity to find concepts in solving problems given, so students did not just memorize the existing concepts.

Chemical learning with the Problem Based Learning model that is associated with sasirangan starting from materials to sasirangan waste also further enhances students' attitudes in every aspect compared to the control class. The curiosity of students can be seen in the discussion activities with group friends about the experimental material carried out and asking questions to the teacher, and this includes aspects of the attitude of giving a response [10].

The responsibility and cooperation of students can be seen from the order during learning and the trust of fellow group members in gathering opinions during the discussion process. The results of a similar study were also revealed by Lestari, Nurmilawati, & Santoso [14] that the application of Problem Based Learning can improve students' social attitudes, one of which is collaborating with friends from various social, ethnic and religious statuses. Students also demonstrate a collaborative attitude by ensuring group members' understanding of the assignment given. This treatment indirectly makes students understand what they are doing will influence others and help students little by little to communicate with others better.

The results of skills learning outcome that measured during practicum also have highly skilled results in the experimental class compared to the control class. Learning to use practicum not only makes getting the information sought, but also familiarizes students to be skilled in using laboratory equipment, managing materials and finding experimental results [18]. The difference in experiments between experiment class and control class was the use of sasirangan waste to prove the colloidal adsorption properties using activated carbon.

The use of sasirangan waste as a practical material is something that has just been obtained by students. As a result, the experimental class students were encouraged to investigate something new by finding ways to do something better when experimenting [17]. It is in line with the research conducted by Putri, Suciati, & Ramli [16] where the Problem Based Learning model with the experimental method using concept maps and mind map techniques has a better influence on the skills aspects of class X students in biology learning.

C. Response and Correlation of Critical Thinking with Knowledge Learning Outcomes

The response of students after being given different treatments were also measured and found that the experimental class gave a better response to the use of the Problem Based Learning model assisted by sasirangan ethnoscience student worksheet in colloidal material, which was 42.03%, compared to responses in the control class with a percentage of 40.08% that use the expository model. The highest response result is the use of Problem Based Learning model assisted with sasirangan etnoscience student worksheet can foster good interaction between students and feel not bored during learning.

This result is due to the use of sasirangan etnoscience to be new things that students get during chemistry learning at school. Integration of sasirangan as a traditional cloth that is close to everyday life and its relation to chemical material makes students excited and enthusiastic about paying attention and the following learning to the end.

Learning also becomes more interesting because the facts used in the learning process to connect students' knowledge or experience have a large contribution [11]. It is in line with the research conducted by Atmojo [13], where the appreciation of students experienced an increase in science learning with ethnoscience approach to the tempe craftsman profession in Kedungtuban.

In this study, the relationship between critical thinking skills and learning outcomes of knowledge analyzed using product moment correlation is also found. The research findings show a positive correlation between the learning outcomes of knowledge and critical thinking skills with the price of $r_{count} > r_{table}$ which is 0.478 > 0.334. Based on the value of r obtained at 0.478, indicating the strength of the relationship between critical thinking skills and knowledge learning outcomes is at a moderate level and can be interpreted that students who have high critical thinking skills, tend to have high learning outcomes as well, and vice versa.

IV. CONCLUSION

The conclusions drawn from this study are: (1) There is a significant difference in critical thinking skill between learning using Problem Based Learning model assisted by sasirangan etnoscience student worksheet with expository on learning colloid material. (2) There is a significant difference in knowledge learning outcome and the average value of attitude and skill learning outcome of experiment class that uses Problem Based Learning model assisted with sasirangan etnoscience student worksheet, had a better result than control class that uses expository model. (3) Students responded positively to the practice of Problem Based Learning model assisted with sasirangan ethnoscience student worksheet compared to expository learning on colloid material.

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