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Analysis of mathematical abstraction ability in terms of learning style kolb assisted by google slides media

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Abstract: *The purpose of this study was to describe students' mathematical abstraction abilities in terms of the types of learning styles diverger, accommodator, converger, and assimilator. This research is a qualitative research with research subjects namely students of class VIII SMP. Of the 16 research subjects, one subject was selected in each Kolb learning style group based onbasis purposive. The instruments used in this study were Kolb's learning style questionnaire, mathematical abstraction test questions, and interviews. Mathematical abstraction ability tests are given online viamedia google slides. Based on the data analysis, it is concluded that (1) Student with diverger learning styles can complete indicators of mathematical abstraction ability, except indicators make generalizations. (2) Student with an accommodator learning style can complete indicators of mathematical abstraction ability unless the indicator identifies the characteristics of the object being manipulated or imagined and the indicator makes generalizations. (3) Students with converger and assimilator learning styles can solve all indicators of mathematical abstraction ability.*

Keywords: Mathematical Abstraction Skills; Kolb's Learning Style; *Google Slides*.

INTRODUCTION

Every student must be able to master the ability in learning mathematics, one of which is the ability of mathematical abstraction. This is because, one of the important abilities that students must have is the ability of mathematical abstraction. This is because abstraction is the basic process of mathematical recipes. Ferrari (in Wiryanto, 2014) states that abstraction is a fundamental process in learning mathematics. One of the characteristics of mathematics is studying abstract objects of study, namely those related to mental or thought such as facts, concepts, operations, and principles (Fiantika, Budayasa, & Lukito, 2017). Therefore, we need an abstraction process, which is a process that directs students to carry out and experience activities that lead to the formation of abstract concepts. According to Nurhikmayati (2017) with abstraction, students are able to visualize and manipulate an object that is virtual. According to Yusepa (2017) in learning mathematics the results of an abstraction process are mathematical abstraction abilities. Mathematical abstraction skills are needed to describe mathematical concepts, solve mathematical problems, and represent

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abstract mathematical objects. This is in line with the opinion of Suwanto *et al.* (2017) that mathematical abstraction abilities are used to describe problems into mathematical concepts that can build problem situation models.

Students' mathematical abstraction abilities vary, this is because of the learning styles that influence it. According to (Ghufron & Risnawita, 2014; Amir, 2015) that a person's learning style is different from one another. This is in line with Khoerunnisa et al. (2020) that the learning style of each individual is different depending on the way the individual understands and absorbs the lessons given. Based on these differences in learning styles, some experts classify learning styles, one of which is Kolb's learning style. Ramlah et al. (2014) proved that there was an effect of Kolb's learning style on student academic achievement. The suitability between learning styles and students' abilities makes a good contribution to student academic achievement. So, students who learn to use appropriate learning styles can get better performance. Kolb (in Manolis et al., 2013) asserts that a person's orientation in the learning process is influenced by four trends, namely concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). Learning tendencies are combined into four types of learning styles, namely diverging, accommodating, converging, and assimilator learning styles.

Previous research related to mathematical abstraction abilities has been carried out by Yusepa (2017) regarding mathematical abstraction abilities in junior high school students. In addition, Tata (2015) states that the abstraction process is an important thing to pay attention to, especially for the characteristics of junior high school aged children who are not yet able to think formally. Regarding Kolb's learning style, previously Rofiqoh & Kurniasih (2016) conducted research on the analysis of mathematical problem solving abilities based on Kolb's learning style in discovery learning. Meanwhile, Daimaturrohmatin & Rufiana (2019) conducted research on students' mathematical communication skills in terms of Kolb's learning styles. In addition, Handayani & Ratnaningsih (2019) conducted research on students' mathematical reasoning abilities based on Kolb's learning style. Researchers are interested in conducting research on mathematical abstraction abilities in terms of Kolb's learning styles in junior high school students. This is because the mathematical abstraction ability of students at the junior high school level is an important level in the foundation of further abstract thinking with the material presented which is more complex basic material. One of the materials studied in junior high school is the Pythagorean theorem. The Pythagorean theorem is one of the essential materials in mathematics because it is a prerequisite for studying materials related to flat geometry and spatial geometry (Fitriyani & Sugiman, 2014; Ardina, 2016).

