**Jurnal Elemen, 8(2), 572-586, July 2022**
https:/doi.org/10.29408/jel.v8i2.5696

e- ISSN: 2442 - 4226

# Secondary students' mathematical reasoning in terms of learning styles on online learning

**Fresha Anjani *, Syafika Ulfah**

Mathematics Education Department, University of Muhammadiyah Prof. Dr. Hamka, DKI Jakarta, Indonesia

* Correspondence: risa020600@gmail.com


## Abstract

Since COVID-19 was declared a global pandemic, learning has shifted from face-to-face to online. It is a novel environment, particularly in Indonesia. This study aims to determine the profile and correlation between students' mathematical reasoning abilities and learning styles in online learning. The research method used was quantitative. The population was grade VIII students studying in public Junior High School (JHS) in DKI Jakarta province. The sample was 400 respondents, consisting of 208 males and 192 females, using random cluster sampling. To identify the relationship between mathematical reasoning ability and learning style, to be more specific, the researchers took a sample of one class consisting of 39 respondents. The research instrument was in the form of a questionnaire and mathematical ability test questions in the form of a description. The data analysis technique used descriptive statistics and correlation analysis. The results showed that: (1) the tendency of students' mathematical reasoning abilities was included in the medium category, (2) students had varied learning styles, namely visual, auditory, and kinesthetic learning styles (3) the tendency of students learning styles of public JHS in DKI Jakarta is visual learning style with a percentage of 32.25% as many as 129 students from 400 respondents, (4) there is a significant relationship between mathematical reasoning abilities and student learning styles with a Pearson correlation score of 0.565, and the relationship between the two variables is included in the category of moderate correlation. In this case, choosing a suitable learning approach can impact students' ability to think mathematically.

**Keywords:** secondary students; learning style; mathematical reasoning; online learning

Received: 21 May 2022 | Revised: 3 June 2022
Accepted: 13 June 2022 | Published: 1 July 2022

## Introduction

Online learning is one form of learning solution during the COVID-19 pandemic. During the enforcement of community activity restrictions period, there has been an increase in the number of students taking online courses; in China online courses are carried out by educators providing material to students then students study and watch the material (Hong et al., 2021). Not much different from China, in Indonesia, when online learning takes place, educators provide learning materials assisted by learning management systems such as Google Classroom, Canvas, and Microsoft Teams (Pokhrel & Chhetri, 2021). One of the subjects given in online learning is mathematics.

Mathematics is closely related to many things, including the ability to think. It can be seen in the 2013 curriculum, a form of refinement of the 2006 curriculum (KTSP) to learn mathematics that emphasizes student abilities, including mathematical reasoning (Richardo, 2017). The Ministry of Education, Culture, Research, and Technology disclosed that mathematical reasoning and mathematics are two things that cannot be separated since mathematical content is comprehended using reasoning while reasoning is developed via mathematics learning (Octriana et al., 2019). Suppose mathematical thinking abilities are not cultivated early on in pupils. In that case, students will assume that mathematics is only a subject matter that must follow set methods without grasping its underlying significance.

According to Gürbüz and Erdem (2016), mathematical reasoning may be defined as the process of arriving at a choice in a meticulous, inventive, creative, and logical way. Pupils should develop the capacity to think mathematically as it is highly vital in day-to-day living; the ability to reason mathematically serves as a basis on which one may build their mathematical knowledge (Riyanto & Siroj, 2011). According to the findings of TIMSS in 2003, the study showed that Indonesia received a score of 379 while the international average score of TIMSS was 500; in 2007, it obtained a score of 411 from its average international score of 467, and in 2011 Indonesia received a score of 386 from the average international score was 500 (Khoirudin & Rizkianto, 2018). Finally, in 2015, Indonesia received an average score of 397 out of an average international score of 500 (Hadi & Novaliyosi, 2019). According to these findings, Indonesia has never achieved the TIMSS international average score. Hence, Indonesia continues to have an abysmal level of reasoning ability. Therefore, one of the topics in this study is to identify the profile of Junior High School students' mathematical reasoning abilities. It is in line with Indriani et al. (2018) in analyzing students' mathematical reasoning abilities and the habits of mind of Junior High School students in quadrilateral and triangle material. They found that the level of students' mathematical reasoning ability is still very low, supporting their findings.

Students in the Junior High School level are typically youngsters who are between the ages of 12 and 15 years old. According to Indriani et al. (2018), children aged 11 years-old and over have entered a stage where children can think logically and abstractly. It demonstrates that Junior High School students should have entered the operational stage where children can think logically. However, the facts on the ground show that Junior High School students still have many problems with their low reasoning abilities. Additionally,

Indriani et al. (2018) contend that the lack of mathematical reasoning abilities, particularly in Junior High School students, cannot be separated from many factors. These factors include the surrounding environment, learning process characteristics, and parents' lack of attention. Indriani et al. (2018) argue that the lack of mathematical reasoning abilities, particularly in Junior High School students, cannot be separated from many factors. Student learning styles are characterized by learning traits that are intrinsically linked to knowledge absorption, processing, and reception (Sari, 2014). The view of Sayuri et al. (2020), which demonstrates that learning style is one of the aspects that impact the students' mathematical reasoning ability, also lends credence to this idea.

