

Literature Review on the Relationship between Proportional Ability and Mathematical Analytical Thinking Ability in Mathematics Learning

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ABSTRACT

This study aims to examine the relationship between the ability of proportional reasoning and the mathematical analytical thinking ability of students. This type of research is a literature study with a qualitative approach that analyzes various academic sources in the form of relevant scientific journals, books, and conference articles. Data collection techniques include identification, selection, conceptual exploration, and critical analysis, while data analysis techniques include data coding, interpretation of findings, and drawing conclusions. The results show that proportional reasoning helps students understand the relationship of ratio and comparison multiplicatively, while analytical thinking allows students to break down complex problems into simpler parts, identify relationships between components, and draw conclusions systematically. The relationship between the two lies in the analytical cognitive process, where proportional reasoning involves reasoning about the overall relationship between two rational statements such as values, ratios, divided outcomes, and fractions that require analytical understanding and high problem-solving skills. such as the ability to think critically, creatively, collaboratively, and independently learn. The integration of these two abilities provides an effective solution to develop students' high-level thinking skills in mathematics learning.

Keywords: *Literature Studies, Proportional Reasoning Skills, Analytical Thinking Skills.*

1) INTRODUCTION

Education is a means of developing knowledge. According to Monk & Pangkey (2024) Education is a fundamental element in the development of a nation because it functions to prepare a generation that is able to think critically, creatively, and adaptively to global changes. Fitriani et al. (2022) emphasizing that education must and can foster students' thinking skills as the core of 21st century learning. Through education, individuals are not only equipped with academic skills, but also the ability to think and reason logically in order to adapt to social changes (Hakim, 2023). In the world of education, mathematics is one of the core subjects in the independent curriculum.

Mathematics plays an important role in developing logical, critical, and analytical thinking skills (cognitive domain), fostering diligence, research, and confidence in facing challenges (affective

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domain), and practicing the skill of applying concepts in real life in problem solving through exploratory activities (psychomotor domain) (Simanjuntak & Murniarti, 2024). Mathematics learning is directed to cultivate deep thinking skills through mastery of proportional reasoning and mathematical analytical thinking. These two abilities play an important role in helping students understand the relationships between concepts, formulate logical arguments, and interpret and evaluate information mathematically (Rahman et al., 2023; Mahyastuti et al., 2020). Therefore, in learning mathematics, these two abilities are very important to be realized.

Proportional reasoning allows learners to recognize the relationship of ratio, scale, and comparison in a variety of situations, both numerical and contextual (Hidayati, 2023). According to Yuliani et al. (2021) This ability is not only the basis for understanding various mathematical concepts, but it is also an important foundation for mastering more complex thinking skills. Students who have good proportional reasoning tend to be better able to recognize patterns of relationships between variables, estimate outcomes reasonably, and implement efficient completion strategies (Fadilla & Siswono, 2022). The process encourages learners to analyze the relationships between variables and make rational mathematical decisions, which ultimately strengthens analytical thinking and problem-solving skills (Dassa et al., 2022).

However, facts on the ground show that the proportional reasoning skills of junior high school students still need to be improved. Research conducted by Yuliani et al. (2021) explained that the students' proportional reasoning ability only reached 48,46%, which indicates that most students are not able to understand proportional relationships well. Widayanti et al. (2020) It was also found that the proportional reasoning of students had not reached the minimum standard of completeness in the comparative material. Furthermore, mathematical analytical thinking skills are also important skills in mathematics learning.

Mathematical analytical thinking skills are a person's ability to break down a problem into simpler parts, identify the relationships between components, and draw conclusions based on logic and existing evidence (Daulay et al., 2025). In the context of mathematics learning, this ability helps students to understand concepts in depth, find connections between ideas, and assess the accuracy of a procedure or problem-solving outcome. This makes analytical thinking skills an important foundation in building conceptual understanding and meaningful problem-solving skills (Mahbub &

Sulistiyorini, 2025; Wagola & Mataheru, 2023). Therefore, analytical thinking skills can develop students' problem-solving and conceptual skills.

Students who have good analytical thinking skills tend to understand abstract concepts more easily because they are able to connect ideas, principles, and procedures logically (Mahbub & Sulistiyorini, 2025). They can Simplify complex problems into more manageable parts, then develop a systematic solution strategy and evaluate the learning outcomes (Wang et al., 2025). Opinion Mahbub & Sulistiyorini (2025) which states that analytical thinking skills can improve students' high-level thinking skills so that they can develop their own abilities.

