AKSIOMA: Jurnal Program Studi Pendidikan Matematika
Volume 11, No. 3, 2022, 1897-1908

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

STUDENTS' MATHEMATICS POWER VIEWED FROM THE STUDENT'S CRITICAL THINKING SKILLS

Widya Ayu Pangestika[1], Nuqthy Faiziyah[2*]

[1,2*] Universitas Muhammadiyah, Surakarta, Indonesia
**Corresponding author. Jl. A. Yani, Mendungan, Pabelan, Kec. Kartasura, Kabupaten Sukoharjo, Jawa Tengah 57169*
E-mail: *a410180067@student.ums.ac.id* [1)]
nf171@ums.ac.id [2)]

Received 01 June 2022; Received in revised form 02 August 2022; Accepted 16 September 2022

Abstract

The problems in this study started from students' difficulties in solving non-routine problems, which resulted in students' low mathematical power, so students' mathematics learning achievement was not optimal. This study aims to analyze students' mathematical power viewed from the students' critical thinking skills. This study was conducted at State Junior High School 3 Polokarto. The subjects of the study were determined using the snowball sampling technique. The research instrument was in the form of essay test questions and interview guidelines. The triangulation method was used as a reference to check the data. The data were analyzed using data collection, data reduction and data categorization, data presentation, and drawing conclusions. The results showed that 1) students with high critical thinking skills have good mathematical reasoning abilities with deductive mathematical reasoning models and they also have good mathematical communication and mathematical connections; 2) students with moderate critical abilities have deductive mathematical reasoning abilities with poor mathematical reasoning and mathematical communication skills, but they have good mathematical connections as e students have a longer time in understanding oral questions than written questions; and 3) students with low critical thinking skills have low mathematical deductive reasoning abilities, mathematical communication, and mathematical connections. The low students' mathematical power is caused by the difficulty in understanding the problem.

Keywords: Communication, connection, critical thinking, mathematical power, reasoning

Abstrak

Problematika pada penelitian ini berangkat dari kesulitan siswa dalam pemecahan masalah non rutin yang berakibat pada rendahnya daya matematis siswa, sehingga prestasi belajar matematika siswa tidak maksimal. Sebuah penelitian kualitatif yang bertujuan untuk menganalisis daya matematis siswa ditinjau dari kemampuan berpikir kritis siswa dilaksanakan di SMP Negeri 3 Polokarto. Subjek penelitian dipilih dengan teknik snowball sampling dengan instrumen penelitian berupa soal tes uraian dan pedoman wawancara. Triangulasi metode dijadikan rujukan untuk memperoleh data yang jenuh dengan analisis data yang meliputi pengumpulan data, reduksi data dan kategorisasi data, display data, penarikan kesimpulan. Menghasilkan simpulan penelitian berupa: 1) siswa dengan kemampuan berpikir kritis tinggi mempunyai kemampuan penalaran matematis yang baik dengan model penalaran matematis deduktif, selanjutnya pada komunikasi matematis dan koneksi matematis memiliki kemampuan yang baik; 2) siswa dengan kemampuan kritis sedang mempunyai kemampuan penalaran matematis deduktif dengan penalaran matematis yang kurang baik, begitu juga pada kemampuan komunikasi matematisnya, namun pada koneksi matematis mempunyai kemampuan baik, ini dikarenakan siswa memiliki waktu yang lebih panjang dalam memahami pertanyaan lisan dari pada pertanyaan tertulis; dan 3) siswa dengan kemampuan berpikir kritis rendah, siswa mempunyai kemampuan penalaran deduktif matematis, komunikasi matematis, dan koneksi matematis yang rendah. Rendahnya kemampuan daya matematis siswa disebabkan karena kesulitannya siswa dalam memahami masalah.

***Kata kunci**: Berpikir kritis, daya matematis, komunikasi, koneksi, penalaran*

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

INTRODUCTION

The problems of mathematical learning in Indonesia are complex resulting in low student achievement. The obligation of Indonesian students to learn mathematics at all levels of education is not without foundation. The importance of learning mathematics cannot be separated from its role in various aspects of life (Sopiyah et al., 2020). Besides, by learning mathematics, a person is accustomed to thinking systematically, scientifically, logically, and critically to increase his creativity. Aditya, (2018) states that mathematics is important as a tool, a science, a shaper of attitudes, and a guide for thinking patterns. Considering the importance of mathematics in everyday life, mathematics needs to be understood and mastered by all levels of society, including students as the nation's future generation (Algani & Eshan, 2019). According to Pourdavood et al. (2020) the general objectives of learning mathematics are (1) learning to communicate (mathematical communi-cation); (2) learning to reason (mathematical reasoning); (3) learning to solve problems (mathematical problem solving); (4) learning to link ideas (mathematical connection); and (5) learn to represent (mathematical representation). These five aspects are also known as mathematical power (Ruwah & Husnul, 2020). The term "mathematical power" is not explicitly stated in the mathematics learning curriculum in Indonesia, but the objectives of learning mathematics in the Indonesian curriculum indicate that it is part of the objectives to be achieved.

