International Journal of Education, Culture, and Society

e-ISSN : 3024-8973
p-ISSN : 3024-8981

Index: Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/IJECS.v4i2.9840

Profile of Meaningful Learning in Mathematics among Elementary School Students on Number and Operations Topics

Yonathan S Pasinggi
Makassar State University, Indonesia
yonathan.saba@unm.ac.id

Article Info:

Submitted:	Revised:	Accepted:	Published:
Mar 16, 2026	Apr 13, 2026	Apr 25, 2026	Apr 30, 2026

Abstract

Meaningful learning is a crucial aspect of elementary mathematics instruction, particularly in number and operations topics, which serve as the foundation for further mathematical understanding. However, mathematics learning in elementary schools still tends to emphasize procedural skills and provides limited opportunities for students to connect mathematical concepts with real-life contexts, resulting in less meaningful understanding. This study aims to analyze the profile of meaningful learning in mathematics among elementary school students on number and operations topics. A descriptive method with a qualitative approach supported by quantitative data was employed. The research was conducted at SDN 50 Bonto Panno, Pangkep Regency, during October–November 2025, involving 25 fifth-grade students as research subjects. Data were collected through contextual-based tests on number and operations, a meaningful learning questionnaire, classroom observations, and documentation of students' work. Data were analyzed by categorizing students' meaningful learning based on indicators of conceptual understanding, connections to real-life experiences, and the ability to explain and reflect on mathematical concepts. The findings indicate that students' meaningful

IJECS Journal is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License

learning in mathematics was generally at a moderate level. Students demonstrated adequate procedural understanding of number operations but experienced difficulties in connecting mathematical concepts to contextual situations and verbally explaining the meaning of the concepts learned. These findings suggest that meaningful learning in elementary mathematics requires stronger integration of contextual, reflective, and student-centered instructional practices. This study contributes to elementary mathematics education by providing empirical insight into students' meaningful learning profiles and highlighting the need to improve instructional strategies that support conceptual understanding in number and operations topics.

Keywords: Meaningful Learning; Elementary Mathematics; Number And Operations; Contextual Learning; Conceptual Understanding

INTRODUCTION

Mathematics learning in elementary schools plays a fundamental role in developing students' logical, analytical, and systematic thinking skills from an early age. Mathematics is not merely a collection of computational procedures, but a means of fostering reasoning, problem solving, and the ability to interpret situations encountered in everyday life. Among the core topics in elementary mathematics, number and operations constitute a foundational domain, as these concepts underpin students' understanding of more advanced mathematical ideas at higher levels of education (Prastiyo et al., 2024). Despite their importance, mathematics learning in elementary schools continues to face significant challenges, particularly in promoting meaningful conceptual understanding rather than procedural proficiency alone (Kemendikbudristek, 2022).

At the global level, the results of the Programme for International Student Assessment (PISA) indicate that students' mathematical performance, especially in solving contextual and reasoning-based problems, remains below expected levels in many countries (Keguruan et al., 2022). These findings suggest that students often struggle to apply mathematical concepts flexibly in real-life situations. Similarly, at the national level, the implementation of Indonesia's *Asesmen Kompetensi Minimum* (AKM) has revealed that many elementary school students experience difficulties in understanding and applying mathematical concepts in meaningful ways, particularly in the domain of numbers and operations (Rittle-Johnson & Schneider, 2020). This condition highlights a gap between the intended goals of mathematics education—which emphasize understanding, reasoning, and

problem solving—and the actual classroom practices that tend to prioritize procedural mastery (Majid et al., 2020).

In response to this issue, the researcher argues that the core problem in elementary mathematics learning lies not only in low achievement outcomes but also in the limited meaningfulness of students' learning experiences (Andrews et al., 2023). Meaningful learning refers to a learning process in which new information is actively connected to learners' existing cognitive structures in a substantive and non-arbitrary manner. According to Ausubel's theory of meaningful learning, learning becomes meaningful when new concepts are integrated with prior knowledge through logical and relevant relationships (Silviyanti et al., 2023). In contemporary mathematics education, this perspective is reinforced by constructivist learning theories, which emphasize students' active role in constructing knowledge through meaningful experiences and reflection (National Council of Teachers of Mathematics (Islam et al., 2024).