Learning style is one of the ways a person receives and processes information or learning materials they receive during the learning process (Widyawati, 2016). Learning style can be said to be a way that a person can do, in the cognitive realm, understand and carry out individual activities (Permana, 2016). Each student has his uniqueness in the level of speed of learning, as well as his learning style (Permatasari, 2021). Based on one's learning style, not all students have the same learning style, and one's ability to receive and absorb information is also different. Some are fast, medium, and slow. To maximize students' mathematical abilities, they must first know whether their learning style is visual, auditory, or kinesthetic.

Visual learning style is a learning style that relies on visual activity. The characteristics of this learning style include: tend to be neat and orderly, and meticulous. Furthermore, the auditory learning style is usually called the listener's learning style. The characteristics of the auditory learning style include: being fluent in speaking and learning through what he hears. Then the kinesthetic learning style is usually superior in the field of sports or activities that involve members of the body. This kinesthetic learning style is often referred to as a driving learning style (Nisa, 2021). It is because students with this type of learning style like to use their limbs during the learning process; the characteristics include: tend to speak slowly and slowly, caring about physical appearance, and being happy with direct practice (Karim, 2014).

Online learning has not been the subject of many mathematical reasoning abilities and learning methods studies. Several prior research, such as those by Astuti et al. (2021) and Wahyudi and Walid (2020), have examined reasoning skills and learning styles in various methods. In grade 10, Astuti et al. (2021) examined the association between learning styles and mathematical reasoning abilities. Wahyudi and Walid (2020) used the Missouri mathematics project learning model to define the relationship between mathematical reasoning abilities and learning styles.

Several previous studies on mathematical reasoning abilities have been carried out. However, a question that remains unanswered is what about the mathematical reasoning ability of students in the current learning environment, such as online learning. During online learning, the authors investigate students' mathematical reasoning skills and learning styles in eighth grade. The purpose of this study was to assess students' mathematical reasoning ability and learning styles, as well as the link between the two.

## Methods

A quantitative research method was applied in this study as it was consistent with the research's goals. The population in this study were Junior High School students in DKI Jakarta, as many as 220.321 (Jakarta Junior High School Students, 2021). The respondents in this study were class VIII students in the odd semester of the 2021/2022 academic year. The estimated number was approximately 73.441 students, which was gained by dividing the population into three grades. The number of samples was determined using Slovin's formula (Wirawan et al., 2019), and a minimum of 400 respondents were obtained to represent the population. Cluster random sampling was used as a technique for sampling, and two public Junior High School was chosen, namely SMP Negeri 171 and SMP Negeri 270. Data analysis techniques use descriptive statistics to describe data about mathematical reasoning abilities and student learning styles. Then, correlation analysis shows the relationship between mathematical reasoning abilities and student learning styles.

The data gathering method was carried out in two stages throughout the process. Before the exam, the first step is to compile information on the various approaches to education the students adopt. The data collecting process began with the administration of a questionnaire as an instrument and then followed with the administration of a test instrument to evaluate the participants' capacity for mathematical reasoning. The mathematical reasoning ability test questions are organized with the test instruments by specified indications, including formulating a hypothesis, executing mathematical manipulation, presenting an explanation or proof for the correctness of the result, and drawing a conclusion. All the students were provided with learning style surveys and test questions.

**Table 1.** Learning style questionnaire

| Learning Styles | Indicator |
|---|---|
| Visual | 1. Organized and tidy is also a good long-term planner.<br>2. It is easier to remember what you see than by hearing.<br>3. Thorough. |
| Auditory | 1. It is easier to understand what is heard than to see it.<br>2. Is a fluent speaker and smart in telling stories.<br>3. Likes to read aloud and move the lips rather than having to write it down. |
| Kinesthetic | 1. Frequent physical activity.<br>2. Prefer to learn through practice.<br>3. Use a lot of body language. |

The learning style questionnaire consists of 24 items which are arranged based on the learning style questionnaire grid. The learning style questionnaire used by the researchers is a modification of Setiana and Purwoko, (2020), the learning style questionnaire grid is shown in table 1. The way to find out the overall tendency of students is to use the following formula:

$$p = \frac{F}{N} \times 100\% \qquad (a)$$

**Information:**

P : Percentage

F : The frequency that the presentation is looking for

N : Number Of Case

In the preparation of the questionnaire instrument using a Likert scale consisting of 4 answer choices, namely always (score 4), often (score 3), sometimes (score 2), and never (score 1) (Setiana & Purwoko, 2020). After the grid is determined, the next step is to arrange the items according to the grid. The sample of the learning style questionnaire is presented in table 2 below.

