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Student Errors Analysis Problem-Solving based Castolan Theory on Relations and Functions Material

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Abstract

The material relations and functions load understanding the concept in lesson mathematics and can help students finish question mathematics excellently. The objective study is to analyze errors in students in finish question relations and functions based on theory Castle, i.e., error conceptual, error procedural, and error technique, as well as reason happening error. This study type is qualitative descriptive research. The subject study is 18 students in class VIII SMPN 13 Dumai. Data collection techniques are carried out with tests and interviews. The instrument used is a test written from valid questions and guidelines interview For verifying reason student in answer question the. Obtained data from the results test, then analyzed using descriptive qualitative methods. Analysis results show that 33% students do error conceptual, 41% do error procedural, and as many as 26% students do error technical. As for what causes students to be wrong, finish question, Relations, and functions include 1) less understanding cause issue Confused student finish the answer; 2) no control rule calculation algebra; 3) rushing in finishing question so that much wrong calculation.

INTRODUCTION

Relations and functions are mathematics material studied in class VIII of junior high school in presenting relations and functions as arrow diagrams, Cartesian diagrams, sequential pairs, and functional equations. Many students experience learning difficulties in mathematics because they lack an understanding of relations and functions. [1] revealed that the material on relations and functions contains many new concepts introduced in junior high schools, so students must reinforce previous concepts. A study [2] says that mastery of concepts in mathematics makes it easier for students to solve math problems properly and correctly. Students who get low scores can be caused by not understanding the concept and its relationship with the information in the problem.

Previous studies related to student error analysis [1] [3] [4] explained that many students made mistakes in answering relations and function questions because they did not master the concept of the material. The concept obtained in the previous material becomes the basis for leading to a new concept. Thus, if students do not understand the concept being taught, it will result in an error in solving the problem. [5] argued that students' lack of understanding in

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solving concepts resulted in errors in solving the questions. This will impact students with the same errors in other questions, thus causing low student work results.

Meanwhile, [6] states that the success of teachers in learning can be seen from the results of students' work in solving problems from the material being taught. A similar opinion [7] states that if the learning process goes well, the teacher can be said to be successful in teaching. One strategy for carrying out an evaluation is giving a test. The results of this test can be used to investigate student errors as a basis for reflection on learning. The reflection in question is an attempt to correct conceptual errors (associating problems in everyday life) or procedural errors (algorithms), or technical errors (calculation operations).

Tracing the mistakes made by students (conceptual, procedural, and technical) can be done by analyzing the mistakes made by students. In line with that, it is necessary to identify and classify deviations or discrepancies in the steps in the settlement algorithm. Associated with the types of errors in castor theory, there are three kinds, namely conceptual errors, procedural errors, and technical errors [8]. Conceptual errors arise because students incorrectly use or do not interpret concepts related to the problem [9]. Procedural errors arise because students cannot find a solution to a mathematical problem [10]. Technical error arises due to a lack of student accuracy in determining the results of arithmetic operations [11].

The study's results [12] show that students' conceptual errors are 66.9% because they cannot determine formulas, theorems, or definitions. As for procedural errors, the error rate reached 11.1% because they did not work on the questions systematically. Then for a calculation error of 22.0%, namely an error in calculating the value of an arithmetic operation and the placement of constants-variables. In addition, the results of research [13] which focused on problem-solving questions showed that students with moderate ability levels made technical mistakes in the stage of understanding the problem, made conceptual mistakes in the planning stage of completion, and made mistakes in writing answers in the stage of reviewing answers. The difficulties experienced by students can be seen from the number or number of mistakes made by students in solving math problems.

The research conducted by Jefrizal above uses the classification of errors according to Tips for social arithmetic material, namely (1) conceptual errors are due to a lack of understanding of concepts related to problems, (2) procedural errors are due to the inability to manipulate the selection of formulas correctly to solve problems, and (3) technical errors are due to lack of knowledge of mathematical content on other topics. Whereas in this study, an analysis of student errors was carried out using Castolan theory, namely (1) Conceptual errors were due to students' erroneous or lack of understanding of concepts related to a problem and students incorrectly using formulas, theorems or definitions and did not provide answers at all, (2) Procedural errors are due to the inability of students to solve math problems and the inconsistent steps in solving problems, (3) technical errors are due to students' lack of accuracy in determining the result of an arithmetic operation. In the research conducted, the object of study is the temporal relations and functions.

