

Analysis of Mathematical Reasoning Ability of Elementary School Students on LCM and GCD Material

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Keywords

Mathematical
Reasoning
Ability Elementary School
LCM and GCD

Abstract

Reasoning ability is an effort to draw conclusions based on existing data, processes, or suitability. This ability is very basic for students in solving problems. The purpose of this study was to identify the causes of low reasoning abilities among fifth-grade elementary school students regarding the topics of Least Common Multiple (LCM) and Greatest Common Divisor (GCD). This study employed a Systematic Literature Review (SLR) as the research method and a Narrative Literature Review (NLR) as the data collection technique. Data collection was carried out by reviewing articles with publications in the last 5 years (2020–2025) and have been indexed by Google Scholar. The results of the study indicated that the causes of students' low reasoning ability are divided into two categories: internal and external factors. Internal factors include 1) understanding the concepts of KPK and FPB; 2) the ability to read and perform arithmetic operations; 3) accuracy and perseverance; and 4) learning motivation. While external factors include 1) learning models; 2) teaching materials; and 3) evaluation of learning used.

1. Introduction

Mathematics is a science that is studied from elementary school to higher levels (Sugiati, M. Zainuddin, & Yuniawatika, 2019). Mathematics learning has complex, structured characteristics, has a regular pattern, and the materials are interrelated (Danuri & Nurjanah, 2022). These characteristics aim to enable learners to develop problem solving, reasoning and evidence, communication, connection and representation of learners (NCTM, 2000). Therefore, students say math is a difficult science to learn. Studying mathematics requires a reasoning process to describe mathematical concepts, solve mathematical patterns, and make conclusions (Riswari, Hanifah, & Ramadhan, 2024). This makes the ability to reason very important to exist and be developed by every learner (Wahyuni et al., 2020).

Mathematical reasoning ability is the ability of learners to process information, find patterns, and draw logical conclusions based on data or relationships between concepts (Sinaga & Surya, 2023). According to NCTM (2000), this ability includes problem solving through models, facts, mathematical properties, and interrelationships of mathematical ideas. Indicators of good reasoning include the ability to express ideas, make decisions, and solve problems appropriately as well as understand and explain solutions through relevant patterns or relationships. However, based on the OECD report (2022), Indonesia's mathematics literacy PISA score decreased from 379 in 2018 to 366 in 2022. This decrease shows that the reasoning ability of students in Indonesia still needs to be improved.

One of the topics in mathematics that requires logical reasoning is Least Common Multiple (LCM) and Greatest Common Divisor (GCD). This material is a development of the concepts of factors and multiples, and is often applied in everyday situations. LCM is used to determine schedules, while GCD helps in dividing things evenly. LCM and GCD problems are generally in the form of stories that require understanding and critical thinking. However, many students have difficulty in understanding and solving them, mainly due to a lack of mastery of basic concepts and analytical reading skills.

Students' reasoning skills will appear when they work on math problems based on reasoning or problem solving (Zaenab, 2020). In line with previous research, by Riswari, et al (2024) problems are seen when students work on reasoning problems, some of the difficulties experienced by students are 1) a weak understanding of LCM and GCD has an impact on the inability to solve problems correctly; 2) the ability to perform multiplication and division arithmetic operations is still undeveloped; 3) students admit that they are hesitant in answering questions so that they have difficulty writing the stages of problem solving completely, 4) difficulty in describing the final answer or drawing conclusions.

In addition to the internal factors mentioned, there are several external factors that cause the low reasoning ability of students. According to research by Wijayanto, et al (2020) stated that learning models, teaching materials, and learning evaluations influence the mathematics learning process. Teachers' dependence on lecture, question and answer, and assignment methods based on textbooks causes students to tend to be passive in the learning process, thus inhibiting the development of critical thinking and mathematical reasoning skills. So that students' mathematical reasoning skills cannot develop. Teaching materials that do not cover all material and learning evaluations that are less valid and reliable will make learning less effective and efficient in achieving learning objectives (Widianingrum et al, 2020; Hanah et al, 2023).

Based on the problems identified from previous studies, it is known that the mathematical reasoning ability of students, especially in understanding the concepts of LCM and GCD, is still at a low level. This is characterized by the difficulty of students in solving story problems that require them to relate concepts to each other and apply them in real situations. Therefore, this study aims to describe more deeply and accurately the condition of the reasoning ability of elementary school students in learning mathematics, especially in the material of LCM and GCD.

