

Analysis of Fifth-Grade Students' Mathematical Connection Ability in Understanding Fraction Concepts

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Abstract. This study aims to analyze the mathematical connection ability of fifth-grade elementary school students in understanding fraction concepts. Mathematical connection ability is one of the essential aspects that should be developed from the elementary education level, as it enables students to recognize relationships among mathematical concepts and apply them meaningfully in real-life situations. The research employed a qualitative descriptive method, with data collected through a mathematical connection ability test, observations, and interviews. The test instrument was developed based on three main indicators of mathematical connection ability proposed by the National Council of Teachers of Mathematics (NCTM), namely: (1) the ability to connect mathematical concepts, (2) the ability to connect multiple mathematical representations, and (3) the ability to connect mathematical concepts to real-life situations. The research subjects consisted of 30 fifth-grade students from a public elementary school in Garut Regency. The results indicate that the indicator of connecting mathematical concepts achieved the highest percentage at 68.7% (moderate category), followed by the indicator of connecting representations at 65.4% (moderate category), while the indicator of connecting mathematics to everyday life reached only 42.1% (low category). These findings suggest that students are generally able to identify relationships among mathematical concepts but still experience difficulties in applying these concepts to real-life contexts. Therefore, more in-depth instructional reinforcement is required to help students develop a more meaningful and applicable understanding of the mathematical concepts they learn.

Keywords: mathematical connection ability, fractions, elementary school, qualitative descriptive research

INTRODUCTION

Mathematics is a discipline that plays an important role in developing logical, analytical, and systematic thinking skills. Through mathematics learning, students are not only required to understand concepts and procedures but also to meaningfully connect these concepts. Mathematical concepts are broad, interconnected, and hierarchically structured, forming a comprehensive and integrated body of knowledge.

To understand mathematics holistically, students need to possess mathematical connection ability, which refers to the ability to connect mathematical concepts across topics, with other disciplines, and with real-life contexts (Wahid et al., 2024). The National Council of Teachers of Mathematics (NCTM, 2000) emphasizes that mathematical connection ability includes the capacity to relate various mathematical ideas or concepts, understand the relationships among these concepts, and apply mathematics in real-world situations.

Mathematical connection ability plays an essential role in supporting meaningful mathematics learning. It enables students to develop a deeper and more durable understanding of mathematical concepts (Adjie et al., 2021). Students with strong mathematical connection ability are able to comprehend relationships among mathematical ideas and concepts holistically, allowing them to solve problems in more flexible and creative ways. According to Hendriana and Soemarmo (2014), mathematical connection ability serves as a foundation for deep conceptual understanding, as students do not merely memorize procedures but also understand the interrelationships among the concepts they learn.

Ni'mah et al. (2017) state that, in general, there are three indicators of mathematical connection ability: (1) identifying fundamental mathematical concepts; (2) describing relationships between objects and mathematical concepts; and (3) understanding real-life problems in the form of mathematical models. This is consistent with the view of the NCTM (2000), which classifies mathematical connections into two types: connections among mathematical concepts and connections between mathematical concepts and other disciplines or everyday life.

At the elementary school level, mathematical connection ability needs to be developed from an early stage so that students are able to recognize relationships among topics and apply them in everyday situations. However, various studies indicate that this ability remains relatively low. Students are often only able to solve routine problems without understanding the conceptual relationships underlying them and experience difficulties when applying mathematical concepts to real-life situations (Jaelani & Hidayati, 2021; Siregar & Surya, 2017; Rosita & Hidayat, 2021). Findings by Saminanto and Kartono (2015) show that students' ability to connect mathematical topics reached only a moderate level (55%), while connections to everyday life were classified as very low (2%).

One of the topics that frequently poses difficulties in developing mathematical connections is fractions. Fractions require students to connect multiple representations in order to fully understand their meaning. According to the NCTM (2000), understanding fractions involves the ability to recognize fractions in various forms of representation, such as images, concrete models, symbols, and real-life contexts. Students need to understand fractions not only as parts of a whole but also as quotients, numbers on a number line, ratios between two quantities, and operators used in comparison and proportion. A comprehensive understanding of these multiple meanings of fractions is an important foundation for mastering more complex mathematical concepts, such as decimals, percentages, and algebra.

Many students are able to perform fraction operations procedurally but do not yet understand the relationships among fractions, decimals, and percentages or their applications in everyday life (Fitri, 2023; Musriliani et al., 2015). Numerous studies indicate that fractions are one of the most challenging topics for elementary school students. These difficulties arise because fractions have multiple abstract conceptual meanings that are often not deeply understood by students (Lamon, 2012). In addition, students frequently struggle to connect fractions with other representations, such as decimals and percentages, even though these concepts are closely related and commonly used together in real-life contexts (Rosita & Hidayat, 2021).