Referring to the increasingly massive spread of covid-19, activities carried out online are a solution as a major milestone so that all activities can continue, especially activities in the field of education. This is because learning activities carried out online are activities that are not bound by time and space. This is in line with Kustiani & Despa (2019) that the online learning system is a form of implementation of distance education. This research was conducted in a state of the Covid-19 pandemic, so the research was conducted online. The

use of media is a solution to research during the Covid-19 pandemic with the help of Google Slides. So, giving a mathematical abstraction ability test is given online through the google slides media. Based on several previous studies, there has been no research related to the ability of mathematical abstraction in terms of Kolb's learning style through Google Slides assisted media. Therefore, the aim of this study was to analyze the students' mathematical abstraction abilities in terms of the Kolb learning style assisted by google slides media.

METHOD

The research method used in this research is descriptive qualitative research. This research was conducted on February 3, 2021 to February 6, 2021. The research location of this research is in one of the junior high schools in Tasikmalaya Regency. This study uses a mathematical abstraction ability test instrument, and a Kolb learning style questionnaire that has been validated and declared worthy to be given to students in this study. This research was conducted on 32 students of class VIII. However, of the 32 students who took part in the study only 16 students. This is because the research was carried out during the Covid-19 pandemic, so there are several obstacles that prevent students from contributing to this research. Some of these obstacles include not all students having smartphones, the limited internet quota that students have, no telephone signal, and so on.

Furthermore, as many as 16 class VIII students were given a Kolb learning style questionnaire. After the students filled out Kolb's learning style questionnaire, the researchers grouped them into Kolb's learning style types, namely divergers, accommodators, convergers, and assimilators. Based on the results of filling out the Kolb learning style questionnaire, the results were that there were 8 students who belonged to the diverger learning style type, 3 students who belonged to the accommodator learning style type, 3 students who belonged to the converger learning style type, and 2 students who belonged to the assimilator learning style type. From each group, one subject was taken using a purposive technique. Purposive is the taking of research subjects based on certain goals or considerations (Yusuf, 2017). The considerations in question are the considerations of the teacher including (1) the ability of students in mathematics, (2) the activeness of students during mathematics learning, and (3) the ability of students to express oral and written opinions so that the acquisition of information is clear.

Furthermore, after the students filled out the Kolb learning style questionnaire, then the research subjects selected from each group of learning style types were given online mathematical abstraction test questions through the media assisted by Google Slides, which is a media whose final result is a pdf page. On the pdf page there are instructions on how to work on tests of mathematical abstraction abilities, questions about mathematical abstraction abilities, and an icon to direct students to the answer upload page that has been linked with the Google Form, by clicking the icon on the pdf page. Mathematical abstraction ability test questions given online through Google Slides assisted media can be seen in Figure 1 below.

