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The Implementation of Problem Based Learning with Reguku on the Topic of Immune System in High School

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Info articles	Abstract
	This research aimed to find out the effectiveness of the implementation of problem-based learning with *Reguku* on the topic of immune system for high school to students' attitude of health caring and learning outcomes for high school student. This research uses pre-experimental design approach which is helped with conducting one-group pretest-posttest design. There were four kinds of data analyzed in this research: (1) students' score, (2) students' attitude of health caring, (3) students' response and (4) questionnaire of teacher's response to problem-based learning with *Reguku*. Students' learning outcomes was analyzed using N-gain formula and classical completeness test, meanwhile the students' attitude of health caring, students' and teacher's response to problem-based learning with *Reguku* were analyzed descriptively using percentage. The students' attitude of health caring indicated a good condition which was 76,02%. The data of learning outcomes for student were obtained from the score of posttest, daily activity, discussion sheet, and exercise. Collectively, 83,6% of the students from both classes passed the minimum passing score of classical completeness test and the increase of N-gain score is in medium criteria (0,345). Both the teachers and the students gave positive response on the implementation of problem-based learning with *Reguku*. Based on the research findings and discussion, it can be said that problem-based learning with *Reguku* is effective to be applied on the topic of immune system in SMA N 2 Bae Kudus.

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INTRODUCTION

Science learning is a systemmatical work with the purpose of creating, building, and organizing students' understanding of the nature. To optimize the students' ability in performing such tasks, it takes a habit in learning. It can be started with implementing the problem-based learning, taking the natural phenomena in students' surrounding as learning materials. A pilot interview with Biology teachers in SMA N 2 Bae Kudus suggested that immune system is a relatively difficult area for students to master. It is due to the fact that immune system is too broad and contains technical terms, which in turn lowers the students' motivation and achievement. During a formative test in the academic year 2016/2017, 7 out of 31 students in XI MIPA 1 and 9 out of 35 students in XI MIPA 2 passed the minimum score set, that is 70.

Azka *et al.* (2016) claimed that teaching learning the immune system has the characteristic that it should be based on problem-solving. The problem-based learning is an approach that provides students with a problem, which later encourages students to think critically about that problem in a real-situated setting. Students are exposed to such problems before they study the related concepts and theory so that they have time to understand and value Biology through classroom activities. Students are supposed to master the critical-thinking skill since it is of great importance when they have to solve problems related to their daily activities (Ayuningrum & Susilowati, 2015).

Kinaseh *et al.* (2015) mentioned that basically the problem-based learning is a model that allows students, either individually or collectively, to have their own way in solving the problem during the lesson. Not only does the inquiry provides students with solution to the problems and enhances their knowledge, but also develops their caring for themselves and surroundings.

The learning of immune system is a contextual learning which provides students with how the immune system works within their body. Therefore, it is important for them to study the system and apply their knowledge in everyday activities. The attitude of health-caring is one of conservacy characteristics likely to be implemented during the teaching-learning of immune system. The immune system is an abstract topic since it runs within the human body so that students need a learning media when they are studying the immune system mechanism. This media can be in the form of videos or visual aids. Besides motivating, the use of visual aids encourages students to participate more in the learning process, which in turn may lead to an increase in the students' achievement. Rahayu *et al.* (2011) suggested that students' participation in classroom organization leads to a deeper understanding of the learning materials studied. However, any forms of visual aids had not been taken into use during the lesson by the students.

According to Arends (2012), there are five phases in problem-based learning: (1) orient students to the problem, (2) organizing students for study, (3) assisting independent and group investigation, (4) developing and presenting artifacts or exhibits, and (5) analyzing and evaluating the problem-olving process. During phase 4, students are developing their visual aids, that is *Reguku* (*Replika Gambaran Umum Kekebalan Tubuh*).

Reguku is a visual aid that helps students to visualize how the immune system works. The use of visual aids may contribute to students designing those of their own in group work following the teacher's instructions. After designing the visual aids, students are supposed to gain better understanding of the topic and the learning process becomes more meaningful, that may result in a sharp increase in their achievement. The implementation of PBL with *Reguku* on the topic of immune system is expected to be effective to the students' attitude of health-caring and academic acheivement.

