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# Systematic Literature Review: Penalaran Matematika di Sekolah Dasar

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***Abstract***

*Based on data from PISA, it shows that students' mathematical abilities in Indonesia are still relatively low. Therefore, improving students' mathematical reasoning abilities is a way in order to cope with those problems. This research aims to analyze research related to the mathematical reasoning abilities of elementary school students in 2018-2022, considering that a literature review on this topic has never been carried out. The type of this research is a systematic literature review. Data was collected by documenting 20 selected articles in Sinta 1-6 journals and Scopus. The results of this research revealed that topics related to mathematical reasoning abilities in elementary schools have not been widely researched in the last five years. The majority of articles discuss the characteristics and the analysis of students' reasoning abilities mapping in a group. The most widely published Sinta 3 and Scopus articles with the most researched material are geometry. The frequent type of research carried out is quantitative. Suggestions for future research are to conduct further research related to the development of mathematical reasoning abilities in elementary schools, especially on fractions and algebra material.*

***Keywords:*** *Mathematics Reasoning, Reasoning, Elementary School*

## INTRODUCTION

Mathematics is a science that plays an essential role in the world of education and the development of modern technology[1]. Taking note of ideal mathematics learning is believed to be able to develop students' thinking abilities and problem-solving abilities[2]. This development of thinking abilities will help students study other fields of science and utilize and even develop modern technology. Therefore, as early as possible, mathematics must be presented well. Good mathematics learning must at least conform to the process standards recommended by NCTM[3]. Process standards in mathematics learning, according to NCTM, include problem-solving, reasoning and proof, connections, communication and representation[4].

Numerous parties have tried to realize good mathematics learning. However, because of its abstract nature, many students still consider this subject difficult[5]. This is supported by several data that illustrate the low mathematics abilities of students in Indonesia. One of them is the results data from PISA, which can be a standard for measuring international mathematics mastery. Based on PISA results, Indonesia has consistently been the country with the lowest ranking over the last 10-15 years. In the field of mathematics, in 2018, Indonesia was ranked 72 out of 78, and in 2020 it was recorded that 71% of students were still below the minimum competency standard[6].

One of the NCTM process standards that is closely related to mathematical abilities is mathematical reasoning abilities[7]. Mathematical reasoning abilities are stated as central to mathematics learning and the goal of contemporary mathematics education[8]. Reasoning ability is the main tool for understanding and using abstract mathematical concepts and solving mathematical problems. Low mathematical abilities based on PISA data are definitely related to low reasoning abilities. Therefore, more studies and research are needed regarding mathematical reasoning abilities at the elementary school level.

Based on bibliometric results via the VoSviewer app, small number of research has been conducted on the topic of mathematical reasoning abilities in elementary schools. Research on the topic of mathematical reasoning is mostly carried out at middle school

[1] Syintia Siti Latifah and Others, 'Think Pair Share sebagai Model Pembelajaran Kooperatif untuk Peningkatan Kemampuan Pemecahan Masalah Matematika' , *Mosharafa: Jurnal Pendidikan Matematika*, 9(1), 35–46
[2] Nanang and Awan Sukandar, " Meningkatkan Kemampuan Siswa SDIT Miftahul Ulum Pada Operasi Bilangan Bulat Melalui CAI-Contextual' , *Mosharafa: Jurnal Pendidikan Matematika* , 9(1), 71–82
[3] Ardiansyah and Others, 'Pengaruh Problem Based Learning terhadap Kemampuan Penalaran Matematik dan Korelasinya dengan Kemampuan Awal Siswa SMP' , Pengaruh Problem Based Learning terhadap Kemampuan Penalaran Matematik dan Korelasinya dengan Kemampuan Awal Siswa SMP' , *Mosharafa: Jurnal Pendidikan Matematika*, 11(3) (2020), 483–494
[4] Marabesy Rosida and Aan Hasanah, Penalaran Matematika: Apa Aspek Sentralnya? *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *5*(1) (2021), 562–577
[5] Wiryanto, Proses Pembelajaran Matematika di Sekolah Dasar di Tengah Pandemi COVID-19. *Jurnal Review Pendidikan Dasar: Jurnal Kajian Pendidikan dan Hasil Penelitian*
[6] Kemendikbud, (2020), *Peta Jalan Pendidikan Indonesia (2020-2035)* (p. 19)
[7] Imam Kusmaryono and M. Abdul Basir, (2018), Suatu Kajian Kognitif Belajar Berpikir Matematis Melalui Penalaran Abstrak, Unissula Press, Semarang.
[8] Marija Kaplar and Others, The Influence of Interactive Learning Materials on Solving Tasks That Require Different Types of Mathematical Reasoning. International Journal of Science and Mathematics Education, 20 (2022), 411–433