**Table 2.** Study style questionnaire sample

| Item Question | Answer Options | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| I am an organized and neat person. | | | | |
| I prefer to listen to explanations from educators or friends rather than having to see them. | | | | |
| I can't sit still for long. | | | | |

The test instrument consists of 5 questions. The topic of the test was the number pattern. The test instrument was arranged based on the reasoning ability test grid accompanied by a scoring rubric. The test and questionnaires are validated by three lecturers in mathematics education and by students. Furthermore, after going through the validation process, the instrument must be tested for reliability. If the value of Cronbach's alpha is more than 0.6, then the data are considered to have a high level of reliability (Dirwan, 2019). On the other hand, the results from the mathematical reasoning ability test have a Cronbach alpha value of 0.798, while the learning style questionnaire data have a Cronbach alpha value of 0.809.

According to the findings of the estimation, it was discovered that both instruments had a Cronbach alpha value that was more than 0.6, which indicates that both instruments may be considered dependable. Then, after the data is valid and dependable, the data must be tested for normality. In the normality test, the data is said to be normally distributed if $L_o < L_{tabel}$ (Marpaung & Winarto, 2013). The sort of learning style was determined by analyzing the responses to a questionnaire about student learning styles. After that, we add up all of the points for each possible learning style. The kind of learning style students hold is determined based on the most significant number of scores among the three different learning styles. The number of scores received is then seen from the highest number of scores among the three different types of learning styles.

# Results

## Mathematical reasoning ability

Table 3 displays the findings from the investigation into the students mathematical reasoning skills. Table 4 provides a profile of the students mathematical reasoning abilities based on the standards of the students mathematical reasoning abilities.

**Table 3.** The results of the analysis of mathematical reasoning abilities

| | | |
|---|---|---|
| **N** | **Valid** | **400** |
| | **Missing** | **0** |
| Mean | | 62.11 |
| Median | | 65.00 |
| Mode | | 65 |
| Std. Deviation | | 19.642 |
| Minimum | | 10 |
| Maximum | | 100 |

Based on table 3, the lowest value is 10 and the highest value is 100. Then it can be seen that the mean is 62.11, the median is 65.00, the mode is 65, and the Standard Deviation is 19.642 using SPSS 25.

**Table 4.** Criteria for mathematical reasoning ability

| Score | Category | Frequency | % |
|---|---|---|---|
| $x \geq 70$ | High | 170 | 43% |
| $70 > x \geq 40$ | Medium | 181 | 45% |
| $x < 40$ | Low | 49 | 12% |

In table 4, the criteria for students' mathematical reasoning abilities based on Nisa (2021) can be seen from 400 respondents. One hundred seventy students with a percentage of 43% have a high level of mathematical reasoning ability, 181 students with a percentage of 45% have a moderate level of mathematical reasoning ability, and 49 students with a percentage of 12% have a low level of mathematical reasoning ability. After knowing the tendency of the level of mathematical reasoning ability of all students, the researchers randomly selected a class of 39 students to see specifically the students' mathematical reasoning ability in solving mathematical problems based on predetermined indicators.

**Table 5.** Description of students reasoning ability scores in each question indicator

| Indicator | N | Min Score | Max Score | Average | % |
|---|---|---|---|---|---|
| Making a conjecture | 39 | 1 | 5 | 2.97 | 30.8 |
| Performing mathematical manipulation | 39 | 2 | 5 | 4.1 | 74.4 |
| Providing reason or evidence for the validity of the solution | 39 | 2 | 5 | 4.53 | 89.7 |
| Drawing conclusion | 39 | 1 | 5 | 3.36 | 51.3 |

Table 5 presents data on students' mathematical reasoning ability scores in each indicator. The average percentage of students' mathematical reasoning is 30.8%. It means that most students have not been able to use patterns or relationships to analyze in the problem-solving process. The performing mathematical manipulation indicator with a percentage of

74.4% means that students can perform a mathematical manipulation in solving a problem. On the providing reason or evidence for the validity of the solution indicator, the percentage of the average obtained is 89.7%; this means most of the students were able to compile evidence or reasons for obtaining a solution. On the drawing conclusion indicator, the average percentage was 51.3%, which means that some students can conclude mathematical problems. Furthermore, the results of the student's reasoning ability test in solving mathematical problems on number pattern material show the results if students' mathematical reasoning abilities have differences between high, medium, or low mathematical reasoning abilities. The following is a sample of student answers in answering questions, including indicators one to four.