Meaningful mathematics learning requires students not only to perform number operations correctly, but also to understand the meaning underlying these operations, to justify their reasoning, and to apply concepts in various real-life contexts (Sari & Prabawanto, 2020). However, recent studies indicate that elementary mathematics instruction remains predominantly teacher-centered, heavily focused on routine exercises, and provides limited opportunities for students to reflect on their understanding (Suryadi & Herman, 2018). As a result, students may succeed in executing algorithms yet encounter difficulties when solving contextual problems that demand conceptual understanding and mathematical reasoning (Rasmini & Antara, 2023).

Several previous studies have examined mathematics learning in elementary schools from different perspectives. Research by Sari and Prabawanto (Novita et al., 2021)found that elementary students' understanding of number concepts tends to remain at a procedural level, with limited conceptual depth. Other studies have demonstrated that contextual and realistic approaches to mathematics learning can improve students' conceptual understanding and engagement (Zulkardi et al., 2017). Furthermore, integrating real-life contexts into mathematics instruction has been shown to enhance students' ability to connect mathematical ideas with everyday experiences (Hiebert & Grouws, 2021).

Nevertheless, most of these studies primarily focus on measuring learning outcomes or evaluating the effectiveness of specific instructional models. There remains a lack of research that explicitly maps students' profiles of meaningful learning in

mathematics, particularly in the area of number and operations. Existing research often relies on test scores as indicators of success, without exploring how students construct meaning, relate concepts to their experiences, or reflect on their understanding (Widodo & Kartikasari, 2025). Moreover, comprehensive studies that integrate multiple indicators of meaningful learning—such as conceptual understanding, contextual connections, and reflective ability—within elementary school settings remain limited.

This study offers a novel contribution by presenting a comprehensive profile of meaningful learning in mathematics among elementary school students on number and operations topics (Yani et al., 2025). The novelty of this research lies in its holistic approach to analyzing meaningful learning, which goes beyond procedural competence to include students' conceptual understanding, their ability to connect mathematical ideas with real-life situations, and their capacity to explain and reflect on the concepts they have learned (Putra & Zulkardi, 2019). By adopting this approach, the study seeks to provide a deeper understanding of how students perceive and internalize mathematical concepts, rather than merely what they can calculate (Dewi & Surya, 2021).

The theoretical framework of this study is grounded in Ausubel's theory of meaningful learning, complemented by constructivist perspectives and contextual learning approaches in mathematics education (Can & Yetkin-Izdemir, 2020). In addition, this study aligns with current national education policies, particularly the *Merdeka Curriculum*, which emphasizes meaningful learning, conceptual understanding, and the development of reasoning and problem-solving skills (Kemendikbudristek, 2022). Through this theoretical and policy alignment, the study aims to contribute both theoretically and practically to the field of elementary mathematics education (Chang et al., 2020).

METHODS

Type of Research

This study employed a descriptive research approach with a qualitative orientation supported by quantitative data (qualitative-dominant mixed approach). The qualitative approach was used to explore in depth students' meaningful learning experiences in mathematics, particularly how they understand, interpret, and connect number and operations concepts with real-life contexts. Quantitative data were used to support the qualitative findings by describing the distribution of students' meaningful learning levels.

This approach is appropriate for studies aiming to construct a comprehensive profile of learning phenomena rather than to test causal relationships (Sugiyono, 2020a).

Research Design

The research adopted a descriptive case study design. This design was selected to allow an in-depth examination of meaningful learning in mathematics within a specific and bounded context, namely a single elementary school. The case study design enabled the researcher to capture the complexity of students' learning processes, classroom interactions, and contextual factors influencing meaningful learning in number and operations topics. The design aligns with the study's objective of describing students' meaningful learning profiles rather than measuring the effectiveness of an intervention (Sugiyono, 2020b).