and high school levels. This could be a research opportunity in the future because mathematical reasoning abilities need to be developed at the elementary school level.

One attempt to discover research opportunities is to look at previous research findings and ltrends. Therefore, this research was conducted as a literature review to display a mapping of research trends on the topic of mathematical reasoning abilities in elementary schools. Literature review research on this topic has never been conducted previously, so this research will be very useful. Apart from looking for research opportunities, it is also helpful for educational practitioners because it will discuss the problem of mathematical reasoning abilities development along with solutions referring to previous research findings. This research aims to analyze research related to the mathematical reasoning abilities of elementary school students in 2018-2022 based on several things, namely year of publication, level of education, journal index, research material, as well as research results on mathematical reasoning abilities.

## RESEARCH METHODS

The research uses the Systematic Literature Review (SLR) method with a quantitative, qualitative approach. SLR is a research method carried out to collect, evaluate, and interpret previous research findings on a topic to answer the problem formulation that has been formulated[9]. The general steps of this research are collecting data, analyzing data, and drawing conclusions[10]. At the data collection step, researchers collect data in the form of primary research published in national and international articles. Electronic databases used by researchers include Google Scholar, Crossref, Semantic, and Scopus.

The initial step of this research is data collection by documenting all research related to reasoning on mathematics topics in elementary schools in 2018-2022, analyzing data in articles, and drawing conclusions. Researchers searched through the Harzing Publish or Perish apps. During the search, researchers wrote down the keywords mathematical reasoning and elementary school up to 65 articles. Those articles are then selected and evaluated using PRISMA according to predetermined criteria. hese are the following inclusion criteria used

1. The content of the article is related to mathematics learning in elementary schools

2. The article analyzes mathematical reasoning in elementary schools

3. The article includes research material

4. There are words related to "Mathematical Reasoning" in the keywords or title

[9] Evi Triandini and Others, Metode Systematic Literature Review untuk Identifikasi Platform dan Metode Pengembangan Sistem Informasi di Indonesia . Indonesian Journal of Information Systems (IJIS), 1(2) (2019), 63–77
[10] Dadang Juandi and Maximus Tamur, (2020). Pengantar Analisis Meta . UPI Press

5. Articles published in the period 2018 – 2022

6. Articles accredited by Sinta or Scopus indexers

Articles not meeting the above criteria will be excluded from this systematic literature study process. The articles that have been collected are then analyzed to answer the problem formulation, and conclusions are drawn. The articles that will be reviewed in this research are 20 research articles with details of 14 national articles that have been indexed in SINTA 1 and 6 Scopus articles published in the period 2018 - 2022.

## RESULT AND DISCUSSION

The results of this research are an analysis of previous articles related to the topic of mathematical reasoning in elementary schools. After obtaining 20 articles based on adjustments to the researcher's inclusion criteria, the articles were then further categorized based on study characteristics. The characteristic criteria for this research are year of publication, level of education, journal index, material used, and research results. The diversity of research on the ability of mathematical proof based on study characteristics will be presented in the explanation below:

### Publication Year

The articles analyzed are focused on mathematical reasoning abilities published in indexed journals Sinta and Scopus in the last 5 years. The following is the data from classification articles based on material:

**Tabel 1.** Number of Studies Based on Publication Year Criteria

| Year | Mathematical Reasoning Abilities Based on :: | | | | | |
|---|---|---|---|---|---|---|
| | **Characteristic / KPM Mapping** | **Approach** | **Model** | **Method/ Strategy** | **Teaching materials** | **Amount** |
| 2018 | 0 | 2 | 1 | 0 | 0 | 3 |
| 2019 | 3 | 0 | 3 | 1 | 0 | 7 |
| 2020 | 2 | 0 | 1 | 0 | 1 | 4 |
| 2021 | 2 | 0 | 0 | 0 | 0 | 2 |
| 2022 | 1 | 0 | 1 | 1 | 1 | 4 |
| **Amount** | **8** | **2** | **6** | **2** | **2** | **20** |

