Profile of problem solving ability of junior high school students in science

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Abstract. Problem solving ability becomes one of the required in 21\textsuperscript{st} Century skills. This research is aimed to describe the students’ problem solving in one of Junior High School in Bandung. This research uses descriptive method. The data was collected using test questions which were developed based on problem solving ability meter according to PISA 2012. The research is conducted towards 40 of 7\textsuperscript{th} grade students of Junior High School in the second semester of 2017/2018 academic year. The data was analyzed quantitatively and presented in percentage chart. Overall, there were only 27.5\% of the students who are able to answer the problem solving question test. 50.25\% of the students were able exploring and understanding problem, and 20\% students are able to representing and formulating problem; and planning and executing solution. Thus, it can be concluded that the students’ problem solving ability in science is still low (30.83\%). The identified dominant factor that causes the students’ low of problem solving ability is the learning process which has not facilitated the students yet to develop the problem solving ability. This research recommends to test a learning method which can help the learning process which is able to train the problem solving ability.

1. Introduction
In the regulation of Republic Indonesia number 20 of 2003 about the National Education System mentioned that the purpose of national education is educate the nation's life and develop a completely Indonesian, that the mankind who believe and piety towards Almighty God and virtuous noble character, possess knowledge and skills, physical and spiritual health, a stable and independent personality and sense of responsibility of society and nationality. One of the subject is learnt to achieve the goals of national education is science. According to Permentek number 24 in 2016, science is studied in junior high school with the aim in order to make the students have several competencies: (1) Living the life with a positive manner, honest and open attitude; with critical, creative, and innovative thinking; and collaborate, based on the nature of science; (2) Understanding the natural phenomena, based on the results of science learning in an integrated manner through its specific fields on Physics, Chemistry and Biology; (3) Evaluating the products of thought that exist in the community based on the principles of natural science and ethics; (4) Solving problems and making decisions in life based on scientific and ethical principles; (5) Recognizing and contributing to solve human problems, such as food availability, health, energy crisis and the environment; and (6) Understanding the impact of the
development of science integrated on the development of technology and human life in the past, present and potential future impacts for himself, others, and his environment [1]. Basically science studied in junior high school has a purpose so that students can use to understand natural phenomena and solve problems in everyday life.

The purpose of science lessons in junior high schools that have been targeted by the Ministry of Education of the Republic of Indonesia basically has led to the demands of 21st century learning. As we enter the 21st century, science and technology are growing rapidly. These developments directly affect the various fields of life including education. In achieving the goals of national education and addressing the challenges of the 21st century marked by rapid technological developments, science has become an important foundation in nation building. Therefore, science learning is expected to deliver students to fulfill their skills such as critical thinking and problem solving, creative and innovative, and able to communicate and collaborate [2]. The problem solving ability is one of the skills that students demand in 21st century education [3]. Therefore, learning should be directed to train problem solving ability both in science teaching in junior high schools and problem solving ability so that students are able to contribute in society.

Problem solving ability is the student's attempt to find answers from a problems encountered based on prior knowledge, understanding, and capabilities that have been previously owned. In general, learning that trained problem solving abilities can support the improvement of high order thinking skills. High order thinking competence is demonstrated by some characteristics such as not algorithmic, it tends to be more complex, often resulting in multiple solutions, involving multiple criteria and thought processes, involving self-regulation and thought processes, considering disorder structures, and involving mental effort. When the problem solving ability is trained, students are required to understand the problem thoroughly, make suitable conclusions, and ultimately find solutions from the problem [4].

PISA 2012 formulates four key indicators in problem solving [5]. The four indicators are shown in Table 1.

| No | Problem Solving Ability                                      | Description                                                                                                                                 |
|----|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Exploring and understanding problem                         | Build a representation of each piece of information presented in the problem. This process involves observing, interacting, searching for information and finding limitations or obstacles; and demonstrate an understanding of the relevant concepts |
| 2  | Representing and formulating problem                        | Represent the problem by constructing table, graphic, symbolic or verbal representations; and formulate hypotheses by identifying the relevant factors in the problem and its relation; organizing and critically evaluating that information. |
| 3  | Planning and executing solution                             | Planning activities consist of goal setting, including clarifying the overall objectives, and establishing sub-objectives, and devising a plan or strategy for solving problems including find the steps to be taken for subsequent implementation. |
| 4  | Monitoring and reflecting solution                          | Monitor the progress on each steps, including checking results, detecting unexpected events, and taking corrective action when necessary; contemplating solutions from different perspectives, evaluating alternative assumptions and alternative solutions critically, identifying the need for additional information or clarification and communicating in an appropriate way. |

Problem-solving ability is an individual or group effort to find answers based on the knowledge, comprehension, ability that has been previously possessed in order to fulfill the demands of the unusual situation [6]. Problem solving requires knowledge and skills to find a solution or achieve a goal. Problem solving has two aspects: remembering or obtaining the information needed to solve the problem, and following effective problem solving procedures [7]. The importance of problem solving competencies for students has been consistently mandated in science education objectives. Thus science
learning that trains the problem solving ability can help students learn the concepts and principles of science and apply them to solve problems.