RESEARCH METHOD

This research uses pre-experimental design approach which is helped with conducting one-group pretest-posttest design. There were two groups of representative samples, XI MIPA 1 and XI MIPA 2, selected using the purposive sampling technique. The independent variable was PBL implementation with *Reguku*. The dependent variable was students' learning outcomes and attitude of health-caring. There were four kinds of data analyzed in this research: (1) students' score, (2) students' attitude of health caring, (3) students' response and (4) teacher's response to problem-based learning with *Reguku*. Students' learning outcomes was analyzed using N-gain formula and classical completeness test, meanwhile the students' attitude of health caring, students' and teacher's response to problem-based learning with *Reguku* were analyzed descriptively using percentage.

This research was divided into two stages (preparation & experiment). The preparation stage includes: (1) designing the lesson plan, (2) designing the research instuments, (3) testing the instruments, (4) analysing the results of instruments test (validity, reliability, discrimination power, and difficulty level) using ANATES version 4.0.9. The experiment stage includes: (1) pretest, (2) intervention, (3) posttest, (4) collecting the students' and teacher' response to questionnaire. The final stage of this research includes: (1) calculating and analyzing the data collected, (2) reporting the research findings, (4) drawing a conclusion.

RESULTS AND DISCUSSION

Students' Learning Outcomes

The students' score was those of posttest score, daily activities, discussion sheet, and exercises. The analysis of students' academic score revealed that a number of students passed the minimum score set, that is 70. The indivual and collective students' achievement are shown in Table 4.1.

Tabel 1 Students' learning outcomes upon the Implementation of Problem-Based Learning with *Reguku* on the Topic of Immune System

Remark	XI MIPA 1	XI MIPA 2
Minimum Score	60	63
Maximum Score	95	94
Mean	77	77
Number of Students Passing	28	28
Number of Students Failing	5	6
Collective Achievement Percentage	84,85%	82,35%
Students' Collective Achievement	83,6%	

The students' score calculation showed that 28 out of 33 students in XI MIPA 1 passed the minimum score with the average score of 77. It is also presented that 28 out of 34 students in XI MIPA 2 passed the minimum score with the average score of 77. Collectively, 83,6% of the students passed the minimum score set, 70. This means the implementation of problem-based learning with *Reguku* towards students' learning outcomes on the topic of immune system is effective since the collective percentage is above 75%. The N-gain calculation showed that the increase in students' score of cognitive aspect is 0,345, which is in medium criteria. There is a significant difference between students' pretest and posttest score. It can be said that the implementation of problem-based learning with *Reguku* towards students' cognitive score on the topic of immune system is effective since the N-gain calculation resulted in medium criteria. These findings, resumed in Figure 4.1, are in line with previuos studies by Fariroh & Anggraito (2015), Kinaseh *et al.* (2015) and Putri *et al.* (2014), that the implementation of PBL leads to an increase in students' achievement.
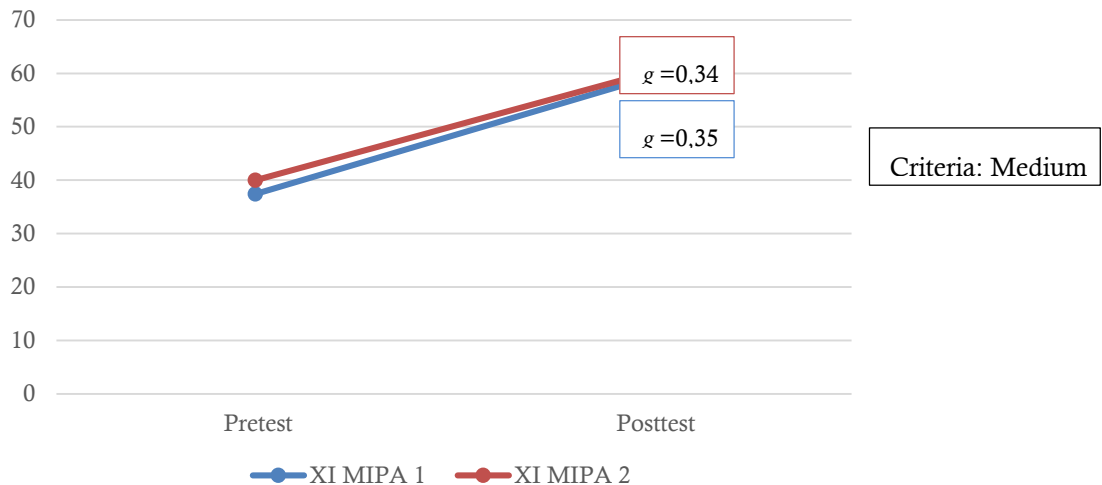
Figure 1 Increase in Students' Cognitive Score According to Pretest and Posttest Result (N-*gain*)

Problem-based learning helps students to improve their communication and collaboration skills in gathering information and making use of it. A study by Aziz *et al.* (2014) indicates an increase in students' independency which allows them to take responsibility and initiation of doing scientific research with(out) teacher's guidance. In Hamalik's view (2014), students are more likely to finish a project if they are involved since the initial stage of the project.

