

Strategies in Accomplishing Mathematics, Science, and Reading PISA Questions: A Case Study at Universitas Sriwijaya and Bengkulu University

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ABSTRACT

The purpose of this study was to determine the strategies used by students in solving PISA questions level 1, 2, and 3. The research method used was descriptive qualitative, with seven (7) students each for Undergraduate Mathematics and Education Education. English Language FKIP Palembang Campus Sriwijaya University, Strata 1 Natural Science Education FKIP Bengkulu University as research subjects. The results of this study indicated that from seven Mathematics PISA problems, the problem strategies used are guessing and testing strategies, calculating every possibility, and logical thinking strategies. Meanwhile, students' strategies in solving PISA Science questions used problem solving and metacognitive strategies that were used in solving PISA reading problems. The conclusion of this study is that the strategies used by students in solving problems depend on the peculiarities of the questions given.

Keywords: Problem solving strategy, Scientific method, Metacognitive strategies, PISA.

1. INTRODUCTION

Solving problems from real life which includes the ability to understand problems, design mathematical models, solve models, and interpret the solutions obtained is one of the goals of learning Mathematics. Students are required to be able and skilled in solving problems and relating mathematical concepts in everyday life [1]. In addition, Mathematics learning emphasizes the methods, strategies, or procedures that students use in solving math problems until they find answers [2]. Teachers are expected to be able to provide problems with a variety of solutions, so that students are not only fixated on one strategy in solving problems. The ability to solve problems can help students get used to solving a problem both in Mathematics and in everyday life [3], [4].

The Indonesian evaluation system still uses a low-level problem was one of the factors from the lack of students' ability in solving the problems such as PISA [5],[6]. In solving math problems, students can only use one strategy. In fact, every problem can be solved with various strategies. This made the researcher want to

know what strategies emerged when the PISA Mathematics questions were tried out in the FKIP Unsri Mathematics Education strategies are methods, steps, or techniques that students use in solving math problems. Some of the problem solving strategies in this research are; open sentence writing strategy (S1), guess and test strategy (S2), table making strategy (S3), drawing or diagramming strategy (S4), calculating every possibility (S5), logical thinking strategy (S6), and finding strategy pattern (S7). With a 4-step problem-solving approach, namely; 1) understand the problem, by determining what is known and what is asked; 2) planning solutions, by gathering information, looking for relationships with existing problems, and identifying usable theorems. 3) solve problems, by carrying out the solutions that have been planned; 4) checking, by reviewing the results, checking the calculations, and concluding the results [7].

Furthermore, solving problems in science problems requires the use of scientific thinking. In the world of research, the use of the scientific method has been recognized by researchers internationally. The case for solving PISA-IPA problems requires a tactical and

practical strategy, namely using problem solving. Several strategies in problem solving 1) identify problems, determine steps, solve problems, 2) get patterns, make graphs, use pictures, 3) make patterns and work in reverse or trial and error [8].

Meanwhile, the importance of reading literacy is shown in the results of achievements among international countries [22]. However, reading literacy has not become a culture in Indonesian students. There are still many students who have not used reading strategies to improve their understanding [9],[10]. Teachers in Indonesia face a serious situation because many students have difficulty reading well [11]. This situation should be taken into consideration because reading is an important and critical skill for students to achieve educational success. Recent research on reading has shown that reading is a complex cognitive activity that is essential for obtaining information. A number of studies have been conducted to investigate metacognitive reading strategies [12-15] used by students while reading academic texts. The study found that students used certain reading strategies in their reading activities to construct meaning in the text, and the use of reading strategies was related to their reading achievement and ability. Students are active readers when they read the text because they use certain ways to understand the text. They use certain methods to help them understand the content of the text.

Metacognitive strategies are considered "high-level executive skills that utilize knowledge of cognitive processes and are attempts to regulate learning by themselves by means of planning, monitoring, and evaluation. Metacognitive strategies are" monitoring and regulatory mechanisms that readers consciously use to improve comprehension," In reading, metacognitive strategies are self-monitoring and self-regulation activities that focus on reading processes and products [16], [17]. Students use metacognitive strategies in solving reading problems. However, the majority of students are unable to solve reading problems. For this reason, the researcher wants to know what metacognitive sub-strategies are used by students by testing reading PISA questions to undergraduate English students in semester 3. In line with the three main abilities, metacognitive has four strategies can be used by learners as a reading problem solving strategy, namely: 1) early reading, 2) reading concentration, 3) understanding meaning, and 4) building and expanding meaning.