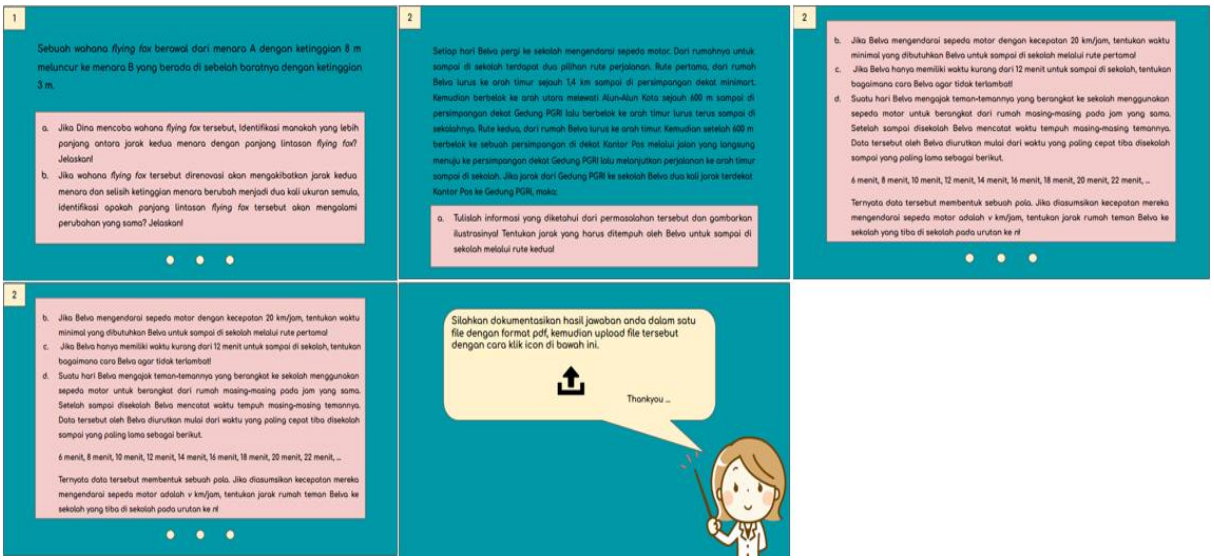

Figure 1. Mathematical Abstraction Abstraction Abstraction Test Questions with Google Slides Assistance

After the research subjects took the mathematical abstraction ability test, to find out more in-depth information, the students selected to be the research subjects were interviewed by researchers related to how the students worked on the mathematical abstraction ability test questions. Furthermore, the data on student work is then analyzed. After the analysis is carried out, a conclusion or verification is carried out. The validity of the data was seen by using data triangulation, namely by comparing the results of filling out Kolb's learning style questionnaire, tests of mathematical abstraction abilities, and interviews. Indicators of mathematical abstraction ability used in this study are based on empirical abstraction theory and theoretical abstraction. In Table 1, the following indicators of mathematical abstraction ability according to Nurhasanah et al. (2017).

Table 1. Indicators of Mathematical Abstraction Ability

Types of Abstraction	Abstraction Ability Indicator
Empirical Abstraction	a. Identify object characteristics through direct experience. b. Identify the characteristics of the object being manipulated or imagined.
Theoretical Abstraction	c. Represent mathematical objects in symbols or mathematical language. d. Releasing material properties from an object or doing idealization. e. Apply the concept to the appropriate context. f. Making connections between concepts. g. Manipulating abstract mathematical concepts. h. Make generalizations.

RESULTS AND DISCUSSION

The results of this study are data about the types of students 'Kolb learning styles, the results of tests of mathematical abstraction abilities, and the results of interviews used to describe students' mathematical abstraction abilities based on Kolb's learning styles, namely divergers, accommodators, convergers, and assimilators. The data were collected and then analyzed by induction, so that the students' mathematical abstraction abilities in each group of Kolb's learning styles could be described. In Table 2, the following are the selected subjects.

Table 2. Research Subjects

No	Kolb's Learning Style	Subject Code
1	Diverger	SD
2	Akomodator	SAk
3	Konverger	SK
4	Asimilator	SAs

Based on the results of the Kolb learning style questionnaire, it shows that the results of the difference between AC and CE are negative and the results of the difference between AE and RO are negative, so the results show that the elementary learning style is diverging. Based on the results of the Kolb learning style questionnaire, it shows that the results of the difference between AC and CE are negative and the results of the difference between AE and RO are positive, so the results show that the SAk learning style is an accommodator. Based on the results of the Kolb learning style questionnaire, it shows that the results of the difference between AC and CE are positive and the results of the difference between AE and RO are positive, so the results show that the SK learning style is convergent. Based on the results of the Kolb learning style questionnaire, it shows that the results of the difference between AC and CE are positive and the results of the difference between AE and RO are negative, so the result is that the SAs learning style is an assimilator. In research with the Pythagorean theorem material, the dominant learning style is the diverger learning style.