The implementation of problem-based learning with *Reguku* on the topic of immune system has the advantages of being implemented in classroom; 1) students become active during the lesson, 2) students think more critically about any problems, 3) students are likely to gather more information, 4) students are likely to develop their creativity, and 5) students' achievement is increased. These results are in line with Adiga & Adiga (2015), Dude *et al.* (2017), Susilowati *et al.* (2017), and Sutriman (2015) who mentioned that there are benefits of implementing PBL, e.g. improving students' skills of critical and analytical thinking, which in turn increase the students' achievement. These are also in line with researchs by Mulyono *et al.* (2012) and Wulandari *et al.* (2017), that suggested the contextually designed learning of Biology affects the students' achievement. Dealing with real objects makes it easier for students to comprehend any concepts in Biology and to expand their thinking capacity

Classroom learning, however, does not always go as expected. The average pretest score of the students of XI MIPA 1 during pretest was 37,42 while during posttest was 59,39, meanwhile, the average score of the students of XI MIPA 2 during pretest was 40 and during posttest was 60,29. The collective achievement of the two groups is still below the minimum score set (70). This achievement indicates that the students' understanding of the topic is not up to standard. It is probably due to some internal and external factors, as pointed out by Slameto (2010). Examples of the external factors causing the below-standard students' achievement are: 1) it takes much time so that teachers need to consider time allocation for each step in PBL, 2) the learning is only focused on the problem given, 3) time allocated for discussion and presentation is not enough, and 4) teachers have to make sure that group discussion is fair. According to Nugroho *et al.* (2014), the students' low motivation and participation can affect their achievement. The quality of the learning media can also affect the students' learning outcomes.
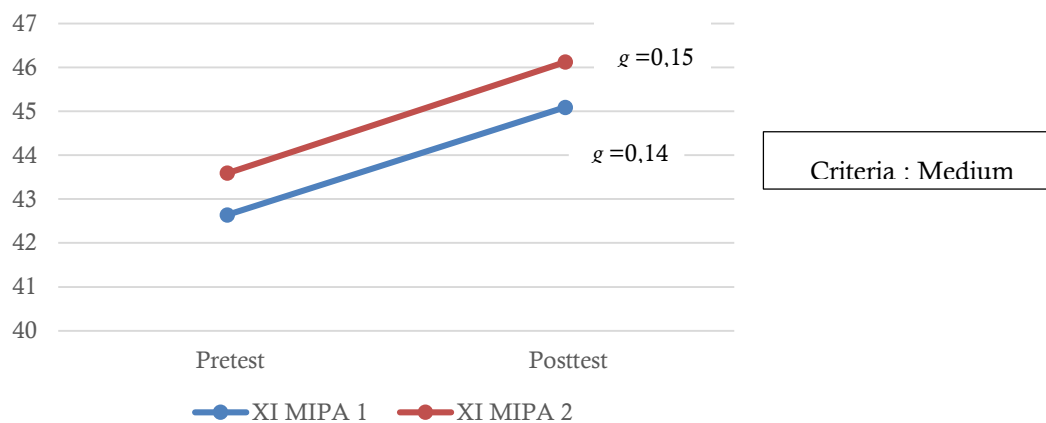
Students' Attitude of health-caring

The students' response to health-caring was collected using a questionnaire. The summary of this data is graded and presented in Table 4.3.

Table 2 Grading and Summary of the Students' Attitude of health-caring Score upon the Implementation of Problem-Based Learning with *Reguku* on the Topic of Immune System

No	Items	Average Score	%
1	I always wash my hands before I have meals	3,64	91,04
2	I consume only nutritious food	3,48	86,94
3	I always do physical exercise at least 3 times a week	3,09	77,24
4	I always keep my body clean	3,6	89,96
5	I always keep my environment clean	3,36	83,96
6	I share my beverage with friends using the same straw	3,45	86,19
7	I always wear a mask when I am sick	2,85	71,27
8	I give no aid to flesh wounds	2,42	60,45
9	I am vaccinated against any new diseases	3	75
10	I stay away from those who are infected smallpox	3,18	79,48
11	I always get enough sleep	2,98	74,63
12	I go for my regular medical check-up once a month	2,52	63,06
13	I take an immunomodulator to boost my immune system	2,69	67,16
14	I help to promote public health through health campaign around my neighbourhood	2,67	66,79
15	My family members are registered in health insurance program	3,36	83,96
	Maximum Score	4	
	Average Score in Percentage (%)	76,02	
	Criteria	Good	

As can be seen in Table 4.3, the average score of students' attitude of health-caring in (%) is 76,02, categorized as good. This means the implementation of problem-based learning with *Reguku* is effective to students' attitude of health-caring. In the two groups, the N-gain calculation of students' attitude score resulted in low criteria. It can be said that the implementation of problem-based learning with *Reguku* towards students' attitude of health-caring score on the topic of immune system is positive. The summary is presented in Figure 2.

