Analysis of Student Errors in Solving Math Word Problems on Matrix Material: A Self-Confidence View Point

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Abstract

The purpose of this study was to describe students' mistakes in solving word problems on matrix material in terms of self-confidence. Therefore, this research is a descriptive research with a qualitative approach. The type of error refers to Newman. In this study, three research subjects were taken, namely one subject with high self-confidence with the highest number of errors, one student with moderate self-confidence with the highest number of errors, one student with low self-confidence with the highest number of errors. Data collection was carried out by means of written test questions, interviews and self-confidence questionnaires. In general, the results show that the subjects with high self-confidence had high self-confidence, were brave and were able to express their ideas so that subjects made mistakes in processing skills. and writing errors in the final answer. Subjects with moderate self-confidence have a lack of confidence, are afraid and feel dependent on others in answering math questions so that the subject makes reading errors, process skill transformation errors and final answer writing errors. Subjects with low self-confidence have low self-confidence, nervousness, lack of understanding of the material and anxiety so that the subject makes reading errors, process skill transformation errors and final answer writing errors.

Keywords:error analysis, word problems, self-confidence

INTRODUCTION

At present the development of education has been increasing rapidly, thus demanding educational institutions to adapt to existing developments, as a tool to produce quality and quality education. One of the sciences that supports the development of education is mathematics (Fitriatien, 2019). Mathematics lessons are also often associated with problems in everyday life. Problems in everyday life are usually set forth in story problems. Alamsyam (2020) states, story questions are questions that are related to everyday life problems and require students to think more deeply in order to understand what is known, asked and solve these questions with the right procedure so they can get the correct answer. In solving word problems students must be able to understand the content of word problems, convert them into mathematical models, and be able to solve these problems with the right procedures.

In addition to the ability to solve math problems, students also need to have good affective abilities, one of which is self-confidence. Students' self-confidence is also related to the ability to solve math problems. Students who are confident can use the best strategy to solve a math problem, students who are confident also have the ability to achieve certain targets as planned (Wulandari, 2018).

Based on the results of interviews from researchers with Mathematics teachers at MA Jannaturroichan Gempol Dampet Ngrandulor Peterongan Jombang, information was obtained that the ability to solve math problems in class XII between students was still very different. Students who can solve math problems are students who already have confidence in class and like mathematics. Mathematics teacher MA Jannaturroichan also explained that matrix material is one of the materials that is difficult for students to understand, due to students' lack of understanding regarding the concept of matrix material so that students experience many mistakes when solving problems related to matrix material. This is supported by the research of Khairani & Kartini (2021) in whose research results stated that students made many mistakes in solving matrix material questions, these errors occurred because students did not understand the concept of matrix material.

METHOD

This research is a descriptive research with a qualitative approach. This study uses a descriptive method because it aims to describe students' mistakes in solving word problems on matrix material in terms of self-confidence. The data obtained in the study were analyzed qualitatively with the stages of data reduction, presenting data and drawing conclusions.

The subjects in this study were class XII students at MA Jannaturroichan Gempol Dampet Ngrandulor Peterongan Jombang. The steps taken to obtain research subjects were: 1) The researcher gave a self-confidence questionnaire to class XII students at MA Jannaturroichan Gempol Dampet Ngrandulor Peterongan Jombang, 2) The researcher gave a story problem test to class XII students at MA Jannaturroichan, 3) based on the results Questionnaire and answers from class XII students then the researcher took three research subjects namely, one student with high self-confidence results with answers that were relevant to the questions given and the highest number of errors in solving the questions, one student with moderate self-confidence results with relevant answers with the questions given and the highest number of errors in solving the questions, one student with low self-confidence results with answers that are relevant to the questions given and the highest number of errors in solving the problems.