2. METHOD

The research method used in this research is descriptive research which aims to identify and elaborate the strategies used by students in solving Mathematics, science, and reading PISA problems. The subjects of this study were 21 students with the

following details: a total of 7 Semester 4 students of the FKIP Unsri Palembang campus, 7 semester 4 students of the Science Education Study Program FKIP Bengkulu University, and 7 semester 4 students of the English Education Study Program, Indralaya Campus. By devising purposive sampling technique, data collection were carried out by providing 6 valid Mathematics, science and reading PISA questions. To analyze the data, the following steps were implemented: (1) collecting various information or data. (2) to analyze the overall information or data obtained. (3) make a description of the students' problem solving strategies.

3. RESULTS AND DISCUSSION

Before the PISA math question sheets were given, the researchers explained that in answering the questions, students were given the freedom to carry out their solving strategies. For the time for taking the test questions, it is quite effective because it is in accordance with the time determined by the researchers, which is 30 minutes, although there were students who can solve the questions in a shorter time. After the data was collected, the researchers adjusted the student work results to the assessment rubric and the strategies it used. From here the researchers grouped students into 3 groups, namely the high, medium, and low groups. From this grouping, the researcher prioritizes students who belong to the high group so that their strategies can be seen and are in accordance with this research. So that researchers get 7 prospective research subjects. Of the ten prospective research subjects, the researcher discussed with the research team to determine the research subject by assigning 7 students as research subjects. This also applies to the Science and English groups. English Study Program students are given 30 minutes to work on reading PISA questions. The time for processing test questions is quite effective in accordance with the time determined by the researcher. None of the students could finish prematurely. Three of them were able to be on time, while the other four were added a little, namely 10 minutes. After the data was collected, the researcher adjusted the student work results to the assessment rubric and the strategies it used. Based on these results, students were only grouped into 2 groups, namely the high and low groups. From this grouping, the researchers prioritizes students who belong to the high group so that their strategies can be seen and are in accordance with this research.

3.1. Description of the Analysis Stages

The research subjects were asked to solve Mathematics PISA questions with details of 3 level 2 questions, 2 level 3 questions, 2 level 4 questions. The following is one of the level 2 questions given to students.

Buses Scoring 1
 Question Intent:
 Process : Demonstrating knowledge and understanding
 Theme : Forces and movement
 Area : Science in technologies

To see the strategies used by all students during the written test, it can be seen in Table 1.

Table 1. Student' Strategies in solving problems in Mathematics

Strategies	Students					
	1	2	1	2	1	2
Guessing and Testing (S2)	X	X	X	X	X	X
Counting every possibility (S5)	X	X	X	X	X	X
Logical thinking (S6)	X	X	X	X	X	X

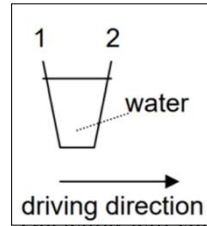
Table 1 shows no one uses the open sentence writing strategy (S1), all students use the guess and test strategy (S2), no one uses the strategy of making tables (S3) and making pictures or diagrams (S4), all students use strategies to count every possibility (S5) and think logically (S6), and no one uses pattern finding strategies (S7). Meanwhile, the problem solving steps used by students are understanding problems, planning solutions, solving problems, and checking.

The following is one of the student answers:

The case:
 Distance to aunt's house = 6km = 6000m
 Average trips = 18 km / hour
 Question: The correct statement?
 average trip = 18 km / hour
 distance to aunt's house = 6km → 6000m
 $18000m / 3600s = 6000m / t$
 $18000m \times t = 21600000 m / s$
 $t = 1200s$
 $t = 20 \text{ minutes}$
 It took Helen 20 minutes to get to her aunt's house.

The research subjects of 4th semester students of Science Education Study Program FKIP Bengkulu University were asked to solve PISA-Science questions with details of 3 low level questions, 2 medium level questions, 1 height level questions. The following is one of the medium level questions given to students:

A bus is driving along a straight stretch of road. The bus driver, named Ray, has a cup of water resting on the dashboard. Suddenly Ray has to slam on the brakes. What is most likely to happen to the water in the cup?



- a. horizontal.
- b. over side 1.
- c. The water will spill over side 2.
- d. The water will spill but you cannot tell if it will spill at side 1 or side 2.

Table 2 is the strategy used by all students during the written test, it can be seen in the following table.

Table 2. Student's Strategies in solving problems in PISA science

Strategies	Students						
	1	2	3	4	5	6	7
Identifying problem	X	X	X	X	X	X	X
Doing Trial and error	X	X	X	X	X	X	X
Using pictures	X	X	X	X	X	X	X
Getting patterns	X	X	X	X	X	X	X
Solving problem	X	X	X	X	X	X	X

Meanwhile, the research subjects of the English Education Study Program were asked to solve the PISA questions to read in detail each of the two questions representing levels 1, 2, and 3. The following is one of the level 2 questions given to students.

