Analysis of Geometry Thinking Ability Reviewed from Student Learning Style

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Abstract

The research was conducted at one of the universities in Banten. Even semester, a sample of all students majoring in mathematics education, which totaled 88 students, was taken. The data collection approach involves learning style questionnaires, geometric thinking skills exams, and interviews, and the research method is qualitative. Qualitative data analysis follows a three-stage flow model: data reduction, data presentation and conclusion, and verification. The research problems are: 1) how students learn during online learning, and 2) how students' geometry thinking skills are reviewed from their learning style. The results of the study concluded that students more have auditorial learning style during online learning. Then based on the ability to think geometry, students are seen from the mastery of fundamental geometry skill indicators and reviewed from their learning style. Known students with visual learning styles master visual indicators and drawing but lack master verbal, logical, and applied indicators. Furthermore, students with an auditorial learning style show mastery of logic and applied indicators but lack mastering visual, verbal, and drawing indicators. Students with kinesthetic learning styles show mastery of drawing and applied indicators but lack mastering visual, verbal, and logic indicators.

Keywords: Learning Styles, Geometric Thinking Skills, Online Learning.

There has been a change in the learning system as a result of the present covid-19 pandemic. Online learning systems are a must-have option that is being deployed at a national level. This raises many problems that immediately arise, especially in the learning process. Because it is not a typical occurrence, many parents and students have expressed their dissatisfaction with the online learning process. According to (Hasanah et al., 2020) online learning during the Covid-19 pandemic caused anxiety, sadness, and confusion. Furthermore, respondents also stated that they do not want online learning if the pandemic is over. (Hasanah et al., 2020)

Problems that arise due to changes in the learning system are students' ability to capture materials delivered by lecturers. Each student's style is different in accepting learning from each others in absorbing the information that is being conveyed. As a result of the current educational system's modifications, it can cause the absorption of student materials to change one of them because of adjustment factors. One's

learning style is collaboration on how one absorbs and processes all the info obtained (Mokodompit et al., 2020) (Şener & Çokçalışkan, 2018). The learning style also relates to how he learns and how one likes what he learns (Pramesti & Ratnadi, 2020). According to (Jamani et al., 2020), the lack of harmony between the learning style of students and teachers tends to make students depressed, bored, and unable to focus in the classroom to get unsatisfactory results. (Mokodompit et al., 2020)

Teachers must maximize the learning process in today's online learning system to fit all style or characteristics of students in learning, including visual, auditory, and kinesthetic (H. Hamidah, Kusuma, et al., 2022; J. W. K. Hamidah & Auliana, 2024; Hamidah & Kusuma, 2020). In this case, the role of teachers is essential for creative and resourceful in using various learning strategies that embrace the needs of student learning style (Marasigan, 2019) (Jamulia, 2018). This is because there is a change in teaching that results in students having to adjust the learning process to the style of learning that has been familiar to students so far. Based on research conducted (Bire et al., 2014) known results a person's learning style of visual, auditorial, and kinesthetic learning style has a significant influence on his learning achievements that are in the category of very strong. The same is shown from the research results (Putri Ningrat et al., 2018) (Lengkana et al., 2020) that the role of one's learning style towards improving learning outcomes is relatively high.

Furthermore, online learning that is still ongoing today has a positive and negative influence on students' geometry thinking skills. Geometry is a material that is inseparable from dimensional image illustrations, so it depends on how teachers utilize technology to deliver material online (Bozkurt, 2018) (Khalil et al., 2019). If the learning is still manual, students will have difficulty producing accurate geometric representations (Jelatu et al., 2018). Much mathematical software supports the

delivery of geometry materials so that teachers maximize the use of the software to deliver the material optimally. Hoffer divides geometry thinking skills into five skills: visual, verbal, drawing, logic, and applied (Primasatya & Jatmiko, 2019). These skills can be well stimulus if learning using mathematical software but can be very difficult if learning is just monotonous as regular learning.

Geometry plays an essential role in one's ability to understand other concepts (Fauzi et al., 2019). Walle writes down several important reasons for studying geometry, including exploring geometry to develop one's ability to solve problems and geometry playing an essential role in understanding other concepts in mathematics (Fonseca et al., 2021; H. Hamidah, Zaenuri, et al., 2022). Furthermore (Mdyunus et al., 2019) states the importance of achieving the concept at the initial level because it becomes the basis at the next level. The same is said of (Rofii et al., 2018), regarding the importance of geometry because it has many concepts so that it is listed in a special place on the mathematics curriculum. The geometry provides a method for solving problems.

