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Enhancing High School Students's Rebuttals as An Important Aspect of Scientific Argumentation Skill Through Problem Based Learning

1st Sindy Nurinda
Master Program of Science Education, Sebelas Maret University
Surakarta, Indonesia
rinda.five@gmail.com

2nd Sajidan
Faculty of Teacher Training and Education
Sebelas Maret University
Surakarta, Indonesia
saiidan@fkip.uns.ac.id

Baskoro Adi Prayitno Sajidan
Faculty of Teacher Training and Education
Sebelas Maret University
Surakarta, Indonesia
baskoroap@fkip.uns.ac.id

***Abstract*— Rebuttal is an essential aspect in scientific argumentation skill. Level of scientific argumentation skill depends on the quality of the rebuttal process. Students who can produce a high-quality rebuttal to defend their claims are proved higher level of scientific argumentation skill than the student who can only produce claims, evidence and reasoning. Problem-based learning (PBL) is a learning model that provides real life ill-structured problem, that need to be solved through investigation and discussion. It is able to help students to enhance their rebuttal skill. This research was aimed to analyze the rebuttal improvement process by applying PBL based module in 10th-grade student of SMAN 1 Punung. This research was an evaluation stage from our R&D research using pretest-post test control-experiment group design. Data were collected using test, interview, and classroom observation. The result showed that the student's rebuttals in the experimental group increase up to 27,27%. The t-test result also indicated different significant result between pretest and posttest scores. Based on the research result can be concluded, that by implementing PBL based model in the10th-grade senior high school is able to improve student's rebuttal skill.**

Keywords: argumentation skills, problem-based learning, rebuttals

I. INTRODUCTION

Scientific argument skills have an important role in the development of other skills required in the era of globalization. The highly competitive era of globalization requires students to have a variety of skills to compete internationally. Skills required include science literacy skills, thinking skills and communication skills. These three skills can be empowered through the empowerment of scientific argumentation skills. Scientific argumentation skills can be a major pillar in the development of science literacy. Literacy of science is the knowledge and understanding of the concepts and processes of science required in decision making [1]. The argumentation activities require students to obtain concepts through the collection of evidence and valid and reliable reasons from various sources so that student can distinguish between fact and fiction as well as opinions and facts.

Critical thinking skills belong to one of the thinking skills that students need to master. The ability to think critically can be improved through the process of analyzing and evaluating the opinions conveyed by teachers or other students during the learning process takes place. Opinions that arise during the learning process involve the ability of teachers and students to argue [2] Argumentation plays an essential role in developing a critical thinking pattern and adds a deep understanding of concepts or thoughts [3].

Communication skills through oral and written are the demands that a person must have to express his or her own ideas. Ideas are expressed through socio-cultural activities. Arguing means building socio-cultural activities through presentation, interpretation, criticism, and revision of an argument [4]. An argumentative skill is needed to develop students' socio-cognitive abilities [5].

Argumentation skills, according to Toulmin's model, have six components, namely: claim, data, warrant, backing, rebuttal, and qualifier [6]. The six components of the general argumentative skill by McNeill and Krajcik are then simplified into scientific argumentation skill which includes four components such as claim, evidence, reasoning, and rebuttal [7]. Claim is a statement or conclusion that answers the problem, the evidence is scientific data, backing, and warrant that support the claim, reasoning is justification that connects the evidence in the claim using the principles of science, and rebuttal is an alternative answer given to refuse other claims or counterclaim.

The skill level of the argument is determined by the rebuttal aspect. The better the quality of rebuttal the higher the level of argumentation skills. There are two categories of rebuttal that are identified as a rebuttal and still weak rebuttal. The quality of the rebuttal is determined by how the student can point out errors in other claims and explain why the claim is inappropriate [8-10].

Rebuttal provides evidence, and an alternative justification to show that other answers other than claims have been given are incorrect. Based on aspects of Toulmin's argument the level of argument ability can be divided into six levels, and at the highest, at level VI a high-quality

argument must contain claim, data, warrant, rebuttal [11]. The scientific argumentation's skill level based on the claim, evidence, reasoning and rebuttal aspects is also divided into six levels. The rebuttal aspect plays a vital role in determining the level of scientific argumentation skills at level 5 and level 6. At level 5, argumentation is completed with the rebuttal, while at level 6 there is an appropriate correlation between rebuttal, alternative evidence and alternative reasons to support the given claim [12].

