

Student's Obstacle in Solving PISA Like Task: An Error Analysis

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ABSTRACT

The PISA survey every three years gives unsatisfactory results since Indonesia was involved in the assessment. The habit of implementing PISA-type questions in schools has not been maximally pursued and is only limited to knowledge. This allows students to make many mistakes in solving PISA-type problems. This study focuses on describing the types of student errors in solving PISA-like problems using the NEA (Newman Error Analysis) procedure. The research was conducted at SMP IT Ibnu Sina Merauke Regency by taking 3 students as research subjects based on the number of mistakes made in working on the two number questions that had been tested for validity. The results showed that the highest error was in the aspects of process skills and writing conclusions or final answers, the transforming aspect, the understanding aspect and the lowest was the reading aspect. The implication of this research is to suggest that students need to be accustomed to working on PISA-type questions for formative and summative assessment with the aim that students will find it easier and more accustomed to solving problems, especially for their application in the future.

Keywords: PISA, Error Analysis, Newman Introduction

1. INTRODUCTION

The process of thinking of students towards learning materials, especially mathematics subjects, is given a sharp spotlight on the present. The quality of human resources is increasingly competitive with the global world which requires Indonesian students to be more observant and thorough in solving problems. In addition, the use of media, strategies and learning methods has developed rapidly to achieve learning objectives [1]. [2] revealed that the process of solving problems is a fundamental thing that humans must have. This is also stated in [3] that learning mathematics is closely related to four aspects, namely problem solving, reasoning and proof, mathematical connections, mathematical communication, and representation. The NTM framework becomes a reference for each developed country to design a numeracy capability assessment based on these four aspects. PISA, which is a program under the OECD organization, also coined the term "mathematical literacy". According to [4] mathematical literacy requires someone to be able to communicate, solve and interpret a contextual problem. Ironically, Indonesia as a country that participated in the survey has not provided encouraging results from year to year. PISA results in [5] [6][7] show that Indonesia's ranking is still

at a low level. [8] revealed that the character of hard work of students in Indonesia is still very low in terms of solving math problems. The low effort of these students can be seen how their process is when working on questions with the PISA type. [9] revealed that the PISA model questions require students to be able to apply, process, predict and interpret contextual problems and interpret the series of processes. The habit of giving questions on the PISA model in schools has not been carried out, it is only limited to knowledge. This allows students to make many mistakes because students are not trained to think at high levels which is one of the characteristics of PISA questions. [10] Revealing students' mistakes in working on questions needs to be done in-depth analysis to find out what factors are the causes. [11] [12] Suggesting Newman's Error Analysis (NEA) is an effective procedure for analysing student answer errors which consist of reading errors, understanding errors, transforming errors, processing errors, and errors concluding answers. Based on the opinion of [13] students made many mistakes in the aspect of understanding the problem. Research [12] indicated that the mistakes most often made by students were errors in understanding the problem and errors in writing answers. Meanwhile, research [14] revealed that students with various mathematical abilities will give

various types of errors as well. [15] revealed that the highest percentage of errors was the misunderstanding of the problem and the error of transforming.

Based on the research context above, the focus of this study is to describe students' mistakes in solving PISA questions based on the NEA procedure. The questions used in this study were questions about the PISA model at the basic level whose validity had been tested.

2. RESEARCH METHOD

This study uses qualitative methods to more accurately reveal the mistakes made by students in solving mathematical literacy problems. This type of research is a case study research. [16] argues that this study aims to collect data, take meaning and gain understanding of the case. The strength of this research is that researchers can obtain in-depth data about human phenomena through direct observation and in-depth interviews with subjects. This research was conducted at SMP IT Ibnu Sina Merauke City. Researchers determined the research subjects using purposive sampling or sampling technique with certain considerations. The research subjects were taken based on the student's ranking from the test results. From the ranking, 3 students were taken from the number of mistakes made while doing the test. The selection of subjects from different groups was carried out in order to obtain complete information.