Participants and Sampling Technique

The participants of this study were 25 fifth-grade students of SDN 50 Bonto Panno, Pangkep Regency, Indonesia. The selection of participants was based on purposive sampling, with the criteria that students had completed instruction on number and operations topics in the mathematics curriculum. Fifth-grade students were chosen because they have sufficient prior mathematical experience to demonstrate conceptual understanding, contextual application, and reflective thinking related to number and operations. The school was selected to represent a typical elementary school context at the local level, allowing for an in-depth exploration of meaningful learning phenomena (Sugiyono, 2020a).

Instruments and Data Collection Procedures

Data were collected using multiple instruments to ensure data triangulation and enhance the credibility of the findings (Sugiyono, 2020b). The instruments included:

1. Contextual Mathematics Test

A set of written test items focusing on number and operations was developed based on meaningful learning indicators. The test included both procedural and contextual problems designed to assess students' conceptual understanding and their ability to apply mathematical concepts in real-life situations.

2. Meaningful Learning Questionnaire

A questionnaire was administered to measure students' perceptions of their meaningful learning experiences. The questionnaire covered indicators such as conceptual understanding, connections to everyday experiences, and reflective learning. The

instrument was reviewed by mathematics education experts to ensure content validity and was pilot-tested to ensure clarity and reliability.

3. Classroom Observation

Non-participant observations were conducted during mathematics lessons to document teaching strategies, student engagement, and opportunities for meaningful learning. An observation checklist was used to guide data collection.

4. Documentation

Students' written work, lesson plans, and assessment records were collected and analyzed to support and validate data obtained from tests, questionnaires, and observations.

The research was conducted during October–November 2025. All data collection procedures were carried out with permission from the school and in accordance with ethical research standards.

Data Analysis Techniques

Data analysis was conducted using both qualitative and quantitative techniques. Quantitative data from the tests and questionnaires were analyzed descriptively to determine students' levels of meaningful learning, including the calculation of frequencies, percentages, and mean scores. These results were used to categorize students' meaningful learning into low, moderate, and high levels (Sugiyono, 2020b).

Qualitative data obtained from observations, open-ended questionnaire responses, interviews (if applicable), and documentation were analyzed using thematic analysis. The analysis followed three main steps: data reduction, data display, and conclusion drawing. Themes were identified based on predefined meaningful learning indicators, namely conceptual understanding, contextual connection, and reflective ability. The integration of qualitative and quantitative findings enabled a comprehensive interpretation of students' meaningful learning profiles and ensured alignment with the study's objectives (Sugiyono, 2020a).

RESULTS

This section presents the research findings regarding the profile of meaningful learning in mathematics among elementary school students on number and operations topics. The results are presented systematically, beginning with the main findings followed by supporting data, based on the analysis of tests, questionnaires, observations, and documentation. All results are described factually and descriptively without theoretical interpretation.

The analysis indicates that students' meaningful learning in mathematics on number and operations topics can be classified into three main indicators: conceptual understanding, connection to real-life contexts, and reflective ability in explaining mathematical concepts.

Overall, most students were categorized at a moderate level of meaningful learning. Of the 25 fifth-grade students involved in the study, the majority were able to solve number operation problems procedurally; however, not all students were able to explain the meaning of the concepts or relate them to real-life situations.

For the conceptual understanding indicator, 18 students were able to correctly solve addition, subtraction, multiplication, and division problems according to proper procedures. Students demonstrated the ability to determine the order of operations and complete multi-step calculations. In their written responses, several students presented solution steps in a logical sequence. For example, one student (S12) wrote, *"The multiplic ation is done first, then the addition,"* indicating an understanding of operational rules.

Regarding the connection to real-life contexts, fewer students were able to relate number and operations concepts to everyday situations. Only 10 students were able to explain the relationship between the problems and real-life experiences, such as buying and selling activities, equal distribution of objects, or calculating quantities of items. Most students provided only numerical answers without contextual explanations, even though the problems were presented in story-based formats.