3.2 Discussion

Based on the results of the study, it is known that 6 PISA test questions number 1 is a varied problem for 4th semester students. This question is a half-open question, that is, with one correct answer but can be searched for in various ways of solving [10]. This can

Macondo

Fascinated by so many extraordinary discoveries, Macondos had no idea where their astonishment began. They stayed up all night looking at the pale electric light bulb fed by the plant that Aureliano Triste brought back when the train made its second journey, and it took time and effort for them to get used to his obsessive toom. They become angry at the vivid image projected by affluent merchant Don Bruno Crespi in a theater with lion head ticket windows, for a character who has died and is buried in one film, and whose tears of distress have been shed, will reappear alive and turn into an Arab at the next moment.

be seen from the various ways used by the five research

The audience, who paid two centavos each to share the difficulties with the actors, would not tolerate the bizarre fraud and they dismissed the seats. The mayor, at Don Bruno Crespi's insistence, explained through the proclamation that the cinema was an illusionary machine that was inappropriate to blow the emotions of the audience. With that discouraging explanation, many feel that they have been the victim of some new and flashy gypsy business and they decide not to return to the cinema, given that they already have too many problems to cry over the imaginary misfortunes of creatures.

Question:

At the end of this reading, why did Macondos decide not to go back to the cinema?

- A. They want entertainment and distraction, but they find the film realistic and depressing.
- B. They cannot afford the ticket price.
- C. They want to save their emotions for real life events.
- D. They seek emotional involvement, but what they find are boring, unconvincing, poor quality films

subjects to solve test question number 1. The methods, steps, techniques, or stages of work that a person uses in solving problem-solving problems are called problem solving strategies [4]. From the test results, it is known that PISA math problems can be solved with 3 strategies, namely guessing and testing strategies, calculating every possibility, and logical thinking. The strategy was chosen as a technique for solving practical problem solving problems. In accordance with the characteristics of problem solving problems, that is, a problem becomes a problem only if it shows a challenge that cannot be solved by routine procedures known to the problem solver [11]. In addition, problem solving problems require students to find a relationship between prior knowledge and a given problem, involving manipulation or operation of previously known knowledge, etc. This is evident when students work on PISA math questions, students can link various mathematical concepts to get solutions to the problem solving problems given.

The results showed that the 6 items of PISA-science received various responses from students. For example, question number 1. In general, students answered with strategies to identify problems, get patterns, trial and error. Problem number 1 requires students to implement Newton I's law in driving activities even though the interview found students who did not know what concept underlies in answering the questions. For prospective teachers, knowing PISA questions is very necessary because curriculum changes in Indonesia are very much in line with PISA and curriculum change in Indonesia is the impact of the PISA program [18]; [19]; [20]. From the test results, it is known that PISA-science questions can be solved with 4 strategies, namely

strategies to identify problems, use pictures, get patterns, trial and error, and solve problems.

Based on the results of the study, it is known that the six PISA test questions number 1 is a varied problem for semester 3 students. This question is an open answer question in the form of one correct answer using various metacognitive strategies. This narrative text-type problem has aspects to integrate and interpret or develop interpretations [21]. The purpose of this question is to deduce the reasons for the character's personality. This is evidenced by the variety of strategies used by students.

The initial reading strategy consisted of five strategies, as many as four students chose the strategy of reviewing the reading thoroughly, two people used the strategy to activate their knowledge, and only one person used the strategy to connect what they already know. Furthermore, a reading focus strategy consisting of five strategies was used by four students in terms of strategies for reviewing subtitles and illustrations. The strategy of understanding meaning consists of three strategies carried out by six students, namely the strategy of monitoring understanding and the rest using the strategy of associating. Meanwhile, the strategy of building and expanding meaning consists of two strategies: four people choose a strategy to make a summary text and three people choose a strategy to discuss common meanings.

All metacognitive strategies were carried out by students [16]. However, there are strategies that are not used at all in each of the main strategies. First, two of the five strategies for reading were not used, namely the strategy of formulating reading objectives and making predictive questions. Another strategy is understanding meaning which consists of three strategies, one of which is not used, namely the strategy of assessing and revising predictions.

4. CONCLUSION

Based on the research results, for the first question, the seven research subjects used a strategy of guessing and testing, calculating every possibility, and thinking logically. The first problem of PISA-IPA, the seven research subjects used the strategy of identifying problems, trial and error, using patterns, solving problems. Even though students have used various metacognitive strategies, they still have difficulty solving PISA reading problems. This is evidenced by the results of answering Mocondo's narrative reading questions, only two students were correct using metacognitive strategies by activating knowledge at the beginning of reading and ending with strategies for making text summaries. Thus it can be concluded that the strategies used by students in solving problems depend on the peculiarities of the questions given.

The recommendations that can be given based on the results of this study are as follows:

- a. For teachers, it is hoped that they will provide students with PISA math, science, and language questions and teach various appropriate problem solving strategies, so that students get used to solving problem solving problems.
- b. For students, to practice problem solving problems more often so that they can find other strategies, not just sticking to one strategy.

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