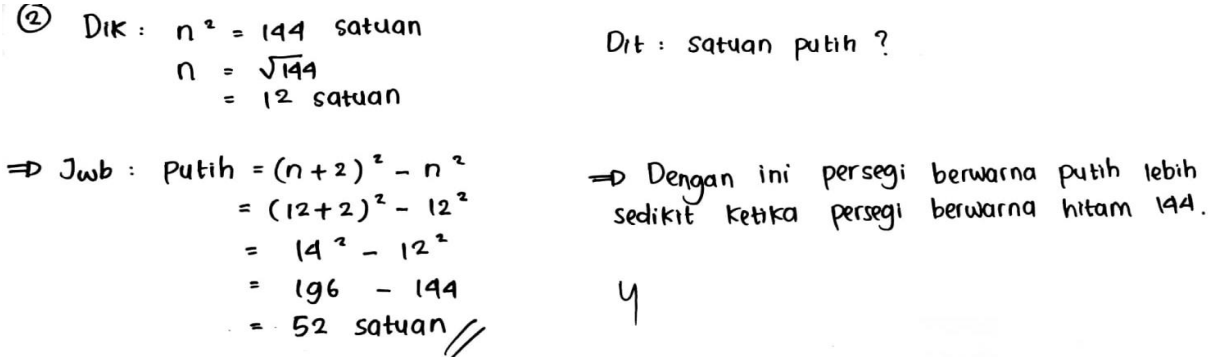


**Figure 1.** Students answers to high-level mathematical reasoning abilities

Figure 1 shows that subjects with high-level mathematical reasoning abilities can use patterns or relationships to analyze the problem-solving process according to the indicators of making a conjecture. Subjects can also work on problems on indicators of performing mathematical manipulation and Provide reason or evidence for the validity of the solution. In contrast, students can manipulate mathematics and compile evidence or reasons to obtain solutions to mathematical problems. Then, students can also conclude a mathematical problem according to the drawing conclusion indicator.

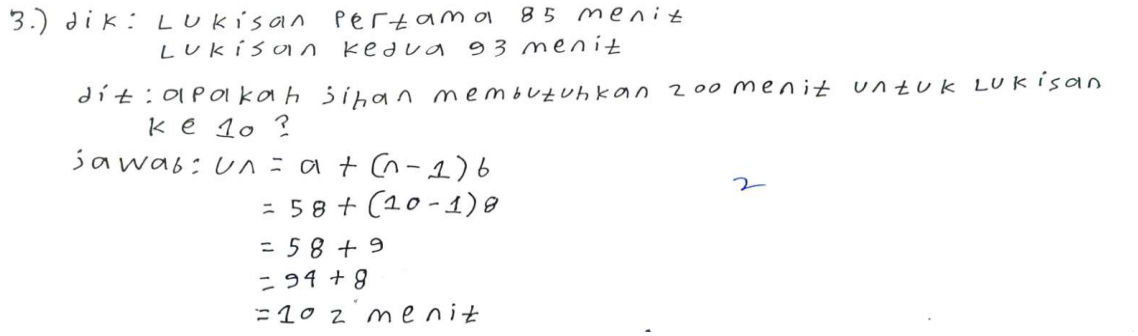


**Figure 2**. Students answers with moderate level of mathematical reasoning ability

Figure 2 shows that subjects with a moderate level of mathematical reasoning ability have not been able to use patterns or relationships to analyze in the problem-solving process according to the indicators of making a conjecture. However, the subject can work on problems on the indicators of performing mathematical manipulation and provide a reason or evidence for the validity of the solution. In contrast, students can manipulate mathematics and

compile evidence or reasons to obtain solutions to mathematical problems. Then, students cannot conclude a mathematical problem according to the drawing conclusion indicator.

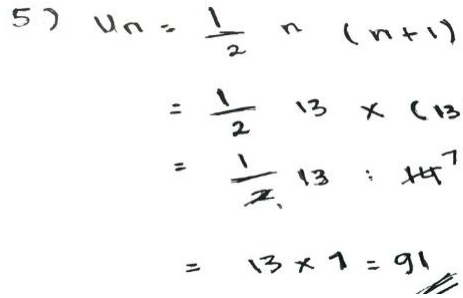

**Figure 3.** Students answers to low-level mathematical reasoning abilities

Figure 3 shows that subjects with low-level mathematical reasoning abilities cannot use patterns or relationships to analyze in problem-solving according to the indicators of making a conjecture. Subjects are also unable to work on problems on the performing mathematical manipulation indicator where students are not able to manipulate mathematics. However, students can compile evidence or reasons to obtain solutions to mathematical problems by the indicator providing a reason or evidence for the validity of the solution. Then, students cannot conclude a mathematical problem according to the drawing conclusion indicator.

**Learning style**

To determine the tendency of all students, the percentage calculation for each student's learning style is carried out, namely visual, auditory and kinesthetic. According to the findings of the calculation, it is known that out of 400 respondents, 129 students, which corresponds to a percentage of 32.25%, have a visual learning style. As many as 114 students, corresponding to 28.50%, have an auditory learning style. As many as 104 students, which corresponds to a percentage of 26%, have a kinesthetic learning style. As many as 53 students have a combination learning style, including 12. According to the collected data, most students in the eighth grade at Junior High School in DKI Jakarta have a visual learning style. In contrast, some have auditory and kinesthetic learning styles. The interpretation of each type of learning style belongs to different categories. It can be seen from the characteristics possessed by class VIII students through the questionnaire method. So, it can be concluded that the learning style trend of eighth-grade students of Junior High School in DKI Jakarta is a visual learning style. The histogram of the student learning style categories is shown in Figure 4.