In line with the above, based on the results of tests of mathematical abstraction abilities and interviews with elementary schools, data / information is obtained related to the characteristics of the type of learning style according to Kolb, namely 1) Be careful in determining the steps for completion, 2) Connecting the object given to the object. others around it, 3) Collect as much data as possible to solve the problem, and 4) Quickly get bored because they can't find a way to solve the problems given. Based on the description above, SD has a tendency towards CE and RO quadrants. According to Kolb, the combination of CE and RO produces diverging learning styles Daimaturrohmatin & Rufiana (2019).

Based on the results of the mathematical abstraction ability test and interviews with SAk, data / information is obtained related to the characteristics of the type of learning style according to Kolb, namely 1) Having high self-confidence, 2) Solving problems given by relating to his experience, and 3) When solving problems often ask researchers about the

results of their work. Based on the description above, SAk has a tendency towards CE and AE quadrants. According to Kolb, the combination of CE and AE produces an accommodator learning style Daimaturrohmatin & Rufiana (2019).

Based on the results of the mathematical abstraction ability test and interviews with SK, data / information related to the characteristics of the type of learning style according to Kolb were obtained, namely 1) Accepting the challenge given by the researcher as proof that SK can solve the problem correctly, 2) SK repeats the process when it is judged that the results of the previous work are not quite right, and 3) Write down the results of the completion in a coherent manner. Based on the description above, SK has a tendency towards AC and AE quadrants. According to Kolb, the combination of AC and AE produces a convergence learning style of Daimaturrohmatin & Rufiana (2019).

Based on the results of tests of mathematical abstraction ability and interviews with SAs, data / information related to the characteristics of the type of learning style according to Kolb are obtained, namely 1) Being very careful in solving the problems given so that it takes quite a long time to write down the answers to these questions, and 2) Resolving the problem systematically step by step. Based on the description above, SAs has a tendency towards AC and RO quadrants. According to Kolb, the combination of AC and RO produces an assimilator learning style of Daimaturrohmatin & Rufiana (2019).

Next are the results and discussion of students' mathematical abstraction abilities in terms of diverger, accommodator, converger, and assimilator learning styles. Based on the research results of students' mathematical abstraction abilities, each research subject has a different Kolb learning style. Research subjects with diverger learning styles (SD), on indicators identify object characteristics through direct experience and indicators identify object characteristics that are manipulated or imagined SD is able to identify the given object, connecting the object with the real object around it which is considered to have the same characteristics even though the two This indicator SD explains it verbally through interviews. This is in line with Ghufron & Risnawita (2014), that individuals with diverging learning styles excel at seeing concrete situations from many points of view. On indicators representing objects into symbols or elementary mathematics language, write the elements in the problem completely, understand the written elements. This can be seen during the interview that SD was able to explain it using their own sentences. It is in line with what was stated by (Anwar, 2017) that individuals who are in the reflective observation quadrant try to grasp the meaning of the things they observe. On the indicator, releasing the material properties of an object or performing SD idealization, describes the given object as a suitable flat shape and imagines it to be a complete object. This is in line with what was said by (Anwar, 2017) that individuals with diverger learning styles have the ability to imagine and connect them into something whole.

The indicators apply the concept to the appropriate context and the indicators make connections between SD concepts using the appropriate concept, before using the concept to solve SD problems first observe the unknown elements. This shows that SD is careful in carrying out a plan. This is in line with Ghufron & Risnawita (2014) that individuals in the

reflective observation quadrant collect as much data as possible related to problems and are careful before making decisions or taking a step. In the indicator of manipulating abstract mathematical concepts, SD relates the problems given to the daily experiences that they have. This is in line with Anwar (2017) that individuals who are in the concreate experience quadrant emphasize the aspects of concrete experience. The indicators make generalizations SD makes a general form of the problem given but the results are not quite right. When SD was asked to prove the results of the work, SD responded well. Until finally SD realized that the general form that was obtained was not suitable. The researcher asked SD to re-check the general form he received but in the end SD refused because he felt bored. This is in line with Ghufron & Risnawita (2014) that individuals with diverging learning styles quickly feel bored if problems take a long time to be resolved. Therefore, SD does not meet the indicators of making generalizations.

