V-A-K GRADE 7 STUDENTS' ERROR IN MATHEMATICAL
PROBLEM SOLVING ABOUT QUADRILATERAL

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ABSTRACT

The purpose of this study is to obtain a type of errors and their reason of 7th -grade students in mathematics problem-solving test about quadrilateral based on visual learning style: auditory learning style, and kinesthetic learning style. The error of this study is based on Newman's Error Analysis that are reading, comprehension, transformation, process skill, and encoding. The subject of this study were 9 students that are 3 students for each learning style student group. This classification is based on the result of learning style questionnaire and test. The analysis data are done by the following steps: data reduction stage, data presentation stage, verification stage, and conclusion. The results showed that (1) visual learning style student mostly makes transformation error, (2) auditory learning style student mostly makes transformation error and process skill, (3) kinesthetic learning style student don't have a tendency on the type of errors. Generally the reason for error, whereas visual, auditory, and kinesthetic, are low prerequisite lessons such as ration, algebra, and one variable linear system. There are solutions for its error such as (1) visual learning style student reads the lesson, (2) auditory learning style student does a contemporary tutorial, and (3) kinesthetic learning style student uses a model.

KEYWORDS: *Visual, Auditory, Kinesthetic, Newman's Error Analysis, Problem Solving*

INTRODUCTION

Mathematics is one important science in building concepts and applications of other sciences. Mathematics is considered so important that it has been included in the primary school learning curriculum. One of the important mathematical characteristics is the deductive process which requires students to think logically and axiomatically [1]. This makes the science of mathematics also influence human cognitive development. Mathematics also has the regularity seen from several rules, axioms, and formulas contained therein. The rules in mathematics are interrelated and form a complete mathematical concept.

Studying mathematics must begin with understanding mathematical concepts. Learning mathematical concepts is fundamental to understanding mathematics [2]. Concepts of mathematics are often so complex made students feel difficult. That matter makes an assumption that mathematics is difficult [3]. The difficult assumption can be found in the fact that students often make mistakes in solving math problems [4,5]. The number of mistakes can be analyzed and used as a guide to the evaluation of students' understanding of the topic.

Further, analysis of students' mistake is going to lead to an explanation of the source of the problem. Sources of mistakes by students should immediately get a complete solution. One method of analysis is Newman's error analysis method. There are 5 hierarchies that a person needs to solve a mathematical problem description. The five hierarchies are reading, comprehension, transformation, process skill, and encoding [6]. Reading error occurs if the student is unable to read the words or symbols contained in the problem. This error can be detected by interview method. Comprehension error occurs when the student is able to read the problem but fails to understand what is needed to correct the problem. Transformation error occurs if the student has understood what is needed in the problem but fails to identify what mathematical operations are being used to answer the solution of the problem. Process skill error occurs when the student is able to determine the operation used but the student has miscalculated or the wrong step is used. Encoding error occurs when the student has been able to solve the problem but the student is unable to restate what the question asks.

The analysis can be used for making a prediction why the student makes mistakes in the math problem. Teachers must understand students' attitude and mistakes in learning math [7,8]. Teachers have to handle the problem. The teacher is responsible for adapting the learning situation to the students' interests, background, and maturity. Therefore, the teacher should design the teaching material and techniques according to students' characteristic [9].

Based on the psychological aspects, the characteristics of students in understanding the concept of a subject matter are also potentially in the mistakes. One of the characteristics of the student is the student's learning style. The learning style has a very significant relationship with the child's attitude toward mathematics [10]. Learning styles are a way that people tend to choose to receive information from the environment and process information. Each student must have their own learning style. By looking at their students' learning styles and teaching according to their learning styles, teachers are more likely to improve teaching effectiveness and increase student learning outcomes [11].