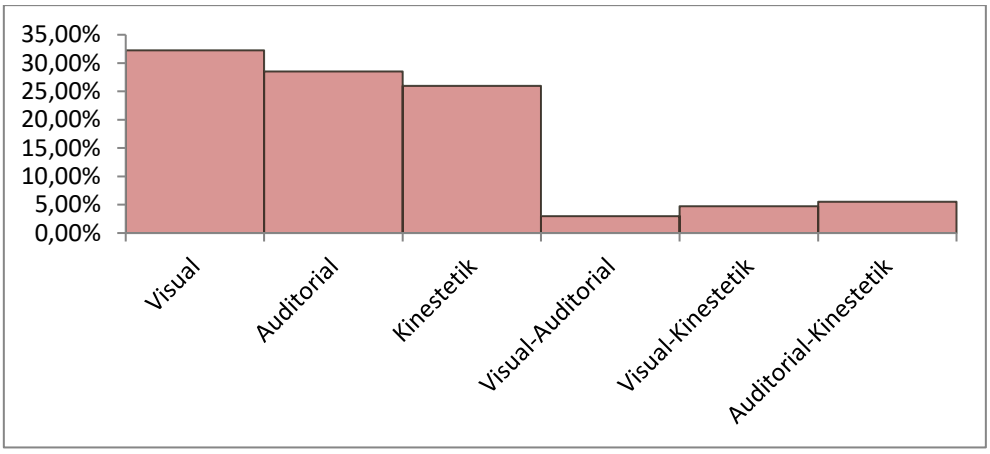


**Figure 4.** Histogram of learning style categories

The researchers estimated the value statistically to measure mathematical reasoning ability and learning style. Then it was found that there were 170 students with 49 with visual learning styles, 43 with auditory learning styles, 52 with kinesthetic learning styles, and 26 with combined learning styles at the level of mathematical reasoning ability in the high category. There are 181 students, with 60 students having visual learning styles, 63 students with auditory learning styles, 40 students with kinesthetic learning styles, and 18 students having combined learning styles that are at the medium level of mathematical reasoning ability. Moreover finally, there are 49 students with 20 students with visual learning styles, eight with auditory learning styles, 12 with kinesthetic learning styles, and nine with combined learning styles with a low level of mathematical reasoning ability.

Furthermore, to find out the profile of learning styles in class VIII Junior High School in DKI Jakarta by calculating the measurement scores to determine the level of criteria for each learning style, namely visual, auditory, and kinesthetic. The criteria for the student learning style questionnaire are presented in table 6 below.

**Table 6.** Criteria for learning style

| Learning Style | Score | Category | F | % |
|---|---|---|---|---|
| Visual | $x \geq 25.7$ | High | 85 | 21% |
| | $25.7 > x \geq 19.3$ | Medium | 250 | 63% |
| | $x < 19.3$ | Low | 65 | 16% |
| Auditory | $x \geq 25.3$ | High | 106 | 26.5% |
| | $25.3 > x \geq 18.7$ | Medium | 223 | 55.75% |
| | $x < 18.7$ | Low | 71 | 17.75% |
| Kinesthetic | $x \geq 25.7$ | High | 81 | 20% |
| | $25.7 > x \geq 19.3$ | Medium | 241 | 60% |
| | $x < 19.3$ | Low | 78 | 20% |

Data from student learning styles shows students who have a visual learning style from 400 respondents, 85 students with a percentage of 21% belong to the high category visual learning style, 250 students with a percentage of 63% belong to the medium category visual learning style and 65 students with a percentage of 16% classified in the low category visual learning style. The tendency of visual learning styles can be seen in the amount of percentage;

the greater the percentage, then that is the most dominant learning style in students. So it can be concluded that the category of visual learning styles of students of Junior High School in DKI Jakarta is included in the medium category. It means that students can process information using visual media such as diagrams, graphs, pictures, and others.

Based on the auditory learning style of the 400 respondents, 106 students, or 26.5 percent of the total, belong to the high category. In addition, 223 students, or 55.75 percent of the total, belong to the medium category, and 71 students, or 17.75 percent of the total, are classified as being in the low category of auditory learning style. Most students at Junior High School in DKI Jakarta have an auditory learning style, and the percentage of those students who identify as belonging to the medium group is 55.75. It indicates that pupils are not only able to digest knowledge by listening to it but also that they can discuss and explain it to other people. While the kinesthetic learning style is known from a total of 400 respondents, 81 students belong to the high category. In addition, 241 students belong to the medium category, and 78 belong to the low category. The inclination of pupils at Junior High School in DKI Jakarta to learn best through auditory means places them in the medium group, with sixty percent falling into this category.

**Mathematical Reasoning Ability and Learning Style**

Correlation analysis was used to determine the relationship between students' mathematical reasoning abilities and learning styles. Before testing the relationship between reasoning ability and learning style, the data of these two variables must be normal. The data from the normality test are in table 7.

**Table 7.** Normality test results

| Instrument | Lo | L table |
|---|---|---|
| Mathematical Reasoning Ability | 0.058375307 | 0.068 |
| Learning Style | 0.050087372 | 0.068 |

Based table 7 above, the mathematical reasoning ability and learning style have a value of $L_o$ less than $L_{tabel}$. It means that these two variables are normally distributed and can represent the existing population. In addition, if it has been established that the data follows a normal distribution, the data hypothesis can be tested. The goal of the hypothesis testing is to evaluate the link between the students of the eighth grade at Junior High School in DKI Jakarta's mathematical reasoning abilities and the learning styles of those students as they engage in online learning. The researchers will be using SPSS 25 in order to investigate the hypothesis. Table 8 illustrates the findings obtained from doing the correlation analysis using SPSS.