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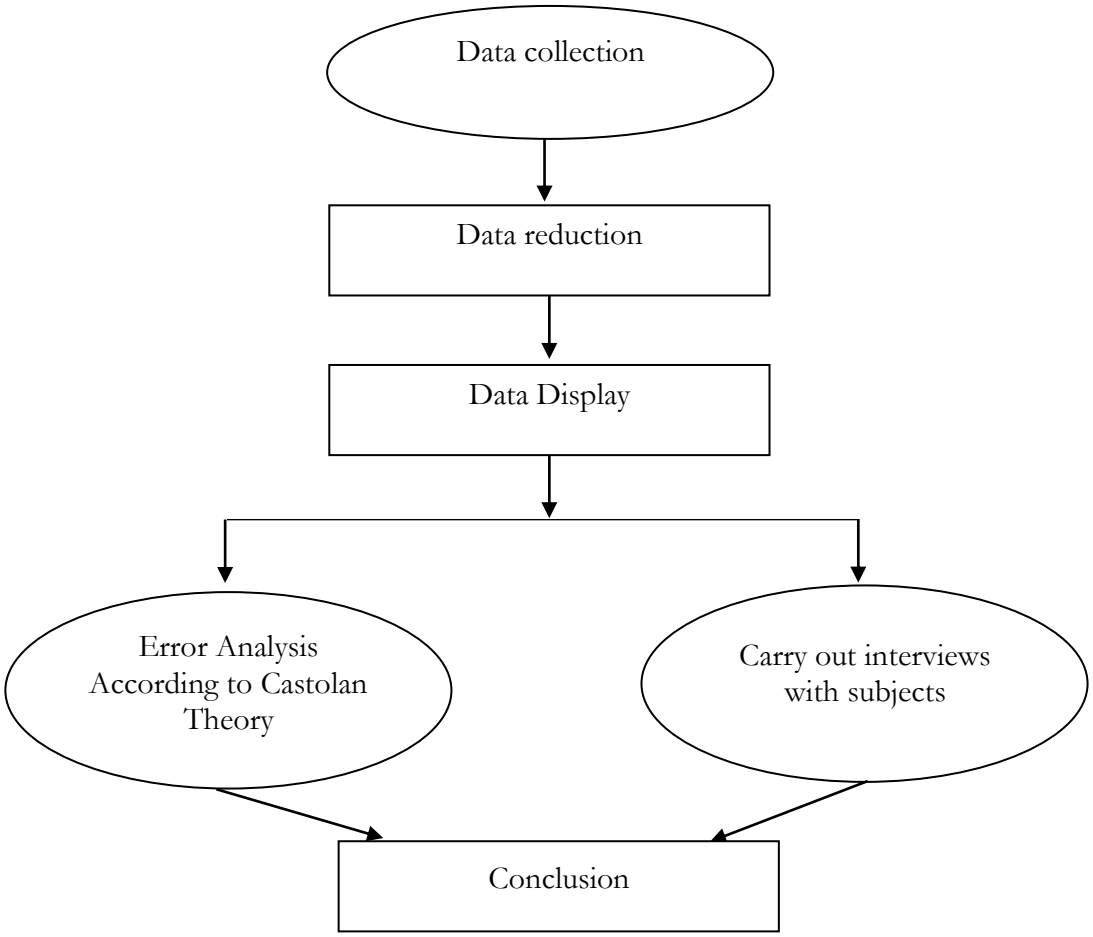
METHOD

This study type is qualitative descriptive research conducted to reveal the types of student errors in solving relations and function problems based on the Castolan theory. This research was conducted on October 13, 2022, for the 2022/2023 school year at SMPN 13 Dumai, class VIII, with 18 subjects who have studied relations and functions. Tests and interviews were carried out with data collection techniques. The test instrument used was a description test which consisted of four questions modified from research [14] which has proven its validity, and interviews to verify and find out why students answered these questions.