Based on the data above, the majority of research on elementary school student's mathematical reasoning abilities from the indexed journals Sinta and Scopus was in 2019. Meanwhile, in other years, small number of research related to mathematical reasoning was conducted. This can be taken into consideration by future researchers to be able to conduct research related to this topic. It has something to do with the fact that

mathematical reasoning ability is one of the standard mathematical abilities students must have[11].

In the last five years, articles on mathematical reasoning in elementary schools regarding analysis of characteristics and mathematical reasoning abilities mapping are still in domination, namely 7 out of 20 studies. This shows that researchers are more interested in exploring characteristics, analyzing the relationship between mathematical reasoning abilities and various other aspects of mathematics, as well as finding out students' mathematical reasoning abilities in various regions. Information about these three things is fundamental and important to choose what action is appropriate to improve students' mathematical reasoning abilities in various elementary schools, for example, choosing the right approaches, models, methods, teaching materials and media. Teachers can improve students' mathematical reasoning skills if the learning design used is innovative and appropriate[12]. Other research states that using teaching materials that suit students' characteristics and abilities effectively improves students' mathematical reasoning abilities[13].

Furthermore, research on mathematical reasoning related to models is also quite interesting for researchers, namely six articles. This shows that researchers have studied and tested several innovative learning models to improve mathematical reasoning abilities. There is also less research related to the use of methods and approaches, namely only 3 and 2 articles. As well as, the research related to the development of teaching materials is still lacking, namely two articles. This shows that there is still little innovation in the use of methods, approaches and teaching materials to improve mathematics skills. In fact, the choice of method/approach and teaching materials also greatly determines students' success in learning ability, including mathematical reasoning. Therefore, there must be further exploration regarding methods, approaches and teaching materials to improve mathematical reasoning abilities in future research.

## Index Journal

Classification based on index is divided into seven groups, namely Scopus, Sinta 1-6. The following is data from classification articles based on journal index:

**Tabel 2.** Number of Studies based on Journal Index Criteria

| Journal Index | Mathematical Reasoning Ability based on: | | | | | |
|---|---|---|---|---|---|---|
| | Characteristic/ KPM Mapping | Approach | Model | Method/ Strategy | Teaching materials | Amount |
| Scopus | 3 | 0 | 1 | 1 | 1 | **6** |
| Sinta 1 | 0 | 0 | 0 | 0 | 0 | **0** |
| Sinta 2 | 0 | 0 | 0 | 0 | 0 | **0** |

[11] Farhah Sakhiyah and Others, Efektivitas Penerapan Model Connecting, Organizing, Reflecting, Extending (CORE) terhadap Kemampuan Penalaran Adaptif Matematika. Ibdida'i, 6(2) (2019), 149–164
[12] Muhamad Saleh and Others Improving the Reasoning Ability of Elementary School Student Through the Indonesian Realistic Mathematics Education. *Journal on Mathematics Education*, 9(1) (2018), 41–54.
[13] Happy Prawitasari Nourmaningtyas and Others, Pengembangan Bahan Ajar Berbasis Pendekatan Open Ended Pada Materi Pengukuran Panjang dan Berat untuk Meningkatkan Kemampuan Penalaran Siswa Kelas IV di SDN Bugangan 03 Semarang. Elementary School, 77–86 (2020)

| | | | | | | |
|---|---|---|---|---|---|---|
| Sinta 3 | 3 | 2 | 2 | 0 | 0 | **7** |
| Sinta 4 | 1 | 0 | 2 | 1 | 1 | **5** |
| Sinta 5 | 1 | 0 | 1 | 0 | 0 | **2** |
| Sinta 6 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Amount** | **8** | **2** | **6** | **2** | **2** | **20** |

Based on the data above shows that the majority of articles about elementary school students' mathematical reasoning abilities are published in Scopus-indexed journals. In the Sinta database, many studies related to this topic were published in the Sinta 3 journal. There are no studies related to this topic in the Sinta 1, 2, and 6 journals.