Mathematical power is an individual's belief in using conceptual and operational knowledge to solve problems using their reasoning, communication, and connection skills together (Sugilar, 2017). NCTM (2000) states that mathematical power covers the ability to explore, guess, and reason logically; to solve non-routine problems; to communicate about and through mathematics; and to link ideas within mathematics and between mathematics and other intellectual activities. In other words, mathematical power is an ability that needs to be possessed by students who study mathematics at any school level (Kusmaryono & Dwijanto, 2016). Therefore, mathematics learning is carried out to develop students' mathematical power.

Mathematical reasoning ability is one of the thinking processes carried out by drawing a conclusion where the conclusion is valid or can be accounted for (Rizqi & Surya, 2017). Mathematical reasoning ability is divided into two, deductive reasoning and inductive reasoning (Nisraeni & Arifanti, 2018). Deductive reasoning is drawing conclusions whose process involves theories or other mathematical formulas that have previously been proven true, while inductive reasoning is an activity, a process, or a thinking activity to draw conclusions or make a new statement of a general nature based on some known specific true statements (Dewi & Harahap, 2016). In reality, the reasoning ability of students in Indonesia is still low. They tend to have difficulty using their arguments to carry out systematic problem solving, as well as difficulties in drawing conclusions. (Marianah, 2020).

Mathematical communication is a way for students to communicate problem-solving ideas, strategies, and mathematical solutions both spoken and written (Nugraha & Pujiastuti, 2019). Meanwhile, mathematical communi-

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

cation skills in problem solving (NCTM, 2000) can be seen when students can correctly use mathematical language to express mathematical ideas. Astuti (2012), stated that mathematical communication skills cover (1) the use of mathematical language presented in oral, written, or visual forms, (2) the use of mathematical representations presented in written or visual form, and (3) the interpretation of mathematical ideas using mathematical terms or notation in representing mathematical ideas, and describing mathematical relationships or models.

Septian et al. (2020) show that low mathematical communication skills are still found, so these students have difficulty solving practical problems. Mathematical connections are linking mathematical ideas both between topics in mathematics and with topics in other fields, as well as between mathematical topics and everyday life (Romli, 2016). Siagian (2016) stated that mathematical connections are activities including (1) looking for relationships between various representations of concepts and procedures, (2) understanding relationships between mathematical topics, (3) using mathematics in other fields of study or daily life, (4) look for connections or other procedures in equivalent representations, and (5) use connections between mathematical topics and with other topics.

However, there are still gaps regarding the condition of mathematical connection abilities. According to research by (Aida et al., 2017), students' mathematical connection abilities are still in the sufficient category. They have difficulty relating material relationships to everyday life problems.

The various studies above show that many mathematical reasoning, communication, and connection abilities are still in the sufficient and low categories. It can be said that the mathematical power of students in Indonesia is not good enough, so the impact of the mathematical problem-solving process is not optimal. Research on mathematical power (Sugilar, 2017) examines students' mathematical power but only covers communication and reasoning abilities which are part of mathematical power. So in this study, we want to know the mathematical power seen in the ability of reasoning, communication skills, and mathematical connection abilities in terms of students' critical thinking skills.

Individual's abilities should always be improved along with the development of Science and Technology. The development of Science and Technology encourages each individual to master abilities in order to face the increasingly rapid competition between individuals. The abilities that are to be possessed are not only life skills in the form of skills but also mathematical power and critical thinking abilities. Mathematics is one of the scientific thinking tools needed to develop students' logical, systematic, and critical thinking skills.

Critical thinking skills are sensitivity to self-reflection, basic abilities, and a desire to ask questions to explain and build understanding in order to draw conclusions and make the best possible decisions in a situation (Mahanal et al., 2019).

