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Thinking Process Analysis (Assimilation, Accommodation, Abstraction) Mathematics Ability of Junior High School Students in terms of Learning Style

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Abstrak

Tujuan dari penelitian adalah untuk mengetahui proses berfikir kemampuan literasi matematika siswa ditinjau dari gaya belajar auditori, visual dan kinestetik. Penelitian ini merupakan penelitian eksploratif dengan pendekatan kualitatif Penelitian ini dilakukan di Sekolah Menengah Pertama yang tergolong Unggul yang terdapat di Kabupaten Aceh Barat. Subjek penelitian dalam penelitian ini adalah siswa kelas IX MTsN 3 Aceh Barat yang memiliki kemampuan tingkat tinggi dan yang mampu menyelesaikan soal literasi matematika, selain itu subjek juga dipilih berdasarkan gaya belajar. Hasil penelitian diperoleh bahwa tidak ada perbedan yang signifikan proses berpikir literasi matematika siswa berdasarkan gaya belajar, dalam hal ini siswa dengan gaya belajar visual adalah proses berpikir asimlasi dan abtarksi. Untuk subjek dengan gaya belajar auditori proses berpikir akomodasi dan abstraksi sedangkan untuk gaya belajar kinestetik proses berfikir asimilasi dan abstraksi.

Abstract

The purpose of the study was to determine the thinking process of students' mathematical literacy skills in terms of auditory, visual and kinesthetic learning styles. This research is an exploratory research with a qualitative approach. This research was conducted in a junior high school which is classified as superior in the district of West Aceh. The research subjects in this study were class IX students at MTsN 3 Aceh Barat who had high-level abilities and were able to solve mathematical literacy problems, besides that subjects were also selected based on learning styles. The results showed that there was no significant difference in students' mathematical literacy thinking processes based on learning styles, in this case students with visual learning styles were assimilation and abstraction thinking processes.

Keywords: Thinking Process; Literacy Ability; Learning Style

INTRODUCTION

The weak mastery of students' mathematical literacy skills results in Indonesia's low achievement in international competitions. This is in accordance with the results of PISA(Sen et al., 2019)which states that the mathematical literacy ability of Indonesian students is still far from the OECD average. The PISA results show that most Indonesian students have not been able to solve problems in the form of analysis and application. Furthermore, the research results of Trends in International Mathematics and Science Study(TIMSS, 2019)shows that the average score of Indonesian mathematics is 397, when

compared to Singapore, which has the highest average score of 618, this shows that there is a very big difference between the average scores of Indonesia and Singapore. This low TIMSS result can be caused by several factors, one of which is because students in Indonesia are not trained in solving contextual problems that demand mathematical literacy skills.

Not much different, mathematics education in Aceh is also still weak, many schools still have not trained their students to be able to develop mathematical literacy. Learning patterns in schools still do not support students in the process of developing mathematical literacy skills. This is in accordance with research conducted by Marwanthe low participation and learning outcomes of students' mathematics is caused by the low ability of students to think, especially to think critically, creatively and representatively in solving mathematical problems (Marwan, M. Ikhsan, 2019). This is due to the fact that most of the learning carried out still uses conventional learning which only emphasizes the demands of the curriculum so that in practice students are passive and narrow the mindset of students about a problem they are studying. As a result, students are unable to develop higher thinking skills in solving mathematical problems.

The lack of students being trained in answering high-level thinking questions makes students unfamiliar and difficult in answering questions, so a lot of research has been done about the low mathematical literacy skills of students by using learning methods that are expected to help students to be more developed, especially mathematical literacy skills. However, in applying the learning method the teacher must also know in advance how the students' thinking process is, because each student has a different way of understanding learning. There are students who quickly understand when the teacher explains, and there are students who have to repeat it many times so that he understands what is being explained. Likewise in answering the questions given by the teacher,

The thinking process of students in solving mathematical problems is strongly influenced by learning styles, this is in accordance with research conducted by Setiana which states that there is a significant relationship between students' mathematical abilities and learning styles (Setiana, 2020). Then in the study of J. Bire, et al. also mentions that student learning styles have a significant influence on student achievement (Bire, AL, Geradus, U., & Bire, 2014). From this statement, it can be seen that learning styles greatly affect students' thinking processes.