Meanwhile, for the reflective ability indicator, only 7 students were able to explain the reasons for choosing specific operations or the meaning of calculation results either in written or oral form. One student (S05, male, 11 years old) stated, *"I used division because the items were shared equally,"* which reflects an initial ability to articulate the meaning of number operations.

Classroom observations showed that students were more active when working on routine computational exercises but tended to be passive when asked to explain their reasoning or relate problems to personal experiences.

To obtain an overall picture of students' levels of meaningful learning in mathematics on number and operations topics, the researcher first classified students based on a combined score derived from test results, meaningful learning questionnaires, and documentation of students' written work. This classification aimed to map students' overall positions into three categories of meaningful learning: high, moderate, and low. Such

mapping is important as a foundation for understanding the distribution of students' abilities before conducting further analysis based on specific meaningful learning indicators.

The results of the classification of students' meaningful learning levels in mathematics are presented in Table 1, which shows the distribution of the number and percentage of students in each category. The data in this table provide a quantitative overview of the general tendency of meaningful learning among fifth-grade students at SDN 50 Bonto Panno on number and operations topics.

Table 1. Distribution of Students' Meaningful Learning Levels in Mathematics

Meaningful Learning Level	Number of Students	Percentage (%)
High	4	16.0
Moderate	15	60.0
Low	6	24.0
Total	**25**	**100**

Based on Table 1, it can be observed that the majority of students were classified at a moderate level of meaningful learning, with 15 students (60.0%) falling into this category. This indicates that most students have developed an initial understanding of number and operations concepts; however, this understanding has not yet fully developed in terms of contextual connection and conceptual reflection.

A total of 4 students (16.0%) were classified at a high level of meaningful learning. Students in this category were not only able to correctly solve number operation problems but also demonstrated the ability to connect mathematical concepts with real-life situations and to explain the reasons for selecting specific operations. Meanwhile, 6 students (24.0%) were categorized as having low meaningful learning. Students in this group tended to experience difficulties in developing a comprehensive understanding of concepts and in relating problems to real-life contexts, although some were still able to complete simple computational tasks.

The distribution shown in Table 1 indicates that students' meaningful learning in mathematics has not been evenly distributed, with the largest concentration in the moderate category. This finding suggests that there remains considerable room for improvement in instructional practices to enable more students to achieve a high level of meaningful learning.

After obtaining a general overview of students' levels of meaningful learning in mathematics, the subsequent analysis focused on students' achievement based on specific

meaningful learning indicators. This analysis aimed to identify which aspects had developed well and which aspects remained challenging for students in constructing meaning in mathematics learning on number and operations topics.

The meaningful learning indicators used in this study included:

(1) conceptual understanding of number and operations,

(2) the ability to connect mathematical concepts with real-life contexts, and

(3) reflective ability to explain the reasons and meanings underlying the use of mathematical concepts.

Students' achievement for each of these indicators is presented in detail in Table 2.

Table 2. Students' Achievement Based on Meaningful Learning Indicators

Meaningful Learning Indicator	**Number of Students Achieving**	**Percentage (%)**
Conceptual understanding	18	72.0
Connection to real-life contexts	10	40.0
Reflective ability to explain concepts	7	28.0

Based on Table 2, conceptual understanding emerged as the most frequently achieved indicator, with 18 students (72.0%) demonstrating mastery of number and operations concepts at a basic procedural and conceptual level. Students who achieved this indicator were generally able to select appropriate operations and complete calculations using correct procedures.

The indicator of connection to real-life contexts showed a lower level of achievement, with only 10 students (40.0%) able to relate number and operations concepts to real-world situations, such as sharing objects, managing money, or other daily activities. Most students remained focused on numerical solutions without providing contextual explanations.

Meanwhile, the reflective ability to explain concepts was the indicator with the lowest achievement. Only 7 students (28.0%) were able to explain the reasons for choosing specific operations or the meaning of the calculation results. This finding indicates that students' ability to reflect on and communicate their mathematical understanding remains limited.

A comparison of achievement across the indicators in Table 2 reveals a noticeable decline in percentages from conceptual understanding to reflective ability. This pattern

indicates that although most students are able to understand and apply number operation procedures, only a small proportion are able to construct deeper meaning through contextualization and reflection.