Data analysis techniques in this study used three stages: data reduction, data presentation, and concluding Sugiyono [18]. The reduced data were analyzed for further conclusions to be drawn. At the data reduction stage, the grouping of student errors was carried out based on the Castolan theory. The second stage of data presentation was carried out by selecting a student as the subject to represent each error found to describe the student's problem-solving process. The third stage is concluding the form of a description based on the data received and has been analyzed.



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RESULTS AND DISCUSSION

Based on data analysis results, information was obtained about the types of errors and their causes by students. In looking at this error analysis, there are four questions, namely question number 1, about determining the concept of relations and functions by giving two contextual statements, question number 2 determining the range of results or the range of the functional equation and the region of origin, question number 3 depicts arrow diagrams, Cartesian diagrams, and the set of ordered pairs of the relation of two sets; and question number 4 determines the result of the function value if the function equation is known. Based on the analysis of students' answers, an overview of the mistakes made based on the Castolan theory is obtained, as shown in the following diagram.

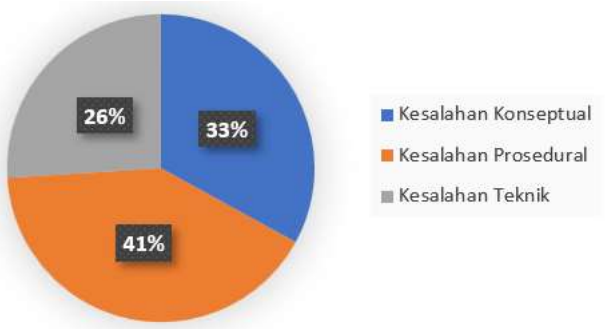

Figure 1. Percentage Error Student

The facts in Figure 1 state that (1) as many as 33% of students make conceptual errors; (2) as many as 41% of students make procedural errors; (3) as many as 26% of students make technical errors. Based on these errors, further investigation was carried out to obtain the fact that conceptual errors occurred because they did not understand the concepts of relations and functions. Procedural errors occur because students do not complete the questions according to the correct algorithm, while technical errors occur due to errors in the results of arithmetic operations.

Error Conceptual

Based on cases of conceptual errors made by students, the number of students who made conceptual errors was obtained as contained in Table 1 below.

Table 1. Percentage Error Conceptual

Question Number	Many Students
1	7
2	11
3	9
4	6
Total	33

Based on Table 1 can be seen an amount of error conceptually done by the student to fifth grain question 33 errors. From the student analysis answer results obtained, many students do not

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understand the draft from relations and functions, and some do not answer until done. Figure 2 below is a snippet of answers to students on question number 1.