2. Method

This research uses the Systematic Literature Review (SLR) method with the Narrative Literature Review (NLR) technique. Baumeister & Leary argue that narrative literature review is a technique for compiling scientific papers by analyzing data obtained from a collection of relevant articles. This research focuses on analyzing articles related to the causes of students' low mathematical abilities in terms of reasoning on the LCM and GCD materials. The data collection process was carried out using Google Scholar and Publish or Perish to collect articles with topics relevant to the research. Articles that will be used as analytical material must meet several criteria, including.

Table 1. Article Submission Criteria

No	Criteria
1.	Google scholar indexed articles
2.	Articles in accordance with the topic of discussion
3.	Articles published in the last 5 years (2020-2025)
4.	The sample used elementary school students
5.	Variable x is mathematical reasoning ability and variable y is LCM and GCD material.

The article screening process in this study was guided by the inclusion criteria outlined in Table 1. Selected articles had to meet five key requirements: (1) indexed in *Google Scholar*, (2) aligned with the topic of discussion, (3) published within the last five years (2020–2025), (4) involving elementary school students as research subjects, and (5) featuring variable x as mathematical reasoning ability and variable y as LCM and GCD material. The identification, screening, and inclusion of articles followed the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) framework, which includes stages such as initial identification, screening based on title and abstract, duplication checks, and full-text eligibility assessment.

Based on the results of the selection of several articles, 7 articles were collected which will be reviewed to produce a discussion that is relevant to the research objectives. The review of articles is carried out in accordance with the technique according to Frandsen, Sorensen, & Anne (2021) which is divided into two, namely the first stage of data collection by selecting titles, viewing article publications, and reading abstracts to determine the relevance of articles to research objectives. The second stage is the review process, after the article meets the criteria

the article can be read in its entirety.

After passing the selection process, articles were coded based on three main categories: research title, grade level of subjects (Grade IV, V, or VI), and research findings. This coding system aimed to facilitate information organization and thematic synthesis. For instance, an article focusing on fourth-grade students' difficulties in understanding word problems in LCM would be coded differently from an article on sixth-grade students' evaluation performance. This process enabled the researchers to identify common patterns and notable differences in the internal and external factors influencing students' mathematical reasoning abilities related to the selected topic.

3. Results and Discussion

Based on the results of the literature review of previous research on students' mathematical reasoning, an overview is obtained that can be used to answer the research objectives. This research uses articles as samples. The following is an overall description of the subject and research results.

Table 2. List of Research Articles

No.	Article Source	Research Subject	Research Results
1.	Danuri dan Eka Nurjanah (2022)	Class V	The mathematical reasoning ability of students is still low based on the test results of 45.45% who scored below the sufficient criteria.
2.	Lovika Ardana Riswari, Nur Hanifah, dan Muhammad Gilang Ramadhan (2024)	Class IV	The results showed that there were 7 students with high criteria, 8 students with medium criteria, and 5 students with low criteria.
3.	Ambar Widianingrum, Joko Sulianto, dan Rahmat Rais (2020)	Class IV	Based on the research results obtained from distributing questionnaires, it can be seen that there are still many students who score below the average.
4.	Kharisma Ardhy Wijayanto, Budiyono, dan Imam Sujadi (2020)	Class V	The results obtained data that students did not understand the concept of LCM and GCD with an average test score of only 5.15.
5.	Marisa Puspa Hanan, Rahmi Raudhatul, Jesi Alexander Alim (2023)	Class V	The results showed that most students had done the LCM and GCD story problems well. However, it is still difficult to determine the problem with the LCM or GCD formula.
6.	Oliv Via Ani Ramadhana, Nala 'Ariikah, dan Nor Hidayah (2024)	Class VI	The results of the study obtained data that there were 4 students who had low reasoning skills, as evidenced by their inability to solve reasoning-based math problems.
7.	Aam Amaliyah, Dini Damayanti, Siti Anisa Erika, dan Ummi Latifah (2022)	Class IV	The results showed that students' problem solving skills were still low. This can be seen from the results of working on the LCM fan GCD story problem which is still not correct.

Based on the literature review, the concepts of LCM and GCD are introduced to students as early as grade IV and continue to be developed until grade VI. However, many students still experience difficulties in understanding and solving problems related to the material. This is due to the complexity of the concept which involves mixed counting operations and requires higher-order thinking skills, especially mathematical reasoning. Factors causing this difficulty can come from internal aspects, such as interest and motivation to learn, as well as external aspects, such as unsupportive learning approaches and the mismatch of the problem context with students' daily experiences. Therefore, it is important to analyze relevant articles to identify these factors in more depth in an effort to improve students' understanding and mathematical reasoning skills in the topic of LCM and GCD.