According to (Maharani et al., 2019), students' lack of ability to examine questions, see every development process, and evaluate the final results leads to students being less skilled in solving their problems. Geometry aids pupils in developing spatial awareness, visualization, sound reasoning, problem analysis, and solution of natural problems faced in everyday life, according to (Bayuningsih et al., 2018). It is a concern to analyze students' geometry skills early on and review their learning styles, especially during the current pandemic.(Maharani et al., 2019)(Maharani et al., 2019)

However, based on the findings of a number of past investigations, Ikhsan (Khumayroh et al., 2019) writes about among the many branches of mathematics that the ability to understand geometry is at the lowest position of learning achievement. Furthermore, the results of

learning geometry courses are relatively low when compared to other courses, according to the facts in the area. In the academic year 2018/2019, 37.5 percent of Bina Bangsa University mathematics education students did not complete Geometry courses, according to UAS data. Known, lack of mastery of materials causes students who do not graduate then affect their ability. Furthermore, UAS data academic year 2019/2020 there are 35% of students do not graduate in Geometry courses. This is known because, in online learning, that is not maximally causing the ability to think geometry students are less pronounced optimally.

Therefore, this research was conducted at Bina Bangsa University, all students majoring in mathematics education even semester amounted to 88 students. The problems in this study are: 1) how the student's learning style is surprising during online learning, and 2) how students' geometry thinking skills are reviewed from their learning style. The purpose of this study is to analyze and describe: 1) the tendency of the student's learning style during online learning, and 2) the student's geometry thinking skills are reviewed from the learning style. Other researchers working on learning models that have a lot of potential for maximizing the online learning process and developing students' geometry thinking skills by paying attention to and considering their learning styles are expected to use the findings of this study as a resource.

Method

The method in the research is qualitative. Qualitative method selection is based on answering the problem formulation that analyses and describes geometry students' learning styles and thinking abilities. The research was conducted on students majoring in mathematics education at Bina Bangsa University in the 2020/2021 school year.

The data collection techniques use student learning style questionnaires, geometry thinking skills tests, and interview tests.

1. The instrument of student learning style is with a questionnaire Likert scale using answers never, rarely, sometimes, often, and always. The questionnaire consists of 27 statements, nine statements each for each visual, auditorial, and kinesthetic aspect. The questionnaire has been tested for validity. The consideration of experts and declared worthy of use as a research instrument. Questionnaires are given to students in the form of google form links and filled in carefully.

2. Geometry thinking skills test. Of the five indicators of ability made seven questions given to one student, namely representatives of each learning style. Students are given the test and given 90 minutes to complete it completely.

3. Interviews are conducted in a structured but open manner that the questions given can develop according to the circumstances of the student test results to explore information about the tendency of the student's learning style and the process of solving geometry problems given.

Data analysis utilizing qualitative data analysis is analyzed using a three-stage flow model. (Mokodompit et al., 2020), reduction of data, presenting data and making conclusions, and rechecking.

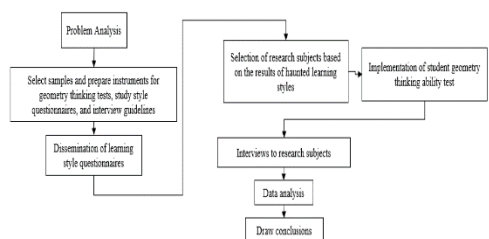The stages of research are presented in the following figure:

FIGURE 1. Research Stages

Result and Discussion

1. Student Learning Style Questionnaire Data Results

Questionnaire was given on June 3, 2021, with 88 students. The data obtained are then grouped (visual, auditorial, kinesthetic, and mixed) learning styles as follows:

TABLE 1. Learning Style Questionnaire Results

Learning Style	Students	(%)
visual	30	34,09
Auditorial	38	43,18
Kinesthetic	13	14,77
mixture	7	7,96
sum	88	100

2. Results Of Data Tes Kemampuan Berpikir Geometry Reviewed From Learning Style

The test was conducted on June 17, 2021, with the number of respondents four students selected one student randomly from each style of study. With details of each one student representing the visual learning style by GG, auditorial by UK, kinesthetic by AS, and mixed by SN. Students personally take the test within two hours. This test will be emulated with the interview results to obtain more in-depth information about the student concerned. Analysis of students' geometry skills is based on geometry ability indicators and the results are as follows:

TABLE 2. Summary of Geometry Thinking Ability Test Data Results Reviewed from Learning Style

Indicators	Geometry Basics Indicators	GG Work Results (Visual) Problem Number							UK Work Results (Auditorial) Problem Number							AS Work Result (Kinesthetic) Problem Number						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Visual	a.	√	√				√	√		√	√		√	√	√	√	√	√			X	√
	b.	√			√	√		√	√			√	√		√	√			√	√		√
	c.		√	√						√	√						√	√				√
	d.	√			√	√	√	√	√		X	√	√	√	√				√	√	X	√
	e.	√	√	√	X	√	√	√	√	√	X	√	√	√	√	√	√	√	√	√	X	√
Verbal	a.	X	√	√	√	√			X	√	√	√	√		√	√	X	√	√		
	b.					√							√								√
	c.			X	X	√	X	X			√	X	√	√	√			X	√	√	√	√
	d.		√							√						X					
	e.		√	X	X	√		X		√	√	X	√	√		X	X	√	√		√
Drawing	a.	√	√	√	√		√	√	√	√	√	√	√	X	√	√	√	√	√	√	√	√
	b.			√		√				√		√					√		√			
	c.	√	√	√	√		√		X	√	√		√	X		√	√	√	√		√	
	d.	√			√		√	√	X			X		X		√	√					√
	e.	√		√	√		√	√	X		√	X		X	√	X	√		√	√		√
logic	a.	√	√	√		√	X		√	√		√	√	√	√	√	√		√	√	√	√
	b.		√	X			X		√	√			√			√	√				√	√
	c.	√			X		X	√			√	√		√	√		X	√			√
	d.				X						√	√					X	X			
	e.		X	X		X	√	√		√	√		√	X		√	√	
Applied	a.				√		X					√		√					√			√
	b.				√		X					√		√					√			√
	c.	√			X	√	X	√		√	√		√	√				√	√		√
	d.			X			X			√			√			√					
	e.	√			X	√	X	√		√	√		√	√	√	√	√			√

3. Analysis of Student Learning Style in Online Learning

From table 1, it is known that the highest number of students are in the auditorial learning style, which is 43.18% of students. It is thus known that the majority of students have an auditorial learning style. Based on the learning process that is currently underway, namely

online learning, the auditorial learning style is suitable because students with this learning style use more hearing to understand and remember the material being delivered. According to (Widayanti, 2013) the characteristic of the auditorial learning style is to position the auditory sense into the primary tool in absorbing existing info.

Furthermore, students with a visual learning style are 34.09%. This shows that not a few students are with visual learning styles. According to (Sundayana, 2018), (Şener & Çokçalışkan, 2018), (Jamani et al., 2020), (Retno et al., 2014), one of the characteristics of auditorial learning style is recall with visual associations. Online learning requires teachers to prepare materials well and interestingly in the form of PPT so that it is easy to understand by students. The results of observations are also known that during the learning process of providing information, many displays images, diagrams, or keywords of the material. This is a positive value for students who are with visual learning styles.

However, that is not the case with students whom kinesthetic learning styles. Students with this learning style, according to (Retno et al., 2014), (Mareta & Sembiring, 2020), and (Wawan et al., 2019) that this type of kinesthetic style learns through physical activities and is directly involved. So it is necessary to prepare how online learning can facilitate students with that learning style. Online learning, in general, rarely involves students doing physical activity in understanding the material. This is due to visual and time limitations. Hands-on practice in online learning difficult to supervise each student during the activity. However, some courses can easily cover kinesthetic learning styles during online learning, namely geometry courses. Teachers can use mathematical software such as GeoGebra or Maple to invite students to be directly involved in understanding the given concept.

Furthermore, the data collection is also conducted interviews to add information about the student concerned. One of the students with auditorial learning styles is UK. He thinks online learning is enjoyable and makes him understand quickly the material delivered. The reason is that there is no noise. In addition, according to him, online learning is not too busy writing because the materials provided by lecturers are already in the form of PPT to focus more on listening. From the results of the interview is also known that the way to memorize is to read aloud the material you want to memorize. In accordance with (Sundayana, 2018) that auditorial learning style characteristic is difficulty concentrating with noisy sounds and if reading aloud.