The research instruments are self-confidence questionnaires, written test questions, and interview guidelines. Data on students' self-confidence levels were obtained from a questionnaire that refers to aspects of self-confidence (a) Believing in one's own abilities (b) acting independently (c) having a positive self-concept (d) Dare to express opinions as presented in the following table:

Table 1. Aspects of *Self-Confidence*

Aspects of Self-confidence	Students' Behavior
Believing in on's own abilities	Believin in oneself
Acting independently	Making decisions / solving problems presented without the help of others
Having a positive self-concept	Diligent, confident, and not easily giving up when facing problems and failures
Having the courage to express an opinion	Being able to express something without coercion

The results of written test questions are used to obtain data on errors made by students. As for obtaining data related to the mistakes made by these students, the researcher adapted the error type indicators from Alamsyam (2020) which categorized them into 5 types of errors according to Newman, as described in table 2 below:

Table 2. Error Type Adaptation Indicator

Types of Errors	Indicators
Reading Errors	a. Error in finding keywords
	b. Error in reading symbol
Comprehension Error	a. Errors in writing down what is known
	b. Error in writing what was asked
	c. Incomplete in writing what is known
	d. Incomplete in writing what is asked
	e. Unable to write down what is known
	f. Could not write down what is asked
Transformation Errors	a. Error in converting into math model
	b. Error in writing the method used
	c. Do not write down the method used
	d. Unable to explain the method used
Process Skills Error	a. Does not write down the procedure for solving story problems
	b. Error in writing the procedure for solving word problems
	c. Unable to continue the story problem solving procedure
	d. Error in calculating
Encoding Errors	a. Errors in writing conclusions
	b. Do not write conclusions
	c. Unable to explain conclusion

RESULTS AND DISCUSSION

Results

The subjects in this study were determined using data obtained from the results of self-confidence questionnaires and test questions given to students. The self-confidence questionnaire and written test were administered to 20 students in class XII MA Jannaturroichan on August 20 2022. From the results of the self-confidence questionnaire and the results of the written test questions, three research subjects were taken: one student with high self-confidence results with answers that are relevant to the questions given and the highest number of errors in solving questions with Code S-10, one student with moderate self-confidence results with answers that are relevant to the questions given and the highest number of errors in solving questions with Code S-07, one students with low self-confidence results with answers that are relevant to the questions given and the highest number of errors in solving questions with Code S-03, as presented in the table below:

Table 3. Retrieval of research subjects

Student code	Self-confidence score	Self-confidence category	Number of errors
S-10	47	High	5
S-07	42	Moderate	7
S-03	34	High	8

From table 3 above, S-10 has a high self-confidence category with the highest number of errors, namely 5 and from the results of the questionnaire it is known that S-10 has high self-confidence and courage. S-07 has a moderate self-confidence category with the highest number of errors, namely 7. The results of the questionnaire also show that S-07 lacks confidence, is afraid and feels dependent on others in answering math questions. S-03 had a low self-confidence category with the highest number of errors, namely 8. The results of the questionnaire also showed that S-03 lacked confidence, was nervous, did not understand the material and was anxious in solving the questions given.

Data Exposure

A. S-10 (subjects with high self-confidence category with the highest number of errors)

From the results of the test questions and the results of the interviews, S-10 made several types of errors according to Newman, namely transformation errors, processing skills errors, and errors in writing the final answer.

Transformation error

In the first transformation error indicator, namely an error in changing to a mathematical model, S-10 was wrong in writing an example to express the score of each triangular shape, namely x as an equilateral triangle, y as an isosceles triangle, z as a right triangle.

Process skill error

In the first process skill error indicator, namely not writing down the procedure for solving word problems, S-10 could not write down and explain the z determinant procedure. In the fourth process skill indicator, namely an error in calculating, S-10 made an error in calculating the result of the determinant of matrix A, In this process S-10 was wrong in calculating the result of the determinant of matrix A, because the answer should have been 5, but S-10 answered 15.

Wrong writing of the final answer

On the error indicator for writing the second final answer, namely not writing the final answer or conclusion, S-10 cannot write down and explain the final answer or conclusion.

B. S-07 (subjects in the moderate self-confidence category with the highest number of errors)

Based on the test questions and interview results, S-07 made several errors, namely errors in reading, transformation, processing skills, and writing the final answer.

Error reading

On the first reading error indicator (i.e., keyword finding error), S-07 cannot specify the keyword. In the second indicator of reading errors (i.e., errors in reading symbols), S-07 was able to mention the symbols in the written test, but it was not complete.