The learning style can also affect the comfort of students in learning. Students will more easily understand learning if the students are also comfortable in the ongoing learning process.The variety of student learning styles means their thinking processes vary. This is as found in research conducted by(Chasanah et al., 2020)shows that students' mathematical abilities will be influenced by different learning styles.

From the observations of researchers at MTsN 2 Aceh Besar by paying attention to the learning process and looking at the characteristics of students' learning styles, it can be seen that teachers have not used learning models that are in accordance with student needs. Many students tend to have difficulty in learning, one of the factors is because the teacher does not pay attention to the learning style of each student. Every student has a different learning style. Due to the lack of comfort of students in learning, it is difficult for students to understand what is explained by the teacher which results in learning not being conveyed properly.

Furthermore, the researcher also conducted limited interviews with several students in class VII and class VIII of MTsN 2 Aceh Besar and obtained information that: (1) students often did not understand the material being taught; (2) students often feel disturbed because of the commotion in class when they are working on practice questions; (3) students are often prohibited from writing before the teacher finishes writing; (4) students are easier to understand the material if they practice or use teaching aids. The things experienced by these students are not paid attention to by the teacher, teachers often apply a learning system that tends to be the same for students whose learning styles are auditory, visual and kinesthetic.

Giving the same learning treatment to students with different types of learning styles will result in the low ability of students to understand certain material concepts and the ineffectiveness of the learning process, teachers should see or know the condition of students in the learning process, this is in accordance with research conducted by(Widayanti, 2013)that state :"In the learning process in the classroom, teachers should not only pay attention to strategies in teaching but also pay attention to the differences in the characteristics of each student. Each student has a different way / style of learning, so that in receiving, processing, and remembering the information obtained is also different. By knowing students' learning styles, teachers can direct them to learn according to their learning styles so that they can easily accept lessons and can improve their learning

outcomes. Efforts that can be made by teachers are to pay attention to student learning styles by grouping based on learning styles.

Therefore, it is important for every teacher to recognize the characteristics of students in the learning process. With the teacher knowing the character of the student, it is easy for the teacher to be able to adjust the learning desired by the student, so as to produce maximum results. To produce quality teachers, it is necessary for educational institutions in Aceh to train prospective teachers who are able to understand the character of students to carry out the teaching and learning process properly. This is one of the goals of the Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training at UIN Ar-Raniry Banda Aceh. Prospective teachers are trained as much as possible to be able to follow the needs of students, both the needs of students in terms of learning styles and cognitive needs such as improving thinking skills.

Based on the foregoing, it is important to know the thinking process of junior high school students' mathematical literacy skills based on learning styles. This study aims to determine the thinking process of students' mathematical literacy skills in terms of auditory, visual and kinesthetic learning styles.

RESEARCH METHODS

This research is to describe students' thinking processes in solving mathematical literacy problems based on learning styles. Based on these objectives, this research is classified as exploratory research with a qualitative approach. This research was conducted at a Junior High School which is classified as Superior in West Aceh Regency. The research subjects in this study were grade IX students at MTsN 3 Aceh Barat who had high-level mathematical abilities, besides that the subjects were also selected based on their learning styles. The data collection instruments in this study were divided into two, namely the main instrument in data collection was the researcher himself and the supporting instruments used in this study consisted of 3 kinds, namely (a) test sheets that measure critical, creative and representative thinking skills; (b) learning style questionnaire (c) interview guide; and (d) recording device. Data collection techniques in this study by giving a test of mathematical literacy skills, giving a learning style questionnaire and interviews.

Furthermore, the data analysis technique in this study refers to the data analysis technique of the Miles and Huberman model which includes Data Reduction (Data

Reduction), Data Display (Data Presentation), Conclusing Drawing / Verification (Withdrawal of Conclusions).