Learning styles are divided into three types. These three types of learning style are visual, auditory, and kinesthetic [12]. These three types of learning styles that are distinguished based on their tendency to understand and capture information more easily using visual, hearing, or do it yourself. To make mathematical learning is good; the teacher must know how student makes an error based on their learning style. So it is important to make a study that combines analysis error and learning style. Quadrilateral was selected because this topic has potential to make a real daily problem.To understand this topic,the student also must have a good knowledge of other mathematics topics.

METHOD

This type of research is a qualitative descriptive. This research was conducted in Semarang, Indonesia. The subject of research were 9 students representing 30 students.The ninth subject has chosen based on the results of learning style questionnaire and problem-solving ability test results. The selected subject consists of (1) the three visual learning style students who do a full test but made much errors, (2) the three auditoria learning style students who do the full test but made much error, and (3) the three kinesthetic learning style students who do a full test but made much error.

Data collection techniques in the research were problem-solving ability test and interview. Problem-solving ability test was six problems. Problem-solving ability test results and data on the results of the interviews further analyzed. Newman's Error Analysis requires an interview. The interview will be explaining the roots of the trouble

students do come from the causes of the problems of language or scientific problem [13,14]

Data were analyzed in three phases. They were the reduction of resources, (2) the presentation of the data, and (3) the verification/withdrawal of the conclusion. Reduction of data does is include the selection process, the concentration of attention on simplification, abstraction, and data transformation. This reduction of activity produced a classification based on the classification of learning styles and then the selection of the subject of the classification which made an error according to Newman's Error Analysis most numerous. Next, the data presented in narrative form and tables. The results of the classification data, specialties, and summary/verify is configuration intact and further sought the meaning of research results.

RESULTS AND DISCUSSIONS

Based on the results obtained by the students learning style questionnaire, students have a different learning style type. The complete results of the comparison of these three learning can be seen in Figure 1.
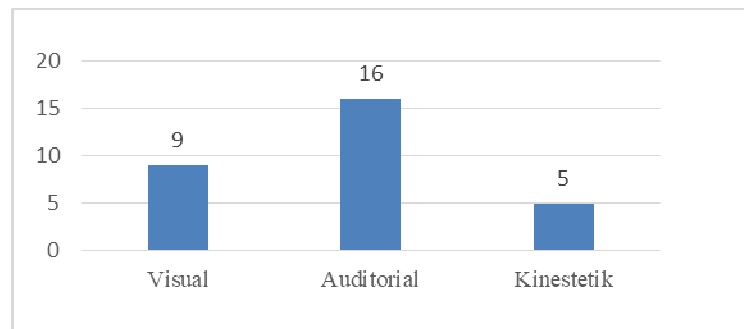

Figure 1: The Result of Learning Style

Based on Figure 1, the dominant learning style was auditorial learning style. It complies with the experience of research, acquired habits of students who tend to refer to the customs-style child auditoria. One example is the customs they are active in talking like a telling their opinion and discussion. To complete the test description of problem-solving ability and broad material around the quadrilateral, necessary measures and systematic order. From the results, it was found the fact that there is no subject that does the main error in the step of reading. The main error recently started on step comprehension. That error varies for each type of subject of their learning style. Based on data analysis, the error of the visual learning style students can be presented in Table 1.

Table 1: The Tendency of the Visual Learning Style Students Error

Subject	Error Accumulation					Tendency
	Reading	Comprehension	Transformation	Process Skill	Encoding	
G12	0	0	4	1	0	Transformation
G17	0	0	4	2	0	Transformation
G05	0	1	5	0	0	Transformation

Furthermore, based on data analysis, the error of the auditory learning style students can be presented in table 2

Table 2: The Tendency of the Auditory Learning Style Students Error

Subject	Error Accumulation					Tendency
	Reading	Comprehension	Transformation	Proces Skill	Encoding	
G23	0	0	1	3	2	Transformation
G11	0	0	3	3	0	Transformation and Process skill
G20	0	0	5	1	0	Transformation

Furthermore, based on data analysis, the error of the kinesthetic learning style students can be presented in Table

Table 3: The Tendency of the Kinesthetic Learning Style Students Error

Subject	Error Accumulation					Tendency
	Reading	Comprehension	Transformation	Process Skill	Encoding	
G24	0	0	2	2	2	Transformation, Process skill, and Encoding
G01	0	1	4	0	0	Transformation
G30	0	3	3	0	0	Comprehension and Transformation

In general, it can be seen that error for every learning style is different. The data that is listed in Table 1, Table 2, and Table 3 can be summarized as presented in Table 4 below.

