The analysis of pattern on empowering metacognition skills with models based on problem based learning

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Abstract. Based on the result of the needs analysis questionnaire conducted at the coffee plantation school in Jember regency, metacognition skills were not empowered in the process of learning science. The Problem Based Learning isa potential teaching strategy to empower metacognition skills in students. This study aims to determine the type of discussion of a problem based learning on metacognition skills. The population in this study was grade VIII SMP / MTs students in neer coffee plantations are in Jember Regency Academic Year 2018/2019. Metacognition skills can be measured using the Metacognition Awareness Inventory (MAI). Data analysis used in this research is descriptive quantitative. The research data was analyzed using Normalized gain (g). Based on the research results that have been carried out, metacognition values around 0.75 categories of high metacognition skills show that problem based learning can empower metacognition skills in science learning.

1. Introduction
The main function of education is to empower human potential and preserve cultures and civilizations. Education is also needed to create a better change and innovative life. A good learning method such as critical thinking skills, collaborating and communicating is badly needed in this modern era [1]. Learning process should be involved in many aspects including formulating questions, describing the mechanism, and can constructing arguments [2].

Problem Based Learning (PBL) is a teaching method in which students problems are used as the topic to enhance their skill. Problems raised in problem based learning do not have a single right answer, it means students should be able to get involved and working together in exploring several questins [3]. The foundation of problem based learning is collaborative process in which students will compile their prior knowledge to obtain their interactio with others. Problem-based learning is a methodological approach in which students can solve a problem at various levels of complexity (based on actual cases) [4].

The application of problem based learning not only help students in creating learning condition which commonly transfer information from the teacher to students, it can also stimulate students and improve students attention in teaching and learning activities [5]. Problem based learning consists of five steps including orienting students to problems, organizing students to learn, guiding individual and group investigations, developing and presenting the result, analyzing and evaluating problem solving processes [1]. Problem Based Learning is much better than conventional teaching methods in improving students' interest, teamwork, problem solving, analyzing, and expression [6, 7]. Problem Based Learning can improve students' critical thinking skills. Students who learn to use problem based learning will have a high ability to think critically than students who do not use problem based learning at all [8].

Problem Based Learning has some advantages. PBL is realistic in students life, the concepts are based on the needs of students, developing the nature of student inquiry, and enhancing students skill to solve some particular problems. Moreover, there are some weaknesses of PBL such as
complex learning preparation, the difficulties in finding the appropriate problem to solve, misconceptions, and this method is need a long time [9].

Teacher as the designer of teaching and learning process has responsibility and opportunity to develop students learning metacognition skills. Metacognition is defined in simplest terms as “thinking about your own thinking”[17]. Metacognition is an interaction between three aspects including knowledge about the process of thinking itself, self-regulation, and beliefs and intuition. The metacognition process includes the ability to ask questions and answer questions about: 1) What do I know about this subject, the subject and problem?; 2) Do I know what I need to know?; 3) Do I know where I can get some information and knowledge?; 4) How long does it take me to learn this?; 5) What strategies should I need to learn this?; 6) Do I understand what I hear, read or see?; 8) How can I see if I make a mistake?; 9) How should I revise my plan if it is not what I expected?. Students who have high metacognition skill will try to learn things easily and get high results.

Some abilities in science will show what has been observed, predict what has not been observed and to test the follow-up of the experimental results, developed with a scientific attitude. These metacognition skills are still underdeveloped or the teacher has not compiled questions to measure the ability of students’ metacognition skills because the teacher only listens but lacks knowledge on it. It is very important to develop in the process of learning activities so that students can be more competent in critical thinking.

2. Method of Research
This research was conducted in seventh grade of junior high school in 2018/2019 academic year. This research was conducted for 3 weeks by using the interactions between organism and environment. 25 students were involved in this research. The research instrument consist of essay tests and metacognition skills questionnaires. The implementation of the problem based learning uses syllabus, learning plans, and worksheets. Whereas metacognitive skills refer to the Metacognitive Awareness Inventory (MAI) questionnaire developed by Scraw, G and Dennison (1994).

This type of research is a quasi experimental study. The subject of the study was given a questionnaire on metacognition skills before learning and a pretest. After pretest, the application of problem based learning model was carried out. Then the application of problem based learning model, all students will be given a post test and final metacognition skills questionnaire.