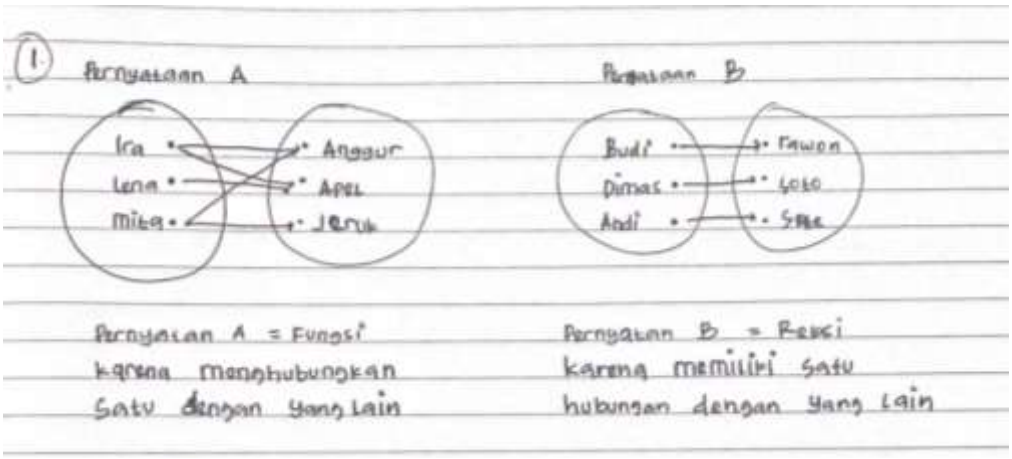

Figure 2. Example Answer Student on Problem Number 1

The interview results showed that students made conceptual errors because they did not understand the meaning of relations and functions. If there are questions about relations, students answer each set A connecting set B, and if asked about functions, students answer set A connecting set B. When asked why they do this, students forget and have not read about the meaning of relations and functions. Besides that, based on interviews with other subjects, students claimed to be sick when working on the questions given. Conceptual errors that occur in students align with the research results [15], finding that the factors causing students to make conceptual errors are because they do not understand the concept of mathematical material and cannot use it. In addition, the research conducted [16] states that several factors from within students can be in the form of lack of motivation, lack of thoroughness, lack of interest in the material being taught, and external factors, namely the condition of the learning environment and health can influence students in solving math problems.

Error Procedural

Based on case errors made by procedural students, obtained amount of students who do error procedural is contained in Table 2.

Table 2. Percentage Error Procedural

Question Number	Many Students
1	9
2	12
3	7
4	13
Total	41

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Based on Table 2, it can be seen that the number of procedural errors made by students on the five items was 41 errors. From the student answer sheets, it was found that many students did not complete the questions in the right way. Figure 3 below is an excerpt of student answers to question number 4.

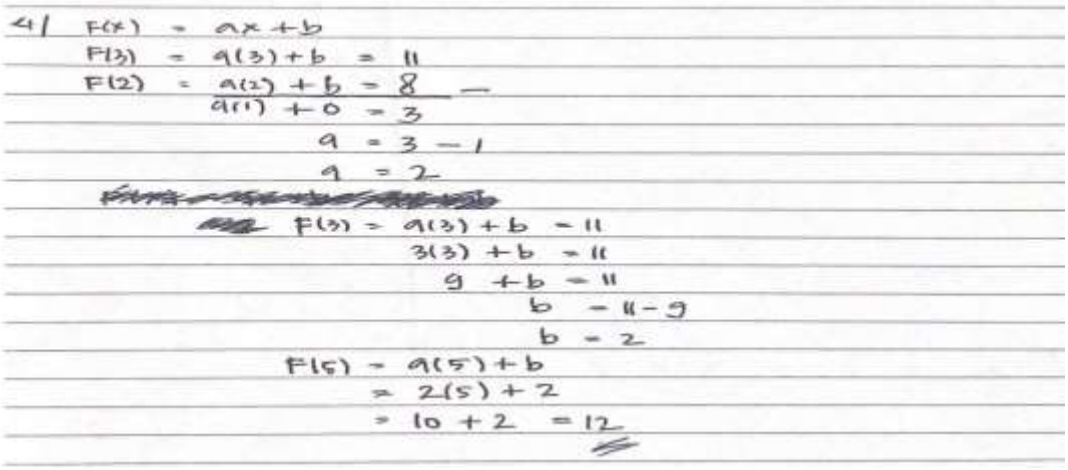

Figure 3. Example Answer Student on Problem Number 4

The interview results showed that they made a conceptual error because they did not solve the problem with the correct algorithm. Students are wrong about how to substitute two function equations. If a + 0 = 3, students answered a = 3 – 1. When asked why they did this, the students answered that they had never learned how to substitute two equations and did not understand the correct steps for solving this. Procedural errors in the research conducted [17] that procedural errors occur because students cannot show manipulation steps properly, and students' inability to perform arithmetic operations causes errors in determining the final results. In addition, [18] explains the main causes of procedural errors, namely inaccuracy in working on the settlement algorithm and forgetting in the counting process.