Table 1.1 Types Of Errors In Nea Stage

No.	Type of Error	Error Code
1.	Reading (reading) Indicator: Students have difficulty understanding the meaning and terms in the questions	F1
2.	Understanding the problem (comprehension) Indicator: Students are not able to reveal what information is known and asked in the questions	F2
3.	Transformation of the problem (transformation) Indicators: Students are able to express what is known and asked in the questions but does not know what operations or strategies will be used to solve the questions	F3
4.	Process Skills Indicator: Students do not know what procedure is used to complete the operation appropriately	F4
5.	Writing the final answer (encoding) Indicator: Students are able to solve problems correctly but cannot conclude into mathematical sentences	F5

The data collection method used was the provision of a Mathematical Literacy Ability Test (TKLM) as much as two items in description and interviews. To test the

validity of the data, the researcher used two data collection techniques, namely test and interview techniques. Test questions are used to determine the type of error committed and interview techniques are used to determine the cause of the error. The research instrument was in the form of TKLM questions and semi-structured interview guidelines. The data is presented in the form of descriptive supported by the student's TKLM result answer sheet according to the Newman procedure error analysis stages including: Reading, Comprehension, Transformation, Process Skills, and Encoding. Indicators for each type of error can be seen in table 1.1.

The TKLM questions used had gone through the validation stage so that the TKLM questions were obtained that were at least in the valid category. The criteria for the validity of the TKLM equipment can be seen in table 1.2

Table 1.2 Description Of Validator Assessment Results

Category	Percentage of Earnings
Very Valid	75% < Value ≤ 100%
Valid	50% < Value ≤ 75%
Enough Valid	25% < Value ≤ 50%
Invalid	0% < Value ≤ 25%

Decision making on the validity of the instrument is based on the validator's consideration based on the scoring guidelines in table 1.3.

Table 1.3 Description Of Validator Assessment Results

Score	Criteria
Score 1	Indicator suitability tidak valid
Score 2	Indicator suitability valid
Score 3	Indicator suitability enough valid
Score 4	Indicator suitability invalid

TKLM validation and interview guidelines involve 2 lecturers who are competent in their fields. The validation process is carried out in 2 stages.

Table 1.4 Tkml Final Validation Results

Components	Percentage		Percentage average (%)	Criteria
	Validator 1	Validator 2		
Content/ Material	70,65	71	70,82	Valid
Design	72,5	70,55	71,52	Valid

Stage 1 does not meet the validity criteria and still needs to be revised. So that it is continued with stage 2 until the instrument is valid. The validity criteria are presented in tables 1.4 and 1.5.

Table 1.5 Final Validation Results Interview Guidelines

Components	Percentage		Percentage average (%)	Criteria
	Validator 1	Validator 2		
Construction	71,25	72,45	71,85	Valid
Language	70,50	70,55	70,52	Valid
Material	71,75	71,35	71,55	Valid

Based on the TKLM validity test and interview guidelines, it was found that the two devices were valid or fit for use for research

3. RESULT AND DISCUSSION

After students work on the TKLM questions, then check the results of the work and group the types of errors made by each student. The results of grouping the errors in question number 1 are presented in table 1.5.

Table 1.6 The Student's Error on Problem Number 1

Subjects	Error In Problem Number 1					Number of Errors
	F1	F2	F3	F4	F5	
S01	0	0	0	0	1	1
S02	0	0	1	1	1	3
S03	0	0	0	1	1	2
S04	0	0	0	1	1	2
S05	0	1	0	1	1	3
S06	0	1	0	1	1	3
S07	0	0	0	1	1	2
S08	0	0	0	1	1	2

Subjects	Error In Problem Number 1					Number of Errors
	F1	F2	F3	F4	F5	
S09	0	0	0	1	1	2
S10	0	0	0	1	1	2
S11	0	0	1	1	1	3
S12	0	0	0	1	1	2
S13	0	1	0	1	1	3
S14	0	1	1	1	1	4
S15	0	0	1	1	1	3
S16	0	0	0	1	1	2
S17	0	0	1	1	1	3
S18	0	0	0	1	1	2
Amount	1	6	7	17	18	51

Based on table 1.6, it is found that students who made mistakes in F1 were 3 students, namely S14 and S17. In Type F2 there are 8 students including S03, S05, S06, S11, S13, S14, S17, and S18. The error type F3 was made by 9 students including S03, S07, S09, S10, S11, S14, S15, S17, and S18. The most errors in type F4 and F5 were made by students, namely 15 students in type F4 including S02, S03, S05, S06, S07, S08, S09, S10 and S11. The type of error F5 was the most common, 17 students made this type of error except for S01.