Research subjects with an accommodator learning style (SAk) on indicators identify object characteristics through direct experience of SAk identifying a given object by presuming that the identification results are that the hypotenuse of a right triangle is longer than the other side that has been studied at the previous level. The following in Figure 2 is SAk's answer to the indicator of identifying object characteristics through direct experience.

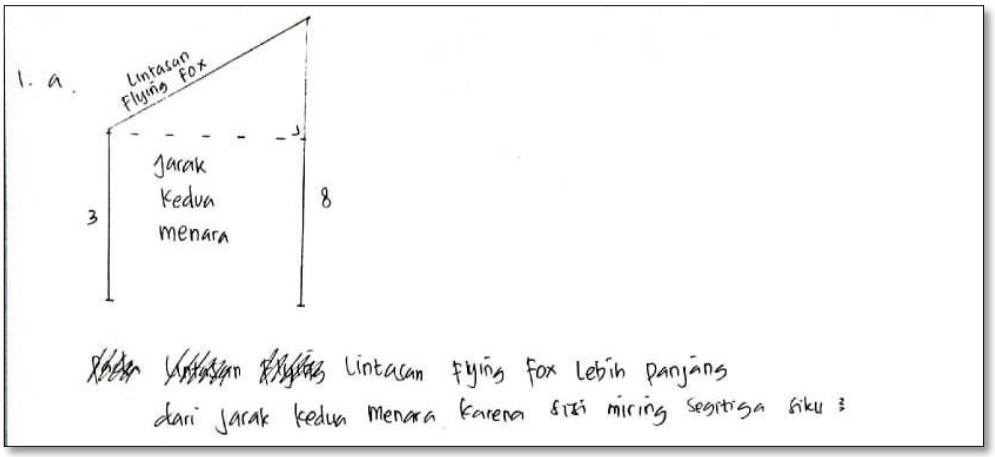

Figure 2. SAk Answers to Indicators Identifying Characteristics of Objects Through Direct Experience

This according to Ghufron & Risnawita (2014) shows that individuals with accommodator learning styles act on intuition and impulse rather than based on logical analysis. On indicators identify the characteristics of objects that are manipulated or imagined and make generalizations SAk cannot solve the problem given. When asked to do it again, SAk asked for help from researchers. This is in line with Ghufron & Risnawita (2014), that individuals with accommodating learning styles in solving problems usually consider human factors to obtain information. Therefore, SAk does not meet the indicators of identifying the characteristics of the object being manipulated or imagined and making generalizations. On indicators representing objects into symbols or mathematical language SAk does not write completely the known elements of the given problem, even though there are still some known elements. During the interview SAk was asked to look for other

elements SAk believed that what he had written was complete. This is in line with Ghufron & Risnawita (2014) that individuals who are in the active experimentation quadrant want to quickly get something and do it immediately with high self-confidence.

The indicator releases the material properties of an object or performs SAk idealization such as guessing the cardinal directions when illustrating an illustration of the problem. This is in line with what Ghufron & Risnawita (2014) said that individuals with accommodating learning styles tend to act on intuition or impulse. In the indicator, applying the concept to the appropriate context, SAk uses the appropriate concept, namely looking for unknown elements using the Pythagorean theorem. SAk writes the conclusions of the problems given clearly. This can also be seen in the indicators making connections between concepts, SAk writing the conclusions obtained from clearly determining the minimum time taken. This is in line with Daimaturrohmatin & Rufiana (2019), that individuals with accommodator learning styles have a good ability to conclude the results of their solutions clearly. In the indicator of manipulating abstract mathematical concepts, SAk connects problems with experiences. SAk said that based on his experience that by increasing the speed of the ride, the time needed will also be shorter. This according to Anwar (2017) shows that individuals who are in the concreate experience quadrant emphasize the aspects of concrete experience.