## Type of Research

Classification based on research type is divided into four groups, namely qualitative, quantitative, RnD, and PTK. The following is data from classification articles based on research type:

**Tabel 3.** Number of Studies based on Type of Research Criteria

| **Types of research** | **Mathematical Reasoning Ability based on:** | | | | | |
|---|---|---|---|---|---|---|
| | **Characteristic / KPM Mapping** | **Approach** | **Model** | **Method/ Strategy** | **Teaching materials** | **Amount** |
| Qualitative | 4 | 0 | 1 | 1 | 0 | **6** |
| Quantitative | 4 | 1 | 2 | 1 | 1 | **9** |
| RnD | 0 | 0 | 1 | 0 | 1 | **2** |
| PTK | 0 | 1 | 2 | 0 | 0 | **3** |
| **Amount** | **8** | **2** | **6** | **2** | **2** | **20** |

Based on the data above, research related to students' mathematical reasoning abilities in the last five years mostly used quantitative research methods in around 9 out of 20 studies. The next type of research that is also widely used is the qualitative type, namely, 6 out of 20 studies. The type of research that is rarely carried out is PTK (classroom action research). Classroom action research is actually a type of research that is relatively easy to conduct. The reason is that the essence of action research is to put an idea into practice in a group/class to improve the quality of learning in that class, so generally, it only involves small-scale subjects and the activities carried out tend to be simple[14]. However, due to its looseness and informal nature, the validity and generalization of the results of classroom action research are likely considered doubtful compared to other types of research. This is what makes this type of research less attractive to researchers if the study topic chosen is intended to deepen and contribute to knowledge. The type of research that is carried out the least is RnD/development research. This is because carrying out development research requires deeper knowledge, longer time and extra funds.

[14] Yatim Riyanto and Trenda A Oktariyanda, (2023), Metodologi Penelitian Kualitatif dan Kuantitatif. Unesa University Press

**Material**

Classification based on material is divided into four groups, namely fractions, geometry, arithmetic and algebra. The following is the data from classification articles based on material:

**Table 4.** Number of Studies based on Material Criteria

| Types of research | Mathematical Reasoning Ability based on: | | | | | |
|---|---|---|---|---|---|---|
| | **Characteristic / KPM Mapping** | **Approach** | **Model** | **Method/ Strategy** | **Teaching materials** | **Amount** |
| Fractional | 0 | 1 | 1 | 0 | 0 | **2** |
| Geometry | 5 | 0 | 4 | 1 | 2 | **12** |
| Arithmetic | 4 | 0 | 1 | 0 | 0 | **5** |
| Algebra | 0 | 0 | 0 | 1 | 0 | **1** |
| **Amount** | **8** | **1** | **6** | **3** | **2** | **20** |

Based on the data above, research related to students' mathematical reasoning abilities in elementary schools is dominated by geometry material, namely 12 out of 20 studies. Another material is arithmetic, namely five studies. This number tends to be said to be small, considering that arithmetic material is very important in instilling basic calculation concepts in students. Another material related to mathematical reasoning which is still rarely researched is fraction material, namely 2 studies. This number is less than the number of studies on geometry and arithmetic material, even though students' ability to operate fractions is also an important indicator that determines students' success in solving mathematical problems. If a student's understanding and mathematical reasoning regarding fractions is low, they will most likely have difficulty working on math problems[15]. Therefore, further research is needed regarding efforts to improve students' mathematical reasoning on fractions in elementary school. Furthermore, the least amount of material was done on algebra, namely 1 study. This is because algebra material generally begins to be studied at the junior high school level when students have reached the formal operational cognitive stage. However, many studies have proven that algebra is still material that is difficult for high school students to understand. Therefore, it is important to introduce the concept of algebraic reasoning and thinking from elementary school as a preparation for studying algebra at the next level[16]. Algebraic reasoning, which needs to be trained from the elementary school level, includes generalization of patterns, representation of relationships and analysis related to changes seen, development of ways of thinking between various topics and preparation for more formal algebraic content

