# Artikel 15

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# ANALYSIS OF STUDENTS' ERRORS IN SOLVING SPLDV PROBLEMS BASED ON CASTOLAN'S THEORY REVIEWED FROM COGNITIVE STYLE

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*Keywords:* Error, kastolan, SPLDV, cognitive style

**ABSTRACT**

This study aims to determine the description of students' errors in solving SPLDV problem in terms of students' reflective and impulsive cognitive styles. This research is a qualitative research using a descriptive approach which was carried out at MTs Husnul Khatimah 02 Semarang in the 2020/2021 academic year. The subjects of this study were grade VIII students with reflective and impulsive cognitive styles. The instrument used is a cognitive style questionnaire, namely the *Matching Familiar Figure Test* (MFFT), the SPLDV problem solving test and interview guidelines. Checking the validity of the data in this study is time triangulation. The indicator of student errors is based on the Kastolan theory, namely procedural errors, conceptual errors, and technical errors. The results of this study are students with an impulsive cognitive style tend to have more errors than students with a reflective cognitive style. Internal factors that cause errors are because students are less thorough, lack of practice questions, do not understand the prerequisite material, do not understand the concept of solving linear inequality problems of two variables, and do not understand the basic concepts of elimination and substitution methods, while the external factor is the lack of time given to students. so that students have not finished working on the questions

## Introduction

Mathematics subjects need to be given to all students starting from elementary school to equip students with logical, analytical, systematic, critical, creative, and innovative thinking skills, as well as the ability to work together (BSNP, 2006). By learning mathematics, at least the knowledge that is the basis of other sciences has been mastered by students so that the learning process can run well. But in reality, there are still some students who do not master mathematics because they think mathematics is a difficult subject than other subjects.

According to Sutisna (2010) difficulty in learning mathematics is a condition where students get obstacles, disturbances, or obstacles in receiving and absorbing lessons and

their efforts to acquire knowledge or skills in mathematics lessons. Student difficulties can cause student achievement in mathematics subjects to be low. It is proven by data from the 2018 UN Exhibition, the average value of the national mathematics exam is the lowest value among other subjects, which is 43.34 (Lenterawati et al., 2018). According to Fatahillah (2017) the difficulties experienced by these students can be caused by many factors, such as internal factors that come from within the child and external factors that come from outside the child. In addition, there are many materials in mathematics that are considered difficult by students, but there are also some materials that are considered easy. One of the materials in mathematics that is still considered difficult by students is the material for the Two Variable Linear Equation System (SPLDV).

According to Puspitasari's research et al. (2015), it was found that some of the students' difficulties in solving SPLDV story problems included difficulties in figuring out variable terms, converting story questions into mathematical sentences, performing operations using elimination and substitution methods, operating addition and subtraction, getting variable replacement values, and difficulty converting variable replacement values into question sentences. The existence of a difficulty can have an impact, one of which is expressed by Untari (2013) that students who have difficulty have the opportunity to be able to make mistakes in solving math problems on each subject in the learning process.

According to Yarman and Yulanda (2018) mistakes made by students in solving math problems can be caused by students not understanding the meaning of the problem, students choosing the wrong formula, students not applying the formula, not according to the steps in solving the problem, students' lack practice in working on questions, are unable to solve problems to a simple stage, are less thorough in answering questions, and are in a hurry so they do not re-check the results of their work. Errors are indeed a natural thing, but if there are quite a lot of mistakes, then there is a need for handling so that errors can be minimized.

According to Brown and Skow (2016), error analysis has proven to be an effective method for identifying patterns of students' mathematical errors. One of the methods used to analyze errors in this study is the stages according to Kastolan. Kastolan stages distinguish student errors into three, namely conceptual errors, procedural errors and technical errors (Khanifah & Nusantara, 2011). Conceptual error if students do not use and apply the formula correctly. Procedural errors if the steps used are not precise so that they are still in a form that is not yet simple, and technical errors if there is a lack of accuracy in calculations or writing errors (Nasrudin, 2017).

On the other hand, student achievement can also be influenced by cognitive style. Desmita (2010) said that cognitive is one of the important aspects of student development that is directly related to the learning process and greatly determines the success of students in school. Grouping the types of cognitive styles can be distinguished in several categories. Puspita and Wijayanti (2016) revealed that cognitive styles are grouped into two, namely: reflective cognitive styles and impulsive cognitive styles. Students with reflective cognitive style are students who have a slow character in answering questions, but they are careful and thorough, so it is likely that the answers given are correct. On the other hand, students who have an impulsive cognitive style are students who have a quick or short character in

answering questions, but are less careful or less thorough, so that the answers given tend to be wrong (Happy et al., 2019).