3.1. Internal Factors

Internal factors are factors that come from oneself that cannot be influenced by others (Jayanti, Arifin, & Nur, 2020). The cause of low mathematical reasoning ability can be reviewed by internal factors based on mathematical reasoning indicators. In line with OECD (2020), there are three indicators of mathematical reasoning, namely formulate, apply, and interpret and evaluate. The results of the theoretical study are as follows.

3.1.1. Formulate

According to OECD (2023) formulate is a person's ability to see and observe to apply mathematical concepts as a tool in analyzing, organizing, and solving problems. LCM and GCD

material is very close to the routine of students. So that in solving it, students can imagine the story in the problem as an event about the students' routine. This process requires reasoning skills and understanding of existing problems (Sholikhah & Chamidah, 2022).

In reality, many students still struggle to understand mathematical problems presented in story form, as they are unable to distinguish between informational and interrogative statements within the text (Ramadhana, 'Ariikah, & Hidayah, 2024). This difficulty stems not only from limited comprehension skills but also from the absence of structured reading strategies that help students break down problem narratives. Often, learners do not recognize the importance of identifying known data, required operations, or the ultimate goal of the question.

Instead of engaging in active problem analysis, many students skip critical steps such as highlighting key terms or restating the problem in their own words. As noted by Amaliyah, Damayanti, Erika, & Latifah (2022), this lack of curiosity and motivation leads students to resort to copying answers from peers rather than trying to solve the problems independently. This behavior is further reinforced by a negative attitude toward mathematics, as many students perceive the subject as inherently difficult, abstract, and disconnected from their daily experiences. Without a shift in both mindset and instructional approach, students will remain disengaged from the foundational reasoning processes needed for successful problem-solving.

3.1.2. Employ

Employ can be interpreted as a person's ability to apply mathematical concepts, facts, procedures, and reasoning when the process of solving problems (OECD, 2023). Learners use the ability to reason to connect information that has been written in the previous stage with the appropriate solution and make arguments based on the results that have been found (Sholikhah & Chamidah, 2022).

The data indicates that the majority of students are still unable to write down problem-solving steps using the correct formulas and procedures. Many students struggle to identify the type of problem they are facing, resulting in confusion when selecting formulas—such as using the LCM formula to solve GCD problems and vice versa (Asdarina & Ridha, 2020). These errors go beyond misapplication of formulas and extend to the omission of essential steps like prime factorization, which is fundamental in solving LCM and GCD problems. Additionally, students often fail to distinguish between informational and interrogative statements, which further hampers their understanding of the problem.

One of the main reasons for this is that many students are not yet fluent in reading and lack mastery of basic arithmetic operations such as multiplication and division (Riswari et al., 2024). Another contributing factor is the tendency of students to pay little attention to the teacher's explanations and rely solely on following worked examples without truly understanding them. As a result, they are unable to solve problems when presented with different formats or contexts (Meilani & Maspupah, 2020). Altogether, this reflects a significant weakness in both conceptual understanding and procedural application, which are critical components of the employ stage in mathematical reasoning.

3.1.3. Interpret and Evaluate

Interpret and evaluate is defined as the ability of a person to make ideas from mathematical solutions and results that have been found (OECD, 2023). Then from the solution obtained, it can be checked again regarding the suitability of the results obtained (Utamaningsih & Subanji, 2021). The conclusion can be interpreted in the context of daily life problems.

In practice, many students struggle to generate final ideas or conclusions that align with the demands of the problem, particularly at the evaluate stage of mathematical reasoning. This difficulty often stems from errors made in earlier stages—such as misunderstanding the problem or applying incorrect procedures—which then carry over into the final step (Ramadhana, 'Ariikah, & Hidayah 2024). As Gultom & Roesdiana (2019) explain, students who cannot formulate logical conclusions based on their own calculations fall into the category of errors in constructing final answers.

This issue is frequently exacerbated by students' tendency to skip the critical step of re-examining their work, failing to check whether the result makes sense in the context of the problem (Ramadhana, 'Ariikah, & Hidayah, 2024). Moreover, some students work too hastily, prioritizing speed over accuracy, which leads them to overlook mistakes and miss opportunities to reflect on their reasoning (Ariani, 2020). These patterns indicate that many students lack habits of reflective thinking and verification—skills that are essential for ensuring that mathematical solutions are not only procedurally correct but also contextually appropriate.