RESULTS AND DISCUSSION

Results

1. Supporting Instrument Development

The supporting instruments in this study consisted of mathematical ability test questions, test questions given in the form of Critical Thinking Ability Test Questions (STKBK), Creative Thinking Ability Test Questions (STKBKf) and Representational Thinking Ability Test Questions (STKBR), in addition to test questions given by researchers also use task-based interview guidelines.

2. Supporting Instrument Validation

a. Test Sheet

Critical Thinking Ability Test Questions (STKBK), Creative Thinking Ability Test Questions (STKBKf) and Mathematical Representation Test Questions (STRM) are complex math problems adapted from Olympic questions and questions that are often tested on the National Examination, because the question has been modified by the researcher, a validation process must be carried out to determine the feasibility of the question before use.

STKBK, STKBKf and STRM validation were carried out by two people consisting of one expert and one expert and practitioners. The experts referred to in this study are mathematics education lecturers and the practitioners referred to are teachers who teach in schools. The selection of teachers as validators in this study emphasizes the suitability of the content of mathematical material with what is contained in the Basic Competencies and sentence construction in mathematical problems that will be solved by students. This is because the teacher as a practitioner is more familiar with the conditions of students in the field.

b. Learning Style Questionnaire

The learning style questionnaire used in this study is a questionnaire developed based on indicators developed by Rusman, namely the Visual, Auditory, or Kinesthetic learning style learning style. And the questionnaire has been validated by a lecturer from psychology.

Collecting data through a questionnaire filled out by MTs students. then a score is given to each statement item so that the data can be analyzed descriptively, after the data has been analyzed then calculate the total score obtained from each learning style (Visual, Auditory, and Kinesthetic). Next, look at the highest score among the three student learning styles. Based on the number of highest scores, each student is classified as to whether it belongs to the tendency of Visual, Auditory, or Kinesthetic learning styles.

The results of classifying students based on students' learning style tendencies can be seen in the following table:

Table 1. Initials in Data Presentation

No.	Subject Initials	Learning Style	Ability
1	NZ	Audio	Critical
2	SN	Visual	Critical
3	SY	Kinesthetic	Critical
4	RL	Audio	Creative
5	AU	Visual	Creative
6	AR	Kinesthetic	Creative
7	NU	Audio	Representation
8	RN	Visual	Representation
9	FH	Kinesthetic	Representation

3. Research Data on the Thinking Process of Students' Mathematical Literacy Ability Based on Learning Style

In this section, the results of research based on students' thinking processes in solving mathematical literacy problems will be presented in this case including critical thinking skills, creative thinking abilities and mathematical representation abilities based on learning styles.

1) Thinking Process of Students' Critical Thinking Ability Based on Learning Style

Based on the results of work and interviews with NZ, SN and SY, the descriptions of the thinking processes of NZ, SN and SY on mathematical critical thinking skills in STKBK 1 and STKBK 2.

The following are questions to measure students' critical thinking skills given to NZ, SN and SY subjects:

"The student council of a school will hold a fundraising event by means of an art performance that is open to the general public. Proceeds from ticket sales for the event will be donated to victims of natural disasters. The committee chose a venue in the form of a theater where the audience seats were arranged in a curved shape in the form of a semi-circle consisting of six rows.

a. If there are 25 seats in the first row, 35 seats in the second row, 50 seats in the third row, 70 seats in the fourth row, and so on. Determine the total number of audience seats in the theater. Write down the solution steps.
b. If the ticket price for the audience in the first seat is the most expensive and the difference in ticket prices between two adjacent rows is Rp. 10,000.00 assuming all audience seats are fully occupied, determine the cheapest ticket price so that the committee can earn Rp. 22,500,000.00."