From the description of the background above, the researcher wants to identify and describe the types of errors based on the Kastolan theory of students in working on the Two Variable Linear Equation System (SPLDV) questions in terms of the reflective cognitive style and the impulsive cognitive style of students.

## Research Methods

This study used a descriptive qualitative approach. This qualitative research was used to obtain in-depth data with the aim of knowing students' mistakes in solving SPLDV questions in terms of students' cognitive styles. The research was conducted at MTs Husnul Khatimah 02 Semarang. The research subjects are two students who have an impulsive reflective cognitive style, have equal mathematical abilities, and are of the same gender.

This research was conducted for two days by conducting a written test and then conducting interviews related to the written test. There are three the data collection technique used, namely the test method, the interview method, and the documentation method. The validity of the instrument used in this study was tested with the help of a validator. The validity of the data is done by time triangulation. Time triangulation is done by checking through interviews, observations, or other techniques in different times or situations. The analytical technique used to analyze the data that has been collected according to Milles and Huberman in Sugiyono (2016), includes 3 components, namely data reduction, data presentation, and conclusion drawing (data verification).

## Results and Discussion

### Results

**a. Analysis of student errors with reflective cognitive style**

***1. The results of the data taken in the first test***

(a) Procedural errors

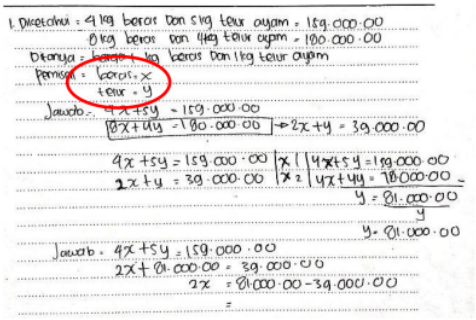


**Figure 1.** FKT subject's answers related to procedural errors on the first test

From the results of the answers and interviews above, it can be seen that the FKT subject made mistakes in writing examples and errors did not work on the questions until the end. In the error of not writing down the information that is

known, asked, and the examples used in the questions, the FKT subject is able to write down what is known, asked, and examples but the examples written are still wrong.

(b) Conceptual Error

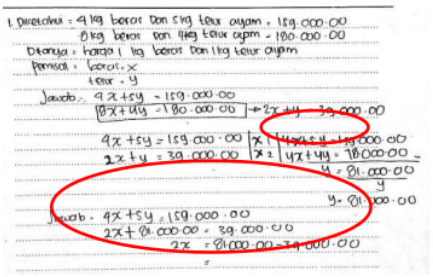

**Figure 2**. FKT subject's answer related to conceptual error in the first test

From the results of the work and the results of the interview above, the FKT subject only made one mistake, namely an error in applying the elimination and substitution method. In the FKT subject elimination method, the calculation is still wrong and the subject substitution method has not been completed. This was supported by interviews with the subject who said that the subject had not yet completed the substitution method but understood what to do next.

(c) Technical error

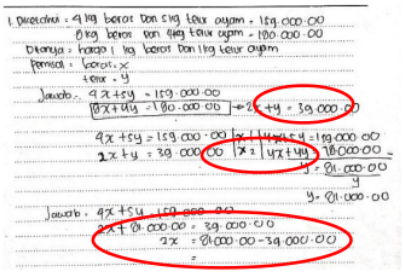

**Figure 3.** FKT subject's answer related to technical error in the first test

From the results of the work and the interview results above, the FKT subject only made an error when performing calculation operations. FKT subjects made mistakes when doing division when simplifying mathematical models and when performing calculations on the elimination and substitution methods.

***2. The results of the data taken in the second test***

(a) Procedural error

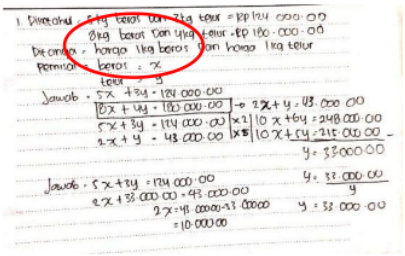

**Figure 4.** FKT subject's answers related to procedural errors in the second test

From the results of the answers and interviews above, it can be seen that the error indicator does not write down information that is known, asked, and the examples used in the questions, the FKT subject has able to write down what is known, asked, and examples even though the examples written are still wrong.