**Tabel 5.** Results of Research on Mathematical Reasoning Ability in Elementary Schools

[15] Mustamin, Penggunaan Alat Peraga dalam Mengatasi Kesulitan Belajar Matematika Materi Pecahan pada Siswa Kelas V. AULADUNA: Jurnal Pendidikan Dasar Islam, 5(2) (2018), 170–182
[16] Wulan Andini, Pengembangan Desain Didaktis untuk Mengantisipasi Learning Obtacles Berpikir Aljabar di Sekolah. At-Tarbiyah: Jurnal Pendidikan, 30(2) (2020), 135–150

| Author and Year | Results |
|---|---|
| (Saleh et al., 2018) | The PMRI/RME approach has been proven to improve students' mathematical reasoning abilities in fraction material more effectively than conventional learning[17] |
| (Setiawan & Dores, 2019) | The mathematical reasoning and problem-solving abilities of fourth-grade elementary school students in Sintang are low. The difficulty lies in understanding and ability to solve non-routine problems[18] |
| (Habibah et al., 2021) | The open learning model has a significant impact on improving mathematical reasoning abilities and could also train students' critical thinking and problem-solving ability[19] |
| (Meirisa et al., 2021) | Students' mathematical reasoning abilities are still low in solving problems based on mathematical cognition[20] |
| (Sakhiyah et al., 2019) | There is a significant positive influence of implementing the CORE learning model in adaptive mathematical reasoning[21]. |
| (Akuba et al., 2020) | Mathematical reasoning abilities have a positive influence on self-efficacy and problem-solving abilities so which indirectly also greatly influence the mastery of mathematics concepts in fourth-grade elementary school[22] |
| (Holisin et al., 2019) | The OSCAR learning method is a valid, practical and effective method for training elementary school students' reasoning ability in solving mathematical problems[23] |
| (Cindyana et al., 2022) | Differentiated learning methods using RME-based geometry teaching materials have a significant impact on the mathematical reasoning abilities of third-grade students at the Madani Islamic School in Riau[24] |
| (Rimadona et al., 2018) | RME led to significant improvements in KPM and helped develop students' mathematical argumentation and problem-solving abilities[25] |

[17] Muhamad Saleh and Others, Improving the Reasoning Ability of Elementary School Student Through the Indonesian Realistic Mathematics Education. *Journal on Mathematics Education*, 9(1) (2018), 41–54

[18] Beni Setiawan and Olengglus Jiran Dores

[19] Hainun bibah and Others, Pengaruh Model Pembelajaran Open Ended terhadap Kemampuan Penalaran Matematika di Kelas Tinggi Sekolah Dasar. Attadih: *Journal of Elementary Education*, 5(2) (2021), 157–166

[20] Arrum Meirisa and Others, Analisis Kemampuan Penalaran Numerik Siswa dalam Menyelesaikan Soal Berbasis Mathematical Cognition di Sekolah Dasar. *Jurnal Basicedu*, 5(4) (2021), 2678–2684

[21] Farhah Sakhiyah and Others

[22] Stefy Falentino Akuba and Others, Pengaruh Kemampuan Penalaran, Efikasi Diri dan Kemampuan Memecahkan Masalah Terhadap Penguasaan Konsep Matematika. *Jurnal Nasional Pendidikan Matematika (JNPM)*, 4(1) (2020), 44–60

[23] Iis Holisin and Others, Pengembangan Model Pembelajaran Oscar untuk Melatih Penalaran untuk Melatih Penalaran Siswa Sekolah Dasar dalam Menyelesaikan Masalah Matematika. *Fibonacci: Jurnal Pendidikan Matematika dan Matematika, 5(1) (2019)*, 1–6

[24] Eksa Aqila Cindyana and Others, Pengaruh Model Pembelajaran Open Ended terhadap Kemampuan Penalaran Matematika di Kelas Tinggi Sekolah Dasar. Attadih: Journal of Elementary Education, 5(2) (2022), 157–166