Table 4: The Tendency of Error Every Learning Style Types

Type of Learning Styles	Tendency
Visual	Transformation
Auditory	Transformation and Process skill
Kinesthetic	Comprehension, Transformation, Process skill, and Encoding

The data have been obtained further discussed in depth what the cause and solution to what can be given. Here is the discussion for this type of error, the cause, and the solution for each type of type of learning style.

Visual Learning Style Students

Based on Figure 1, there were 6 students which were a type of visual learning style students. In the study, there were 3 students representing the student of 6 types of visual style. The third students were G12, G17, and G05. Based on Table 1 it can be seen that the visual learning style students very rarely do major errors in the comprehension step. It was only a major mistake by G05 incomprehension in step number 4. Question 4 is a problem that demands a good linguistic understanding. Due to perceive difficult, then G05 was not able to continue working on this problem. The less error in comprehension step was caused mostly by visual learning style student worksheet written orderly and systematically from what is known and what is asked until the final result. This proves that they are able to understand the problem in question fine. Some students even use images as illustrations reserved to clarify their intentions. Students learning style has clean, orderly, and using visual illustration [12].

Based on the results of data analysis, visual type students tended to do the main error in the step of transformation. Transformation error undertook by the G12 and G17 found in problem 1, 2, 3, and 6. While the G05's errors found in problem 1, 2, 3, 5, and 6. Basically, they would of transformation errors subject less able to use the right strategy after he

understood the problem. These errors include the following: (a) students do not use the information as a whole, (b) using instance, and (c) only memorized the formula but don't understand its use is the cause of this error is less understand material comparison and the concept of the relationship between area and circumference planes.

The findings obtained in this study other facts i.e. a visual learning style students there are still the error process skill. The process skill error is done by G12 in number 4 while G17 do it at number 4 and 5. They had a deficiency in understanding the concept of algebraic calculations and comparisons. While it does look there are major errors in encoding steps. This was also due to the nature of the visual type students clean and systematic so that even though the results of the work are wrong, it was complete.

Suggestions and solutions to minimize these errors can originate the teacher or the students themselves. The suggested activities to teachers to enhance student understanding of the concept and materials so as to minimize their errors are (1) using symbols in giving concepts such as point or pictures, (2) using the copy of the shared keyword to the students which further defines the students with its own language, (3) using figures and tables as a medium of learning, and (4) using any images/writings/objects in the classroom as a learning resource. Meanwhile, students in activities to minimize their culpability i.e. (1) reading more (2) rewriting the material using its own language, and (3) marking an important matter with a pencil/pen of different colors.

Auditory Learning Style Students

Based on Figure 1 data obtained that there were 16 students which were a type of auditory learning style students. In the study, there were 3 students representing all of 16 auditory learning style students. The third students were G23, G11, and G20. Based on Table 2 it can be seen that the auditory learning style students did nothing wrong on the main steps of comprehension. This is due to the auditory learning style students are actually able to understand the problem in question but prefer explanations orally. Judging from the results of his work, students often write auditory type briefly but when confirmed in an interview can actually be explained properly. Auditory learning styles students had problems relating to visual things such as writing but very good in talking [12].