Based on the results of the analysis of the thought process, namely assimilation, accommodation and abstraction of the questions above, it is obtained as presented in Table 2 below:

Table 2. Students' Critical Thinking Process in Solving Mathematical Problems Based on Learning Style

Critical Thinking Indicator	**Learning Style Type**	**Thinking Process on STKBK I**	**Thinking Process on STKBK II**
Interpret the problem by identifying information that is important in solving the problem	Visual	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
	Auditory	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
	Kinesthetic	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
Analyze the problem by determining the right model and strategy to solve the problem	Visual	Assimilation at point (a) and Accommodation at point (b)	Assimilation at point (a) and Accommodation at point (b)
	Auditory	Assimilation in point (a) and	Assimilation of questions in point (a) and

		Abstraction in point (b)	Abstraction in point (b)
	Kinesthetic	Assimilation in point (a), Accommodation and Abstraction in point (b)	Assimilation in point (a), Accommodation and Abstraction in point (b)
Evaluate the problem by carrying out the correct procedure so that the final result obtained is correct	Visual	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
	Auditory	Assimilation at point (a) and Accommodation at point (b)	Accommodation at point (a) and Assimilation at point (b)
	Kinesthetic	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
Inferring the problem by using the right elements to make a conclusion	Visual	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
	Auditory	Assimilation at points (a) and (b)	Assimilation at points (a) and (b)
	Kinesthetic	Accommodation in points (a) and (b)	Accommodation in points (a) and (b)

2) Thinking Process of Students' Creative Thinking Ability Based on Learning Style

Based on the results of work and interviews with RL, AU and AR, a description of the thinking processes of RL, AU and AR on mathematical creative thinking skills in STKBKf 1 and STKBKf 2.

Table 3. Students' Creative Thinking Process in Solving Mathematical Problems Based on Learning Style

Creative Thinking Indicator	**Learning Style Type**	**Thinking Process on STKBKf I**	**Thinking Process on STKBKf II**
Fluency	Visual	Accommodation and Abstraction	Accommodation and Abstraction
		Assimilation and Abstraction	Assimilation and Abstraction
	Auditory	Accommodation and Abstraction	Accommodation and Abstraction
		Accommodation and Abstraction	Accommodation and Abstraction

	Kinesthetic	Assimilation and Abstraction	Assimilation and Abstraction
		Assimilation and Abstraction	Assimilation and Abstraction
Flexibility	Visual	Assimilation and Abstraction	Assimilation and Abstraction
		Assimilation and Abstraction	Assimilation and Abstraction
	Auditory	Accommodation and Abstraction	Accommodation and Abstraction
		Accommodation and Abstraction	Accommodation and Abstraction
	Kinesthetic	Assimilation and Abstraction	Assimilation and Abstraction
		Assimilation and Abstraction	Assimilation and Abstraction
Originality	Visual	Assimilation and Abstraction in question number 3 points (a) and (b)	Assimilation and Abstraction in question number 2 point (a)
	Auditory	Assimilation and Abstraction in question number 2 point (c)	Assimilation and Abstraction in question number 2 point (b)
	Kinesthetic	Assimilation and Abstraction in question number 2 point (c)	Assimilation and Abstraction in question number 2 point (b)

3) Thinking Process of Students' Mathematical Representative Ability Based on Learning Style

Table 4. Students' Mathematical Representation Thinking Process Based on Learning Style

Mathematical Representation Indicator	Learning Style Type	Thinking Process on STRM I	Thinking Process on STRM II
Representing data or information from a problem to a diagram, graph or table representation	Visual	Assimilation at point (e)	Assimilation at point (a)
	Auditory	Accommodation at point (e)	Assimilation at point (a)
	Kinesthetic	Accommodation at point (e)	Assimilation at point (a)
Solve problems involving mathematical expressions or models	Visual	Abstraction and Assimilation in points (a) and (c), and Abstraction in points (d)	Assimilation at points (b), (c) and (d)
	Auditory	Abstraction and Assimilation in point (a).	Assimilation at points (b), (c) and (d).
	Kinesthetic	Accommodation and abstraction in point (a)	Assimilation at points ((b), (c) and (d))
Write the steps for solving mathematical problems in words	Visual	Do not appear.	Do not appear.
	Auditory	Do not appear.	Do not appear.
	Kinesthetic	Do not appear.	Do not appear.

