

Analysis of Students' Thinking Level Based on SOLO Taxonomy in terms of Learning Style

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Abstract: This study aims to determine the level of students' thinking based on the SOLO taxonomy in solving math story problems in terms of Visual, Auditorial, and Kinesthetic (VAK) learning styles. This type of research is qualitative research with a descriptive approach. The VAK learning style questionnaire was given to thirty grade VIII.2 students of SMP Negeri 1 Tomoni to determine each student's learning style. Then the researcher gave tests and interviews to one student from each type of learning style. The results showed that students with visual, auditory and kinesthetic learning styles had different levels of thinking in the SOLO Taxonomy. Based on the indicators of the level of thought in the SOLO Taxonomy, students with a visual learning style are at the uni-structural level, students with an auditory learning style are at the multi-structural level, and students with a kinesthetic learning style are at the relational level.

Keywords: SOLO Taxonomy, Thinking Level, VAK Learning Style.

Introduction

Mathematics is a universal scientific discipline in solving a problem with accuracy. The process of learning mathematics can form logical thinking not just counting but can seek understanding, solve problems, make decisions, gain understanding of the things they face. According to Tyler, learning by providing opportunities for students to acquire skills in solving problems will realize the development of the students' own thinking abilities.

Students' abilities cannot be described clearly during the learning process because students' thinking processes are something that is visible to the eye. Students' ability to solve problems can be seen from students' responses when dealing with mathematical problems. An educator cannot see directly students' mathematical abilities in solving problems through the thinking processes that occur in students when faced with a number of questions, but can determine students' thinking levels from the quality of the responses given including students' abilities in responding to math

problems. Therefore, the researcher used the SOLO (Structure of Observed Learning Outcomes) taxonomy to classify students' thinking levels in solving math problems.

The SOLO (Structure of The Observed Learning Outcome) taxonomy developed by Biggs and Collis (1982) shows that the SOLO taxonomy is used as a tool for assessing the quality of learning at the school and university levels and can be applied in all fields of study. According to Azizah the SOLO taxonomy is the most practical assessment tool for measuring student responses or the quality of answers to certain questions. The SOLO taxonomy classifies students' response skills in problem solving into five different levels, namely: prestructural, unistructural, multistructural, relational, extended abstract. The structure of student responses that appears at each level of the SOLO taxonomy forms the basis for the formulation of the learning cycle.

Each student has different learning abilities in receiving information or responding to a problem. This can be seen from the differences in students'

ability to answer questions. Differences in students' abilities in answering questions are based on the fact that each student applies a different learning style. Learning style is a learning modality that must be owned by every student in receiving, processing, and processing the information obtained. In fact, every student has only one learning style that dominates. Most students have difficulty understanding the learning material provided by the teacher. This is because students do not know how to learn that should be used and applied. So it can be concluded that learning styles have an important role in student achievement. Richard Bandler, John Grinder, and Michael Grinder in their extensive research have identified three different learning and communication styles, namely: visual learning style, auditory learning style, and kinesthetic learning style.

Related to the description above is important for researchersto determine the level of students' thinking based on the SOLO taxonomy in solving math word problems in terms of Visual, Auditorial, and Kinesthetic (VAK) learning styles.

Materials and Methods

Study Area

This type of research uses descriptive research with a qualitative approach which aims to analyze the level of students' thinking based on the SOLO Taxonomy in terms of learning styles. The concentration of the selected research location is SMP Negeri 1 Tomoni.

Procedures

Based on the data collection procedure used in this study are as follows.

Questionnaire

The questionnaire contains questions adapted to indicators of visual, auditory, and kinesthetic learning styles for thirty students in class VIII.2 to find out each student's learning style.

Test Questions

Test questions were given to one student from each type of learning style. The test questions used are SPLDV adjusted based on the SOLO Taxonomy indicator to determine students' level of thinking.

Interview

Interviews with one student from each type of learning style contained several questions that aimed to find out what the research subject wanted to get to strengthen the data from the analysis.

Data Analysis

After the data is collected, data reduction is carried out with the aim of focusing on what will be learned, namely analyzing student answers according to the SOLO Taxonomy chosen as the research topic. This step is in accordance with the data analysis technique used in this study which was proposed by Miles and Huberman (1992) that in data analysis activities are divided into several parts, namely data reduction, data presentation and conclusion.