This study aims to identify the students' mathematical power of each level of critical thinking skills. Currently, students are forced to have critical thinking skills as online learning has its own impact on students. The lack of access to ask questions and seek information encourage students to be able to find solutions independently.

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

METHODS

This study used a qualitative approach with a phenomenology design. Moloeng (2019) defines phenomenology as a subjective experience or a phenomenological experience and a study of awareness from a person's main perspective. This study measures and analyzes students' mathematical power and critical thinking skills by using essay test questions, interview guidelines, and observational texts. The instruments had been validated by experts in the field of mathematics.

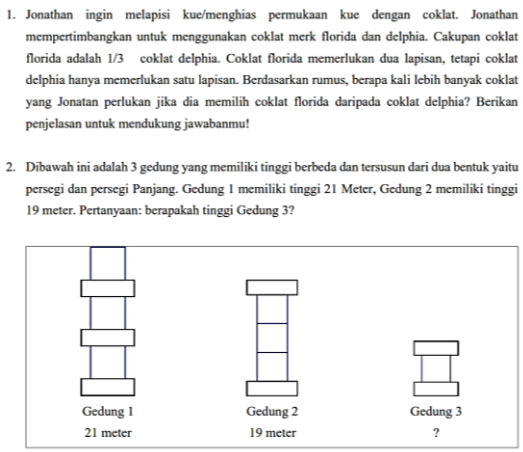
This research was conducted at SMP Negeri 3 Polokarto. Data were collected by giving a critical thinking ability test to students in one class (30 students) then the critical thinking ability test scores become the basis for categorizing students into 3 (three) categories high, moderate, and low. As the key instrument, the researcher selected the research subjects from each category of critical thinking skills as needed with the snowball sampling technique. Selected subjects were given a mathematical power test and interviewed to obtain complete data related to students' mathematical power.

The validity of the data was checked using the triangulation method, namely comparing data from several sources with the same method (tests and interviews). Data analysis includes data collection by determining the category of students' critical thinking skills, continued by collecting subject test answers, both written and oral. The next is data reduction and data categorization by selecting the data to be used based on the snowball sampling technique and analyzing it. Last, data that has been analyzed is presented based on categories and drawing conclusions.

RESULTS AND DISCUSSION

The study was started by identifying the level of students' critical thinking skills. Measurement of students' critical thinking skills was done by giving 2 (two) questions that have been validated by experts. Of the 30 students who solved the critical thinking skill test, the average score was 55.98 with a standard deviation of 27.01. Based on the PAP rules, the distribution of students' critical thinking skills was 11 students with high critical thinking skills, 8 students with moderate critical thinking skills, and 11 students with low critical thinking abilities.

The next part was about the students' mathematical power based on each level of critical thinking skills. The measurement of students' mathematical power used 2 (two) PISA questions, both of which have been validated by experts and stated that they can be used to measure students' mathematical power. The questions are presented in Figure 1. Beside that, the student's answer can be seen in Figure 2 and 3.


1. Jonathan ingin melapisi kue/menghias permukaan kue dengan coklat. Jonathan mempertimbangkan untuk menggunakan coklat merk florida dan delphia. Cakupan coklat florida adalah 1/3 coklat delphia. Coklat florida memerlukan dua lapisan, tetapi coklat delphia hanya memerlukan satu lapisan. Berdasarkan rumus, berapa kali lebih banyak coklat yang Jonatan perlukan jika dia memilih coklat florida daripada coklat delphia? Berikan penjelasan untuk mendukung jawabanmu!

2. Dibawah ini adalah 3 gedung yang memiliki tinggi berbeda dan tersusun dari dua bentuk yaitu persegi dan persegi Panjang. Gedung 1 memiliki tinggi 21 Meter, Gedung 2 memiliki tinggi 19 meter. Pertanyaan: berapakah tinggi Gedung 3?

Figure 1. PISA questions to measure students' mathematical power

AKSIOMA: Jurnal Program Studi Pendidikan Matematika
Volume 11, No. 3, 2022, 1897-1908
ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