**Table 8**. Correlation test results

| | Mathematical reasoning | Learning style |
|---|---|---|
| Pearson correlation | .565 | |
| Sig | .000 | .000 |
| N | 400 | 400 |

Based on Table 8 above, it was obtained that the significance value for both variables was 0.000. A variable can be said to be correlated if the significance value is < 0.05, then if the significance value is > 0.05 then the data is declared to have no relationship or no correlation. So, it can be concluded that the two learning style variables with mathematical reasoning ability have a positive correlation. Then for the pearson correlation or correlation value of 0.565 based on the degree of relationship, the value of 0.565 is included in the category of moderate correlation.

## Discussion

The research findings indicate that students learning styles affect students' mathematical reasoning abilities. It can be seen from the significant value of learning styles and mathematical reasoning abilities, which have values lower than 0.05. The researchers believe this relationship exists because learning styles affect students' ability to reason mathematically. It is related to indicators of mathematical reasoning abilities that have been determined in this study. Mathematical reasoning is related to developing hypotheses, building an argument, making patterns and relationships in mathematics, and choosing the use of appropriate strategies for solving a mathematical problem (Berg & McDonald, 2018).

The results showed that the indicators of mathematical reasoning ability had different percentage values. The indicator with a low percentage is making a conjecture with 30.8%. It is because in the indicator making a conjecture, the average score obtained by students does not reach a score of 4. Then, the indicator with an average percentage is the drawing conclusion with 51.3%. The drawing conclusion indicator is quite good, where 17 of 39 respondents scored 3 and 4. It is in line with the results of research by Agustyaningrum et al. (2019) that the making a conjecture indicator shows a low percentage level, and the drawing conclusion indicator shows a percentage level currently.

Furthermore, for the indicators of performing mathematical manipulation and providing a reason or evidence for the validity of the solution, the percentages are 74.4% and 89.7%, respectively. It shows that the percentage level of the two indicators is in the high category. Based on the average score data, most students get scores of 4 and 5, which causes these two indicators to be included in the high category. It is different from the results of research by Agustyaningrum et al. (2019) that the indicators of performing mathematical manipulation and providing a reason or evidence for the validity of the solution are at a low category level.

Based on the results of an analysis of data regarding students' mathematical reasoning abilities in solving problems according to the indicator stages, it was discovered that students with high mathematical reasoning abilities corresponded with the stages of mathematical reasoning ability indicators. Even though there was a tiny inaccuracy in proposing claims, responders were able to provide accurate findings, computations, and manipulation processes. In contrast, students with average mathematical reasoning abilities can manipulate and produce proper solutions when working on mathematical reasoning ability exam questions. However, they continue to make errors when generating hypotheses and drawing conclusions. Then there are students with low reasoning capacity who, while their mathematical reasoning

skill corresponds to the indicator stages when working on exam questions, make multiple errors in understanding and completing the offered answers, forcing respondents to provide wrong or no responses.

In addition, the computation led to the discovery of the mean value of 62.11. If you look at the table of criteria for students' abilities in mathematical reasoning, you will see that the moderate criteria include the mean price as one of the factors. It is possible to conclude that the degree of mathematical reasoning ability of students in class VIII at Junior High School in DKI Jakarta tends to fall somewhere in the middle of the spectrum. It is consistent with the findings of a study carried out by Wahyuni et al. (2019), which revealed that the mathematical reasoning abilities of pupils were rated as moderate, with a score of 2.02. Students acquire knowledge through their favored modes of learning, and each mode of learning has the potential to influence both the student's mathematical reasoning processes and their learning results (Ridwan, 2017). Marwiyah et al. (2020) found that differences in learning styles can affect students' mathematical reasoning abilities. The results of this research show that students who have visual, auditory, and kinesthetic learning styles each have different mathematical reasoning on each indicator of mathematical reasoning. This finding is supported by the findings of the research conducted by Marwiyah et al. (2020), which found that differences in learning styles can affect students' mathematical reasoning abilities.

According to the findings of this research, most students in the eighth grade at Junior High School in DKI Jakarta preferred the visual learning style as their primary mode of education. These findings are consistent with the study by Nisa (2021), which indicates that the most common learning style among students is a visual learning style, in which students take pleasure in reading and learning via the use of their sense of sight.

## Conclusion

The students' mathematical reasoning ability in Junior High School in DKI Jakarta is included in the moderate category. The researchers also found varied learning styles in students, namely visual, auditory, kinesthetic, and combination learning styles. In addition, the trend of the learning style of Junior High School in DKI Jakarta students is visual learning style. Students' mathematical reasoning abilities and learning styles in online learning have a significant relationship. In this case, it can be stated that if in the mathematics learning process, educators use appropriate methods according to students learning styles, this will significantly affect their mathematical reasoning abilities.

