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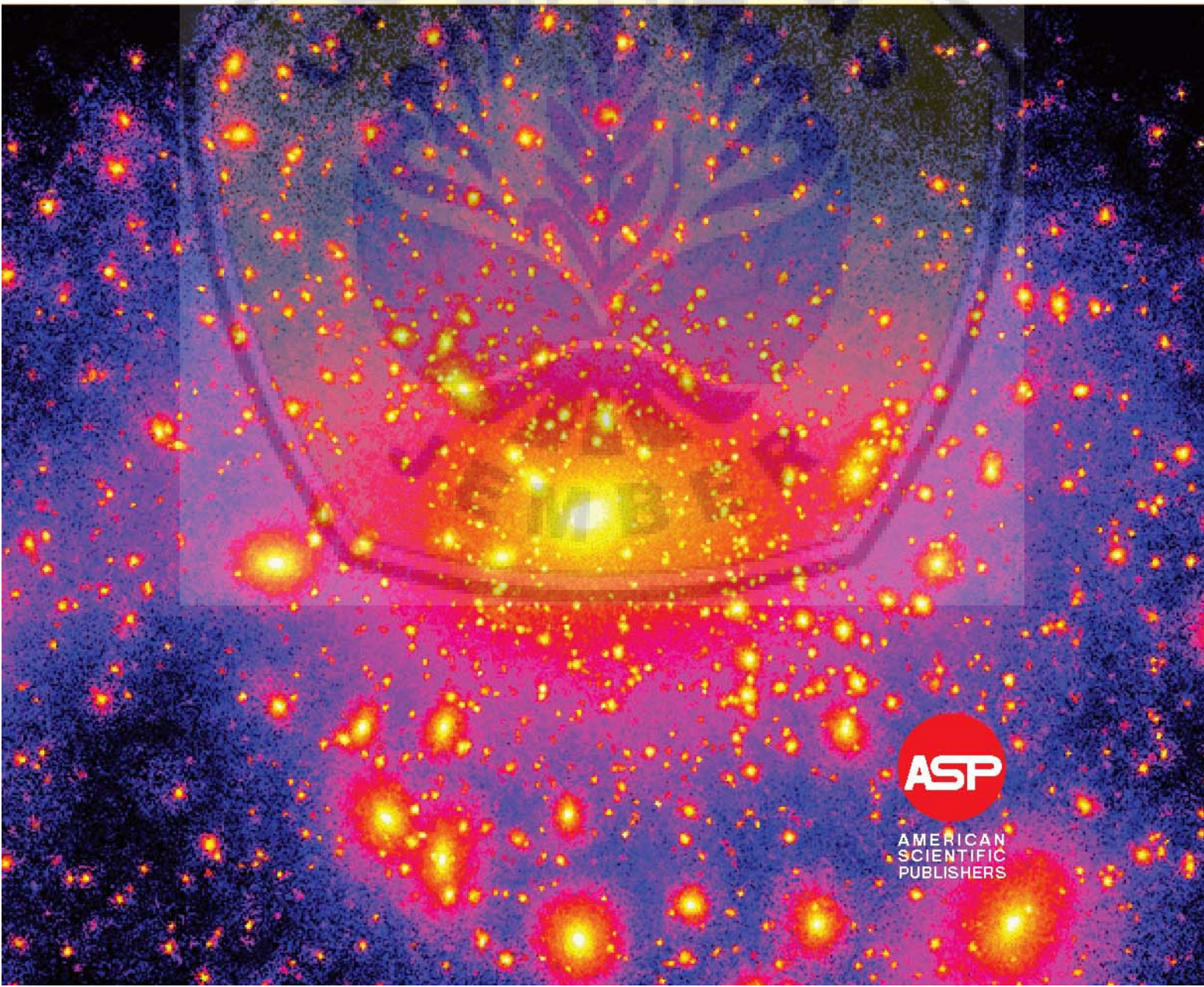

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# Analysis of Students' Mathematics Performance in Solving the PISA Standard Based Test Item Using a Qualitative Content Analysis Method

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The research aims to describe the gradation level and to analyze the math performance of students aged 15 years in Jember Regency, East Java, Indonesia in solving PISA standardized tests in 2015 using qualitative content analysis method. Questions used as a research instrument was essay questions which referred to the rules of PISA 2015 and adjusted to actual conditions in the students' environment. In this research, the analysis of student's mathematics performance would be based on three abilities namely formulating, implementing, and interpreting problems related to space and shape. The research participants were 120 students aged 15 years or born in 2002. Stages of this research referred to the stage of qualitative content analysis methods, namely (1) giving test, (2) presenting in detail about the mathematics performance of students, and (3) doing in-depth interview. The result showed that there were 20.8% of students at level 1, 19.2% of students at level 2, 20% of students at Level 3, 16.7% of students in level 4, 7.5% of students at level 5, 6.7% of students at level 6, 2.5% of students in level 7, 1.7% of students respectively at the level 8, 9, and 10, and 0.8% of students at level 11 and 12. In general, students in Jember Regency in solving PISA standardized tests in 2015 had a good performance because 40% of students were at level 1 and 2. The tendency of students having the ability to implement an idea in their mind was very optimal rather than the indicator of the ability to interpret and formulate.