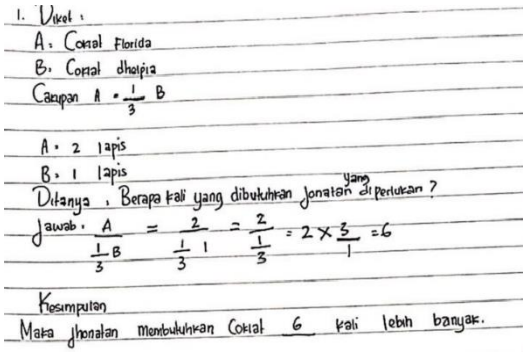


Figure 2. Answer sheet of S1 for question number 1

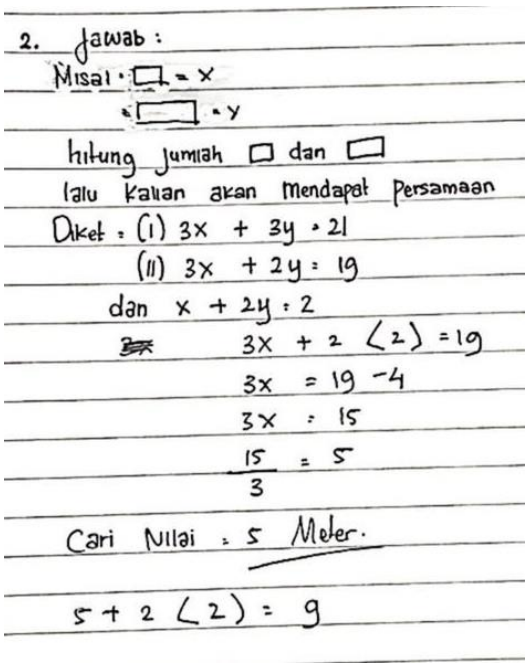


Figure 3. Answer sheet of S1 for question number 2

The subject with high-level critical thinking skills (S1) could solve problem 1 accurately and systematically by applying various concepts, namely fractions and multiplication operations to get the right conclusion. In problem 2, S2 could do it precisely and systematically too using the Two-Variable Linear Equation System (SPLDV). These implications can be seen in Figure 2 and Figure 3. Based on the use of appropriate concepts and conclusions, it can be said that the subject with high critical thinking skills has good mathematical reasoning abilities. Interviews with S1 were to confirm the written answers. S1 said that the flow of problem-solving is to identify problems, find concepts, and solve problems. The analysis of the answer sheets and interviews is in accordance with the definition of deductive reasoning. Thus, it can be said that S1 uses deductive reasoning abilities in solving problems 1 and 2.

Then, for the same subject, it seems that in the answer sheet, the subject uses mathematical language to simplify the information contained in the questions. In both questions, S1 could apply mathematical language by writing down the information in the questions using a code. S1 said that the use of the code was to summarize the question and make calculations easier. The answer was in line with the function of the application of mathematical language. Thus, it can be said that S1 can apply mathematical language well. Then, in the application of solving strategy, S1 seemed to immediately write down the mathematical model based on the concepts used in each question because S1 had memorized them and was familiar with this form of a question. In the first questions, S1 used a mathematical model of fractions and used a two-variable linear equation system for the second question. Moreover, the two answer sheets listed computation by applying a mathematical model. In the first answer sheet, S1 applied the concept of fractions and multiplication operations to solve problems. Then, in the second question, S1 used the concept of linear equation systems with two variables. Thus, S1 can use his mathematical communication skills well. Based on interviews, the use of computations refers to the flow explained by the

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

teacher. It illustrates that in the second answer sheet, the students' concepts of SPLDV are only limited to elimination and substitution resulting in the narrow limits of students' mathematical communication. Both questions could be solved well and one of which relied on a good solution plan. Therefore, it can be said that S1 can use mathematical communication skills well.

Mathematical connection ability is used to measure how well the subject understands the relationship between concepts and procedures and the relationship between question concepts and daily problems. This analysis was carried out through the answers obtained during the interview. S1 explained the questions smoothly regarding the relationship between concepts and procedures. S1 said that question number 1 related to comparison requires the concept of fractions, while question number 2, calculating the value of a variable using the SPLDV concept. Then the researcher asked whether there was a relationship between these questions and other daily problems. In the first question, the concept used fractions, and S1 mentioned fractional problems for comparisons. In the second question, the subject mentioned that the SPLDV concept could be applied to find the value of two variables from two interrelated linear equations, for example finding the price of an item. Thus, it can be said that S1 can relate problems to daily problems. Therefore, it can be said that S1 has good mathematical connection abilities. The three abilities of students' mathematical power are good and it becomes a basis for the conclusion that subjects with high-level critical thinking skills have good mathematical power.