The method used in this study is the incorporation of qualitative methods and quantitative methods. Quantitative methods were used to analyze data taken from the tests (pre test and posttest) and questionnaires about metacognition skills after the application of problem based learning patterns. While qualitative methods are used to analyze data taken from questionnaires and interviews with 7 schools near coffee plantations. The variables in this study are independent variables and dependent variables. The independent variable includes a pattern based learning model pattern while the dependent variable includes metacognition skills. This following Figures is experimental research design mixed with qualitative and quantitative methods.
Based on Figure 1. The steps of qualitative method include questionnaires carried out in 7 schools near coffee plantations in order to find some articualr problems faced by teachers and students in science learning. After conducting questionnaires, the datas that has been collected were processed.

**Figure 1. The step of qualitative method**

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**Figure 2. Quantitative Method**

Based on Figure 2. The results of questionnaires conducted by literature studies then designing the right pattern that is appropriate to empower metacognition skills. Then make instruments (RPP, Syllabus, tests, implementation of learning) that will be validated by experts. The next step is to validate the instrument by experts. After that the researcher determines the research subject, tests the problem based learning learning pattern, results, analyzes the data and the last step is conclusion.

The following is the formula for normalized gain
normalized gain \( (g) = \frac{\text{metacognition of late} - \text{scores early metacognition}}{\text{metacognition score of maximally} - \text{early metacognition scores}} \)

Value scale that can be used in achieving the ability of metacognition as follows:

| Normalized gain score | Criteria normalized gain |
|-----------------------|--------------------------|
| 0.70 ≤ normalized gain | High                     |
| 0.30 ≤ normalized gain < 0.70 | Medium                 |
| Normalized gain < 3.0  | Low                      |

3. Results And Discussion

3.1. Results

Research on problem based learning model was carried out in class VIII of SMP / MTs near coffee plantations in Jember Regency on Academic Year 2018/2019. The results of the study were obtained from 25 respondents, the study obtained from data metacognition skills on the application of problem based learning models. The research data for the application of problem based learning models is in the form of quantitative and qualitative data. Data from metacognition skills at the beginning and end can be seen in Table 2, while the graphs of the average score of metacognition skills can be seen in Figure 3 and discussion patterns that can develop the metacognition alignment on pre-based reflective based learning can be seen in Figure 3 and discussed can see on Figure 4.

**Figure 3.** Pattern of discussion on empowerment of problem based learning based metacognition skills

General description of the discussion that took place in the classroom, the teacher uses images and videos as teaching media, the example of media can be seen in Figure 4.
Figure 4. Coffee Plants and Shade Plants

Based on Figure 4, the teacher provides a stimulus to students to find a problem for students; a component that affects the growth of coffee plants, why coffee plants need shade plants. Then students are asked to discuss with their groups to find hypotheses and students collecting data by making observations in the school environment.

Table 2. Results of metacognition skills on problem based learning based reflective learning models

| No | Metacognition Skills           | The number of students | Mean ± SD | Normalized gain | Category |
|----|--------------------------------|------------------------|-----------|-----------------|----------|
| 1  | initial metacognition skills  | 25                     | 70,3 ± 12,4 | 0,75            | High     |
| 2  | final metacognition skills    | 25                     | 92,3 ± 5,8  |                 |          |

Table 2 shows the mean initial metacognition skills with the number of students as many as 25 people have an average of 70.3 while the average final skill with a total of 25 students has an average of 92.3. Normalized gain (n) metacognition skills of 0.75 with a high category.
Figure 5. Graph of average initial and final metacognition skills and Standardization Standard

Figure 5 shows a graph of the mean initial metacognition skills with an average of 70.3 with a standard deviation of 12.4 while the average final skill is 92.3 with a standard deviation of 5.8.

3.2. Discussion

The research steps were carried out by researchers as role models. The sample used in this study was 25 students. First, the teacher makes a discussion pattern that will be used in empowering metacognition skills in the problem-based learning model. Then the model teacher provides an inventory of initial metacognition skills. An inventory of initial metacognition skills aims to determine the level of students' initial metacognition skills before being given problem-based learning.

