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Printed in the United States of America

Advanced Science Letters
Vol.23, Number 2, 2017

The Analysis of Students' Cognitive Problem Solving Skill in Solving PISA Standard-Based Test Item

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The problem solving skill of 29 students in the age of 15 in finishing the task in PISA standard was analyzed on this research. The used indicators of problem solving and test were based on the Standard of PISA in 2012. Based on data analysis and discussion, it can be concluded that students achieved well the phase of exploring and understanding. Moreover, on the phase of representing and formulating, the students tended to arrange a wrong hypothesis, and to make a good problem statement although it did not represent the data. On the planning and executing stage, the students tended to organize and execute the plan that was wrong. On the monitoring and reflecting stage, students tended not to monitor the process of every step that was used, and they did not check the final result, and did not repair the wrong part. Students did not reflect by using different solution, and it was the most problem which students had.

Keywords: Analysis, Problem Solving Skill, PISA 2012.

1. INTRODUCTION

In this globalisation era, the development of science and technology increases sharply. Mathematics education is also influenced by the development of science and technology itself. However, in Indonesia, students' ability in mathematics is still low. Because of that, this research conducted The Program for International Student Assessment (PISA) in 2012 on 15 years old students who delivered the results that the students' mathematics ability in Indonesia were ranked 63 from 64 countries with an average score of 375.

In 2012, it also obtained some data that from 6 level as the specified level of PISA, 42,3% students in Indonesia were still in level 1, and almost none of students stayed on level 6. Based on the result, it should necessarily have lots of changes made in order to improve the students' mathematics ability in Indonesia [1].

It is as one of the goals in mathematics learning process in the National Council of Teacher of Mathematics (NCTM) which stated that problem solving is not only the target in mathematics learning process but also as the main tool to learn of which is expected in learning, students were able to build new mathematics ability through solving the appearing problem, applying the various strategies to solve the problem, and monitoring and reflecting the process of problem solving [2].

Stay in line with the NCTM, the goal of mathematics education is an effort to improve reasoning and problem solving abilities. Based on the Institution of Education Standard National in Indonesia, the entire competences are used and applied by using problem solving process.

Based on the explanation above, problem solving in mathematics must be given attention because it will be a determinant in the success of mathematics learning process. The improvement of problem solving and mathematic ability can be done by giving routine

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exercises; so that, they became familiar with the test items which are PISA standard. However, given material was done before giving some exercises. The important thing in giving material was the teacher has to know the students' prior-ability in problem solving. It is aligned with Kirkley's theory which stated that problem solving is the basic ability that is needed in learning process everyday [3].

To find out the level of problem solving in students, it is needed a problem which has a good problem solving level. This research used test items in standard PISA with the tested validity. The type of test items was open-constructed respons items which is the test items that should be answered in the form of essay. Besides, having a good validity, the OECD which initiated PISA has a process in problem solving, such as Exploring and Understanding, Representing and Formulating, Planning and Executing, and Monitoring and Reflecting [4].

The problem of the research was how the students' problem solving ability worked into test items of standard PISA, and which stage became the major weakness in problem solving. The purpose of this reseach was to describe the students' problem solving ability worked into test items of standard PISA and find out which stage became a point of students' weakness in problem solving.

2. PROBLEM SOLVING

Dunker stated that the problem is a situation that happen when someone has a specific goal to achieve but do not know directly the solution. The problem is called good if it fulfills the aspects such as accessible, developmental, revealing, and extendable [5]. Problem solving is an overall ability including the mechanical ability, systematic, and dicontextual that related into one which is used to solve the problem or mathematics equations [3].

Problem solving was an important thing in learning activities, especially mathematics. By using an edequate problem solving ability, basic concepts that owned by the students can be applied maximally. This is supported by the NCTM that suggested the importance of problem solving which was to buid a new mathematics ability, to solve the problems in both the contexts of mathematics and other contexts, to train applying problem solving strategies and to monitor as well as to reflect the process of mathematics problem solving [6].

For the purposes of the PISA 2012 problem-solving assessment, the processes involved in problem solving are namely: (1) exploring and understanding which included observing, searching for connection, information, and data that are used but is not known directly, understanding and relating the information with the concept; (2) representing and formulating the problem which included representing problems in form of tables, graphs or symbols, formulating problems and determining the hypothesis; (3) planning and executing which set the plan to achieve the sub-goal till finding the main objectives and to implement the plans that have been made; (4) monitoring and reflecting which

include monitoring the process for each step, checking out the final results and doing the improvement if an error occurs and doing the reflection by using different solution [4].

3. RESEARCH METHOD

It is a descriptive study. It analyzed and explained the result of students' ability in problem solving based on the test items of standard PISA and established the phase that was the weakness of problem solving process.

This research was conducted in a school in Jember regency, East Java, Indonesia. The research subject were 29 students (7 boys and 22 girls) in the age of 15 or was born in 2000.