Transformation error

In the first transformation error indicator (i.e., error in transforming into a mathematical model), S-07 could not write down and explain how to change to a mathematical model. In the second transformation error indicator (i.e., error in writing down the method used), in the answers to the written test questions, S-07 could not write down the method used; but during the interview, S-07 was able to explain the method used to complete the written test questions.

Process skill error

On the third process skill error indicator (i.e., unable to continue the story problem-solving procedure), S-07 was able to write down part of the solving procedure correctly and was unable to continue the solving procedure. In the fourth process skill indicator (i.e., an error in calculating), S-07 made an error in calculating the result of the determinant of matrix A. In this process, S-07 was wrong in calculating the result of the determinant of matrix A because the correct answer is 5, but he answered 15.

Wrong writing of the final answer

On the second error in writing the final answer (i.e., not writing the final answer or conclusion), S-07 was unable to write down and explain the final answer or conclusion.

C. S-03 (subjects in the low self-confidence category with the highest number of errors)

Based on the test questions and interview results, S-07 made several types of errors: reading, transformation, process skills, and final answer writing errors.

Reading error

From the results of the interviews, it is known that S-07 made a reading error on the first indicator, namely an error in finding keywords. S-03 is wrong in mentioning the keyword. On the second reading error indicator (i.e., a symbol reading error), S-03 could not name the symbols in the written test questions, namely a picture of a right triangle, a picture of an isosceles triangle, a picture of an equilateral triangle. |A| is the determinant symbol and A^(-1) is the inverse symbol.

Transformation error

The first transformation error indicator is an error in transforming into a mathematical model. In this process, S-03 made an error in entering the score value in the 3rd equation, namely 2x+5y+z=680 (which is correct, namely 2x+5y+z= 68). S-03 does not transform a system of linear equations into matrix form.

Process skill error

On the third process skill error indicator, namely, unable to continue the story problem-solving procedure, S-03 was unable to continue the completion procedure. In the fourth process skill indicator, namely an error in calculating, S-03 made an error in calculating the result of the determinant of matrix A. In this process, S-03 wrongly calculated the result of the determinant of matrix A because the answer should have been 5, but S-03 answered 150. S-03 also made an error in calculating the determinant of x. In this process, S-03 was wrong in calculating the result of the determinant of matrix A because the answer should have been 40, but S-03 answered 45.

Wrong writing of the final answer

In the second indicator of writing the final answer, namely, not writing the final answer or conclusion, S-03 cannot write down and explain the final answer or conclusion.

Discussion

A. The subjects with high self-confidence with the highest number of errors

Subjects with high self-confidence with the highest number of errors made several types of errors (i.e., transformation errors, process skills errors, and final answer writing errors).

It can be concluded that subjects with high self-confidence can write down all procedures or steps for completion, but there are errors in writing procedures. This means that high self-confidence also results in high students' ability to complete written test questions. This is evident from the results of the self-confidence questionnaire and the results of written test questions which show that students with high self-confidence have few errors. With high self-confidence, students have high confidence and courage in solving math problems. This is in line with the research by Akbar et al. (2018), which shows that the level of students' self-confidence influences student success in solving problems in learning mathematics. This is also in line with research conducted by Noviza (2019), which states that the higher the self-confidence of students, the easier it is for students to do the assignments given and are more capable, more careful, and more persistent in doing assignments. Sunaryo (2017) revealed that students' high self-confidence in mathematics lessons encourages students to be more diligent and have an attitude that wants to try to determine strategies or solve problems for each task given.

B. The subjects who have moderate self-confidence with the highest number of errors

Subjects with moderate self-confidence with the highest number of errors made several types of errors, namely reading errors, transformation errors, processing skills errors, and final answer writing errors.

Reading errors made by the subject were not complete in mentioning the symbols in the problem. Judging from the results of the written test questions, many students made reading mistakes. There were 12 out of 16 students who had moderate self-confidence and experienced reading errors. This is in accordance with research by Rindyana & Bintari (2013), which states that there are still many students who experience reading errors, namely as many as 84.4% of 30 students. Students who make reading errors occur because they cannot interpret the sentences or symbols they read properly.