Results and Discussion

Analysis results questionnaire shows that each student has a different learning style. Based on the results of a questionnaire test for class VIII.2 students at SMP Negeri 1 Tomoni, totaling thirty people with twenty minutes of working time, there were sixteen students with a visual learning style, six students with an auditory learning style, five students with a kinesthetic learning style, and three students with a visual-auditory mixed learning style. Subjects selected from the results of the questionnaire test were determined based on the dominance of the highest score of each visual, auditory and kinesthetic learning style. This sorting aims to make it easier to see the state of students in determining the type of learning style they have. Furthermore, students are grouped into three categories from each learning style criterion. So that three subjects were obtained with one student each in the visual learning style category, one student in the auditory learning style category, and one student in the kinesthetic learning style. The following is a list of the selected subjects:

Tabel 1. Research Subject Data

No	Name	Learning Style	Subject
1	BA	Visual	S ₁
2	ANF	Auditorial	S ₂
3	NH	Kinestetetic	S ₃

Based on the level of thinking in SOLO's taxonomy in the SPLDV story problem material, it was found that the three subjects in the research conducted on class VIII.2 students had different levels of thinking. The following is a list of the results of the analysis of student test questions based on the thinking level of the SOLO taxonomy:

Tabel 2. Student Thinking Level Based on SOLO Taxonomy

Student's name	Thinking Levels									
	Number 1				Number 2					
	0	1	2	3	4	0	1	2	3	4
BA	√	√	√			√	√			
ANF	√	√	√			√	√	√		
NH	√	√	√	√		√	√	√	√	
Total	3	3	3	1		3	3	2	1	

Based on table 2, it can be seen that the level of students' thinking in solving SPLDV story problems is at several levels of the SOLO taxonomy including: level 0 is the prestructural level, where 3 students fulfill the indicators for the prestructural level. about. Level 1 is unistructural, where 3 students meet the indicators for the unistructural level. This is in accordance with the responses to the answers given that students can solve unistructural indicator questions.

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Level 3 is relational, where only 1 student fulfills the relational level indicator. This is in accordance with the responses to the answers given that students can complete the relational question indicators. Level 4 is an extended abstract, where no students meet the expanded abstract level.

The following will present answers to test results and interviews with 3 subjects selected from visual, auditory and kinesthetic learning styles as follows:

1. Subjek 1 (V1)

Based on the results of the test subject answer sheet 1 (V1) is presented in the following image.

Handwritten student answer for subject 1 (V1) showing a system of linear equations in two variables (SPLDV) and its solution:

$$\begin{aligned} & \text{1. a. } 10 \text{ kg tepung ketan} \\ & \quad 6 \text{ kg gula merah} \\ & \text{b. } 10x + 6y = 163.000 \\ & \quad 6x + 4y = \text{Rp. } 103.000 \\ & \text{c. } 10 \text{ kg tepung ketan dan gula merah} = 163.000,00 \end{aligned}$$

Image 1. Answer number 1

Handwritten student answer for subject 1 (V1) showing a system of linear equations in two variables (SPLDV) and its solution:

$$\text{2. a. } 120 \text{ kendaraan dan } 290 \text{ roda}$$

Image 2. Answer number 2

The results of the analysis based on tests and interviews conducted, subject 1 (V1) is a student who applies a visual learning style when studying. It can be seen that students tend to give answers based on visual associations when the interview is conducted between the subject and the researcher. Students in solving these questions are able to write answers sequentially and regularly based on information known from the problem. Student V1 indicated that students started using a piece of known information to answer the problem. This is in line with the opinion of DePorter & Hernacki (2008) that students who rely on a visual learning style have the characteristics that what is seen can be remembered and how to remember it tends to use visual associations in this case students are quite good at remembering the information given in the problem. However, there are other facts obtained from this study, including that there are several obstacles experienced by V1 students, namely students can complete some parts of the problem but are inconsistent in writing some mathematical symbols. Students have not been able to draw conclusions about the questions given, this shows that students have not been able to understand the problems that must be solved in the questions.

Based on indicators of students' thinking levels in solving math problems based on SOLO Taxonomy, it can be concluded that V1 students with a visual learning style in solving math problems are at the Unistructural level, namely: (a) Students only use at least one piece of information to solve problems, (b) Students using the completion process based on the information obtained from the problem.

This is in line with research conducted by Anis Farida Jamil (2017) that students with level 1 thinking skills are at the unistructural level. This shows that students are able to solve problems by using relevant information to respond to a given problem. That is, the answers given by students only focus on one information given question. For example, students in working on questions tend to focus on images or concrete objects to answer these questions.