The instrument used in this research were researcher, assessment rubrics, test items of standard PISA, and questionnaire to measure the ability of problem solving and guidelines for the interview. The data collection methods were the test, interview, questionnaire. The goal of questionnaire was to get the data that were not gotten from the result of the test.

The participants were given test and questionnaire, then the result of problem solving ability would be categorized into high level, average level, and low level. Then, subject election was done by using Snowball Throwing that is represent those three categories. It functioned to conduct the interview. Many subjects were selected depending on whether the data has been saturated or not. The data is called saturated when there were at least 2 students on one level of the same problem solving ability obtained the identical information. This interview was made triangulation; so that, the data obtained were more valid. It can be concluded that triangulation was a method used which compared the data more than 1 method, namely, test and questionnaire methods with interview method. In this research, the students' ability of problem solving indicators that PISA used was analyzed. The purpose was to know which stage that became the point of students' weaknesses in problem solving.

4. THE RESULT OF THE RESEARCH

Based on the result of the questionnaire and the test about problem solving skill, the highest and the lowest score are 93,2 and 48. From the score, the categories of problem solving level are made which is presented on table 1.

Table.1. Categorization of Score in Problem Solving.

NO	SCORE	CATEGORIES
1	$48 \leq \text{score} < 64$	Low
2	$64 \leq \text{score} < 80$	Average
3	$80 \leq \text{score}$	High

Therefore, based on the table of students' problem solving ability score with 29 students by using code S01 up to S29 can be seen on table 2.

Table.2. Score and Categories of Students' Problem Solving.

CODE	SCORE	CATEGORIES
S01	93.2	High
S02	69.32	Average
S03	48	Low
S04	87.4	High
S05	76	Average
S06	62.6	Low
S07	80.2	High
S08	77.2	Average
S09	48	Low
S10	83.2	High
S11	60.8	Low
S12	70.8	Average
S13	48.6	Low
S14	62.6	Low
S15	78.4	Average
S16	64.6	Average
S17	60.8	Low
S18	49.6	Low
S19	69.8	Average
S20	69.2	Average
S21	57.2	Low
S22	64.98	Average
S23	59	Low
S24	78.8	Average
S25	72	Average
S26	48	Low
S27	73.8	Average
S28	80	High
S29	56.8	Low

Based on the score, interview had been done randomly on the subjects that represent high level; they are with code S01 and S04, represent average level is S02 and S05, and represent low level is S03 and S06. After that, data is called saturated. Beginning to analyze and discuss based the data obtained is the next stage.

The data analysis and discussion stage is done by reviewing 29 students' work because it is focused on process by using indicators of problem solving in PISA.

Then, the tendency of 29 students in each step of problem solving is determined. Moreover, by giving attention to the tendency, it can be determined which stage of problem solving that is frequently ignored and became the point of students' weaknesses in problem solving.

The high level student tends to find and understand the information that given, and find the correct problem that solved. Although in the first step, the student write the information and the problem without the symbol of mathematics, but the student can mention and write the symbol when interviewed. Furthermore, the student tends to create and implement the plan properly. In the last step, the student tends to look back the every process until the last answer. However, the student tends to do not reflect the final result with the other ways. The answer of the high level student is in Figure 1.

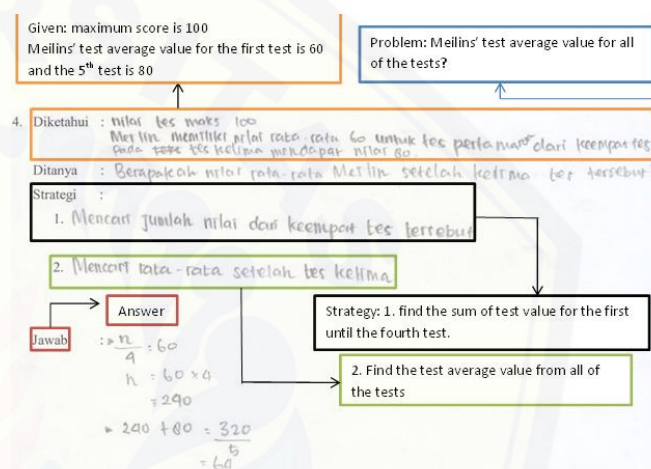


Fig.1. Answer of the High Level Student

Some the tendencies of the average level students' answer are the student can find and understand the correct information, but the student can't write the correct symbol. Moreover, the student tends to connect the correct concept even though it has fewer mistakes. The average level student tends to create the correct hypothesis. The average level student has a correct plan, but the student still have a mistake when implementing the strategy that planned. So, the final result of the problem that given is wrong. In the last step of solving the problem, the student tends to do not check the process and the final result. Furthermore, the student tends to do not reflect the final result with the other ways. The answer of the average level student is in Figure 2.

The low level student tends to find the information that given, but the student can't write thy correct symbol of mathematics. Furthermore, the student tends to understand the information, but the student can't relate it with the correct concept. Moreover, the student can create the correct problem, but do not represent the data in the form of table, graphs, or other symbol. The student still has a wrong hypothesis and a wrong strategy to solve the problem. At the end step, the student tends to do not look back and check the process until get the final result. The

answer of the low level student is in Figure 3.