To clarify the distribution of students' meaningful learning achievement in mathematics on number and operations topics, the classification of meaningful learning levels is presented not only in tabular form but also visualized through a graphical representation. This visualization aims to provide a more intuitive overview of the proportion of students in each meaningful learning category, allowing overall data patterns to be observed more clearly.

Figure 1 presents a graph illustrating the percentage distribution of students' meaningful learning levels in mathematics, which consists of three categories: high, moderate, and low. The graph is constructed based on the data presented in Table 1 and is used to visually highlight the dominance of certain categories as well as the gaps between categories.

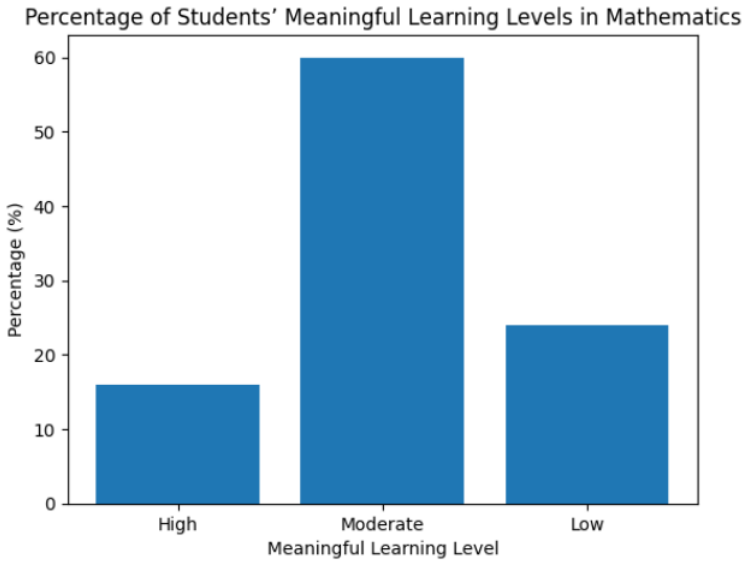


Figure 1. Percentage of Achievement for Meaningful Learning Indicators in Mathematics

Based on Figure 1, the moderate meaningful learning category occupies the largest proportion compared to the other categories. The percentage of students in the moderate category reaches 60.0%, as indicated by the most prominent bar or segment in the graph. This finding indicates that the majority of students are positioned at a moderate level of meaningful learning, where they have developed a basic understanding of number and operations concepts but have not consistently demonstrated the ability to connect these concepts to real-life contexts or to explain the meaning of the procedures used.

The low meaningful learning category ranks second, accounting for 24.0% of students. The visualization in Figure 1 shows that nearly one-quarter of the students fall into this category. Students classified at a low level generally tend to solve simple problems mechanically and demonstrate limitations in understanding the underlying meaning of number operations.

Meanwhile, the high meaningful learning category represents the smallest proportion, at 16.0%. This is clearly reflected in Figure 1 by the relatively smaller size of the corresponding bar or segment compared to the other categories. This percentage indicates that only a small proportion of students have achieved an optimal level of meaningful learning, characterized by the ability to understand mathematical concepts, relate them to everyday life situations, and provide reflective explanations of the calculation processes and results.

Overall, Figure 1 reveals an uneven distribution of students' meaningful learning levels in mathematics, with a clear dominance of the moderate and low categories. This visual pattern emphasizes that students' meaningful learning achievement is still largely concentrated at a basic level, while achievement at a high level of meaningful learning remains relatively limited.

In addition to the general patterns identified, this study also revealed several data points that did not fully align with the dominant trends.

Two students (S21 and S24) demonstrated very strong procedural skills, achieving high scores on number operation tests, but obtained low scores on the meaningful learning questionnaire. These students were able to solve nearly all computational problems correctly; however, they did not provide contextual or reflective explanations for story-based problems.