(b) Conceptual Error

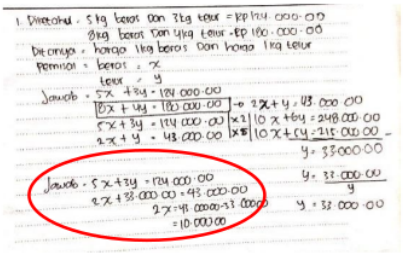

**Figure 5.** FKT subject's answer related to conceptual error on the second test

From the results of the work and the results of the interview above, the FKT subject only made one mistake, namely an error in applying the elimination and substitution method. In the FKT subject elimination method, the calculation is still wrong and the subject substitution method has not been completed. This was supported by interviews with the subject who said that the subject had not yet completed the substitution method but understood what to do next.

(c) Technical Error

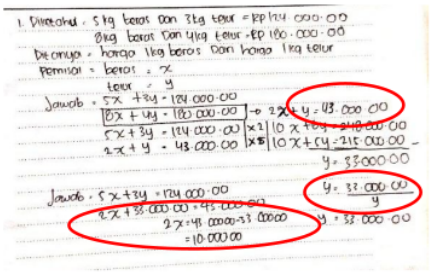

**Figure 5.** FKT subject's answer related to technical error on the second test

From the results of the work and the interview results above, the FKT subject only made an error when performing calculation operations. The FKT subject made a mistake when doing division when simplifying the mathematical model and when performing calculations on the substitution method. This can be seen from the answers and explanations of the subject at the time of the interview.

**b. Analysis of student errors with impulsive cognitive style**

***1. Results of data taken on the first test***

(a) Procedural error

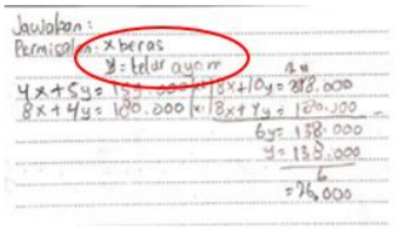

**Figure 1.** US subject's answer related to procedural errors on the first test

From the results of the work and interview results above, the US subject only wrote examples and did not write down what was known and asked in the questions and did not work on the questions until the final stage.

(b) Conceptual Errors

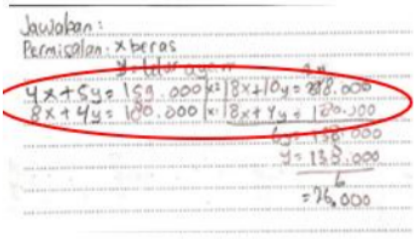


**Figure 2**. AS subjects' answers related to conceptual errors on the first test

From the results of the work and the results of the interviews above, the AS subjects were able to substitute the values of x and y into equations and apply mathematical models or equations, but the subject have not been able to understand the concept of SPLDV completion and apply the substitution method.

(c) Technical error

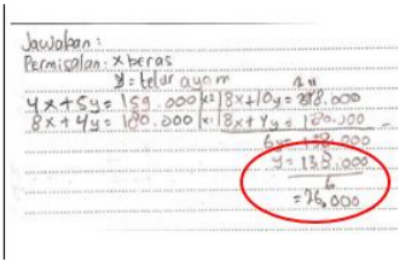


**Figure 3.** US subject's answer related to technical error on the first test

From the results of the work and the results of the interview above, the US subject was able to equalize the equation and only made one error, namely an error when performing the division operation in the elimination step.

### *2. The results of the data taken on the second test*

(a) Procedural errors

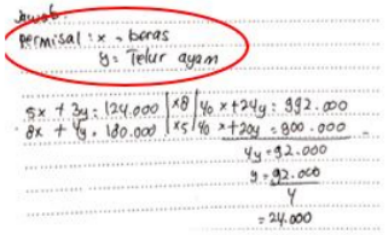


**Figure 4.** US subjects' answers related to procedural errors on the second test

From the results of the work and the results of the interviews above, the US subjects did not write down what was known and asked in the questions and had not worked on the questions until the final stage. At the beginning of the work.

(b) Conceptual Errors

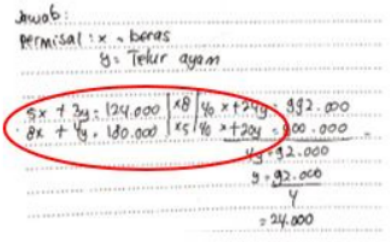


**Figure 5**. AS subjects' answers related to conceptual errors on the second test

From the results of the work and the results of the interviews above, AS subjects were able to substitute the values of x and y into equations and apply mathematical models or equations, but the subjects had not been able to understand the concept of completion SPLDV and apply the substitution method.

(c) Technical Error

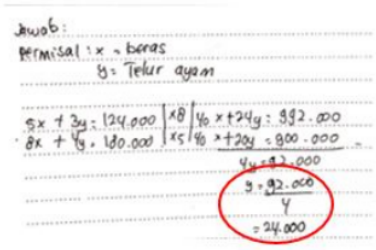


**Figure 5**. FKT subject's answer related to technical error on the second test

From the results of the work and the results of the interview above, the AS subject was able to equalize the equation and only made one error, namely an error when performing the division operation in the elimination step.