Based on the results of data analysis, auditory learning styles students tended to make a main error in transformation and process skills steps. Subject G23 tended to make process skill error, subject G20 were likely to make transformation error, the subject G11 tended to do both. The errors have done G23 looks at the numbers 3, 4, and 5. The error was indicated by calculation process error in algebra and linear equation. The reason for this error was the students have less material prerequisites. The next error committed by the G20 is looked at numbers 1, 2, 3, and 6. The G20's error was indicated from the subject just memorized the formula but don't understand its use so that strategies used only contextual in nature. For example the question of asking then the G20 only used areas formulas alone without utilizing any other information. The reason for this error is less understand material comparison and the concept of the relationship between area and circumference planes. The last subject i.e. self-made G11 error in all numbers with details of the numbers 1, 3, and 6 is the transformation error while the 2, 4, and 5 are the error process skill. It was the same case with the two other subjects; G11 also has weaknesses in the material prerequisites.

The findings obtained in this study other facts i.e. auditory learning style students have something new to do in step encoding. Subject G23 made encoding errors in number 1 and 2. This is due to incorrect G23 in determining the appropriate unit. The subject considers that the unit is cm^2.

Suggestions and solutions to minimize these errors can originate the teacher or the students themselves. The suggested activities to teachers to enhance student understanding of the concept and the material so that it can minimize errors are (1) vary your vocal when giving explanations such as intonation, volume, and velocity, (2) using of repetition-repetition of concepts that are already given, (3) forming a group of peer tutors, and (4) interspersing learning with music. Meanwhile, students can do activities to minimize errors are discussing with friends who are more savvier and listen to video learning.

Kinesthetics Learning Style Students

Based on Figure 1, there are 5 students with a kinesthetic learning style. In the study, there were 3 students representing 5 kinesthetic learning style students. The third students were G24, G01, and G30. Based on Table 3, it can be seen that kinesthetic learning style students tended to do major mistakes in all the steps except for reading. It was indicated that kinesthetic learning style students had various level of understanding the material. The stylish kinesthetic learning style students start from which cannot be exercised at all (comprehension) until the small error that is carelessness in the final answer (encoding).

The subject of the G24 tended to make transformation error, process skills error, and encoding error, G01 tended to do transformation error and G30 tended to do comprehension error and transformation error. When it was more analyzed, the third subject was equally made transformation error in all the numbers. This transformation error is caused using the wrong strategy. Judging from the results of the work, kinesthetic learning style students often try to resolve the matter by using his strategy of its own. Although their strategy of "try and error" is often wrong in concept kinesthetic learning style students do everything (try new things) as well as learning through manipulation and practices. The cause of this error is less understand material comparison and the concept of the relationship between broad and round the quadrilateral so after understanding what is reserved, the subject does not know how to solve them. In this study also obtained the findings of fact that are similar to other types of learning style students kinesthetic have constraints in materials of algebra. This causes error processing skill.

Suggestions and solutions to minimize these errors can originate the teacher or the students themselves. The suggested activities to teachers to enhance student understanding of the concept and the material so that it can minimize mistakes are (1) always using visual aids or props or media that can be seen, touched, and manipulated the students as they learn to stimulate curiosity, (2) getting used to standing/sitting next to students in guiding students individually, (3) making the rules of the game so that the students could be doing a lot of motion in the classroom, and (4) using the drama/simulation concept concretely. Meanwhile, students in activities to minimize his mistakes include learning by making use model and practice find the strategy completion problem itself without having to memorize the formula of raw.

CONCLUSIONS

The research results obtained summary, (1) visual students tend to make transformation error, 2) auditory students tend to make transformation error and process skill error, and (3) kinesthetic students is not tendency on one type of error. Generally, the reason, whereas visual, auditory and kinesthetic, is less understood the material prerequisites such as comparison, algebra, linear equations and one variable. The solution that can be done is 1)visual learning style students read the materials more, 2) auditory learning style students learn with tutorial friends, and 3) kinesthetic learning style students use model. In addition, teachers should also make a learning using vision, hearing, and physical activity.

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