Students’ Errors in Solving Mathematical Problems

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**Abstract**. Education is an important aspect so that success in education needs to be achieved by every single country in the world. Success in education can be seen from the results of assessments conducted on several subjects, one of them is mathematics. Based on PISA and TIMSS, Indonesian mathematics performance is still in the low rate. It means that many things need to be evaluated. This literature review examines students' errors in answering mathematical problems. This is for teacher's guidance in assessing student’s answers so that teachers can evaluate the existing learning. 10 articles from various accredited journals reviewed in this article. The results show that 21 students’ errors can be found in solving mathematical problems.

1. **Introduction**

Education is an important aspect so that success in education needs to be achieved by every single country in the world. Success in education can be seen from the results of assessments conducted on several subjects, one of them is mathematics. One of the platforms assessing mathematics performance is PISA (Program for International Students Assessment). In PISA 2018, [1] stated that the mathematics performance of Indonesian students positioned 73 from 80 participating countries. For more detail, the average score of Indonesian students was 379 while the International average score was 489.

Furthermore, TIMSS (Trends for Mathematics and Science Study) also conducts an international assessment in mathematics. TIMSS is an international-scale assessment assessing science and mathematics for students in grades 4 and 8. Based on the results of [2], Indonesia positioned 44 from 49 participating countries. This shows that the mathematics performance of Indonesian students is relatively low.

The low mathematical ability of Indonesian student needs to be improved by analyzing the reasons further. [3] states that the low mathematical ability can be seen from the analysis of mathematical ability measurement scores. Furthermore, [4] stated that teachers need to measure the abilities of students accurately because it can help students.

Measurement of students’ ability will detect difficulties experienced by students in solving mathematical problems. [5] stated that the teacher's diagnostic practice about student difficulties is important step to design and manage lessons in the classroom. Indications of the difficulties can be seen from students' mistakes in figuring out what was given and what was asked on the item [6]. Difficulty in solving mathematical problems can cause students to make some mistakes [7]. The students’ difficulty is related to the quality of learning carried out. In this case, one of efforts to enhance learning quality is by improving the quality of the assessment system [8].

In assessing mathematical ability, the important thing is to determine the right or wrong answers. In this case, students' wrong answers are needed to be aware in correcting their answers. As an illustration of what are the students' errors in answering mathematics problems, this literature review will discuss about students' errors in answering mathematical problems in order to find out the students' weaknesses. The aim of this literature review is to find out students' error in answering mathematical questions. Furthermore, because there must be appropriate choices and considerations before teacher implements learning strategies or techniques in the learning process according to the needs of students [9], knowing mistakes that are commonly made by students are evaluations to consider learning strategies and techniques probably applied in the classroom. This literature review can be used as a teacher's reference in giving assessment as well as evaluating various aspects in learning.

1. **Method**

2.1 Looking for procedure

This literature review has several procedures. Various studies from national and international reputable journals are examined. The studies taken are about analyzing student errors in solving mathematical problems. In this article, the data taken are empirical data. Data are collected by searching as many relevant sources as possible through Google, Research Gate and the webs of international and national journals. Keyword used is the analysis of students' error in mathematics. The articles used are published from 2000 to 2020.

2.2 Selection Criteria

Several criteria are applied to the articles taken as sources in this literature review. First, the articles taken contain empirical data about the analysis of student errors in answering mathematical problems. Second, the subjects are from elementary school students to high school. Third, the year of articles taken are published from 2000 to 2020 so that this literature review examines the newest articles expected. Therefore, ten articles from relevant sources reviewed in this literature review.

2.3 Coding strategies

In this study, several articles were chosen based on several considerations. The articles taken are about analyzing student errors in solving mathematical problems collected in the table with information below

* writers
* Publication Year
* Title
* Subjects

then, coding strategy is done to analyze the articles.

1. **Results and Discussion**

Based on the results of the articles search, 10 relevant sources are analyzed. The following table contains information of the articles.

**Tabel 1.** Overview of Student Error Analysis Study

|  |  |  |
| --- | --- | --- |
| Writer (Year) | Title | Subjects |
| I R Agustina , Mulyono &M Asikin (2016) | Students’ Errors Analysis of Grade VIII in Solving Essay Questions Based on Solo Taxonomy  | Grade VII Junior High School Number 2 Patebo |
| Hesty Marwani Siregar (2019) | Students’ Errors Analysis in Solving Mathematical Creative Thinking Ability on Circle Matter | Grade VII in One of Public Junior high Schools in Pekanbaru |
| Dinda Rahmawati & Laelatul Dhian Permata (2018) | Students’ Errors Analysis in Solving Linear Program Essay Questions with the Newman Procedure  | 15 students of Grade XI Senior High School Number 1 Wonosari  |
| Widi Pradini (2019) | Students’ Errors Analysis in Solving Two-linear Variable Equation in Form of Essay Questions  | 23 students of Grade VIII A Junior High School Number 1 Karangrejo, Magetan Regency, Jawa Timur |
| Magfirah, Erni Maidiyah & Suryawati (2019) | Students’ Errors Analysis in Solving Mathematical Essay Questions Based on The Newman Procedure  | 7 Students in Grade XI-2 Islamic Junior High Public School Model Banda Aceh  |
| Muhammad Irfan (2017) | Students’ Errors Analysis in Problem Solving Based on Mathematics Learning Anxiety | Junior High School Number 2 Ngaglik, D. I. Yogyakarta |
| Doni Indra Setiawan & Sri Adi Widodo | Students’ Errors Analysis in Solving Rectangular ProblemsBased on Cognitive Development | 4 Students of Grade VII Junior High School 15 Yogyakarta. |
| Ansyori Gunawan (2016) | Students’ Errors Analysis in Solving Essay Question in Mathematics Subject of Grade V Elementary School Number 59 Bengkulu | 55 students of Grade V Elementary School Number 59 Bengkulu consisting of two classes  |
| I Baskoro & H Retnawati (2019) | Analyzing vocational school students’ error in solving mathematics problems involving higher order thinking skills  | 12 students of vocational school |
| T I Pramesti & H Retnawati (2019) | Difficulties in learning algebra: An analysis of students’ errors | 65 students from middle schools in Bantul Regency, Special Region of Yogyakarta Province |