However, facts in the field show that students' analytical thinking skills still need to be improved. The results of the research conducted by Mahyastuti et al. (2020) revealed that junior high school students in grade VII who were tested in solving mathematical problems were not able to solve problems perfectly. The results of the research conducted by Listiani et al. (2025) It shows that the analytical thinking skills of students are at a low criterion with an average percentage of 59.60%. The low ability of students to reason in proportion and mathematical analytical thinking is largely due to learning models and approaches that lack emphasis on the development of these abilities. The learning activities that are implemented also have minimal discussion and reflection, thus limiting the opportunity for students to develop their abilities (Solihah et al., 2021); Mahyastuti et al., 2020). Based on this, there is a need for a study of literature that discusses holistically the relationship between proportional ability and mathematical analytical thinking skills of students. It is hoped that this study can contribute to an in-depth literature review on the aspects of students' proportional ability and analytical thinking ability.

2) METHODS

This research applies a qualitative approach with the type of literature study research. Literature study is an activity carried out by reading and recording the results of the collection of literature data and managing it into research material (Hamin et al., 2025). The selection of literature studies allows for an in-depth analysis of academic sources that are relevant to the problem being studied, namely the relationship between proportional reasoning skills and analytical thinking skills. Data sources in this study include scientific journals, as well as books that discuss the ability to reason, and analytical thinking skills, as well as scientific conference articles. The data collection techniques used are identification, selection, conceptual exploration, and critical analysis. The data analysis techniques used

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include data coding by grouping information from various sources into main themes, interpretation of findings by compiling the results of the analysis proposed in the literature, and finally compiling conclusions.

3) RESULTS AND DISCUSSION

a. Proportional Reasoning Ability

Proportional reasoning skills are important for students to master because they are the basis for understanding various mathematical concepts (Rahman et al., 2023). Proportional reasoning skills can also be interpreted as the ability to think relatively to understand, analyze, and explain the relationship between two quantities or quantities that are proportional to each other, Not just using mathematical procedures such as cross-multiplication. These skills include thinking about ratios, comparisons, and proportional changes, as well as developing through a gradual and in-depth learning process (Mardika & Mahmudi, 2021).

This ability includes thinking about relationships and comparisons between quantities in a way that relative (multiplication), not in a way that absolute (summation), and is an important basis in understanding mathematical concepts such as comparison, ratio, and proportion (Izzatin, 2022). This is in line with the opinion Sari et al. (2023) that Proportional reasoning ability is defined as the mental activity of understanding the relationship between one quantity and another through multiplicative relationships and is used to solve problems involving comparison or proportion. Proportional reasoning is an important basis for understanding mathematical relationships involving balanced changes between variables (Khasawneh et al., 2022). Proportional reasoning is an important form of mathematical thinking in everyday life because it helps individuals make logical and appropriate decisions when faced with situations involving comparisons or ratios (Gündoğdu & Tunç, 2022).

So Proportional reasoning skills be the ability to think, analyze, and explain the relationship between two or more multiple-dependent quantities. Indicators of proportional reasoning ability according to Cramer et al., (1993) in Lutfi et al. (2024) It consists of (1) the ability to understand the mathematical relationships contained in proportional or multiplication problems, (2) the ability to solve missing value problems in direct proportion, (3) the ability to solve numerical comparison problems, (4) the ability to solve qualitative prediction problems, (5) the ability to distinguish between proportional and non-proportional problems, and (6) the ability to solve lost value problems in inverse proportion. The role of proportional reasoning skills for students is as the basis for understanding

advanced mathematics concepts. The importance of this ability is due to the concept of proportions being integrated in various aspects of mathematics such as ratios, percentages, scales, and linear equations. Thus, the ability to reason proportionally is the main foundation that supports students' mastery of advanced mathematical concepts (Mardika & Mahmudi, 2021).