When it comes to the data collection process, the information provided by respondents through questionnaires does not always show the actual opinion of the respondents, which occurs because of differences. Based on the direct experience of the researchers, there are some limitations that the researchers need to pay attention to for future researchers to finish their research. Each responder has its own unique set of thoughts, comprehensions, and replies. Another aspect that plays a role in determining results is the respondents' level of candor when filling out the questionnaire, in addition to their capacity for mathematical thinking. In addition, researchers have limitations with time and money, so researchers cannot

reach the entire population of grade VIII students in the DKI Jakarta area because the area coverage is extensive.

## Conflicts of Interest

Regarding the publishing of this work, the authors state that there is no potential for a conflict of interest. In addition, the authors have taken full responsibility for any ethical concerns that may have arisen, including but not limited to instances of plagiarism, misconduct, data fabrication and/or falsification, multiple publishing and/or submission, and redundancy.

## References

Agustyaningrum, N., Hanggara, Y., Husna, A., Abadi, A. M., & Mahmudii, A. (2019). An analysis of students mathematical reasoning ability on abstract algebra course. *International Journal of Scientific and Technology Research*, *8*(12), 2800–2805.

Astuti, E. A., Nurimani, & Wulandari, A. (2021). Hubungan gaya belajar siswa dengan kemampuan penalaran matematika [Relationship between student learning style and mathematical reasoning ability]. *Prosiding Seminar Nasional Pendidikan Matematika*, 73–79. http://jurnal.stkipkusumanegara.ac.id/index.php/semnara2020/article/view/1065

Berg, D. H., & McDonald, P. A. (2018). Differences in mathematical reasoning between typically achieving and gifted children. *Journal of Cognitive Psychology*, *30*(3), 281–291. https://doi.org/10.1080/20445911.2018.1457034

Dirwan. (2019). *Statistika: Aplikasi praktis untuk penelitian [Statistics: Practical applications for research]*. PT Rajagrafindo Persada.

Gürbüz, R., & Erdem, E. (2016). Relationship between mental computation and mathematical reasoning. *Cogent Education*, *3*(1), 1–18. https://doi.org/10.1080/2331186X.2016.1212683

Hadi, S., & Novaliyosi. (2019). TIMSS Indonesia (Trends in international mathematics and science study). *Prosiding Seminar Nasional & Call For Papers*, 562–569. https://jurnal.unsil.ac.id/index.php/sncp/article/view/1096

Hong, J.-C., Lee, Y.-F., & Ye, J.-H. (2021). Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown. *Personality and Individual Differences*, *174*, 1–8. https://doi.org/10.1016/j.paid.2021.110673

Indriani, L. F., Yuliani, A., & Sugandi, A. I. (2018). Analisis kemampuan penalaran matematis dan habits of mind siswa SMP dalam materi segiempat dan segitiga [Analysis of mathematical reasoning ability and habits of mind junior high school students in quadrilateral and triangle material]. *Jurnal Math Educator Nusantara (JMEN)*, *4*(2), 87–94. https://doi.org/10.29407/jmen.v4i2.11999

Jakarta junior high school students. (2021). *Data jumlah siswa dan guru SMP provinsi DKI Jakarta* [*Data on the number of students and teachers of DKI Jakarta provincial junior high school*]. Jakarta Open Data. https://data.jakarta.go.id/dataset/data-jumlah-siswa-dan-guru-smp-provinsi-dki-jakarta

Karim, A. (2014). Pengaruh gaya belajar dan sikap siswa pada pelajaran matematika terhadap kemampuan berpikir kritis matematika [The influence of students learning styles and attitudes in mathematics lessons on mathematics critical thinking ability]. *Jurnal Formatif*, *4*(3), 188–195. https://doi.org/10.30998/formatif.v4i3.154

Khoirudin, & Rizkianto, I. (2018). Pengembangan perangkat pembelajaran problem based

learning dan hypothetical learning trajectory yang berorientasi pada kemampuan penalaran matematis siswa [Development of problem based learning and hypothetical learning trajectory learning devices oriented to students mathematical reasoning ability]. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(2), 207–218. https://doi.org/10.31980/mosharafa.v7i2.34

Marpaung, I., & Winarto. (2013). Pengaruh pengembangan karir terhadap penilaian prestasi kerja (Studi kasus pada PT. PLN (Persero) wilayah Sumatra Utara) [Effect of career development on job performance assessment (Case study at PT. PLN (Persero) North Sumatra region)]. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Marwiyah, S., Pujiastuti, H., & Sukirwan, S. (2020). Profil kemampuan penalaran matematis siswa ditinjau dari gaya belajar V-A-K pada materi bangun ruang sisi datar [The profile of students mathematical reasoning abilities in terms of the V-A-K learning style on the flat-sided geometric material]. *Teorema: Teori dan Riset Matematika*, *5*(2), 295. https://doi.org/10.25157/teorema.v5i2.3738