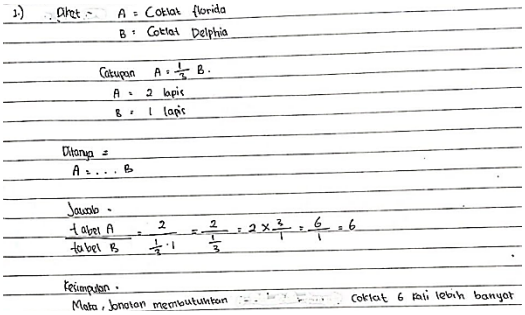


Figure 4. Answer sheet of S2 for question number 1

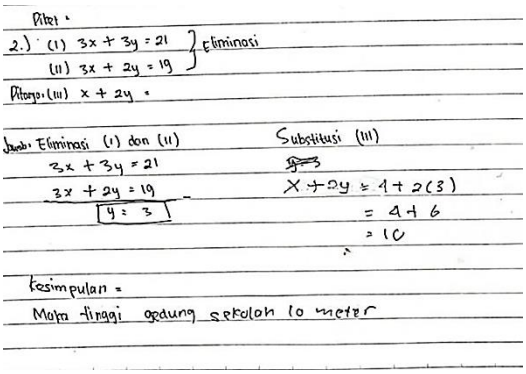


Figure 5. Answer sheet of S2 for question number 2

Subjects with moderate critical thinking skills (S2) referring to Figure 4, S2 could solve the question correctly using the concept of fractions and conclude them appropriately as well. However, based on Figure 5, S2 made a calculation error that failed to infer the concept used, even though the concept used was correct. Thus, it can be said that S2 has poor mathematical reasoning abilities as seen on his answer sheets in Figure 4 and Figure 5, the use of concepts to get the answer for conclusion drawing. In interviews, S2 explained the workflow in accordance with the written answers. Thus, it can be said that S2's mathematical reasoning ability leads to deductive mathematical reasoning.

A person's mathematical communication skills are used to be able to visualize questions in the mathematical language in order to appropriately plan

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

the solutions. Based on Figure 4, S2 could visualize the information on the question in mathematical language by providing codes, but not for Figure 5 in which S2 did not visualize information in mathematical language. Then, it was confirmed by the researcher that S2 did not do the visualization as it was to shorten the time and as he had spent time understanding the question. The use of the mathematical language of S2 is not good. This indicates that critical thinking skills also affect a person's speed in understanding something. Then, S2's mathematical language was applied appropriately according to the concept of each question as seen in Figure 4 and Figure 5. Thus, S2's ability in using mathematical language in mathematical concepts is good. And then S2's ability in interpreting mathematical symbols in computing based on the use of symbols in computing and the accuracy of calculations in question number 1, S2 could provide a good computational visualization using the concepts of fractions and multiplication to produce the correct answer. However, in question number 2, he made a calculation error resulting in a wrong answer. After an in-depth interview, S2 stated that he was rushed in counting resulting so that he was not careful enough. Thus, it can be concluded that S2's mathematical communication skills are not good due to a lack of good critical thinking skills.

The mathematical connection ability to measure how well the subject understands the relationship between mathematical concepts and procedures used, as well as the use of these concepts related to daily problems. S2 could answer all questions regarding the relationship between the concepts and procedures used and other related concepts. S2 said that question number 1, was about the concept of fractions and to solve them easily, so he need to turn it into mathematical languages and models to facilitate computation. Then, in question number 2, the SPLDV concept had to use a systematic workflow, starting from making mathematical models to computing the answer. S2 could also answer interview questions regarding the use of concepts in daily life by stating that the concept of fractions can be applied to the distribution of property or goods and the SPLDV concept can be used to solve problems about the price of goods. S2 said that because it had been discussed in the classroom. So it can be said that S2 has good mathematical connection abilities. S2's skills have been analyzed and it can be concluded that S2's mathematical power is not good as his mathematical reasoning and communication skills are still low.

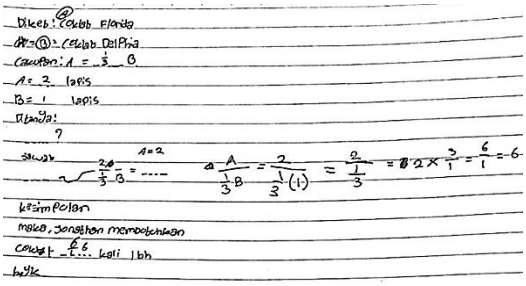


Figure 6. Answer sheet of S3 for question number 1

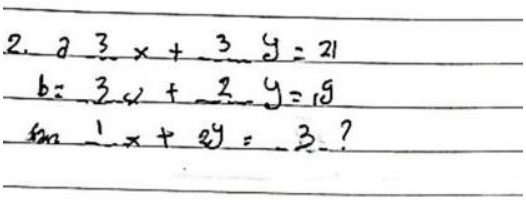


Figure 7. Answer sheet of S3 for question number 2

The student with a low level of critical thinking skills (S3) tends to have difficulty understanding questions and