After categorizing the errors in question number 1, the same thing was done in question number 2 which is presented in table 1.7.

Table 1.7 The Student's Error on Problem Number 2

Subjects	Error In Problem Number 1					Number of Errors
	F1	F2	F3	F4	F5	
S01	0	0	0	0	1	1
S02	0	0	1	1	1	3
S03	0	0	0	1	1	2
S04	0	0	0	1	1	2
S05	0	1	0	1	1	3
S06	0	1	0	1	1	3
S07	0	0	0	1	1	2
S08	0	0	0	1	1	2
S09	0	0	0	1	1	2
S10	0	0	0	1	1	2
S11	0	0	1	1	1	3
S12	0	0	0	1	1	2

S13	0	1	0	1	1	3
S14	0	1	1	1	1	4
S15	0	0	1	1	1	3
S16	0	0	0	1	1	2
S17	0	0	1	1	1	3
S18	0	0	0	1	1	2
Amount	1	6	7	17	18	51

In table 1.7, it can be seen that the majority of students made mistakes with type F4 and F5. Only 1 student made a type F1 error, namely S14, while for type F2 there were 6 students including S03, S05, S06, S09, S13, S14. The error type F3 was carried out by 7 students, namely S02, S03, S09, S11, S14, S15, S17. Furthermore, the error type F4 was made by all students except S01 and in type F5 errors were made by all students without exception.

The next step carried out by the researcher was selecting 3 subjects to be interviewed with the consideration that the three subjects made various mistakes in questions 1 and 2, and they had good communication skills. The three students who will be the subject of the study are S14 with a total of 10 errors made, each of which is 5 types of errors in numbers 1 and 2. The second subject is S03 with a number of errors 8 in numbers 1 and 2. Each number has 4 the type of error to create. The next subject is S09 with a total of 7 errors each of the 3 types of errors in number 1 and 4 types of errors in number 2. The following details the types of errors made by each research subject.

Tablee 1.8 Details of Selected Research Subjects

Subject Code	Fault Location no.1	Fault Location no.1	Number of Errors
S14	F1, F2, F3, F4, F5	F2, F3, F4, F5	7
S03	F2, F3, F4, F5	F4, F5	6
S09	F3, F4, F5	F4, F5	5

After determining the subject of the next study is to conduct interviews with each subject based on the interview guidelines and the results of the TKLM students' work.

A. Results of Error Analysis S14 in Problem Number 1

Subject S14 is the subject with the most mistakes, namely 10 errors. TKLM number 1 S14 made 5 types of errors. This means that all questions were not answered

correctly. All error types F1, F2, F3, F4 and F5 are committed by S14.

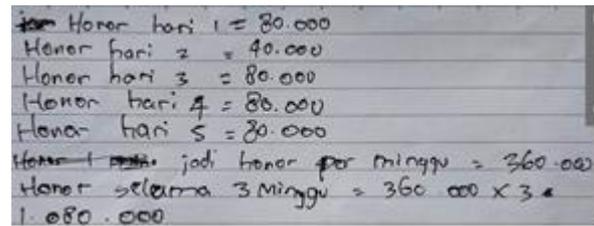


Figure 1. Work Result S14 Problem Number 1

From the results of the interview at the reading stage S14 was not able to understand the questions well. S14 considers the questions to be too long and difficult to identify the purpose of the questions, too much information is provided and confusing (F1). Because they did not understand the problem, S14 had difficulty writing down what was known and asked (F2). It can be seen that S14 has made a mistake in calculating (transforming the problem) so that the effect is an error of type F3. S14 cannot explain the calculation process so that the results of employee salaries are obtained from day 1 to day 5. He got this value without the right reason so that it is certain that there are errors in type F4 and F5.

B. Results of Error Analysis S14 in Problem Number 2

In question number 2 S14 did not carry out the appropriate procedure for handling questions. In the reading process, S14 admitted that he could imagine the direction of the wind which would be the benchmark in answering question no.2. S14 can understand the word "parallel" which means the position of the ship from its original point is in line, this indicates that the error of type F1 was not carried out by S14. At the stage of understanding the problem, S14 did not write down what was known and asked in the questions, as a result, it can be ascertained that S14 made an error of type F2. S14 revealed that the subject forgot to include the elements that were known and asked about in the questions, because according to him the description of the sktsa was quite clear to represent the information that was known. At the transformation stage, S14 does not perform a calculation or correct process of correctness.