## Discussion

*Students' errors in solving math problems with reflective cognitive style (FKT) on the SPLDV material.*

Students with reflective cognitive style have a fairly dominant percentage in the class. The results of this study showed that there were 11 students in the category of students with a reflective cognitive style with a percentage of 44%. This is in line with the results of research by Warli (2013) which showed that up to 36% of students with reflective cognitive style.

From the results of the analysis that has been carried out by researchers on FKT subjects with cognitive style, when working on mathematical problems with SPLDV material on the first and second tests, it is known that the FKT subjects made several mistakes. In the type of procedural error, the FKT subject experienced an error on two indicators, then the conceptual error experienced an error on one indicator and on the technical error experienced an error on one indicator.

In carrying out the work of FKT students with a reflective cognitive style in solving problems using the best possible time. FKT students still have 3 minutes before the time for completing the FKT subject, the FKT subject tries to complete all the answers to completion even though the 3 minutes is not enough. This is in line with the research of Rozencwajg & Corroyer (2005) that children with reflective cognitive style are children who have the characteristics of using a long time to answer problems, but are careful / thorough so that the answers given tend to be correct.

*Student errors in solving math problems with impulsive cognitive style (AS) on SPLDV material*

The results of the MFFT test showed that there were 9 students with an impulsive cognitive style with a percentage of 36%. With this, students with impulsive cognitive style have a dominant percentage in the class compared to students in the fast category which tend to be correct and slow tend to be incorrect. This is in line with the results of research by Amimah and Fitriyani (2017) which showed that up to 36.36% of students with an impulsive cognitive style. Based on the results of the analysis that has been carried out by researchers on AS subjects with impulsive cognitive styles, when working on mathematical problems with SPLDV material on the first and second tests, it is known that the AS subjects made several mistakes. On the type of procedural error, the US subject experienced errors on two indicators, then on conceptual errors experienced errors on two indicators and on technical errors experienced errors on one indicator.

In working on written tests, US students tend to be in a hurry and do not maximize the time available. US students did not re-examine their answers in line with research by Abdurrahman (2003) which stated that impulsive children tend to answer questions quickly but make a lot of mistakes. In this study, the US subjects did not believe in the answers that had been written and did not complete the answers.

*Factors Causing the Occurrence of Reflective and Impulsive Student Errors*

Based on the results of tests and interviews that have been conducted, there are two factors that cause students who have reflective and impulsive cognitive styles to experience errors in solving problems, namely internal factors and external factors. In reflective students, internal factors consist of a lack of understanding of the prerequisite material, students' lack of understanding in using the substitution method, and students' lack of accuracy. While the external factors consist of the lack of time given to students so that students have not finished working on the questions. Then the internal factors that cause impulsive students to experience consist of a lack of student understanding of the prerequisite material, lack of student understanding in solving SPLDV questions in the form of story questions, lack of student understanding in using the substitution method, and lack

of student accuracy. While the external factors consist of the lack of time given to students so that students have not finished working on the questions.

## Conclusion

Reflective students have procedural errors, namely they are still wrong in writing examples and do not solve the problem until they are finished. The next error is a conceptual error, namely the student is wrong in applying the substitution method and the technical error the student is wrong in performing the division operation when simplifying the mathematical model and when performing calculations on the substitution method. In this study, reflective students made fewer mistakes than impulsive students because reflective students used as much time as possible to complete answers. Meanwhile, impulsive students tend to have more errors than reflective students. Impulsive students have procedural errors, namely not writing what is known and asked and still wrong in writing examples and not completing the problem until the final stage. While the conceptual error is wrong in applying the SPLDV solution concept and the substitution method, then the technical error is wrong when performing the division operation in the elimination step. In solving problems, impulsive students are faster than reflective students and do not use as much time as possible to complete answers so that they do not finish working on questions. Impulsive students tend to find more mistakes and are not sure of the answers they have written.

Reflective and impulsive students experience errors in solving problems with two factors, namely internal factors and external factors. For reflective students, internal factors consist of students' lack of understanding of the prerequisite material, students' lack of understanding in using the substitution method, and students' lack of accuracy. While the external factors consist of the lack of time given to students so that students have not finished working on the questions. Then the internal factors that cause impulsive students to experience errors in solving problems, consist of a lack of student understanding of the prerequisite material, lack of student understanding in solving SPLDV questions in the form of story questions, lack of student understanding in using the substitution method, and lack of student accuracy. While the external factors consist of the lack of time given to students so that students have not finished working on the questions,

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