Conversely, one student (S03) exhibited a different pattern. Although this student made several calculation errors in number operation tasks, they were able to explain the meaning of the problems using real-life examples, such as sharing food with family members. This finding indicates a mismatch between procedural competence and meaningful learning for some students.

Observational data also showed that three students appeared less engaged during discussions of contextual problems, even though they independently completed routine calculation tasks. These findings suggest variations in students' characteristics in constructing meaning within mathematics learning.

To illustrate the level of meaningful learning in mathematics on number and operations topics, the research findings are also presented through an analysis of students' ability to use and understand mathematical equations. The equations analyzed were derived from contextual test items and represent basic number operations commonly taught in fifth-grade elementary mathematics.

One form of equation analyzed involved addition and subtraction of whole numbers presented in everyday contexts, such as simple buying and selling situations.

$$245 + 178 = 423 \qquad (1)$$

Based on students' written work, 18 out of 25 students correctly solved Equation (1). Most students performed the calculation using a vertical algorithm and directly obtained the final answer without providing an explanation of the contextual meaning of the problem. Meanwhile, 7 students made calculation errors, mainly related to carrying digits, indicating limitations in accuracy during basic operations.

The next equation involved multiplication, contextualized through grouping objects in daily life, such as the number of items in several boxes.

$$24 \times 6 = 144 \qquad (2)$$

The results showed that 15 students were able to solve Equation (2) correctly and systematically. However, only 6 students presented complete calculation steps. Some students wrote only the final answer without showing the process, while 10 students made errors, particularly in understanding multiplication as repeated addition.

Division operations were analyzed through problems that required students to distribute numbers equally into groups.

$$96 \div 8 = 12 \qquad (3)$$

Based on the test results, only 13 students correctly solved Equation (3). Some students applied repeated subtraction strategies, while others used multiplication facts. In contrast, 12 students experienced difficulties, as evidenced by incorrect final answers or incomplete solutions.

In addition to single operations, students were also given problems involving combined operations to examine consistency in conceptual understanding.

$$(45 + 15) \times 4 = 240 \qquad (4)$$

The results indicated that only **9 students** correctly solved Equation (4) by following the correct order of operations. Several students directly multiplied 15 by 4 without first completing the addition, which led to incorrect answers. This finding highlights variation in students' ability to understand the structure and sequence of number operations.

Overall, students' work on mathematical equations indicates that students were relatively more successful in solving equations involving single operations, particularly addition and subtraction. In contrast, success rates decreased for multiplication, division, and combined-operation equations. These results demonstrate differences in students' levels of meaningful learning in understanding number operations both procedurally and conceptually.

DISCUSSION

The findings of this study indicate that students' meaningful learning of mathematics in number and operations is predominantly situated at a moderate level, with the highest achievement observed in the conceptual understanding indicator. This result suggests that most elementary school students have acquired basic competencies in understanding number concepts and performing arithmetic operations correctly; however, this understanding has not yet fully developed into meaningful learning that is contextualized and reflective (Silviyanti et al., 2023).

Regarding conceptual understanding, the majority of students were able to identify appropriate arithmetic operations and solve problems accurately following correct mathematical procedures. This finding indicates that classroom instruction has effectively supported students in mastering procedural and basic conceptual knowledge. Nevertheless, meaningful learning extends beyond obtaining correct answers; it requires students to comprehend the underlying meaning of mathematical procedures and to connect these procedures with real-life experiences (Sari & Prabawanto, 2020).

The findings further reveal that students' ability to relate number concepts and operations to everyday contexts remains limited. Less than half of the participants were able to explain mathematical problems using real-world situations such as buying and selling activities, fair sharing, or calculating quantities in daily life. This suggests that mathematics learning in the classroom is still largely abstract and symbol-oriented, thereby limiting students' opportunities to construct meaningful connections between mathematical concepts and real-life applications. Similar findings have been reported in studies

emphasizing the importance of contextual learning in elementary mathematics (Andrews et al., 2023).