[25] Putri Rimadona, Penerapan Pendekatan Realistic Mathematics Education (RME) untuk Meningkatkan Penalaran Matematika Siswa Kelas IV Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 3(1) (2018), 54–63

| | |
|---|---|
| (Nining, 2019) | The Creative Problem Solving model is able to improve students' mathematical reasoning abilities to a sufficient level[26] |
| (Nourmaningtyas et al., 2020) | An open approach can help students develop KPM on length and weight measurement material[27] |
| (Ahmad et al., 2021) | The average result of mathematical reasoning for fourth-grade students at SDN Tlogomulyo on polygon material is 62% for fourth-grade students in the medium category[28] |
| (Rachmaningtyas et al., 2020) | There is a diversity of mathematical reasoning and problem-solving abilities of fifth-grade students with details:<br>Students with above-average reasoning and problem-solving abilities are able to solve mathematical problems with appropriate procedures and respond.<br>Students with standart-average reasoning and solving abilities can solve mathematical problems, but their calculations are inaccurate.<br>Students with below-average reasoning and solving abilities show a lack of ability in procedural solving and mathematical calculations[29]. |
| (Benito & Bailera, 2022) | Problem-solving strategies using chess media is useful in improving students' reasoning abilities[30] |
| (Silva & Luna, 2019) | There is a (moderate-strong) and positive correlation between logical reasoning and KPM in children[31] |
| (Obara, 2019) | It is crucial to introduce pattern activities from an early age to students to improve their mathematical reasoning abilities and algebra problem-solving abilities[32] |
| (Rosdiana et al., 2021) | Using pictures, diagrams, and coordinates in geometry material could develop students' mathematical reasoning and critical thinking abilities[33] |
| (Kaplar et al., 2022) | Students in classes that use interactive learning materials have a higher level of success in mathematical reasoning[34] |

[26] Nining, Penerapan Model Creative Problem Solving untuk Meningkatkan Penalaran Matematika. Pedagogik, 7(1) (2019), 32–41
[27] Happy Prawitasari Nourmaningtyas and Others
[28] Gofur Ahmad and Others, Mathematical Reasoning Ability of Grade IV Elementary School Students on Polygon Materials. Thinking Skills and Creativity Journal, 4(2) (2021), 62–67
[29] Nur Anisyah Rachmaningtyas and Others, Classification of Mathematical Reasoning Competencies based on Mathematical Problem Solving in Elementary School. Journal of Applied Physics, 2268(1) (2020), 1–6
[30] Dámaso Miguel Vera Sáez-Benito and Alberto Arnal-Bailera, Working with Patterns Through Cess-Based Problems. Strategies and Reasoning Levels of Primary School Students. *International Journal of Innovation in Science and Mathematics Education*, 30(2) (2022), 14–28
[31] Simone de Oliveira Andrade Silva and Sergio Vasconcelos de Luna, *Correlacao entre o Raciocinio Logico e o Raciocinio Matematico em Criancas Escolanrizadas. Bolema, Rio Claro*, 33(65) (2019), 1047–1066
[32] Samuel Obara, Pre-service Teachers Exploring the Role of Pattern-based Reasoning in the Context of Algebraic Thinking. *EURASIA Journal of Mathematics, Science and Technology Education*, 15(11) (2019), 1–16
[33] Rosdiana and Others, Pre-service elementary school teachers' reasoning profile in solving geometry problems based on mathematics ability. *Journal of Physics*, 1752(1), 1–5
[34] Marija Kaplar and Others

| | |
|---|---|
| (Nuraeni et al., 2019) | Implementation of the Predict-Observe-Explain (POE) learning model could improve the reasoning abilities of fifth-grade students at SDN Anggrawati[35] |

The ability to "do mathematics" has a significant impact on students' understanding of other scientific disciplines because it is the queen and mother of science[36]. Mathematics is knowledge that is structured hierarchically[37]. This means that students must understand previous knowledge to be able to understand the new knowledge. One of the tendencies that makes students not understand mathematical concepts is a lack of reasoning abilities[38]. Based on the research results above, it was found that the mathematical reasoning abilities of elementary school students are generally still low. Low mathematical reasoning will hinder students' problem-solving abilities and self-confidence in learning mathematics. It was also found that students with low mathematical reasoning abilities also tend to have difficulty arguing and carrying out mathematical calculations using formulas or postulates. Therefore, reasoning abilities need to be given from an early age[39]. The teachers could start it in a simple and more meaningful way adapted to the characteristics of the students, which then later could be such as reasoning abilities, customs, or habits.