Most studies indicate that the most dominant errors occur during the employ stage, where students are expected to apply mathematical concepts, procedures, and facts to solve problems, as highlighted by Danuri & Nurjanah (2022) and Wijayanto et al. (2020). These studies found that students often confused the use of LCM and GCD formulas, failed to perform prime factorization, and struggled to connect problem information with appropriate solution strategies. This suggests that although students may grasp the problem superficially (formulate stage), they lack the ability to operationalize their knowledge logically and systematically. However, this finding does not fully align with the study by Ramadhana, 'Ariikah, & Hidayah (2024), which revealed that the most frequent errors occurred at the formulate stage, where students struggled to identify key information in word problems, differentiate between given data and questions, and relate the problem context to relevant mathematical concepts. This contrast indicates that reasoning errors may emerge at different stages depending on student characteristics and learning environments, highlighting the need for teachers to conduct a comprehensive diagnosis of students' thinking processes rather than focusing solely on final answers.

3.2. External Factors

External factors are factors that come from outside (Jayanti, Arifin, & Nur, 2020). The cause of low reasoning ability can be influenced by the learning provided by the teacher, including the learning model, teaching materials, and evaluation tests given. The following are the results of the theoretical study.

3.2.1. Learning Model

According to Kemp & Dayton (1995), a learning model is a series of activities that are systematically designed to achieve learning objectives effectively and efficiently. There are various types of learning models that can be adjusted to the conditions of the learners and the objectives to be achieved. However, based on research by Wijayanto, Budiyo, & Sujadi (2020), the learning approach generally used by teachers is still direct and dominated by lecture, discussion, and assignment methods, so learning tends to be teacher-centered. As a result, students become less active in the learning process and their reasoning skills are not optimally developed, because they only follow the pattern set by the teacher in solving problems.

Therefore, research by Wijayanto, Budiyo, & Sujadi (2020) provides an alternative in the form of applying the TGT (Teams Games Tournament) and TAI (Team Assisted Individualization) models. Both learning models are effective in improving learning outcomes, mathematical logic intelligence, especially mathematical reasoning ability. Both learning models also show higher effectiveness in improving learning achievement than the direct learning model.

3.2.2. Teaching Materials

Teaching materials according to Kosasih (2021) are materials that cover aspects of knowledge, skills, and attitudes that must be achieved by students. The form of teaching materials varies, such as books, food, photos, impressions, and live conversations. However, in reality, the results of research by Widianingrum, Sulianto, & Rais (2020) show that there are obstacles regarding mathematics teaching materials that have not been able to motivate students to be interested in LCM and GCD material. Existing teaching materials still do not cover all material, have not been able to improve students' reasoning skills, and limited infrastructure. This affects the learning outcomes of students, the majority of which are still below average.

3.2.3. Learning Evaluation

Evaluation is an activity carried out to find out, collect, determine and make decisions on the level of achievement of learning objectives (Akhmadi, 2021). Evaluation is applied to evaluate the success of the learning process that has been carried out and improve the quality of learning in the future (Aini, M, & Basith, 2023). So that the teacher's role in the evaluation process is as an evaluator. Evaluation questions that are not valid and reliable will have an impact on less effective learning.

In line with the research of Lestari & Nahdataeni (2022); Khairiyah (2020); and Salamah & Ginting (2020), there are still many students who experience concept errors, low understanding, and poor reasoning skills in mathematics subjects, especially in LCM and GCD material, with a percentage of 48.52% of students still making concept errors. This is thought to be caused by the lack of giving evaluation questions in the form of stories, so that students are more accustomed to problems that directly present questions, making them miss the reasoning process that is important to understand the context of the problem in depth.

Therefore, research by Hanan, Jannah, & Alimm (2023) provides an alternative solution that learning evaluations are in the form of story problems. The effort was taken to facilitate students' learning needs according to their abilities and characteristics, and to develop their cognitive aspects.

3.3. Conclusion

Based on the results of a literature review conducted through narrative literature review techniques. The mathematical reasoning ability of students in learning mathematics, especially in the KPK and FPB material, is still at a low level. This phenomenon is influenced by a number of factors, both internal and external. Internal factors include 1) in-depth concepts of LCM and GCD; 2) limited ability to read problems and perform basic arithmetic operations; 3) low accuracy and perseverance in the process of solving problems; and 4) minimal motivation to learn. The external factors involve 1) learning models that tend to be conventional and teacher-centered; 2) teaching materials that have not been fully designed to develop higher order thinking skills; and 3) evaluation strategies that focus more on aspects of memory or memorization than on measuring the ability to reason logically and systematically.

Author Contributions

Imelda Relig Putri Rahmatika: Conceptualization, Methodology, Writing – original draft. Yuniawatika: Title selection, Writing – review and editing. Erif Ahdhianto: Methodology, Data curation, Software.

Funding

No funding support was received.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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