DISCUSSION

Based on the results of the analysis of the first mathematical ability, namely the ability to think critically based on learning styles, the results of the analysis of STKBK I and STKBK II visual students (NZ) on the first indicator of critical thinking ability, namely interpreting the problem by identifying important information in solving the problem of the NZ thought process in completing STKBK I and STKBK II students only need an assimilation process in completing STKBK I and STKBK II. The same thing also happened to auditory students (SN) and kinesthetic students (SY). For the second indicator of critical thinking skills, namely analyzing the problem by determining the right model and strategy to solve the problem of the results of the analysis of STKBK I and STKBK II visual students (NZ) the thinking process of NZ students in solving STKBK I problems appears assimilation

processes and accommodation processes as well as in STKBK II students also bring up the process of assimilation and the process of accommodation.

The thinking process of auditory students (SN) appears as assimilation and abstraction processes as well as in STKBK II the subject appears assimilation and abstraction processes, then for the kinesthetic subject (SY) the subject's thought processes in completing STKBK I and STKBK II appear assimilation, accommodation and abstraction thinking processes. Furthermore, for the third indicator of critical thinking skills, namely evaluating the problem by carrying out the correct procedure so that the final result obtained is right for the visual subject (NZ) in completing STKBK I, the assimilation thinking process appears, for auditory subjects (SN) assimilation and accommodation and for kinesthetic subjects (SY) appears assimilation thinking process in completing STKBK I and STKBK II. The fourth indicator of critical thinking ability is inferring problems by using the right elements to make a conclusion on visual (NZ) and auditory (SN) subjects in solving problems STKBK I and STKBK II appear assimilation thinking processes. As for the kinesthetic subject (SY) in solving the STKBK I and STKBK II problems, the thought process of the accommodation subject.

This is in accordance with research conducted by Hayuningrat and Listiawan (2018) which states that students are at the stage of understanding the problem of carrying out assimilation thinking processes, namely students can express information from the problems given correctly and smoothly. Furthermore, at the stage of preparing a plan, students generally carry out assimilation thinking processes and a small portion carry out accommodation thinking processes, at this stage students have also experiencedabstraction thinking process because students are able to integrate the information received into symbols in the form of examples. Then in the next stage, namely carrying out the plan, students are able to assimilate and directly integrate the newly obtained information into the existing schema in their minds and students also experience an accommodation thinking process because at this stage students are seen to be silent and confused in solving mathematical problems. At the last stage, namely re-checking, students are able to check the suitability of the results with known data and can decide and be sure that the final answer is correct so that at this stage students carry out the assimilation thinking process.

The results of the analysis of the second mathematical literacy ability, namely the ability to think creatively based on learning styles, the results of the analysis of STKBKf I and