Nisa, N. H. K. (2021). *Analisis kemampuan penalaran matematis ditinjau dari gaya belajar siswa SMPIT Al-Falah Bandungan tahun ajaran 2020/2021* [*Analysis of mathematical reasoning abilities in terms of learning styles of SMPIT Al-Falah Bandungan students for the 2020/2021 academic year*]. IAIN Salatiga. http://e-repository.perpus.iainsalatiga.ac.id/id/eprint/10658

Octriana, I., Putri, R. I. I., & Nurjannah. (2019). Penalaran matematis siswa dalam pembelajaran pola bilangan menggunakan PMRI dan LSLC [Students mathematical reasoning in learning number patterns using PMRI and LSLC]. *Jurnal Pendidikan Matematika*, *13*(2), 131–142. https://doi.org/10.22342/jpm.13.2.6714.131-142

Permana, A. D. I. (2016). Pengaruh gaya belajar dan motivasi belajar mahasiswa terhadap kemampuan belajar ilmu alamiah dasar [The influence of learning style and student's learning motivation on learning ability of basic natural sciences]. *Jurnal Formatif*, *6*(3), 276–283. https://doi.org/10.30998/formatif.v6i3.999

Permatasari, A. G. (2021). Komunikasi matematis siswa SMA ditinjau dari gaya belajar dalam pembelajaran daring [Mathematical communication of high school students judging from learning styles in online learning]. *Jurnal Pengembangan Pembelajaran Matematika*, *3*(1), 12–21. https://doi.org/10.14421/jppm.2021.031-02

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future*, *8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Richardo, R. (2017). Peran ethnomatematika dalam penerapan pembelajaran matematika pada kurikulum 2013 [The role of ethnomathematics in the application of mathematics learning in the 2013 curriculum]. *LITERASI (Jurnal Ilmu Pendidikan)*, *7*(2), 118–125. https://doi.org/10.21927/literasi.2016.7(2).118-125

Ridwan, M. (2017). Profil kemampuan penalaran matematis siswa ditinjau dari gaya belajar [Profile of students mathematical reasoning ability viewed from learning style]. *Kalamatika Jurnal Pendidikan Matematika*, *2*(2), 193–205. https://doi.org/10.22236/KALAMATIKA.vol2no2.2017pp193-206

Riyanto, B., & Siroj, R. A. (2011). Meningkatkan kemampuan penalaran dan prestasi matematika dengan pendekatan konstruktivisme pada siswa sekolah menengah atas [Improving reasoning ability and mathematical achievement with a constructivism approach in high school students]. *Jurnal Pendidikan Matematika*, *5*(2), 111–128. https://doi.org/10.22342/jpm.5.2.581

Sari, A. K. (2014). Analisis karakteristik gaya belajar VAK (Visual, auditorial, kinestetik) mahasiswa pendidikan informatika angkatan 2014 [Analysis of the characteristics of learning style VAK (Visual, auditorial, kinesthetic) informatics education students batch

2014]. *Jurnal Ilmiah Edutic Pendidikan dan Informatika*, *1*(1), 1–12. https://doi.org/10.21107/edutic.v1i1.395

Sayuri, M., Yuhana, Y., & Syamsuri. (2020). Analisis kemampuan penalaran matematis siswa SMP ditinjau dari gaya belajar [Analysis of the mathematical reasoning ability of junior high school students in terms of learning styles]. *Wilangan*, *1*(4), 403–414. https://jurnal.untirta.ac.id/index.php/wilangan/article/view/10072

Setiana, D. S., & Purwoko, R. Y. (2020). Analisis kemampuan berpikir kritis ditinjau dari gaya belajar matematika siswa [Analysis of critical thinking skills in terms of students learning styles of mathematics]. *Jurnal Riset Pendidikan Matematika*, *7*(2), 163–177. https://doi.org/10.21831/jrpm.v7i2.34290

Wahyudi, I. D., & Walid. (2020). Mathematical reasoning ability of students based on learning style using missouri Mathematics project learning model. *Unnes Journal of Mathematics Education*, *9*(3), 206–210.

Wahyuni, E. S., Susanto, & Hadi, A. F. (2019). Profile of the student's mathematical reasoning ability in solving geometry problem. *Journal of Physics: Conference Series*, *1211*(1), 012079. https://doi.org/10.1088/1742-6596/1211/1/012079

Widyawati, S. (2016). Pengaruh gaya belajar terhadap prestasi belajar mahasiswa program studi pendidikan matematika (IAIM NU) metro [The influence of learning style on student achievement in the mathematics education study program (IAIM NU) metro]. *Al-Jabar: Jurnal Pendidikan Matematika*, *7*(1), 107–114. https://doi.org/10.24042/ajpm.v7i1.135

Wirawan, W. A., Aghastya, A., & Lailya, A. L. (2019). Permodelan alat penghitung jumlah penumpang kereta berbasis mikrokontroler atmega 2560 [Modeling of train passenger counting device based on atmega 2560 microcontroller]. *Jurnal Perkeretaapian Indonesia*, *3*(1), 55–61. https://doi.org/10.37367/jpi.v3i1.66