Figure 2 Increase in Students' Attitude Score to Health-Caring (N-gain)

The attitude of health-caring is the way human beings behave consciously that shows respect for their well-being and environment as if it is their responsibilty. In teaching-learning, teachers play an important role in "shaping" the students' attitude. Again in Hamalik's view (2014), teachers are in charge of helping the students to change their attitude into a better one. The change in students' attitude is of affective aspect, which cannot be measured in a short period. But the attitude of health-caring can grow when driven by a learning process that can encourage students to understand the material. Correspond to Fauzi *et al* (2018) and Kresnawati (2013), the higher the students' score is, the more positive attitude they get. In other words, the students' cognitive understanding of health-caring

influences their knowledge of problems related to immune system. In this research, the students' attitude score of health-caring is measured using a scale that employs a questionnaire. Usman *et al* (2017) stated that students are more careful to respond to items in a questionnaire than any other kinds of data collection instruments, and students would take the most reasonable choice that suits them.

Students' Response

The data of students' response to PBL with *Reguku* was collected using a questionnaire upon completion of the course. The result is presented in Table 4.3. The result indicates that the implementation of problem-based learning with *Reguku* had a good response from the two groups with the collective percentage of 79,95% in the good criteria.

Table 3 Students' Response to the Implementation of Problem-Based Learning with *Reguku* on the Topic of Immune System upon Completion of the Course

| No | Items | Group (%) | | Mean | Criteria |
		XI MIPA 1	XI MIPA 2		
1	It is easier for me to understand any learning materials which done by solving the problems	77,5	80	78,75	Good
2	The immune system learning that is done by solving the problems I face makes me excited to attend the learning	85	85	85	Good
3	Immune system learning done by solving problems which I face makes me want to know more about those problems	80	80	80	Good
4	I am motivated to conduct scientific investigations to find solutions of problems I face	75	77,5	76,25	Good
5	Immune system learning done by linking the problems that I face make my critical thinking skill about the environment around me develop	80	80	80	Good
6	Problem-based learning on immune system makes me care more about health	80	82,5	81,25	Good
7	The making of a replica of immune's general description helps me to understand more about immune system	80	82,5	81,25	Good
8	*Reguku* encouraged me to think creatively	77,5	77,5	77,5	Good
9	*Reguku* makes me more active when learn the immune system	77,5	80	78,75	Good
10	The immune system learning conducted by the teacher made me optimistic that I would get the optimal score on the daily assessment about immune system	77,5	82,5	80	Good
	Maximum Score			4	
	Average Score in Percentage (%)			79,95	
	Criteria			Good	

Teacher's Response

The data of teacher's response to PBL with *Reguku* is summarized in Table 4.4. As shown in Table 4.4, the implementation of problem-based learning with *Reguku* had a good response from the teacher with the collective percentage of 85% in the good criteria.

Table 4 Teacher's Response to the Implementation of Problem-Based Learning with *Reguku* on the Topic of Immune System

No	Items	Score	Maximum Score	%	Criteria
1	Implementation of problem-based learning assisted by teaching aids can make students easier to understand immune system	3	4	75	Good
2	Presentation of the material is systematically arranged	4	4	100	Good
3	*Reguku* (a replica of the general description immune) involving students can make students more creative and active in the learning	3	4	75	Good
4	Material about learning immune system by applying problem-based learning can grow the students' attitude of health caring	3	4	75	Good
5	I am interested in applying the learning model of Problem Based Learning assisted by teaching aids in other materials	4	4	100	Good
	Average Score in Percentage (%)		85		
	Criteria		Good		

CONCLUSION

Based on the research findings and discussion, it can be said that problem-based learning with *Reguku* is effective to be applied on the topic of immune system in SMA N 2 Bae Kudus. In details, the score of students' attitude of health caring is in a good criteria (76,02%). The percentage of students passed the minimum passing score is 83,6% and the increase of N-gain score is in medium criteria (0,345).

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