According to Khasawneh et al. (2022) The role of proportional reasoning skills for students is as a means to understand various real-life phenomena, because many aspects of daily life take place following the rules of proportion, such as price comparison, profits, losses, and investments. Gündoğdu & Tunç (2022) Proportional reasoning skills not only help learners understand the mathematical relationship between two quantities, but also train them to analyze information rationally and systematically. Through proportional reasoning, learners can learn to recognize patterns, distinguish proportional and non-proportional situations, and draw conclusions based on valid quantitative relationships.

b. Analytical Thinking Skills

The ability to think mathematical analytically is an ability in the cognitive realm that integrates various stages ranging from the initial process, solution planning, solving implementation, to drawing conclusions, so that the right answer is obtained (Figoro et al., 2021). Analytical thinking skills include the ability to think deeply, understand information, outline problems, evaluate evidence, and generate reasoned ideas and conclusions (Wang et al., 2025). The ability to think mathematical analytically in the field of mathematics is related to process skills, namely the ability to solve a problem, perform various operational steps, and think in a structured and systematic manner in the context of scientific mathematics learning (Kamid et al., 2022). Analytical thinking also includes the ability to transform reality into abstract forms such as symbols, words, or numbers in order to be objectively analyzed (Qolfathiriyus et al., 2019). Analytical thinking includes activities such as Analyze, assess, compare, contrast, criticize, and evaluate information to gain a deep understanding and the right solution (Azizah et al., 2021). Thus, the ability to think mathematical analytically is complex and structured cognitive abilities, which involves the process of identifying, describing, analyzing, and understanding the relationships between elements in a mathematical problem logically and systematically.

Anderson et al (2001) in Azizah et al. (2021), mathematical analytical thinking ability can be identified through three main indicators, namely the ability to distinguish (differentiating),

Organizational skills (Organizing), and attributability (Attribution). This ability helps students to break down a problem into simpler parts, recognize patterns, relationships, and draw logical and systematic conclusions (Syaiful et al., 2021). Analytical thinking also trains students to reflect on their own way of thinking, evaluate mistakes, and correct them independently (Figoro et al., 2021). Analytical thinking stimulates a spirit of exploration and discovery, allowing learners to ask questions and discover mathematical patterns independently (Wang et al., 2025). The role of mathematical analytical thinking skills for students is very significant in the learning process. This ability encourages students to be more actively involved, think creatively, and be independent, as they are faced with the demands to analyze problems in depth and find various strategies. Mathematical analytical thinking not only strengthens students' academic mastery, but also equips them with 21st-century skills, such as problem-solving skills, creativity, collaboration, and independent learning (Kamid et al., 2022); Bircan et al., 2023).

c. The Relationship between Proportional Ability and Mathematical Analytic Thinking Ability

Proportional reasoning skills and mathematical analytical thinking skills are closely related in the context of mathematics learning, where they support each other in the development of students' cognitive competence. Proportional reasoning is defined as the ability to detect, analyze, analyze, explain, and provide evidence of proportional relationships that involve multiplicative thinking to measure quantity and predict the value of a quantity based on the value of another quantity (Izzatin, 2022). Meanwhile, mathematical analytical thinking is a crucial ability that involves two main abilities: deconstructing mathematical problems to assess their components and applying deep analysis to find the right solution, where students are able to break complex problems into smaller parts, reason logically, prove theorems, think abstractly, and apply mathematics to the analysis of real-life problems in modeling and data (Wang et al., 2025, 2025).

The relationship between the two lies in the cognitive processes that are analytical, where proportional reasoning involves reasoning about the overall relationship between two rational statements such as values, ratios, results shared, and fractions that require analytical understanding and high problem-solving abilities (Mardika & Mahmudi, 2021; Mahyastuti et al., 2020). Therefore, the development of proportional reasoning can simultaneously improve students' mathematical analytical thinking skills through systematic practice in identifying patterns, building logistical relationships, and implementing structured problem-solving strategies.

4) CONCLUSIONS

Based on the results of the literature review that has been conducted, it can be concluded that the ability to reason, proportional reasoning, and the ability to think mathematical analytically encourage the rational analysis of the relationship between variables, recognize proportional patterns, and build logical arguments based on mathematical evidence. Proportional reasoning skills and mathematical analytical thinking skills are two important interrelated skills in mathematics learning.

Proportional reasoning helps learners understand the relationship of ratio and comparison multiplicatively, while analytical thinking allows learners to break down complex problems into simpler parts, identify relationships between components, and draw conclusions systematically. The relationship between the two lies in the analytical cognitive process, where proportional reasoning involves reasoning about the overall relationship between two rational statements such as values, ratios, divided outcomes, and fractions that require analytical understanding and high problem-solving skills. such as the ability to think critically, creatively, collaboratively, and independently learn.

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