**Keywords:** Mathematics Performance, the Qualitative Content Analysis, PISA Standard Based Test Item in 2015.

## 1. INTRODUCTION

Program for International Students Assessment (PISA) is the study of international student assessment programs organized by the Organization for Economic Corporation and Development (OECD) or the organization for economic cooperation and development. PISA study is carried out within a period of three years. PISA was first conducted in 2000 and most recently in 2015. The aim of PISA is to evaluate the education system in the world by testing school students who are aged 15 years in terms of skills and knowledge of mathematical literacy. From the results of PISA tests conducted in 2015, it showed that Indonesia's ranking was 62nd out of 70 countries [1]. This suggested that the skills and knowledge of students in Indonesia to mathematical literacy was still very low.

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PISA conducts an analysis to the results of science performance, students' attitudes towards science and expectations of science-related careers, reading performance, and mathematics performance, cognitive problem solving skills, students' performance and students' attitudes to the 70 participating countries [1]. The average score on the math performance of students in Indonesia who followed PISA was 386 with the ranks 62 of 70 countries took part.

The result was also consistent with the results of research specifically tested to Jember regency, namely students' cognitive skills in solving the problem of PISA standardized tests in 2012 in Jember Regency East Java Province Indonesia that was very low. Students in Jember regency tended to have weaknesses in the stage of solving the problems. The weaknesses were in the form of connecting existing information on the questions with the mathematical concept, representing a problem, constructing hypotheses, developing and

implementing the completion strategy, checking back to the solution of problems, as well as doing reflection [2].

Based on the explanation above, it was necessary to do an analysis to the mathematical performance of students aged 15 years, especially in Jember Regency, East Java province of Indonesia. Hence, it could be known a tendency of students thinking when they solved the PISA problems that was under reviewed from mathematical performance. Furthermore, referring to the results of the analysis in this research, the education practitioners in Jember, East Java, Indonesia was able to find a method or learning model of mathematics in order to ease students in completing PISA tests in 2018 and developed the ability of mathematical performance. In addition, the school was able to improve and develop the applied policy related to the students' habits in solving mathematical problems associated with their environment. On the other hand, the students had skill in applying mathematics learned in school in their daily lives.

The suitable analytical method used to analyze the mathematical performance of students in solving the problems of PISA was a qualitative content analysis method. A qualitative content analysis method is a systematic and objective means of describing and quantifying the phenomenon [3]. Besides, qualitative content analysis is a research method that analyzes the data in valid and reliable based on the real data, with the goal of in detail the abilities and knowledge of the research participants, presenting new thinking, and representing a fact of real activity [4].

Students' mathematical performance in solving the PISA standards-based test item refers to the ability of mathematical literacy of students aged 15 years. Literacy ability is the ability to formulate, implement and interpret the problems of the various contexts; to describe, predict, and explain the phenomenon; and to identify rules that are often used in everyday life related to mathematics [3]. Students' performance can be summarized on four scales, relating to space and shape, change and relationships, quantity, and uncertainty phenomena [5]. In this research, the analysis of student's mathematics performance would be based on three abilities namely formulating, implementing, and interpreting the problems related to space and shape. Space and shape relates to the material of geometry. Geometry is an important basis for this category which covers the phenomena related to the patterns, object properties, position and orientation, the representation of the object, decoding and encoding of visual information as well as dynamic navigation and interaction with other real forms. In addition, geometry is a fundamental branch of science in mathematics, and is an important material for students to develop the mathematical thinking skill [6]. Therefore, the mathematical performance can be seen in detail through problem solving activity related to the geometry.

First, indicators of the ability to formulate problems related to the theme of space and shape in this research were: (1) pouring a picture and information of PISA standardized questions about geometry material in their mind into the form of pictures, (2) using of picture's help in solving problems related to PISA standardized questions about geometry material, (3) mentioning the concepts correctly related to PISA standardized problems of geometry material, and (4) connecting between the data known to the concept owned. Second, the indicators of the ability to apply when solving the problems related to the theme of space and shape in this research were: (1) understanding the problem from the perspective of divergent, (2) sparking many ideas to solve the problems related to PISA standardized questions about geometry material, and (3) completing the given problem in detail and correctly. Third, the indicators of the ability to interpret the problems related to the theme of space and shape at this research were finding a pattern of PISA standardized problems about geometry material given and applying the results of geometry problem solving in everyday life.