Survey results and research results on an international scale also show students' argumentation skills in some countries are still a problem. PISA results organized bythe OECD in 2015 show that 20% of PISA participating countries including Indonesia are still below average in terms of science literacy. The science literacy measured by the students' ability to provide scientific arguments and counter-arguments indicates that students' results are still difficult to find evidence to base their arguments. This is because students have not been able to change the data obtained into concrete evidence to prove their claims.

Scientific argumentation skills can be built through activities that create conditions where students have the opportunity to express their arguments [2] One example of activities that can be used to improve argumentation is in discussions aimed at enhancing collaborative reasoning [13]. One example of a learning model that accommodates the skill component of argument is Problem Based Learning (PBL). PBL is a student-centered active learning approach where unstructured problems are used as guidelines for the discovery and learning process. PBL is not only about problem-solving but is a constructivist-based model where real problems are used in inquiry learning, self-learning, information-gathering, and problem-solving in an integrated manner [14].

The learning steps using problem investigations will stimulate students to find solutions by developing argument skills in group discussions. The hypothesis testing process generates argumentative discussions while the discovery and inquiry process provides an opportunity for students to explore and understand the insights independently where later that understanding will be used to strengthen the argumentation [15].

Discovery-based or inquiry learning can help students improve their arguing skills. Students construct explanations those support arguments through investigation of phenomena or problems [14]. Problem Based Learning model according to Tan (2003) to connect between inquiry, independent learning, information gathering, and problem-solving in an integrated way.

Learning activities and evaluation questions can be integrated with the form of teaching materials that are module. Modules have advantages over another teaching materials. The module is a kind of learning material that is self-contained and includes a set of learning experiences that are planned and systematically designed to help students achieve learning objectives. Modules have learning objectives, learning activities, materials and evaluation questions that can be adapted to improve students' scientific argumentation skills. Learning activities that exist in the module can use the steps of the learning model. Through PBL learning steps that are integrated into the module, students' argumentation skills can be improved through the process of analyzing the problems that occur and seeking solutions by scientific argument.

II. METHODS

This research was conducted at SMA Negeri 1 Punung Pacitan district. The participants of this research were the students of class X in the 2nd semester of the academic year 2016/2017. This research is an evaluation stage from our R&D research to know the effectiveness of our PBL based module. We used a quasi-experimental research design. The sampled class has passed the homogeneity and normality test. The test results showed no significant difference between the two classes selected as the control class or existing class and the experimental class or module class. The research design can be seen in Table 1 below:

TABLE I. RESEARCH DESIGN

Class	Pre-test	Treatment	Posttest
PBL Module Class	A1		A2
Existing Class	B1		B2

A1 and A2 are the pretest and posttest values in the experimental class, B1 and B2 are the pretest and posttest values in the control class. X1 is the treatment given in the experimental class that is the use of Problem Based Learning based module, while X2 is treated in the control class by using teaching materials and the conventional model commonly used in school.

Instruments used to collect data in the form of observation instruments and test questions that amounted to 5 essay questions. These questions have passed the validation stage before being used for written tests. The problem used to measure aspects of students' scientific skill in writing skill, while the observation instrument was used to view students' scientific skill of arguing verbally.

Data analysis technique used is descriptive quantitative. The scoring of the rebuttal aspect was adapted from the scoring rubric of the aspect of scientific skill argument as follows:

TABLE II. TREBUTTALS SCORE RUBRIC (REBECCA ET AL., 2014)

Score	Rubric of Rebuttal
0	Does not provide the rebuttal or incorrect rebuttal
1	Provide rebuttal without evidence and reasoning
2	Provides appropriate but insufficient counter evidence and reasoning
3	Provides appropriate and sufficient counter-evidence and reasoning

The lowest score is 0, and the highest score is 3. The score of each student in the control class and the experimental class is then analyzed to know the effectiveness of Problem Based Learning based module in improving the aspect of skill of argument especially the rebuttal aspect. The effectiveness of the module is tested by using the gain test and t-test.

III. RESULT AND DISCUSSION

The results of research conducted to find out the increasing of scientific argument skill's aspects especially the rebuttal using the PBL based module showed an increase in rebuttal aspect score seen from the pretest and posttest score of the students. The results of the rebuttal score can be seen in the following Fig.1.

