

MATHEMATICAL ERROR ANALYSIS WITH KASTOLAN'S THEORY IN TERMS OF LEARNING STYLE

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ABSTRACT

This Mathematics is known as a lesson that requires students to explain the process before answering, through the essay questions will be able to find out the errors made in answering the questions. This research aims to analyze students' error in doing the mathematics problems in terms of students' learning styles. Error analysis was carried out based on the Kastolan method. The research method used is descriptive qualitative. Data was collected using instruments in the form of a essay test on squared root material, a learning style questionnaire, and an interview sheet guide. The subjects in this research were junior high school students in class IXC. The results of research showed that subjects who have a visual learning style made the most concept errors. Furthermore, technical errors were made by all subjects, visual, kinesthetic and auditory subjects. Procedural errors were only made once by subjects in the auditory learning style. The percentage of concept and technical errors is the equal of 67%,. Based on the results obtained, it shows that each learning style has its advantages and disadvantages so they made the different errors when doing the mathematics problems.

Keywords: Error analysis; mathematics; learning styles; Kastolan's theory

1. Introduction

The understanding and view of mathematic can vary one individual to others. Some individuals might be hard of learning mathematic or less favorable subject with various reasons, such as they required providing the process of the answer. By examining the processes of how the students solved their mathematic problems, teachers are able to identify their errors or confusion occurred during the activity. This allows teachers to provide more useful feedback to help the students improve their understanding.

The error analysis should be conducted to improve the learning effectiveness (Kartini, 2022). Several important reasons to conduct students' error analysis are: (1) by analyzing students' errors, teachers know the students' understanding of the subject matter. This allows teachers to adjust their teaching methods and help the students who need more attention. The students can learn from their own mistakes. (2) By knowing the students' error, they can improve their own understanding and avoid the same mistakes in the future. Teachers can adjust their

teaching based on the frequently mistakes made by students. This can help to improve teaching effectiveness and students' learning outcomes. (3) The error analysis also helps to develop the students' critical thinking skills. They can be taught to find and understand why they made mistakes, rather than just correcting their answers.

An error is a deviation or mistake which is done by someone against the actual answer made in solving a given problem, task or problem (Mayani, 2022). The Kastolan theory method is one of the approaches used in analyzing student errors in answering. Kastolan said that researching the procedures students use to solve problems can help accurately identify mistakes made by students (Hendriyanto et al., 2022). The components or categories of errors in identifying errors in solving problems accurately are (1) conceptual errors; (2) procedural errors; (3) technical errors (Kartini & Alawiyah, 2023).

The diversity of errors made by students can be caused by various factors. One of them is the learning process and student characteristics in class (Safitri, 2021). The student characteristics

commonly referred to learning style. Errors occur due to the students' learning style in understanding the concepts of each material (Handican, 2022).

People can learn easily if they find the appropriate learning style for themselves (Putri, 2019). Learning style is an approach that explains how individuals learn or the way they take to focus on the process, also master the difficult and new information through different perceptions (Ghufron, Risnawita 2012). Learning styles refer to the way individuals learn and process information. Every individual has different preferences and methods of learning, and this can affect the effectiveness of their learning.

Learning styles are divided into visual learning styles (visual learner), auditory learning styles (auditory learner), kinesthetic learning styles (tactual learner) (Wahyuni 2021). It is important to remember that most individuals may have a combination of several of these learning styles, and their learning preferences may change over time (Rambe, 2019).

The importance of knowing learning styles is to lead students to achieve their best results in learning activity. It is important to remember that most individuals may have a combination of some of these learning styles, and their learning preferences may change over time. The result of research shows that there is a correlation between learning styles and student learning achievement (Wahyuni, 2021; Irawati, 2021).

Analyzing students' errors and knowing students' learning styles as an assessment for learning itself can be a reflection among the teachers and students so it can be expected to guide students in achieving maximum learning outcomes. Therefore, in this study, students' errors were analyzed based on their learning styles using Kastolan's theory.

2. Research Methods

This research used descriptive qualitative method. Data collection used a learning style questionnaire, essay questions on squared root material, and an interview sheet guide. This research was conducted at SMP N 4 Sukawati in the odd semester of the 2023/2024 school year. The research subjects were class VIII students totaling 36 people. The sample selection was carried out by purposive sampling so that the last six students who had the highest tendency of each learning style were taken. All subjects were given tests and questionnaires, then calculations were

made on the questionnaire to see the dominant learning style possessed by a student, then the test was used to assist in analyzing errors. The interview sheet was used to confirm the test results shown. Furthermore, two people who had the highest dominance for each learning style were selected to further analyze the students' error and do the confirmation.

The essay test instrument consists of five valid and reliable questions. The learning style questionnaire consists of fourteen questions developed by Sugianto (2021). The interview sheet contains the questions which confirmed the answers had been made by the six selected subjects.