## 2. RESEARCH METHOD

This research was a qualitative descriptive study. Stages of this research referred to the stage of a qualitative content analysis method. The stages were: (1) providing standardized test PISA 2015 focused on the material space and shape adapted to the real conditions of students in the Jember regency, (2) presenting in detail the mathematical performance of students in Jember referring to all the indicators of the three abilities which were based on the results of test, and (3) doing in-depth interview to the research participant with the aim of confirming and deepening the analysis of data presentation. In this research, the type used of interview was an unstructured interview. Unstructured interviews intended to obtain information that was deeper than the respondents who became the research participants.

The research participants were 120 high school students aged 15 years or born in 2002. The participants were spread to some levels of mathematical ability that was high, medium, and low. There were 76% of students from 120 research participants ever worked on PISA standardized questions in their school routinely. Hence, the questions given in this research was routine questions. The theme of the questions tested was related to geometry in high school and adapted to the real conditions occurred in Jember. The test was given by 4 essay questions. To determine the level of mathematical performance from level 1 to level 12, it can be seen in Table 1 as a reference. Students are said to have a good mathematical performance if its tendency is at level 1 and level 2.

Table.1. Level Criteria of Mathematical Performance

| LEVEL | A | B |
|---|---|---|
| 1 | √√ | √√ |
| 2 | √√ | X |
| 3 | √√ | - |
| 4 | √ | √√ |
| 5 | √ | X |
| 6 | √ | - |
| 7 | X | √√ |
| 8 | X | X |
| 9 | X | - |
| 10 | - | √√ |

| LEVEL | A | B |
|---|---|---|
| 11 | - | X |
| 12 | - | - |

Note:

A = The steps in completing questions
B = The last answer
√√ = Correct
√ = Not all correct
X = Wrong
- = No answer

## 3. RESULT AND DISCUSSION

The beginning stage of this research was to give PISA standardized tests 2015 focused on space and shape material adjusted to the real conditions of students in Jember regency. From the results of tests and interviews, there were 12 groups of students with level 1 to 12. This was because there was a similar analysis process of answering and the answer of some research participants. Each research participant was given a code Sxxx, with xxx was the serial number of research participants.

The results of the analysis of data for 120 participants and classified into 12 levels will be presented in Table 2.

Table.2. Level of students' mathematical performance

| CODE SUBJEK | LEVEL |
|---|---|
| S001 – S0025 | 1 |
| S026 – S048 | 2 |
| S049 – S072 | 3 |
| S073 – S092 | 4 |
| S093 – S101 | 5 |
| S102 – S109 | 6 |
| S110 – S112 | 7 |
| S113 – S114 | 8 |
| S115 – S116 | 9 |
| S117 – S118 | 10 |
| S119 | 11 |
| S120 | 12 |

Students classified in level 1 had tendencies of mathematical performance in solving the problems related to the theme of space and shape, namely (1) students were able to pour the information contained in test questions into the form of visual images (able to mention all the steps correctly and the final answers were correct); (2) Students were able to associate and apply the concepts related to the test questions given (able to mention all the steps correctly and the final answers were correct), (3) Students were able to complete the test questions given divergently (able to mention all the steps correctly as well as the final answer were correct), and (4) Students were able to find a pattern of test items given (able to mention all the steps correctly and the final answers were correct). Meanwhile, the tendencies of students at level 2, namely (1) The students were able to pour the information contained in test questions into the form of visual images (able to mention all the steps correctly but the final answers were not correct), (2) Students were able to associate and apply the concepts related to test questions given (able to mention all the steps correctly but the final answers were not correct), (3) Students were able to complete the test questions given divergently (able to mention all the steps correctly but the final answers were not correct), and (4) Students were able to find a pattern of a test items given (able to mention all the steps correctly but the final answers were not correct).