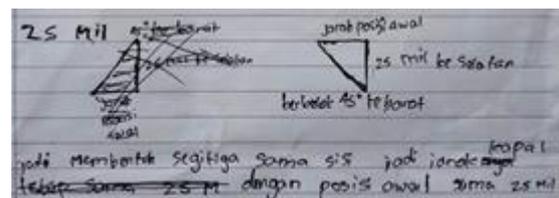


Figure 2. Work Result S14 Problem Number 2

The subject only estimates that the triangle formed by the ship's trajectory is an equilateral triangle, so that it can be stated that S14 made a type F3 error and its impact on the settlement process also occurred with an F4 type error

and the process of writing the final answer was also incorrect (F5).

C. Results of Error Analysis S03 in Problem Number 1

Students with code S03 are students with a number of errors 8 and there are 4 types of errors for question number 1.

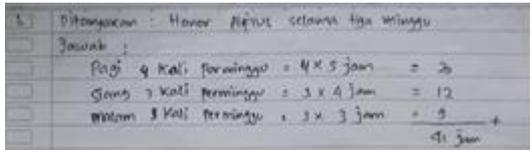


Figure 3. Work Result S03 Problem Number 1

The process of completing question number 1 by S03 at the reading stage of S03 admitted that she had clearly defined the meaning of the question. At the stage of understanding the problem S03 has written what was asked in the question but did not write down the information that was known. At the stage of transforming the problem, it is known that S03 can calculate the number of hours assigned. Subjects have been able to determine the length of work for 3 shifts, namely morning, afternoon and evening. Furthermore, the number of each shift is multiplied by the length of time worked for each shift. From the information it was found that S03 understood that Alfius worked less than 60 hours per week, because in a week he only worked 41 hours. However, in the answer there is no proper transformation process because the answer is incomplete, so it can be ascertained that S03 made a mistake in transforming the problem (F3). The results of the work of S03 only stop at the transformation process and are not continued with the skills in the process and writing of the final answer, so that it is certain to make mistakes of type F4 and F5.

D. Results of Error Analysis S03 in Problem Number 2

In the process of working on question number 2, S03 explained that the meaning of the question had been understood, namely in this question he calculated the distance of the ship after turning to its starting point, so it could be said that S03 had no difficulty in the aspect of reading. At the stage of transforming the problem, S03 only writes down the aspects in question, S03 argues that if you write down what you know, there will be a lot of things and what you know is already written in the picture, so it can be stated that S03 has been able to transform the problem and knows what strategy to use.

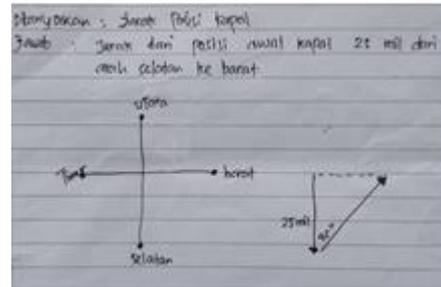


Figure 4. Work Result S03 Problem Number 2

At the process skills stage, S03 admitted that the questions could be sketched by making the cardinal directions to make it easier to answer. The cardinal directions are correct with the correct angle estimation. However, the decision to determine the distance was not correct because S03 was unable to identify the type of triangle formed from the three lines. As a result, S03 made a process skill error (F4). The next finding is that S03 does not encode in the form of drawing conclusions on answers. There is no explanation whatsoever as the final result of the answer to the questions, so it is certain that S03 has made a type F5 error.

E. Results of Error Analysis S09 in Problem Number 1

Before working on question number 1 S09, looking at the purpose of the question after reading over and over again the information contained in the questions, from the interview S09 admitted that it was a very long question that had to be really understood because the information in it would be closely related, so that S09 can be said to have made no mistakes in this aspect.

read. In the aspect of understanding the problem, he has been able to write down the elements that are known and asked in the problem. Writing the information that is known and asked is summarized in the form of important things that must be sought and found, it can be said that S09 did not make a mistake in understanding the problem.