Based on the description above, the aim of this study is to obtain a profile of the problem solving ability of junior high school students in science. The descriptions of problem solving ability that is being explored ranging from exploring and understanding problem, representing and formulating problem to planning and executing solution.

2. Method
The research method that used is descriptive research that aims to describe the problem solving ability of students in a junior high school in Bandung. Data collection techniques that used are observation of science lesson, giving the instrument of problem solving test, and interviewing with science teachers. Completely, the data collection techniques are listed in Table 2 below.

Table 2. Data collection technique

| No | Data obtained                        | Data source                          | Data retrieval techniques          |
|----|--------------------------------------|--------------------------------------|----------------------------------|
| 1  | Profile of student problem solving ability | Test result data of problem solving ability | Test of problem solving ability                             |
| 2  | Profile of learning activities        | Learning observation sheet           | Observation                        |
|    |                                      | Interview questionnaire              | Interview                          |

Table 2 shows the data collection techniques undertaken to identify students' problem solving abilities. Problem solving abilities test given in this research be in the form of problem solving ability developed based on indicators of problem solving ability according to PISA 2012. The test instrument consists of 4 items essay on the energy of heat topic. Research data in the form of problem solving ability test results are analyzed quantitatively and presented in the form of percentage chart.

Research activities are conducted in the second semester of the 2017/2018 academic year. The subjects of this study were the seventh grade students in one junior high school in Bandung consisting of 40 students selected at random.

3. Result and Discussion
Based on the PISA 2012 problem solving indicator, the problem solving indicator indicators include (1) exploring and understanding problem; (2) representing and formulating problem; (3) planning and executing solution; (4) monitoring and reflecting solution. After the problem solving question test given to student's sample, there are only 27.5% from all students who are able to answer the problem solving question test. The following shows the percentage of students who can answer problem solving test each problem solving indicator of the research sample.

![Figure 1. Profile of problem solving ability of junior high school students](image-url)
Figure 1 shows that students' problem solving ability on each indicator. The highest percentage achievement is achieved on indicators of exploring and understanding problem, while the achievement of the lowest indicator is achieved on indicators of representing and formulating problem and planning and executing solution. It is generally seen that the problem solving ability of junior high school students in science is still low. The writers estimate that the ability to explore and understanding problem is a basic ability in the overall problem solving ability. [8] Explains that demands in identifying problems include noting key words, asking oneself what is asked, or reiterating problems in a language that can be understood more easily. Surely this basic ability is already owned by junior high school students who step on the age of adolescence. It’s different from the ability to formulate problems and design solutions, these abilities are not naturally obtained by junior high school students because it belongs to higher order thinking skill.

From the observation of learning activities the writers found out that one of the causes of low the students problem solving ability is the learning process is not in accordance with the current educational paradigm. The learning process has not yet facilitated the students to develop problem-solving ability. Learning activities are still teacher centered, less of cooperative learning between students and less of excavating students’ thinking so that learning tends to be passive and the concept that obtained is not the result of his own findings. The teacher starts the lesson by explaining a certain concept, followed by the exercise questions taken from the student’s book. The exercises are far from real life problems. Though ideally in science learning, in order to make students able to develop problem solving abilities, therefore the student should be given the opportunity to obtain and find the concept through a series of learning activities that are faced with a real problem that can challenge the students to find solutions from the problems given. The learning process should encourage students to find out from various sources of observation, able to formulate problems, solve problems, train students to think analytically and have the ability to work together and collaborate in solving problems [9].

While the interview results with science teachers obtained data that the teacher had tried to train problem solving ability on learning science, but there are obstacles faced by teachers both in the preparation and the implementation. At the time of preparation, teachers have difficulty in finding problems that can accommodate the material at the meeting, and teachers have limitations to prepare instructional media that support problem solving ability. While in the implementation process, it is found two obstacles that students confused in determining the early steps in solving the problems given by teachers, and lack of students’ confidence in the process of solving the problem. Finally, the teacher always gives instructions. It has been suggested by [10] that students need help for a problem solving process that allows students to concentrate on solving problems within the scope of their competence.

From the description above, it shows that there is a relation between the low of student’s problem solving ability with the learning process applied. This is along with [11] that the low student problem solving abilities are not separated from the classroom learning process. The selection of learning models, learning methods, and learning approaches will have an affect for students problem solving ability. There are different problem-solving approaches depending on the problem solving, the characteristics of the activities, the nature of the problem and the person who is interested with the problem [12]. To overcome the low of students problem solving ability, we need to test the learning model that can help the learning process of students according to the 21st century learning paradigm that involves many students and able to trained problem solving ability. It has equal of the results study [13] that problem solving ability can be improved through students’ active learning methods, which aim at participants’ exploring and applying knowledge, themselves. With the involvement of students in such learning process will then train the student’s problem solving ability exists in their environment.

4. Conclusion
Based on the research that has been conducted, it is concluded that the profile of problem solving ability of students in one of junior high school in Bandung is still low. This can be seen from the percentage of students who can answer problem solving test only 30.83% with details of students who are able to explore and understand problem of 52.5%, represent and formulate problems by 20%, and planning and execute solution 20%.
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