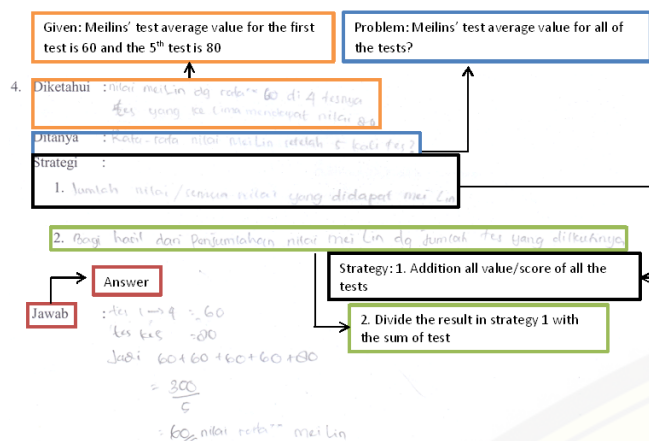


Fig.2. Answer of the Average Level Student

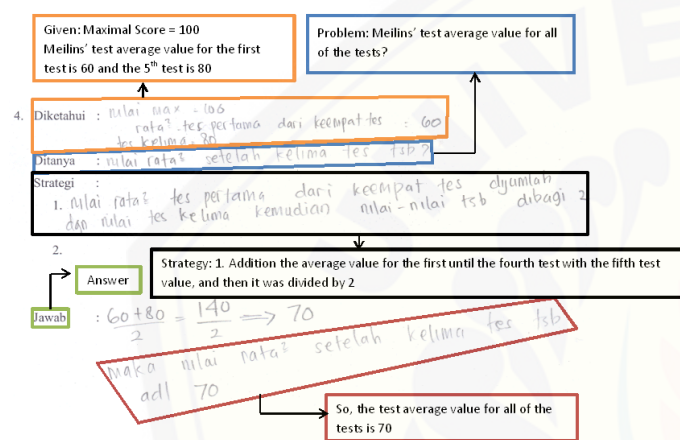


Fig.3. Answer of the Low Level Student

Based on the data analysis in above, it is obtained a tendency that the students tend to be able to do the stage of exploring and understanding well which means the students on this stage tend to do an observation, search for connection, find the information and search anything that do not know directly. They tend to understand the information, but they tend to don't connecting the result of their observation with the concept that related.

On the stage of representing and formulating, students tend to do less well because they tend to be able to formulate the problems that are given but cannot represent in the form of the tables, graphs, or other symbols. Moreover, in formulating the hypothesis, students tend to arrange a wrong hypothesis.

On the stage of planning and executing, students tend to do in wrong way. It is happened because the research results obtained the data that students tend to have a plan but the plan is still not the right way; so that, the obtained final result is wrong.

Whereas, on the last stage, monitoring and reflecting, they tend to implement less well which is caused from result of the questionnaire and supported by interview. Students tend to monitor on the part of the process, but they do not check on the final results. Besides, they do not repair if there is a wrong section. It is happened

because they only do the process monitoring, not until re-counting, and see whether the steps are suitable or not. with the strategy that they have. They tend to finish the monitoring that is done. At the end of this stage, they do not do reflection with different solution.

Based on the tendency that has been discussed, we can conclude that students' weaknesses in the problem solving are as follows:

1. Students can't connect the information with the correct concept,
2. Students do not understand about the concept that related with the problem,
3. Students do not represent the data in the form of tables, graphs, or other symbols,
4. Students tend to have an incorrect hypothesis,
5. Students tend to have a plan that is still wrong, so it affects the students to implement the wrong strategy,
6. Students do not check the final result,
7. Students do not repair on the wrong part,
8. The last, students do not reflect by using different solution.

However, based on the results of deeper analysis, there is a phase where students often make some mistakes, namely, reflecting stage. It is happened because in the research, none of students use a reflection by using different solution.

5. CONCLUSION

Based on the result of analysis and discussion related with students' problem solving level, it can be taken some conclusion. There are as follows:

1. The students tend to do exploring and understanding stage very well, while they can't connect it problem with the concept. On the representing and formulating stage, students tend to do less well because they tend to be able to formulate the problems that are given but cannot represent in the form of the tables, graphs, or other symbols and students tend to arrange a wrong hypothesis. On the planning and executing stage, students tend to set and do the plan that is wrong way while on the monitoring and reflecting stage, students tend to do a monitoring in process that is used but do not check the final result, and do not repair on the wrong part. In addition, students do not do the reflection with the different solution.
2. Students tend to have weaknesses in problem solving, such as relating the information with the concept, representing the problem, arranging the hypothesis, organizing and doing plans, checking out the final results, and making improvement and doing a reflection.
3. The major problem is they do not do reflection by using different solution.

6. RESOURCES

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