STKBKf II visual students (RL) on the first indicator of creative thinking ability, namely*fluency*(fluency and fluency) in solving creative thinking process problems, RL in completing STKBKf I number 1 and STKBKf II number 1 students need accommodation and abstraction processes, while in completing STKBKf I number 2 and STKBKf II number 2 RL students need a process of assimilation and abstraction . Audio students (AU) in completing STKBKf I and STKBKf II AU students need accommodation and abstraction processes. Visual students (AR) in completing STKBKf I and STKBKf II students need assimilation and abstraction processes. For the second indicator of critical thinking ability, namely flexibility (flexibility and flexibility) in completing STKBK I and STKBK II visual students (RL) need a process of assimilation and abstraction, auditory students (AU) in solving STKBK I and STKBK II problems require accommodation and abstraction processes. , and kinesthetic (AR) students in completing STKBKf I and STKBKf II require assimilation and abstraction processes. Then the third indicator, namely Originality (originality and novelty), visual students (RL) in completing STKBKf I number 3 point a and STKBKf II number 2 point a require assimilation and abstraction processes. Auditory subjects (AU) in completing STKBKf I number 2 point c and STKBKf II number 2 point b require assimilation and abstraction thinking processes. Kinesthetic subjects (AR) in completing STKBK I number 2 point c and STKBK II number 2 point b require assimilation and accommodation processes. visual students (RL) in completing STKBKf I number 3 point a and STKBKf II number 2 point a require assimilation and abstraction processes. Auditory subjects (AU) in completing STKBKf I number 2 point c and STKBKf II number 2 point b require assimilation and abstraction thinking processes. Kinesthetic subjects (AR) in completing STKBK I number 2 point c and STKBK II number 2 point b require assimilation and accommodation processes. visual students (RL) in completing STKBKf I number 3 point a and STKBKf II number 2 point a require assimilation and abstraction processes. Auditory subjects (AU) in completing STKBKf I number 2 point c and STKBKf II number 2 point b require assimilation and abstraction thinking processes. Kinesthetic subjects (AR) in completing STKBK I number 2 point c and STKBK II number 2 point b require assimilation and accommodation processes.

This is in accordance with research conducted by Sopamena et al. (2018) Students who have an assimilation thought process will be able to solve math problems smoothly from the process of students responding to problems that exist in the problem until students

immediately work on the existing problems, so that after being asked to reflect the results of their work students remain confident in their answers, so that S1 adapts to their thinking processes with the problems given. While students with accommodation thinking processes have difficulty and cannot solve the given problem, students do not experience adaptation between their thinking processes so that their thinking structure is not in accordance with the problem structure. After being given the opportunity for reflection, then students can correct their mistakes and solve problems so that there is an adaptation between their thinking process and the problem. In the abstraction process according to Yuwono's (2010) research, students are able to use mental objects, namely symbols as symbols to help them in answering math problems.

The result of the analysis of the third mathematical literacy ability is the ability to represent mathematically based on the learning style of the results of the analysis STRM I and STRM II visual students (RN) on the first indicator of mathematical representation ability, namelyRepresenting data or information from a problem to the representation of diagrams, graphs or tables, RN subjects in completing STRM I and STRM II students only need an assimilation process, for auditory subjects (NU) in completing STRM I and STRM II students' thinking processes go through the accommodation process , then for the kinesthetic subject (FH) in completing STRM I and STRM II students' thinking processes are assimilation and accommodation.

Furthermore, the results of the analysis of students' thinking processes in the mathematical representation of students on the second indicator, namelysolving problems by involving mathematical expressions or models, visual subjects (RN) in completing STRM I and STRM II an assimilation process appears, then auditory subjects (NU) in completing STRM I and STRM II through assimilation and abstraction processes. Subjects with kinesthetic learning style (FH) in completing STRM I and STRM II through the process of accommodation and abstraction.

The third indicator of mathematical representation iswrite the steps for solving mathematical problems in words for visual (RN), auditory (NU) and kinesthetic (FH) subjects for STRM I and STRM II the subject has not yet appeared assimilation, accommodation or abstraction thinking processes, this is because the subject is not used to it. with the process of writing the completion steps in their own language

Based on the research results of Nahdataeni et al (2015) students with visual, kinesthetic and auditory learning styles carry out assimilation thinking processes in understanding the problems given. However, in determining solutions to answer math problems, students with visual and kinesthetic learning styles experience confusion when converting the sentences in question into mathematical models. Students with visual and kinesthetic learning styles must read the questions repeatedly to be able to change sentences in the form of mathematical models. So in this case, the student carries out the accommodation thinking process, while the auditory learning style student uses the wrong strategy in answering the questions, so it can be said that the auditory student carries out the accommodation thinking process in formulating strategies.

CONCLUSIONS

The results showed that there was no difference in students' mathematical thinking processes based on visual learning styles, namely assimilation and abstraction thinking processes. For subjects with auditory learning style, accommodation and abstraction thought processes, while for kinesthetic learning styles, assimilation and abstraction thinking processes.

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