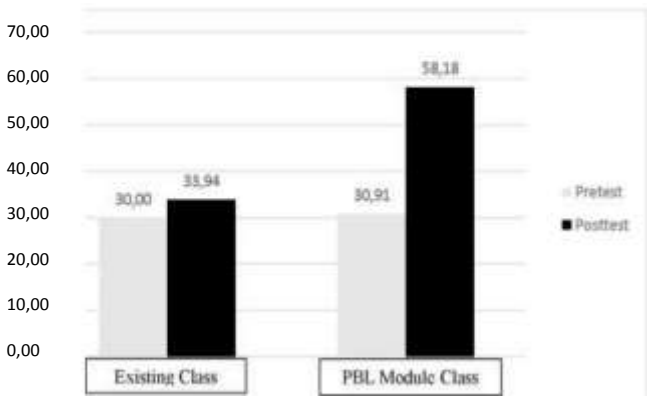

Fig.1. The Pretest and Posttest scores of Rebuttal in existing class and PBL module class

Based on these results it can be seen that the rebuttal score of students in both the existing class and PBL module class increase. In the existing class, increase. In the existing class, to 27.27%. This results then tested using gain test with the following results as in Table 3.

TABLE III. GAIN-TEST RESULT

Class	Average Gain Score	Category
Existing Class	0,1	Low
PBL Module Class	0,4	Medium

Based on Table 3 it can be seen that the PBL module class has a higher gain score compared to the existing class. The result of this gain test showed that the use of Problem Based Learning based module is effective to improve student's rebuttal. Module class gain score is included in the moderate category, and higher than the existing class which is only in the low category. Gain scores of both classes did not reach the high category because of the average student has not been able to obtain maximum rebuttal score. Most of the students in the existing class could not increase their rebuttal scores while in the module class the students' rebuttal score between pretest and posttest increased even though most recently achieved two scores. On written an argument, rebuttal aspects were rarely raised by students [11].

It is because the student's difficulty to compile evidence and alternative reasons to show that the other claims given are incorrect. In this study, though the question of written tests have been modified to provoke the emergence of rebuttal, however, students still unfamiliar with a rebuttal or have difficulty in forming the high-quality rebuttal.

The analysis of whether or not there is a significant difference between the pretest and posttest results of the module class or existing class was performed using the t-test. The result of the prerequisite test in the form of normality test and homogeneity test shows data to be analyzed distributed normal and homogeneous as in Table 4. Based on this result we used the T-test for further analyzed. The result of the t-test of control and experiment class is as follows.

TABLE IV. HOMOGENEITY AND NORMALITY TEST RESULT

Type of Test	Type of Analyze	Existing Class	PBL Module Class	α (Alpha)	Conclusion
Test of Homogeneity	Levenes'	0,318		0,05	Homogene
Test of Normality	Kolmogorof Smirnov	0,229	0,0827	0,05	Normal

Based on this result we used the T-test for further analyzed. The result of the t-test of control and experiment class is as follows.

TABLE V. T-TEST RESULT

Class	Type of Test	Sig.	Conclusion
PBL Module Class	T-Test	0,00	There's a significant difference between pretest score and posttest score
Existing Class	T-Test	0,06	There's no significant difference between pretest score and posttest score

Based on Table 4. above, it can be seen that the rebuttal score of students has a significant improvement in the module class by using a PBL-based module. It proves that the use of PBL-based modules is effective for improving rebuttal and student's argumentation skills in general. Students construct explanations that support arguments through investigation of phenomena or problems [15]. Problem-Based Learning model according to Tan (2004) connects between inquiry, independent learning, information gathering, an integrated way. The five steps of Problem Based Learning model that has been integrated into the module contains the investigation the activity of the problem continued with the discussion process. These learning steps can help students to shape their arguments.

In the solution, presentation and reflection stage, the rebuttal aspect appears. Each group reports and presents the results of it's group discussion to other groups classically so that there is discussion betweengroups. This activity can raise the aspect of rebuttal because at this stage students experience cognitive conflict from the discussion process [16]. During the discussion process, students are exposed to a variety of claims different from their claims. Students are required to bring evidence and alternative reasons to deny any other claims or alternative claims posed by other groups.

The results of direct observation show students can obtain evidence and reasoning or justification in the stage of discovery and reporting. Students work in groups to investigate problems. The evidence and reasons are collected through observation, experiments and literature studies. These proofs and reasons will be used to support the claim and make rebuttal [17].

In this study, students have been able to collect evidence and reasons to support their claims, but some students are still confused when they have to show evidence and alternative reasons to form a rebuttal against the counterclaim. It can be caused by the lack of student's knowledge of the problems [17]

IV. CONCLUSION

Based on the result analysis can be concluded that implementing PBL based module in the 10th-grade senior high school is able to improve student's rebuttal skill. The results showed that students in module class had higher rebuttal score than control class. This result is proved by gain test and t-test which significant differences between pretest and posttest scores.

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