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

concluding results. Based on Figure 6, S3 could perform calculations according to the concept and could draw conclusions. The flow of work is the same as S2 and S1 with the use of concepts to draw conclusions which is a type of deductive reasoning. However, in Figure 7, S3 did not perform calculations at all so there is no conclusion. In interviews, S3 explained verbally that he could not understand question number 2. It is different from question number 1, so he could not answer it. This indicated that S3's mathematical reasoning ability is low.

The ability to use mathematical language to solve question number 1 is analyzed through three components including the use of mathematical language, the use of mathematical representations, and the interpretation of mathematical symbols in computing as well as describing mathematical relationships or models. It can be seen in the answer sheet that in question number 1, S3 could visualize problems using mathematical language by modeling the information obtained. Meanwhile, in question number 2, S3 did not visualize it using mathematical language at all. Interviews were conducted to confirm this. S3 said that he had the same case as S2, namely difficulty understanding the questions and running out of time to work on them. So in the first component, S3 can't do well. Then in representing mathematical language to mathematical concepts, S3 did not do it correctly as evidenced by the incorrect application of the initial concept in solving question number 1 and his ignorance in solving question number 2. When confirmed about the truth, S3 could provide a clear explanation of the application of mathematical language to existing concepts due to not understanding the question. So the ability of S3 in the use of mathematical representations is not good. S3 performed the computation of the mathematical symbols obtained through the calculations in Figure 6, but in Figure 7, S3 did not perform any calculations at all. Without the use of mathematical language and the application of existing concepts, calculations are impossible in which S3 said that it is all due to the inability to understand the question well.

The mathematical connection ability was to measure the extent to which students understand the relevance of the concepts used and procedures, as well as the use of concepts in daily life. Based on Figure 6, S3 could write down the process and the answer correctly. But in interviews, S3 said that he did not know the relationship between the concepts and the procedures used. S3 could answer this question because he is used to working on similar questions in the class or from other books. For the second question, S3 could not explain the relationship between concepts and procedures and did not know whether this concept can be applied in daily life or not. Thus, it can be concluded that S3's mathematical power is low because almost all abilities in mathematical power are still in the low category.

Next, a discussion of the findings is carried out. The results showed that students with a high level of critical thinking skills had a straight relationship with students' mathematical power. Students with high critical thinking skills have good mathematical power, namely good mathematical reasoning, mathematical communication, and mathematical connections. Good critical thinking skills help students in solving non-routine questions. Meanwhile, the

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

instrument in this study used a question similar to PISA which is non-routine. This is in line with Nurhayati et al. (2019) that good critical skills will make it easier for someone to understand and solve a question.

The mathematical power of a student with moderate critical thinking skills shows poor mathematical reasoning and communication skills. But it is good for mathematical connection abilities. Errors in calculations make the conclusion drawing less precise. This is what happened to this subject. This causes poor mathematical reasoning and communication skills. In line with this statement, problem-solving is influenced by good reasoning and communication skills (Rosita, 2014). Thus, it is necessary to make students accustomed to solving questions in the classroom, especially non-routine questions.

The low critical thinking skills are caused by the lack of training in critical thinking, teacher-centered learning, and weak in analyzing (Nuryanti et al., 2018). The mathematical power of subjects with low critical thinking skills shows low mathematical reasoning, mathematical communication, and mathematical connections. This low mathematical reasoning ability is because of the difficulty in understanding non-routine questions and the habit of working on a question for a long time. It is in line with Vebrian et al. (2021) that students with low mathematical reasoning abilities have difficulty understanding the problem. Furthermore, in mathematical communication skills, subjects with low critical thinking skills have difficulty in visualizing the form of story questions into mathematical language, and this results in errors in drawing conclusions and even there are no calculations at all on the answer sheet. Faizah & Sugandi (2022) revealed that subjects with low communication skills have difficulty working on it so they do not do it at all. Moreover, due to low mathematical connection ability, the subject cannot explain how the procedures and concepts are related, and the relation to daily problems. It is in accordance with Kenedi et al. (2019) that the subject finds it difficult when the problem is associated with practical problems. According to Sugilar (2017) students' low mathematical power is due to some factors, one of which is students' unfamiliarity with solving the non-routine question. These three abilities are the basis that students with low critical abilities have low mathematical power.