In the transformation error, the subject makes an error when transforming into a mathematical model. The subject could not write down the mathematical model in the answers, which was reinforced by the interview results indicating that the subject had difficulty explaining how to change to the matrix model. This is in accordance with the research of Rindyana & Bintari (2013), which states that students make transformation errors because they cannot arrange the meaning of the words they think of into mathematical forms.

In process skill errors, the subject makes an error because he cannot continue the procedure or completion steps, and the subject makes an error in the calculation. From the results of the interviews, the subject could only explain the procedures or steps for completion due to a lack of students' understanding of the matrix material. This is in accordance with Gunawan's research (2017) which states that process skill errors occur because students do not master the material and calculation concepts. This is also in accordance with the research by Safitri et al. (2019), which stated that students made process skill errors due to students lack of understanding regarding material concepts and lack of accuracy when doing calculations.

In the mistake of writing the final answer, the subject did not write the final answer or conclusion on the answer sheet. The interview results found that the subject did not write down the final answer or conclusion because he had not completed the procedure until finished.

The results of the self-confidence questionnaire show that subjects with moderate self-confidence show a lack of self-confidence, are afraid, and feel dependent on other people to answer math questions. This is in line with research conducted by Pangestu (2021) that students who have self-confidence, who are nervous, depend on other people to answer math questions, and feel afraid of being wrong in answering math questions.

C. Subjects with low self-confidence with the highest number of errors

Subjects with low self-confidence with the highest number of errors made several types of errors, namely reading, transformation, process skill, and final answer writing errors.

Reading errors made by the subject are wrong in mentioning keywords. The subject can mention keywords, but the answers are not quite right. But at the error understanding stage, the subject only wrote down what was known and did not write down what was asked. When interviewed, the subject could explain what was known and asked in the test questions. This shows that students understand the questions. This result is different from research conducted by Fitriatien (2019). She stated that the subject did not write down what was understood due to a lack of understanding of the problem. As a result, the question's meaning did not match what was asked.

The mistakes made before also affect the results of the answers in the next stage. The subject cannot change the information obtained into a mathematical model, which makes the subject experience a transformation error. According to Wulandari (2009), if students cannot understand the questions, then students will not be able to change the question sentences into mathematical sentences or mathematical models. However, this study found that the subject could understand the problem, namely being able to say what was known, but the subject could not change the sentence in the problem into a mathematical model. This can happen because the subject's ability to make mathematical models is still low.

In this type of process skill error, the subject makes an error on the indicator, cannot continue the completion procedure, and makes an error in the calculation. From the results of the written test and interview answers, the subject could not continue the procedure or settlement steps due to a lack of students' understanding of the matrix material. The subject also made an error in his calculations, which made the resulting answer less precise.

In this type of error in writing the final answer, the subject cannot write down and explain the final answer or conclusion he gets because the subject cannot continue the procedure to the end. These results are in line with research conducted by Hanifah (2021), which showed that students made mistakes in writing final answers because they did not complete the answers to the questions given, left the answers blank, did not complete all the completion steps, and did not provide a final conclusion of the answer.

Of all the exposure to the types of errors that the subject has made, there are four types of errors made: reading errors, transformation errors, process skill errors, and final answer writing errors. This is in accordance with the results of Dini's research (2021) which states that subjects with low self-confidence also have a low ability to solve math problems. This results in the subject making a lot of mistakes when solving problems, where the subject is unable to explain the meaning of the problem, read symbols, identify what is known and what is being asked, formulate mathematical problems, and choose the methods and procedures to solve Math problems. This means that low self-confidence affects the results of the subject's answers. The higher the self-confidence that students have, the fewer mistakes students make. Having good self-confidence can foster a sense of confidence in solving the problems given. Meanwhile, the lower the self-confidence, the more mistakes students make. Poor self-confidence can foster insecurity, nervousness, and anxiety in solving the problems given.

CONCLUSION

Based on the research results obtained, it can be concluded that:

Students with high self-confidence do not make many mistakes when solving problems. Because with high self-confidence, students also have high confidence in solving problems.

Students with moderate self-confidence show a lack of self-confidence, are afraid and feel dependent on others when answering math questions.

Students with low self-confidence have a low ability to solve math problems. This causes students to make many mistakes when solving questions.

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