Students with visual learning style tendencies are GG. One of the reasons for appreciating online learning, according to the interview results, is that the PPT provided by lecturers is fascinating and diversified. Furthermore, GG also states that it is easier to understand what is seen than heard. The online learning process conducted by lecturers, in general, makes it easy for students to see the appearance of the material, and students can also easily access the material to be reread if it is still tricky. Nevertheless, GG states that he sometimes has difficulty expressing his ideas directly because many words want to be spoken but it is difficult to express them. Following the opinion (Sundayana, 2018), the visual learning style prefers to do demonstrations rather than speeches.

Students with kinesthetic learning styles are AS. The interview results stated that AS likes to walk while memorizing material because she doesn't like to sit still. In the learning process, AS is happy if the learning uses GeoGebra. Some opinions (Sundayana, 2018), (Wawan et al., 2019), (Widayanti, 2013) mention that a characteristic that is typical kinesthetic style, namely placing the hand as the primary information recipient in order to keep it in mind. This is in keeping with AS statement that understanding is more accessible if done with hands-on practice.

Students' tendency in visual, auditorial and kinesthetic learning styles distinguishes how the student absorbs information to determine the dominance of activities and how students process the information conveyed during learning. However, according to (Retno et al., 2014) the categorization of the learning style does not mean that students only have one characteristic of a particular way of learning so that it does not have the characteristics of other ways of learning. This categorization is a guide that students tend to the most prominent of these learning styles. This tendency causes the student concerned if they get appropriate stimuli in learning to absorb them better.

4.   Student's Geometric Thinking Ability Analysis Reviewed From His Learning Style

    a.   Visual Learning Style

The summary results in table 2 show the work of GG students representing students with visual style, judging from the indicators of geometry thinking ability known GG master almost all essential skills of visual indicators of 7 questions is given. They are starting from the skill of knowing many different flat wakes, observing the parts, classifying them by nature, collecting information based on visuals, and presenting model representations. This can be seen from the GG answer in the image below.
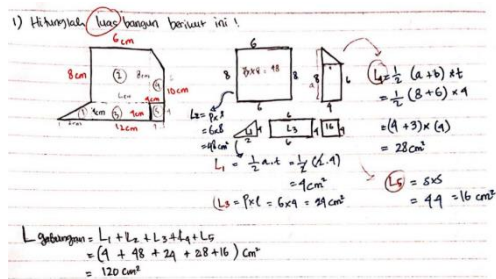

FIGURE 2. GG's Result
Students with Visual Learning Style

The picture above shows that GG cuts the image on the problem into several kinds of flat builds to observe and gather information, making it easier to determine the next step in solving the problem. The answer GG shows that GG tries to describe the question visually to solve the problem. This is following the opinion (Widayanti, 2013) that the character of people with visual learning style is to focus on what is seen, in other words clear and accurate evidence must be presented first to understand the problem.

Furthermore, judging by the work of GG, there is not much to say in solving the problem, but many pieces of the drawing show that the visual learning style likes to draw. Furthermore, there is a red circle and some arrows, which indicate that GG more thoroughly and detail in solving problems and has a habit of making mind mapping to understand a given problem and give a short answer. This fact is by the statement (Widayanti, 2013) about the characteristics of a person with a tendency to the visual learning style that is to use colourful markers when making(Widayanti, 2013)(Widayanti, 2013) important notes and have a sufficient understanding of artistic problems. The same is stated by (Sundayana, 2018) that a person who has the characteristics of learning with visual style has thoroughnessand detail and the answer is relatively short to a question.

If reviewed in its entirety from indicators of geometry capabilities, namely visual, verbal, drawing, logic, and applied, then in general, GG representing students with the tendency of visual learning style shows more mastering skills in visual indicators and drawing. Meanwhile, GG students show a lack of basic skills for verbal, logical, and applied indicators.

    b.   Auditorial learning style

The next analysis is the results of the answers of UK students representing students with auditorial learning styles. More often using the auditory senses is a characteristic of people who have learning characteristics with auditorial style (Sundayana, 2018). Furthermore, according to (Widayanti, 2013) someone with auditorial learning style tendencies has (Widayanti, 2013)(Widayanti, 2013)problems with work involving visualization, such as cutting parts to

fit each other. This is by the results of the answers of UK students, namely students with a tendency to auditorial learning style.
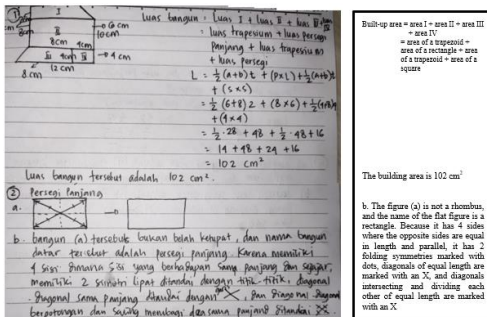