The advantage of this study is to analyze all abilities covered by mathematical power. There is a comparison or review of mathematical power to the category of critical thinking ability, and the resulting findings in the form of a description of the characteristics of students' mathematical power at each level or category of critical thinking ability. The limitations of this research are on the research subject by limiting the subject only based on the category of students' critical thinking abilities. This study provides an overview of students' mathematical power characteristics based on the category level of critical thinking abilities. It will be helpful for educators or teachers in addressing the situation and students' abilities in teaching and learning mathematics to be effective. Provide insight for readers and researchers so they can conduct to develop this research.

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

CONCLUSION AND SUGGESTION

Students with high critical thinking skills have good mathematical reasoning abilities with deductive mathematical reasoning models. Even, they have good mathematical communication and mathematical connections. Then, students with moderate critical thinking skills have deductive mathematical reasoning abilities with poor mathematical reasoning and mathematical communication skills, but they have good mathematical connections. It is because students have a longer time in understanding oral questions than written questions. Students with low critical thinking skills have low mathematical deductive reasoning abilities, mathematical communication, and mathematical connections. The low ability of students' mathematical power is caused by the difficulty in understanding the question.

A person's abilities can be improved and continue to be developed. In this study, the researcher recommends continuing to train students to solve non-routine questions that can be developed by the teacher or even searching from other relevant sources.

REFERENCES

Aditya, P. T. (2018). Pengembangan Media Pembelajaran Matematika Berbasis Web Pada Materi Lingkaran Bagi Siswa Kelas Viii. *Jurnal Matematika Statistika Dan Komputasi*, *15*(1), 64. https://doi.org/10.20956/jmsk.v15i1.4425

Aida, N., Kusaeri, K., & Hamdani, S. (2017). Karakteristik Instrumen Penilaian Hasil Belajar Matematika Ranah Kognitif yang Dikembangkan Mengacu pada Model PISA. *Suska Journal of Mathematics Education*, *3*(2), 130. https://doi.org/10.24014/sjme.v3i2.3897

Algani, Y. M. A., & Eshan, J. (2019). Reasons and Suggested Solutions for Low-Level Academic Achievement in Mathematics. *International E-Journal of Educational Studies*, *3*(6), 181–190. https://doi.org/10.31458/iejes.604884

Astuti, A. (2012). Peran Kemampuan Komunikasi Matematika Terhadap Prestasi Belajar Matematika Siswa. *Jurnal Formatif*, *2*(2), 102–110. https://doi.org/http://dx.doi.org/10.30998/formatif.v2i2.91

Dewi, I., & Harahap, M. S. (2016). The Development of Geometri Teaching Materials Based on Constructivism to Improve the Students' Mathematic Reasoning Ability through Cooperative Learing Jigsaw at the Class VIII of SMP Negeri 3 Padangsidimpuan. *Journal of Education and Practice*, *7*(29), 68–82. https://iiste.org/Journals/index.php/JEP/article/view/33597

Faizah, H., & Sugandi, E. (2022). Analisis Kemampuan Komunikasi Matematis Tulis Siswa SMP pada Soal Cerita Bentuk Aljabar dalam Pembelajaran Daring. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(1), 291–304. https://doi.org/http://dx.doi.org/10.24127/ajpm.v11i1.4429

Kenedi, A. K., Helsa, Y., Ariani, Y., Zainil, M., & Hendri, S. (2019). Mathematical Connection of Elementary School Students to

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

Solve Mathematical Problems. *Journal on Mathematics Education*, *10*(1), 69–80. https://doi.org/https://doi.org/10.22342/jme.10.1.5416.69-80

Kusmaryono, I., & Dwijanto, D. (2016). Peranan Representasi Dan Disposisi Matematis Siswa Terhadap Peningkatan Mathematical Power. *JIPMat*, *1*(1), 19–28. https://doi.org/10.26877/jipmat.v1i1.1089

Lexy J. Moloeng. (2019). *METODOLOGI PENELITIAN KUALITATIF*. PT Remaja Rosdakarya.