These conditions indicate that mathematics learning in elementary schools still tends to focus on procedural completion and final results rather than on conceptual thinking processes and the interconnections among ideas. As a result, students experience difficulties in recognizing relationships among mathematical concepts and applying them to real-world situations. Therefore, an in-depth study is needed to analyze the extent to which students' mathematical connection ability has developed, particularly in the topic of fractions, which serves as a foundation for many mathematical topics at higher educational levels.

This study aims to analyze the mathematical connection ability of fifth-grade elementary school students in understanding fractions. The analysis focuses on three aspects of mathematical connection ability as proposed by the National Council of Teachers of Mathematics (NCTM): (1) the ability to connect mathematical concepts, (2) the ability to connect multiple mathematical representations, and (3) the ability to relate mathematical concepts to real-life situations. The results of this analysis are expected to provide empirical evidence regarding the profile of elementary students' mathematical connection ability and to serve as a basis for developing deeper and more contextual instructional strategies to enhance their mathematical understanding.

METHODOLOGY

This study employed a qualitative approach with a descriptive research design. Data analysis in qualitative research is conducted by systematically searching for and organizing data obtained from the field through processes of organizing, describing, synthesizing, identifying patterns, selecting relevant information, and drawing conclusions (Saleh, 2017). This approach was chosen because the research focuses on phenomena that are currently occurring and reflects present conditions. In qualitative research, the researcher serves as the

key instrument, playing a central role in determining the research focus, identifying and selecting data sources, conducting data collection, processing and analyzing data, and formulating conclusions.

The instruments used in this study included tests, observations, and interviews. The mathematical connection ability test was developed by the researcher in the form of essay questions on fraction concepts, designed based on indicators proposed by the National Council of Teachers of Mathematics (NCTM) and validated by experts. The research subjects consisted of 30 fifth-grade students from SDN 2 Sukahurip, Pangatikan District, Garut Regency. In addition, observations and interviews were conducted to obtain in-depth information directly from the participants.

The data collection procedure in this study consisted of the following steps: (1) students completed the mathematical connection ability test; (2) test results of students' mathematical connection ability were obtained; (3) task-based interviews were conducted to clarify and further explore students' mathematical connections in solving the given problems; (4) interview data were collected; (5) technique triangulation was applied to examine data credibility; and (6) data analysis was carried out by processing the data obtained from the research process in order to address the formulated research questions.

RESULTS AND DISCUSSION

RESULT

This study aims to analyze the mathematical connection ability of fifth-grade elementary school students in the topic of fractions. The test results obtained from 30 fifth-grade students indicate that students' mathematical connection abilities vary across several categories. Based on the average cognitive test scores, most students were classified in the moderate category (16 students or 53.3%), followed by the low category (12 students or 40%), while only 2 students (6.7%) reached the high category.

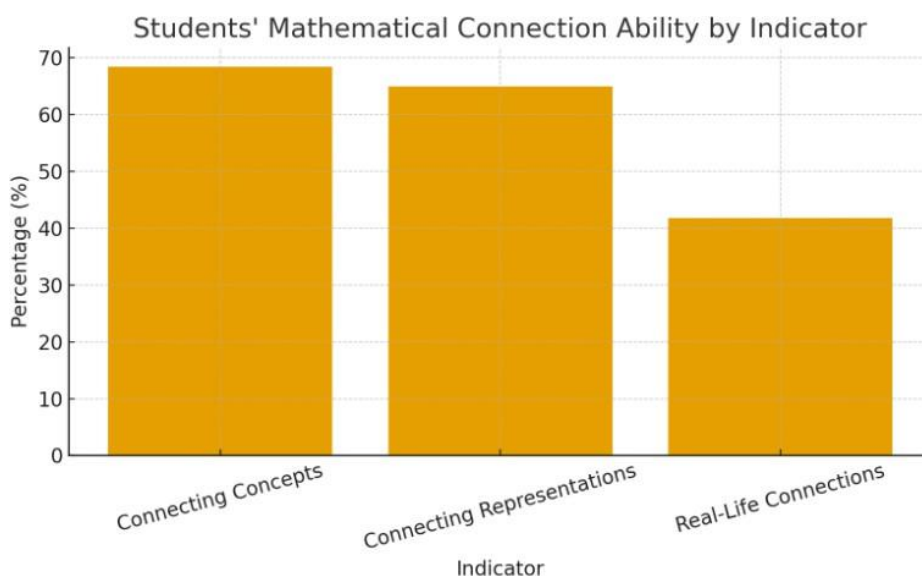
When classified according to each indicator, the results of the analysis are as follows:

Table 1. Distribution of Students Based on Mathematical Connection Ability Categories

No	Indicator of Mathematical Connection Ability (NCTM)	Percentage (%)	Category	Number of Students	Description
1	Connecting among mathematical concepts	68.4	Moderate	16	Students are fairly able to relate different mathematical concepts but still need support in deeper conceptual understanding.
2	Connecting various mathematical representations	64.9	Moderate	16	Students can link representations such as symbols, numbers, and diagrams, though not yet consistently.
3	Connecting mathematics with real-life situations	41.8	Low	12	Students still have difficulty applying mathematical concepts to real-world contexts.
	Overall Average	58.4	Moderate	30	Most students have an average level of mathematical connection ability, with notable weakness in real-life application.

When illustrated in graphical form, the percentages of students' mathematical connection abilities based on each indicator are as follows:

Figure 1.



Based on the graph above, the *Connecting Concepts* indicator shows the highest percentage (approximately 68–70%). This indicates that students are relatively capable of linking one mathematical concept to another, such as identifying relationships among topics or prerequisite concepts. From a pedagogical perspective, this suggests that students' internal conceptual understanding has been fairly well developed.

The *Connecting Representations* indicator is slightly lower than concept connections (approximately 63–65%). This implies that students are reasonably able to relate various mathematical representations, such as symbols, diagrams, tables, or models; however, some gaps remain. This finding highlights the need for explicit and consistent reinforcement of instruction that emphasizes multi-representational approaches.

In contrast, the *Real-Life Connections* indicator shows the lowest percentage (approximately 40–42%), with a considerable gap compared to the other two indicators. This provides strong evidence that students experience difficulties in applying mathematical concepts to everyday contexts or authentic situations.

These findings indicate that the majority of students fall within the moderate category, while a substantial number are classified in the low category. This condition suggests that although some students are able to understand problems and apply mathematical concepts effectively, many still encounter difficulties, particularly in connecting mathematical concepts to real-life situations.

A deeper examination of each indicator shows that students perform moderately well in connecting mathematical concepts (68.4%) and in linking different representations (64.9%). These results indicate that students have a basic level of conceptual understanding and can interpret mathematical ideas across various forms of representation. However, their understanding is not yet flexible or comprehensive, as difficulties remain in consistently transforming information from one representation to another.

The lowest achievement is found in the indicator related to connecting mathematical concepts with real-life contexts (41.8%), which falls into the low category. This reflects students' limited ability to apply mathematical ideas—particularly fractions—to everyday situations. Their understanding tends to remain theoretical rather than practical, making it difficult for them to recognize the functional use of fractions in daily activities.

DISCUSSION

The findings indicate that students' mathematical connection abilities in Grade V are varied and not yet fully optimal. Most students fall into the **medium** category, while a significant portion are still in the **low** category. This distribution suggests that although some students are able to understand problems and apply mathematical concepts effectively, many still experience difficulties, particularly in connecting mathematical ideas to real-life situations.

Overall, the average score of **58.4%** (lower bound of the medium category) indicates that although students possess foundational understanding, their mathematical connection ability is not yet well developed. The particularly low ability to link mathematics to real-life situations significantly affects the overall performance. Furthermore, the wide variation in students' abilities suggests the need for instructional approaches that are more adaptive, contextual, and designed to deepen conceptual comprehension.

Furthermore, interview results reveal that nearly all respondents were unable to answer the researcher's questions. The questions were designed to assess indicators of elementary students' mathematical connection ability, and none of the students were able to provide correct responses. These results underscore the urgency of implementing more innovative and in-depth instructional approaches to ensure that students' mathematical connection abilities develop in a more balanced manner—not only strong in internal connections (concepts and representations) but also relevant and applicable to real-life contexts.

CONCLUSION

The findings of this study indicate that the mathematical connection ability of fifth-grade students is still not well-developed and remains uneven across indicators. Although most students fall into the medium category, a considerable proportion still demonstrates low levels of ability. This suggests that while some students are able to understand problems and connect mathematical concepts to a certain extent, many continue to face significant challenges.

Overall, the average score of 58.4% places students in the lower range of the medium category. These results indicate that although students possess foundational mathematical knowledge, their ability to make meaningful mathematical connections has not yet developed optimally. The difficulty in relating mathematical concepts to real-life situations is the most prominent factor hindering their overall performance. Additionally, the wide variation in student abilities highlights the need for more adaptive, contextual, and conceptually oriented instructional strategies to strengthen students' mathematical connection abilities.

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