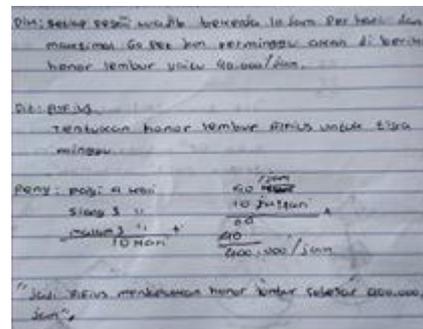


Figure 5. Work Result S09 Problem Number 1

When transforming the problem, the strategy used was not correct because it added up the working hours per shift which should have been multiplied by the length

of time he worked, so it was said that S09 made a type F3 error. In the process skills step, S09 was unable to use the calculation procedure correctly, according to the information in the previous process it was wrong so he made a type F4 error. In the process of writing the final answer has been done but it is not correct, therefore an error type F5 has occurred.

F. Results of Error Analysis S09 in Problem Number 2

From the results of the interview, S09 revealed that he could already understand the meaning of the question without having to read it over and over again, from the information it can be ascertained that the subject did not make mistakes in reading and understanding the questions. In the aspect of understanding the problem S09 did not write down what was known and asked, this aspect he put in the solution which should have been a different element when working on the problem. According to the explanation, he was confused about what to write about in these two aspects. According to him, using pictures is enough to explain the meaning of the problem, this shows that S09 has no difficulty understanding the problem.

Furthermore, in the process of transforming the problem, he uses a sketch of a ship whose position is parallel, he reveals that the ship is parallel, means that it is in line with its initial position, and thinks that this understanding is correct, therefore the stage of transforming the problem is correct. On the element of process skills, S09 admitted that he had difficulty applying the mathematical concepts used and in accordance with the problems, as a result the solving steps he used were not correct. From the test and interview data, it was confirmed that S09 had made a type F4 error.

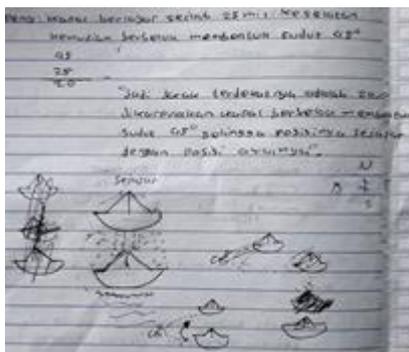


Figure 6. Work Result S09 Problem Number 2

Because the problem-solving process is not correct, the final answer S09 cannot be written correctly, resulting in an error type F5. The results of the analysis of the three students who have been the subject can be summarized in diagram 1.1 to further clarify the percentage of each type of error made.

Table 1.9 Error Type Percentage Diagram

Error	No.1	No.2	Amount	Percentage
F1	1	0	1	10%
F2	2	1	3	30%
F3	3	1	4	40%
F4	3	3	6	60%
F5	3	3	6	60%

The highest percentage based on the sampling of selected subjects, all students made F4 and F5 errors by 60%, transforming errors by 40%, understanding errors by 30%, and 10% for reading errors. The results of this study are in accordance with the findings of [12] that errors in understanding the problem are caused by the lack of knowledge of the students on the problems given, in this case the students are not trained in working on the PISA type questions. In the error of transforming a problem, students cannot determine what method or formula will be used to solve it [17]. Furthermore, [18] stated that errors in process skills include errors in calculations including incorrectly manipulating data and inaccuracy in calculating. It is in line with the opinion [19] that in transforming errors students tend not to write the appropriate answers because the process steps are not correct.

4. CONCLUSION

The types of errors made by the three subjects in solving the PISA questions gave different findings according to the types of errors made. The fewest reading errors were made because each subject had no problems in the aspects of language and communication, in the aspect of understanding the subjects tended to be unable to write down what was known and asked about the questions in their own language. In the aspect of informing students are less able to make a problem model into the language of mathematics or connect mathematical knowledge in accordance with the problem at hand. In the aspect of process skills, students are not able to apply predetermined formulas or make a logical flow that is part of the problem solving process. In the aspect of writing the final answer, students tend to depend on aspects of the process. The impact is that aspects of the process that are not right will result in conclusions and interpretation of wrong answers.

This research indicates that there is a need to get used to working on PISA-type questions to better train students in empowering the thinking process, especially in the aspects of communicating, processing and working as well as concluding and interpreting the results. With this habituation, students will be better prepared to face the challenges of life in the future.

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