The leading cause of low mathematical reasoning abilities is not training students to think non-routinely[40]. Other causes, as have been discussed in the studies above, include not discussing various strategies in formulating answers to problems, not memorizing multiplications, poor memory, embedding concepts that are still abstract, and tend to rely on a system of "remembering concepts", approaches/models/ Passive learning methods that are not varied and do not suit the characteristics of the material and students. The following solutions have been proven to improve students' mathematical reasoning abilities:

1. Use the PMRI/RME method, for instance, in geometry and fractions.
2. utilizing cutting-edge learning methods like the open learning model, the CORE model, the OSCAR model, the POE model, Problem Based Learning model utilizing a chess board, for example in mathematics fractions and geometry
3. Using differentiated learning methods, for example in geometry material
4. Develop open-ended based teaching material products, for example geometry and measurement materials or interactive teaching materials
5. Train students to work on cognition-based non-routine questions

[35] Nina Nuraeni and Others, Implementasi Model Pembelajaran Predict-Observe-Explain (POE) dalam Meningkatkan Kemampuan Penalaran Matematika Siswa Sekolah Dasar. *Jurnal Educatio FKIP UNMA*, 5(1) (2019), 1–11.
[36] Novita Ainurrohmah and Neni Mariana, Refleksi Kritis terhadap Pandangan Matematika dari Perspektif Siswa dan Pendidik Sekolah Dasar, *JPGSD*, 6(10) (2018), 1706-1717
[37] Budi Febriyanto and Others, Peningkatan Pemahaman Konsep Matematis Melalui Penggunaan Media Kantong Bergambar pada Materi Perkalian Bilangan di Kelas III Sekolah Dasar. *Jurnal Ckarawala Pendas*, 4 (2018), 32–44
[38] Constanta Olteanu, Programming, mathematical reasoning and sensemaking. *International Journal of Mathematical Education in Science and Technology*, 53(8), 2046–2064
[39] Mohammad Archi Maulyda (2019). Paradigma Pembelajaran Matematika Berbasis NCTM. CV IRD
[40] Barep Yohanes and Others, Penalaran Induktif Siswa Sekolah Dasar dalam Menyelesaikan Masalah Keterbagian Bilangan Bulat. SIGMA, 8(2), 84–93

6. Presenting mathematical material with the help of certain tools such as pictures, diagrams and coordinates,

The learning design chosen must be adjusted to the level of students' thinking and reasoning abilities. In fact, every student has different reasoning abilities[41]. The classification of mathematical reasoning is divided into three parts according to the level of mathematical problem-solving ability: high, medium and low. The main characteristic that differentiates students with above-average reasoning abilities from those below average lies in their ability in procedural solving and mathematical calculations. Students with good reasoning abilities will be able to solve mathematical problems according to procedures and respond appropriately. Students with moderate reasoning abilities generally could solve mathematical problems, but with calculations that are not always accurate. Meanwhile, those with low mathematical reasoning abilities are generally unable to solve mathematical problems and calculations. In addition, several studies show that the increase in mathematical reasoning abilities in students with high initial mathematical reasoning abilities tends to be more significant than in students with low to moderate reasoning abilities. In other research, information was also obtained that gender also represents students' reasoning abilities. Female students are proven to have better reasoning abilities than males.

## CONCLUSION

Topics related to mathematical reasoning abilities in elementary schools have rarely been researched in the last five years. The most published subtopics are related to the type of description of characteristics and mathematical reasoning abilities mapping. In contrast, those related to teaching methods and materials are still small in number. This topic has been published several times in Scopus-indexed journals. In the Sinta database, many studies related to this topic have been published in Sinta 3 journals, while none are in Sinta 1, 2, and 6 journals. The majority of research uses quantitative research and a few use developmental and classroom action research. The material that is most researched is about geometry, while the least researched material is fractions and algebra. This can be taken into consideration by future researchers to carry out development research related to mathematical reasoning in fractions and algebra material. The reason is because understanding and reasoning of mathematic regarding fractions in elementary school really determines students' success in solving mathematical problems. Meanwhile, in algebra material, although it is generally taught in junior high school, algebraic reasoning could be introduced at the elementary school level as well.

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