Furthermore, the tendencies of the students' mathematical performance who were at level 3 and level 4 had the similarity, namely (1) The student were able to pour the information contained in test questions into the form of visual images (able to mention all the steps correctly but there were no the final answers), (2) Students were able to associate and apply the concepts related to the test questions given (able to mention all the steps correctly but there were no the final answers), (3) Students were able to complete the test questions given divergently (able to mention all the steps correctly, but the answer no end), and (4) Students are able to find a pattern of a given test item (is able to mention all the steps correctly but there were no the final answers). While level 5, the tendencies of the mathematical performance were (1) The students were able to pour the information contained in test questions into the form of visual images (cannot mention all the steps correctly, and cannot give final answers correctly), (2) Students were able to associate and apply concepts related to test questions given (cannot mention all the steps correctly, and cannot give final answers correctly), (3) Students were able to complete the test questions given divergently (cannot mention all the steps correctly, and cannot give final answers correctly), and (4) Students were able to find a pattern of test items given (cannot mention all the steps correctly, and cannot give final answers correctly).

Next results was the tendencies of the mathematical performance of students in completing the test on level 6 namely (1) The students were able to pour the information contained in test questions into the form of visual images (cannot mention all the steps correctly, and there were no final answers), (2) Students were able to associate and apply the concepts related to the test questions given (cannot mention all the steps correctly, and there were no final answers), (3) Students were able to complete the test questions given divergently (cannot mention all the steps correctly, and there were no final answers), and (4) Students were able to find a pattern of test questions given (cannot mention all the steps correctly, and there were no final answers). As for level 7 and 8 the, tendencies were similar, namely (1) Students were not able to pour information contained in test questions into the form of visual images (all the steps were wrong, and the final answers were incorrect), (2) Students were not able to associate and

apply concepts related to the test questions given (all the steps were wrong, and the final answers were incorrect), (3) Students were not able to complete the test questions given divergently (all the steps were wrong, and the final answers were incorrect), and (4) Students were not able to find a pattern of test questions given (all the steps were wrong, and the final answers were incorrect).

The tendencies of the mathematical performance of students at level 9, 10, and 11 had the similarity, namely (1) Students were not able to pour the information contained in test questions into the form of visual images (the completion steps were not mentioned, but able to provide the final answer correctly), (2) Students were not able to associate and apply concepts related to the test item is given the completion steps were not mentioned, but able to provide the final answer correctly), (3) Students were not able to complete the test questions given divergently (the completion steps were not mentioned, but able to provide the final answer correctly), and (4) Students were not able to find a pattern of test questions given (the completion steps were not mentioned, but able to provide the final answer correctly). The last tendencies were the students at level 12 namely (1) Students were not able to pour the information contained in test questions into the form of visual images (the completion steps were not mentioned, and there were no final answers) (2) Students were not able to associate and apply concepts related with test questions given (the completion steps were not mentioned, and there were no final answers), (3) Students were not able to complete the test questions given divergently (the completion steps were not mentioned, and there were no final answers), and (4) Students were not able to find a pattern of test questions given (the completion steps were not mentioned, and there were no final answers).

Based on the tendency of each level of students‘ mathematical performance in solving PISA standardized 2015, it could be said that students in Jember regency, especially aged 15 years, had a good performance, although some indicators of the ability to interpret and formulate from a problem were less optimal. Therefore, it was necessary to do routine activities in PISA standardized problem-solving that focused the student to have a mathematical performance was optimal in all aspects.

In addition, based on the research results, it was known that 120 students as research participants had different problem solving abilities seen from each level of mathematical performance that were influenced by each learning applied in school and in environments. This was suitable with other research results which state that the results of each student’s performance in solving the problems by using standards of Trends in International Mathematics and Science Study (TIMSS) and the Program for International Students Assessment (PISA) have different tendencies which are influenced by environmental conditions, school policy and the development of students’ thinking ability [7]. Besides, accustoming students in solving the PISA problems, the teacher should invite the students to focus on mathematical performance. The school also must perform a new policy related to the use of the students’ environment in everyday lives in each activity of teaching and learning activities in the classroom either in determining the model or the method of learning, the instructional media, or the problems provided on students' worksheets.

## 4. CONCLUSIONS

The conclusions of this study showed that there were 20.8% of students at level 1, 19.2% of students at level 2, 20% of students at level 3, 16.7% of students at level 4, 7.5% of students at level 5, 6.7% of students at level 6, 2.5% of students at level 7, 1.7% of students respectively at level 8, 9, and 10, and 0.8% of students at level 11 and 12. In general, students in Jember regency in solving PISA standardized 2015 had a good mathematical performance because 40% of students were at level 1 and 2. The tendencies of students had the ability to implement ideas in mind were very optimal rather than the indicator of the ability to interpret and formulate. Some weaknesses of students' ability to interpret and formulate which included (1) the ability to pour a picture and information of problems standardized PISA of geometry material in their mind into the form of an image, (2) the ability of understanding mathematical concepts, (3) the ability to find patterns of problems standardized PISA, and (4) the ability to apply the results of geometry problem solving in everyday life.

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