In the first study conducted by the model teacher, the teacher explained the apperception, motivation and learning objectives to be achieved that day. The teacher shows a learning video that is useful to encourage students to find a problem. Next is to go directly to the problem based learning syntax based reflective learning by explaining the material. In the first stage, the teacher explains the material and the teacher asks students to ascertain important concepts in the material and make questions from the material that has been delivered by the teacher. The second stage is discussion. In the discussion, process students become centers (student centers) students discuss previously made questions and find solutions to answer questions that have been asked. With the discussion, students are able to share ideas and experiences, learn collaboratively, and apply knowledge into real world problems. Through active discussion among students and with their teacher, and through interaction, students develop a capacity to reflect on their ideas and apply it. In the third stage students look for data on various sources that support to solve problems. The last stage is research / experiment, students and teachers go to the environment around the school to make observations. The existence of research activities or experiments will make students more aware of the environmental conditions around the school. At this stage of research or experiment students identify what components are in the ecosystem in the environment around the school. The research or experimental steps can prove what students have learned in real life. Experimental activities will make students more confident in the truths or conclusions that come from their own research rather than just accepting teachers or other sources.

The last activity in this study is inventory metacognition conducted before and after the learning process. From the results of the study in getting the mean initial metacognition skills with the number of students as many as 25 people had an average of 70.3 while the average final skill with the number of students as many as 25 people had an average of 92.3. Normalized gain (n) metakoqnisi skills of 0.75 with a high category.

Marking important concepts in the learning process will help students understand the material presented by the teacher, so that they will empower students' metakoqnisi skills. In addition, student control makes questions and answers test themselves. Activities to make questions and conduct data collection will make students become more independent and can empower metacognition skills. The
second is discussion, students communicate between each other to discuss the questions they have made and find alternative solutions to the questions asked. At this stage the division of groups is divided heterogeneously [10]. With a small group of students, they can find out their own knowledge so students can empower their respective methods. The discussion method is very important because it can create a positive learning environment. In addition, the discussion can build a pattern of student participation so that there is a social interaction between the teacher and students and as the result class becomes more active.

Some aspects of students' metacognitive skills can be empowered through discussion activities. Group discussion is a meeting of two or more people which aim to produce joint decisions through a process of mutual exchange of experiences and opinions. The goals and benefits obtained when conducting discussions are that students can gain valuable experience from discussion friends and discussion guides, enhance motivation and enthusiasm of students to do some tasks, develop critical thinking skills, able to do analysts, and can develop metacognitive skills and student courage opinion clearly [11].

The next step is collecting data from various sources to solve a problem faced by each group. The last is research or experiment. In the experimental phase there are communication activities between group members and various student arguments when making observations outside the classroom. A study can not be separated from communication between groups and various arguments. The process of functioning of communication and debating skills cannot be separated from the principles contained in the components of metacognition skills in planning, information management, monitoring, revision, and evaluation [12]. Therefore, research or experimental activities has the potential to improve students' metacognition skills.

Metacognition skills cannot come alone without being facilitated. Metacognition skills do not appear automatically in the learning process. Metacognition skills allow students to mastering information and can solve problems more easily [13]. Metacognition is very important to be empowered to students in the learning process for students' academic success. With the empowerment of metacognitive skills students will be able to manage positive conditions and students can find out their weaknesses so that they can be improved by building a new perspective. Remaining metacognition skills can be trained to become a students habit so that they can be able to understand the situation under consideration, students will become more trained in how they manage and perform positive abilities [14].

Middle school students with high metacognition skills have knowledge of the cognitive skills they have. In addition, they learn faster and harder using certain strategies that involve metacognition. Metacognition skills influence students' intelligence and improve their problem solving process.

4. Conclusions
The common problems faced by teachers are they have not empowered metacognition skills yet in teaching science. In fact, if students empower metacognition skill, they would be able to know how to learn well so that their learning outcomes would be increase. The results of the research of the ability of metacognition can be measured by using the Metacognitive Awareness Inventory (MAI). It can be concluded that discussion patterns can celebrate metacognition in reflective learning models and problem based learning, metacognition skills obtained by students amounted to 0.75 with a high category. So the discussion pattern of student centers can empower students' metacognition skills in problem based learning based reflective learning models. Suggestions in this study are: before the learning process is carried out, the teacher must prepare learning media, explain to students the learning steps and discussion patterns that will be applied in the learning process so that metacognition skills can be well empowered.
Acknowledgments
We gratefully acknowledge the support from Faculty of Teacher Training and Education - the University of Jember, especially TBL and LSLC Research Group – FKIP-University of Jember of year 2019.

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