Engineering Error

Based on Figure 1, the error technique is the most minor error the student makes. This aligned with research [19] that error technique is the lowest and rare error done by students. Amount students who do error techniques like loaded in the following table 3.

Table 3. Percentage Engineering Error

Question Number	Many Students
1	0
2	8
3	13
4	5
Total	26

Based on Table 3, the amount of error technique performed by students to fifth grain question 26 errors from student answer sheet obtained student mistaken in count results from

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something operation count. Figure 4 below is a snippet of answers to students on question number 2.

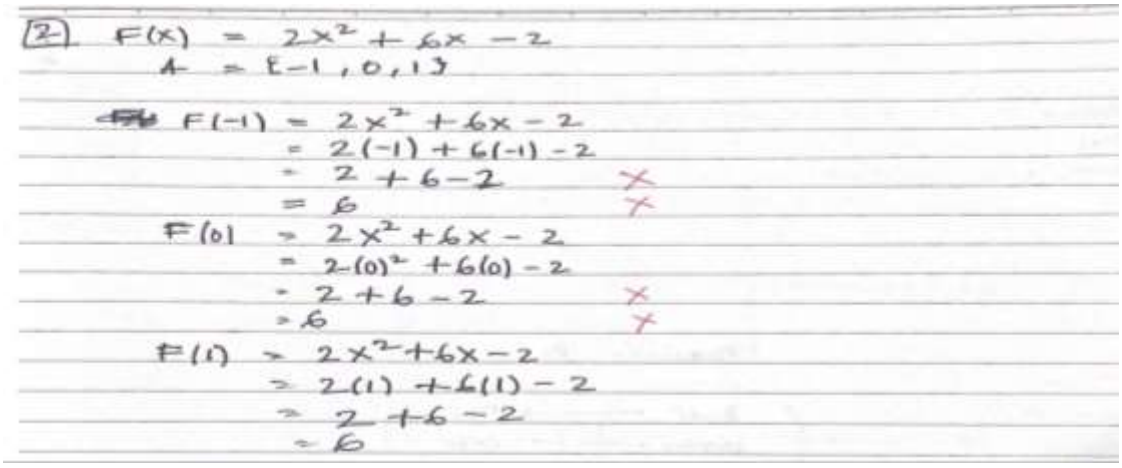

Figure 4. Example Interview Answer Student on Problem Number 2

The results interview obtained information that an error in count results from something operation count. Students make errors in multiplication number negative and ways to enter the x value in function *f*(*x*). If asked 2 x (-1), students answer 2. When asked why do matter, the student answered I do not understand about multiplication number negative. should be 2(-1) + 6(-1) -2 the result is -6. Error technically carried out by the student in line with research [21], which stated that error technique happens Because the student is too in a hurry to do calculations and not careful in doing questions.

In this study, technical errors ranked the lowest among students. This is in line with research conducted by [20], which stated that one of the causes of technical errors is that students are wrong in carrying out mathematical operations. The error of students in finishing question relations and functions include 1) less understanding, causing students to be confused about finishing the answer; 2) no control rule calculation algebra; 3) rushing in finishing questions so that Lots of wrong calculations. Besides that, students should be given exercises independently of the material taught. Exercise questions done by students expected can reduce mistakes made by students in questions. Mastery of draft mathematics is needed to make learning more effective in class. This aligns with the opinion [21]–[23] that students can understand something draft mathematics well if they actively participate in the learning process.

CONCLUSION

There are three types of errors from Castolan's theory that can be used as a guide when describing errors made by students: conceptual, procedural, and technical errors. From the results of the analysis that has been carried out, it can be concluded that 1) students made conceptual errors 33%, including errors in understanding the concepts of relations and functions; 2) students made 41% procedural errors because they could not work on the questions according to the proper steps; and 3) technical errors made by students 26% due to not being careful in carrying out arithmetic operations.

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Things that cause students to make mistakes include 1) lack of understanding of the questions, which causes students to be confused in completing the answers; 2) do not master algebraic calculation rules; 3) being in a hurry to solve the problem so that many calculations are wrong.

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