Research subjects with an accommodator learning style (SK) on indicators identify object characteristics through direct experience, identify object characteristics that are manipulated or imagined, and release the material properties of an object or perform idealization SK observes the object of the given problem, provides identification results then linked to the material he has studied previously. This is in line with what Ghufron & Risnawita (2014) said that individuals with a convergent learning style adapt and integrate their observations into a theory. On indicators representing objects into symbols or mathematical language, SK writes the known and questioned elements completely and neatly. In addition, the SK converts the distance from kilometers to meters to make calculations easier. This according to Ghufron & Risnawita (2017) shows that individuals in the abstract conceptualization quadrant will work coherently, systematically, and step-by-step. In the indicator, applying the concept to the appropriate context, SK uses the concept that is in accordance with the given problem. SK can clearly conclude the problems it has resolved. In the indicator, the relationship between SK concepts felt that there was something wrong with the previous work so he decided to repeat. Then in the second work, SK wrote down its work neatly and carefully. This is in line with Ghufron & Risnawita (2014) that individuals who are in the abstract conceptualization quadrant are perfectionists, cannot rest in peace if the problems they are facing have not been resolved properly. On the indicator of manipulating abstract mathematical concepts, SK tries to consider the results obtained from the previous point. When the researcher asked SK to try to do it in another way, SK responded well and was able to solve the challenge. This is in line with Anwar (2017) that individuals with convergent learning styles have a good ability to solve problems and immediately try to find the right answer. In the indicator A8 SK resolves the problem given

well, without being asked SK shows that the results of the work can be proven correctly. This according to Anwar (2017) shows that individuals with convergent learning styles excel at finding practical functions from various ideas and theories.

Research subjects with assimilator learning styles (ASs) on indicators identify the characteristics of objects through direct experience and identify the characteristics of objects that are manipulated or imagined, SAs provides an explanation that the identification he gets from his observations is then linked to his theories, writes the results of his identification in the form short and clear. This is in line with what Anwar (2017) said that individuals with assimilator learning styles tend to be more theoretical and respond to various information and arrange them in a logical, concise, and clear format. On indicators representing objects into symbols or the SAs mathematical language, write down the known and questioned elements completely, converting the units of distance from kilometers to meters with the intention of not making mistakes when doing calculations. This is in line with Ghufron & Risnawita (2014) that individuals in the reflective observation quadrant are careful before making a decision or taking a step. On indicators releasing the material properties of an object or doing idealization SAs illustrates a problem and provides an explanation in detail and tries to explain it with the theories they have. This is in line with what Ghufron & Risnawita (2014) said that individuals with an assimilator learning style really understand a problem before taking action and tend to be theoretical.

In the indicator, applying the concept to the appropriate context, SAs first observes the things needed to solve the problem before taking steps to solve the problem. This is in line with Ghufron & Risnawita (2014) that individuals with an assimilator learning style try to understand first before taking action. The indicators make a relationship between the SAs concept, observing the things needed to solve the problem. SAs also wrote down the answers neatly and systematically. This is in line with Ghufron & Risnawita (2014) that individuals who are in the reflective observation quadrant collect as much data as possible related to a problem, besides that individuals with an assimilator learning style think analytically, coherently, and systematically. In the indicator of manipulating abstract mathematical concepts, SAs can solve problems well, really understand the problem, and use the theories it has. This is in line with Anwar (2017) that individuals with assimilator learning styles tend to be more theoretical. On the indicators of making generalizations, SAs are able to solve the problems given well. Sas makes it into its simplest form. This, according to Ghufron & Risnawita (2014), shows that individuals with an assimilator learning style want what they do to be at least the same or better as what has been or has been done before.

CONCLUSION

Based on the results of research and data analysis, conclusions are obtained, namely (1) students with diverger learning styles can complete indicators of mathematical abstraction ability which include empirical abstraction and theoretical abstraction unless indicators make generalizations. (2) students with accommodator learning styles can solve

indicators of mathematical abstraction ability which include empirical abstraction and theoretical abstraction, unless the indicator identifies the characteristics of the object being manipulated or imagined and the indicator makes generalizations. (3) students with a convergent learning style can solve all indicators of mathematical abstraction ability which include empirical abstraction and theoretical abstraction. (4) students with an assimilator learning style can complete all indicators of mathematical abstraction ability which include empirical abstraction and theoretical abstraction.

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