FIGURE 3. UK's Results
Students with Auditorial Learning Style

Figure 3 shows that UK students gave the wrong answer to question number one. UK shows the difficulty in observing the part of the flat build given. The UK also does not try to make an image construction and apply geometry models in problem-solving to get precise information from the problem so that the information obtained is wrong and gives the wrong answer. According to (Widayanti, 2013) someone with an auditorial learning style has difficulty absorbing information in the form of writing or drawing directly. In other words, a person with an auditorial learning style better understands the problem in the form of a direct question and answer statement.

However, the results of the UK answer to question number 1 show its ability in several indicators of basic geometry skills, including in classifying flat builds, formulating flat builds, uncovering the interconnectedness of flat wake traits, and uncovering the interrelationships between the properties software. According to (Sundayana, 2018), one person's characteristics with auditorial learning style is to explain something at length. This can be seen from the UK's work, which shows that the UK explains each step and concludes the answer. When compared to the GG answer in figure 2, the difference is in captioning.

However, if studied from UK number 2, students with auditorial learning styles showed good writing skills. THE UK smoothly gives the correct reason for the question. This is not in line with the opinions (Widayanti, 2013) and (Sundayana, 2018), which mention that one of the characteristics of auditorial learning style(Widayanti, 2013)(Widayanti, 2013) is to find it challenging to write, so this requires further study of the meaning of difficulty to write. Furthermore, from the UK answer, overall from indicators of geometry capabilities i.e. visual, verbal, drawing, logic, and applied, UK representing students with the tendency of auditorial learning style shows more mastering logic and applied indicators. Furthermore, for visual, verbal, and drawing indicators, GG students lack basic skills.

c. Kinesthetic learning style

AS is a student who represents students with kinesthetic learning style. From the AS work results below, the AS has constructed a flat wake image by dismembering it into several other flat wakes. AS has also been able to gather information correctly to find the next steps in resolving the issue. From the results of work number 6, AS has also been able to apply the properties of the definition. Moreover, know the interrelationship between the properties of a flat build to solve the given problem. Overall, the AS is used to trying to sketch and draw pieces to gather information on solving problems. This is by the opinion (Widayanti, 2013) that arachnid typical for someone who has a kinesthetic learning style is to put the hand as the primary information receiver tool, happy to draw and experiment.
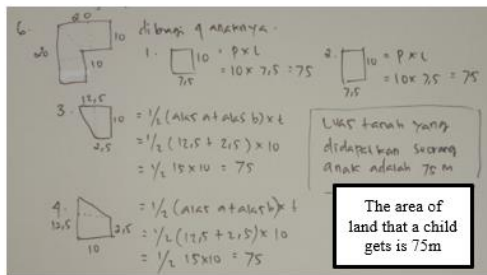
FIGURE 4. AS's Result
Students with Kinesthetic Learning Style

Suppose studied further, the results of AS work is not very neat compared to the work of GG and UK. For example, in terms of writing, GG and UK are neater compared to AS. As said (Sundayana, 2018) that someone with a kinesthetic learning style has terrible handwriting. However, overall, the indicators of geometry capabilities, namely visual, verbal, drawing, logic, and applied, AS representing students with kinesthetic learning styles show more mastering drawing and applied indicators. Furthermore, for visual, verbal, and logical indicators, AS shows still a lack of basic skills that it has.

CONCLUSION

Based on the above results and discussions, it can be concluded that more math students have auditorial learning styles during online learning. Then based on the ability to think geometry, students are seen from the mastery of fundamental geometry skill indicators and reviewed from their learning style. Known to students with a visual learning style more master the skills on visual indicators and drawing. Meanwhile, for verbal, logical, and applied indicators, students show a lack of basic skills. Furthermore, students with auditorial learning styles show more mastering skills on logic and applied indicators. Meanwhile, for visual, verbal, and drawing indicators, students show a lack of basic skills. For students with kinesthetic learning style shows more mastering skills on drawing and applied indicators. Furthermore, for visual, verbal, and logical indicators, students show a lack of basic skills.

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