3. Results and Discussion

The results of the essay test given to 36 students showed that the average student learning outcome was 77.3. Furthermore, the results of the learning style questionnaire show that there are 15 people who tend to have a visual learning style, 7 people tend to have an auditory learning style, 5 people have a kinesthetic learning style, and 9 people have a mixed learning style in the class. The mixed learning style is referred to a learning style that has two dominant learning style tendencies. Therefore, the selected samples are two people with the highest tendency (score) that leads to one of the existing learning styles.

After the samples were selected, namely A1, A2, V1, V2, K1, and K2, the errors made in answering squared root questions were analyzed. In the material of squared root, students are presented with directed problems, not contextual, so that the students directly apply their understanding of the concepts that have been taught in solving the mathematic problems, namely simplifying root forms, rationalizing root forms, squaring root forms and arithmetic operations in root forms.

Based on Kastolan's Theory, it shows that there were three types of errors from the six subjects observed. Procedural errors were made by subjects with auditory learning style. Technique errors were made by subjects with visual and kinesthetic learning styles. While concept errors were made by all subjects except subject A2. The complete results are shown in Table 1.

Table 1. Result of the Learning Style Test Analysis.

Questions	A1	A2	V1	V2	K1	K2
1	T	T	CE	T	T	T
2	PE	TE	T	T	T	TE
3	CE	T	T	T	T	T
4	T	T	CE	TE	TE	T
5	T	T	T	CE	CE	T

Description:

A1, A2 are subjects with auditory learning style.

V1, V2 are subjects with visual learning styles.

K1, K2 are subjects with kinesthetic learning style.

T is the question answered correctly.

CE is concept error.

TE is technical error.

PE is procedure error.

Based on the results shown in Table 1, every subject almost made conceptual errors. This result encourages to do the interview. The following is shown the results of students' error.

Figure 1. CE by subject A1

Figure 1 shows the concept error made by subject A1 in solving the addition operation of root numbers. After the interview, it showed that the student did not understand and forgot the concept of adding squared root numbers.

Furthermore, Figure 2 shows a slight technical error made by subject A2, in which the error made by subject did not make error in the results obtained. The interview results showed that the subject forgot to remove the "-" sign in the second step, but in the mind, the subject A2 had worked on the numbers that should have been, so the next step wrote the correct result. The clearly result can be seen in Figure 2.

Figure 2. TE by Subject A2

Figure 3. CE by subject V1

Figure 3 shows the concept error in simplifying the root form. The interview result confirms that students have not understood the concept of decomposing the root form.

Figure 4. TE and CE by subject V2

Based on the results of the interview, it stated that students wrote incorrectly for question 4. While question 5 did not complete the answer because it ran out of time in the process. This result was also found during the interview with subject K1, and the results of the student's work are shown in Figure 5.

4 Dik: $\frac{2}{3+\sqrt{5}}$
Dit: bentuk rasional
Jawab:
$$\frac{2}{3+\sqrt{5}} = \frac{2}{3+\sqrt{5}} \times \frac{3-\sqrt{5}}{3-\sqrt{5}}$$
$$= \frac{2(3-\sqrt{5})}{9-5}$$
$$= \frac{2(3-\sqrt{5})}{4}$$
$$= \frac{1}{2}(3-\sqrt{5}) \rightarrow \text{KT}$$

5 Dik: $\frac{2}{3\sqrt{2}-\sqrt{5}}$
Dit: bentuk rasional
Jawab
$$\frac{2}{3\sqrt{2}-\sqrt{5}} = \frac{2}{3\sqrt{2}-\sqrt{5}}$$

Figure 5. TE and CE by Subject K1

The results of analyzing students' errors in answering the questions, especially power and root number material show that there are many students who answer the questions in wrong concept, especially for students with visual learning style. Visual learning is a learning style in which the learners get the information through the visual formats such as pictures, diagrams, shows, demonstrations, or videos. Providing information through pictures or diagrams is a stimulus in the visual learning style (Irawati, 2021). This characteristic strengthens the results of this study, because in the power and root number material, there is no visualization displayed based on the characteristics of the material. This is the cause of subjects with visual learning style; it is difficult to understand the concept of roots and powers.

The error that occurs in all learning styles is a technical error. Technical error is an error that occurs due to lack of accuracy in determining the result of an arithmetic operation or in short

negligence (Kartini & Alawiyah, 2023). Technical errors are related to accuracy in counting. This means that the students still make many inaccuracies in writing signs and numbers in solving the mathematic problems. Such errors can affect the students in determining the answer result. Therefore, the follow-up in learning activity is necessary to be done so these kinds of errors can be avoided by students.

4. Conclusions

Error analysis with Kastolan's theory divides errors in answering questions into three types, namely concept errors, procedural errors, and technical errors. Based on the results of error analysis the students' learning styles, it shows that subjects who have a visual learning style made the most concept errors. Furthermore, technical errors were made by all subjects, visual, kinesthetic and auditory subjects. Procedural errors were only made once by subjects in the auditory learning style. The percentage of concept and technical errors is the equal of 67%, especially in the material of squared root in mathematics. The achievement of good learning outcomes is by understanding the characteristics of the material presented and observing the students' learning styles.

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