In assessing student assignments, teacher can encounter several errors or mistakes in student answers. Research [10] examines students’ errors analysis in solving essay questions based on Solo Taxonomy. The matter is about tangent circle. Some errors found from students' answers are misconceptions, error in using data, error in language interpretation, technical errors and error in giving conclusions. Furthermore, the study found the error of applying pythagoras theorem, writing formulas, calculating calculations and using irrational roots.

Furthermore, research [11] discusses the analysis of students' errors in solving mathematical creative thinking ability test questions. The matter is about circle. It was found that students used wrong concept, mentioned important information incorrectly related to the problem, did not answer the problem in different ways, calculated incorrectly and used the wrong formula.

[12] examines students' errors in answering linear program essay questions with the Newman Procedure. In this study, it was found that students could not interpret the intention of the questions given, find keywords of the questions given, write information and use mathematical symbols. In addition, it was found error in understanding that students did not figure out what was known and what was asked by the questions. The transformation errors were incorrect in writing mathematical information into mathematical symbols, determining the formula and performing count operations. The error in process skills were using wrong concepts and procedures and did not know the steps used to answer the questions. Furthermore, the errors of writing final answers were obtaining the wrong answers, showing the final of the answers incorrectly and being unable to write the final answers with conclusion.

Furthermore, [13] examines the students' errors in answering essay questions. The matter is linear equation of two variables. This research shows that students’ errors are in understanding problems, in devising plans to solve the problems and in solving problems. In this case, the types of students' errors are fact, procedure and carelessness error.

[14] discusses students' errors in answering essay questions. In this study, the questions given to students were related to solid geometry area namely cubes, rectangular solid, prisms, and pyramid. From the study, several mistakes by students in solving the questions was found. These are errors of transformation, skills and writing answers.

[15] analyzes the students' errors in solving problem solving questions under system of two-variable linear equations matter. In the study, several students’ errors in solving problems are found. The students' mistakes were errors in writing mathematical symbols, interpreting mathematical models and using symbols consistently.

 [16] examines students' errors in solving rectangular problems based on cognitive development. Moreover, there are two phases namely the concrete and transition phase in the study. In these two phases, it is shown that the errors made by students are not writing down what is known and what is asked correctly and drawing the solid geometry incorrectly. Moreover, students are wrong in preparing a plan to solve the problems and do not re-check the answers.

[17] examines the students' errors in solving mathematical essay questions. In this study, the questions are for grade 5. Students’ errors in solving the mathematical problems are understanding the problems given incorrectly, writing important information in form of what is known and asked of the problem incorrectly, making mathematical models incorrectly and calculating to write the expected conclusion incorrectly.

Furthermore, the research [18] remarks that there are also students’ errors in solving mathematics problems. In the study, subject matter is about subtracting and adding algebraic operations. Students’ errors are applying the concept incorrectly, doing the operation incorrectly and doing incorrect answers because of careless (wrong in applying the concept and doing the operation).

In research [19], there are some mistakes made by students in answering mathematical problems. Students read the questions incorrectly, calculated incorrectly, understood the problem incorrectly, did not write the reason of the solutions, did not write the conclusion or did not give conclusions and used concept incorrectly.

 [20] examines students’ errors in solving algebra problems. In this study, there are three errors related to students' difficulties in solving algebra problems. This study showed that students are wrong in understanding the problem, wrong in applying concept (errors in understanding the meaning of variables) and wrong in carrying out procedures (errors in operating algebraic forms).

Based on the studies, students' errors in solving mathematical problems are:
1. misconception
2. error in using data
3. language misinterpretation
4. technical error
5. error in giving conclusions

6. error in applying procedure

7. error in determining formula.

8. errors in calculation
9. errors in conveying important information related to the problem
10. do not answer the problem in different ways
11. error in reading
12. error in understanding the problem
13. process skill error
14. error in writing the final answer
15. error in devising plans
16. error in writing mathematical symbols
17. error in interpreting mathematical models
18. Inconsistent error in using symbols.
19. error in drawing solid geometry.
20. do not re-check answers.
21. do not write the reason of the solutions

1. **Conclusion**

Based on the discussion, there were 21 errors probably happened in solving mathematical problems namely: misconception, error in using data, language misinterpretation, technical error, error in giving conclusions, error in applying procedure, error in determining formula., errors in calculation, errors in conveying important information related to the problem, do not answer the problem in different ways, error in reading, error in understanding the problem, process skill error, error in writing the final answer, error in devising plans, error in writing mathematical symbols, error in interpreting mathematical models, Inconsistent error in using symbols, error in drawing solid geometry, do not re-check answers and do not write the reason of the solutions. The scores obtained are not complete on the item containing the errors. Therefore, students’ errors in answering mathematical problems need further research to find several solutions in order to overcome it.

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