2. Subjek 2 (A1)

Based on the results of the answer sheet test number 1, subject 2 (A1) is presented in the following image.

1. a 10 kg tepung ketan 6 kg gula merah

B $10x + 6y = 163.000$
 $6x + 4y = 103.000$

C $10x + 6y = 163.000 \times (2)$
 $6x + 4y = 103.000 \times (3)$

Image 3. Answer number 1

2. a kendaraan 120 dan jumlah roda 290

b $x + y = 120$
 $2x + 4y = 290$

Image 4. Answer number 2

The results of the analysis based on tests and interviews conducted, subject 2 (A1) is a student who applies an auditory learning style when studying. This is in accordance with research conducted on A1 students who still experience difficulties and are not careful in writing answers

on worksheets, but when conducting interviews these students can explain questions that are well known. Student A1 showed that students were able to understand the questions given and began to relate some of the known information to determine the form of the linear equation. Student A1 still experiences obstacles in solving questions, namely students can complete some parts of the questions given, but the process used to solve the questions is not quite right, students are less thorough in working on questions and are not skilled in re-checking answers before drawing conclusions. This is in line with the opinion of DePorter & Hernacki (2008) that students who have an auditory learning style have difficulty writing but are great at telling stories.

Based on indicators of students' thinking levels in solving math problems based on the SOLO Taxonomy, it can be concluded that A1 students with an auditory learning style in solving math problems are at the Multistructural level, namely: (a) Students can make several connections from some of the information from the problem, (b) Students use the solving process based on information obtained from the questions, (c) Students are able to convert word problems into mathematical form, and (d) Students have started to understand the problem and plan a solution, but are less skilled in evaluating their answers.

This is in line with research conducted by Anis Farida Jamil(2017) that students with level 2 thinking skills are at a multistructural level. This shows that students are able to solve problems by using some relevant information to respond to a given problem, but this information is not well integrated. For example, students in working on problems can change word problems into mathematical form, students know the form of linear equations but have not been able to find the set of solutions to the system of equations.

3. Subjek 3 (K1)

Based on the results of the answer sheet test number 1, subject 3 (K1) is presented in the following image.

a. Jumlah kendaraan (x) dan roda (y)
 Kendaraan = 1200
 Roda = 2000

b. Siswa mendapat skor 80%
 Jumlah siswa = 200
 Siswa = 160
 Siswa = 40

c. Siswa mendapat skor 70%
 Siswa = 140
 Siswa = 60

Image 5. Subject answer K1

The results of the analysis based on tests and interviews conducted, subject 3 (K1) is a student who applies a kinesthetic learning style when studying. Students in solving problems are able to mention the information that must be completed correctly. K1 students in determining the steps to be taken are very simple to get the final conclusion correctly. K1 students are able to apply the concept of word problems in the form of linear equations well. However, K1 students still experience errors in writing down the work steps, are not careful in evaluating answers before drawing a conclusion. This is in line with the opinion of DePorter & Hernacki (2008) that students who have a kinesthetic learning style prefer to learn using visual aids or learning media.

Based on the indicators of students' thinking levels in solving math problems based on the SOLO Taxonomy, it can be concluded that K1 students with an auditory learning style in solving math problems are at the Relational level, namely: (a) Students can use the information obtained from the questions then apply the concept by connecting the process to draw a conclusion, (b) Students in solving problems are able to understand what is known and asked from the problem so that the results are relevant, (c) Students can make steps for solving based on the answers given, and (d) Students are able to understand the problem and plan a solution.

This is in line with research conducted by Anis Farida Jamil(2017) that students with level 3 thinking skills are at the relational level. This shows that students are able to integrate some of the information provided into a coherent structure. That is, at this stage students are able to generalize relationships to symbolic patterns based on the

information obtained. For example, students in working on problems are able to determine the linear pattern, understand the x and y symbols, determine the form of the linear equation from the problem and can apply the linear equation to solve the problem.

Conclusions

Based on the indicators of the level of thinking in the SOLO taxonomy of students with a full visual learning style indicators of the unistructural level, students with a visual learning style reach level one, namely unistructural. Students with an auditory learning style fulfill two indicators of the SOLO taxonomy level of thinking, namely unistructural and multistructural, so students with an auditory learning style reach level two, namely multistructural. Students who have a kinesthetic learning style meet the three indicators of the SOLO taxonomy level of thinking, namely unistructural, multistructural, and relational. So students with kinesthetic learning styles can reach up to level three, namely relational.

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