Mahanal, S., Zubaidah, S., Sumiati, I. D., Sari, T. M., & Ismirawati, N. (2019). RICOSRE: A learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction*, *12*(2), 417–434. https://doi.org/10.29333/iji.2019.12227a

Marianah, H. (2020). Analysis of Mathematical Reasoning Ability Viewed from Student Learning Motivation. *Journal of Mathematics Education*, *5*(2), 5–10. https://doi.org/http://doi.org/10.31327/jme.v6i1.1758

National Council of Teachers Mathematics'. (2000). *Principles and Standards for School Mathematics* (Evaluation).

Nisraeni, N., & Arifanti, D. R. (2018). Describe Reasoning of Students in Completing Three-Dimensional Problem-Solving. *Journal of Mathematics Education*, *3*(1), 28–32. https://doi.org/10.31327/jomedu.v3i1.526

Nugraha, T. H., & Pujiastuti, H. (2019). Analisis Kemampuan Komunikasi Matematis Siswa Berdasarkan Perbedaan Gender. *Edumatica : Jurnal Pendidikan Matematika*, *9*(1), 1–7. https://doi.org/10.22437/edumatica.v9i1.5880

Nurhayati, Angraeni, L., & Wahyudi. (2019). Pengaruh model problem based learning, kemampuan berpikir kritis terhadap kemampuan berpikir tingkat tinggi. *The Natural Science Education, Biology Education, Physics Education, and Chemistry Education Journal*, *11*(1), 12–20. https://doi.org/https://doi.org/10.15408/es.v11i1.7464

Nuryanti, L., Java, C., Zubaidah, S., Malang, U. N., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan:Teori, Penelitian, Dan Pengembangan*, *3*(2), 155–158. http://journal.um.ac.id/index.php/jptpp/

Pourdavood, B. R., McCarthy, K., & McCafferty, T. (2020). The impact of mental computation on children's mathematical communication, problem solving, reasoning, and algebraic thinking. *Athens Journal of Education*, *7*(3), 241–254. https://doi.org/10.30958/aje.7-3-1

Rizqi, N. R., & Surya, E. (2017). An Analysis of Students' Mathematical Reasoning Ability In VIII Grade of Sabilina Tembung Junior High School. *International Journal of Advance Research and Innovative Ideas in Education (IJARIIE)*, *3*(2), 3527–3533. https://doi.org/16.0415/IJARIIE-

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i3.5322

4704

Romli, M. (2016). Profile of Mathematical Connection of High School Female Students with High Mathematics Ability in Solving Mathematics Problems. *Jurnal Ilmiah Pendidikan Matematika*, *1*(2), 145–157. https://doi.org/https://doi.org/10.26877/jipmat.v1i2.1241

Rosita, C. D. (2014). Kemampuan Penalaran Dan Komunikasi Matematis : Apa, Mengapa, Dan Bagaimana Ditingkatkan Pada Mahasiswa. *Euclid*, *1*(1), 33–46. https://doi.org/10.33603/e.v1i1.342

Ruwah, N., & Husnul, I. (2020). Penerapan Metode Problem Posing untuk Meningkatkan Kualitas Akuntansi. *Jurnal Pendidikan Matematika*, *6*(1), 15–27. https://doi.org/http://dx.doi.org/10.33474/jpm.v6i1.2961

Septian, A., Darhim, & Prabawanto, S. (2020). Geogebra in integral areas to improve mathematical representation ability. *Journal of Physics: Conference Series*, *1613*(1), 895–908. https://doi.org/10.1088/1742-6596/1613/1/012035

Siagian, M. D. (2016). Kemampuan koneksi matematik dalam pembelajaran matematika. *MES: Journal of Matematics Education and Science2*, *2*(1), 58–67. https://doi.org/https://doi.org/10.30743/mes.v2i1.117

Sopiyah, Nurikhsan, J., & Hafina, A. (2020). Efektivitas Teknik Konseling Cognitive Behavioral untuk Meningkatkan Self-Efficacy Siswa pada Pelajaran Matematika. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, *11*(2), 102–124. https://doi.org/10.37640/jip.v11i2.128

Sugilar, H. (2017). Daya Matematis Mahasiswa Program Studi Pendidikan Matematika. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *1*(1), 97. https://doi.org/10.33603/jnpm.v1i1.252

Vebrian, R., Putra, Y. Y., Saraswati, S., & Wijaya, T. T. (2021). Kemampuan Penalaran Matematis Siswa dalam Menyelesaikan Soal Literasi Matematika Kontekstual. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2602–2614. https://doi.org/http://dx.doi.org/10.24127/ajpm.v10i4.4369