Moreover, reflective ability emerged as the lowest-achieved indicator. Only a small proportion of students were able to explain the reasons for selecting specific arithmetic operations or articulate the meaning of their computational results. This finding indicates that reflective thinking, mathematical reasoning, and communication have not yet been strongly emphasized in daily mathematics instruction. Yet, reflective ability is a crucial component of meaningful learning, as it enables students to internalize concepts, evaluate their thinking processes, and articulate mathematical meaning (Powell, 2023).

Overall, the results suggest that students' meaningful learning of mathematics remains at a transitional stage, shifting from procedural competence toward deeper conceptual and reflective understanding. This condition reflects a common characteristic of elementary mathematics instruction, which often prioritizes computational accuracy over conceptual explanation and contextual reasoning (Ausubel, 2000).

The findings of this study align with Ausubel's theory of meaningful learning, which emphasizes that learning becomes meaningful when new information is substantively related to learners' existing cognitive structures. In this study, students who were able to perform calculations accurately but failed to explain concepts or connect them to real-life contexts demonstrated learning that remained largely mechanical rather than meaningful.

This result is consistent with contemporary research indicating that procedural proficiency does not automatically lead to conceptual understanding or transferability of knowledge (Tall, 2013). In the context of elementary mathematics education, the present findings corroborate those of Novita et al. (Can & Yetkin-Izdemir, 2020), who reported that students tend to perform better on routine computational tasks than on contextual problems requiring interpretation and meaning-making.

Notably, this study also identified anomalous patterns that enrich the existing literature. Some students with high procedural performance demonstrated low levels of meaningful learning, whereas a student with weaker computational accuracy was able to provide meaningful contextual explanations. These findings support the view that meaningful learning in mathematics is multidimensional and cannot be inferred solely from procedural achievement (Widodo & Kartikasari, 2025). Instead, it is shaped by learning

experiences, opportunities for reflection, and students' engagement with mathematical meaning (Bakker et al., 2021).

Thus, this study reinforces previous research by highlighting that meaningful learning in mathematics cannot be adequately captured through computational performance alone but must be examined through conceptual, contextual, and reflective dimensions.

From a theoretical perspective, the findings strengthen the framework of meaningful learning in mathematics by reaffirming that procedural knowledge alone is insufficient. Meaningful learning should be understood as an integrated process involving conceptual understanding, contextual application, and reflective explanation.

From a practical perspective, the results suggest that elementary school teachers should design mathematics instruction that explicitly emphasizes meaning-making. Teachers are encouraged to provide more opportunities for students to connect number concepts and operations to real-life situations through contextual word problems, problem-based learning, and classroom discussions grounded in everyday experiences.

Additionally, mathematics instruction should promote students' reflective thinking by encouraging them to explain their reasoning processes both orally and in writing. Reflective activities—such as justifying the choice of operations or interpreting the meaning of results—can serve as effective strategies for enhancing meaningful learning.

At the institutional and policy levels, these findings support the implementation of student-centered and context-based learning approaches as emphasized in the Merdeka Curriculum. Strengthening meaningful learning in mathematics can help ensure that instruction not only improves academic achievement but also develops students' reasoning, communication, and conceptual understanding.

Despite providing valuable insights into students' meaningful learning of mathematics, this study has several limitations. First, the sample size was relatively small and limited to a single elementary school, which constrains the generalizability of the findings. Second, the descriptive design and limited time frame prevented examination of changes in students' meaningful learning over time. Third, the instruments focused primarily on cognitive indicators, which may not fully capture affective and motivational dimensions.

Future research is therefore recommended to involve larger and more diverse samples, adopt longitudinal or experimental designs, and integrate instructional

interventions aimed at enhancing meaningful learning in mathematics. Such studies would contribute to a deeper understanding of how instructional strategies foster students' conceptual, contextual, and reflective engagement with mathematics.

CONCLUSION

This study examined the profile of meaningful mathematics learning among elementary school students in the topic of numbers and operations. The findings indicate that students' meaningful learning is predominantly at a moderate level. Most students demonstrated adequate conceptual understanding and procedural accuracy in performing arithmetic operations. However, their ability to connect mathematical concepts to real-life contexts and to reflect on the meaning of mathematical procedures and results remained limited.

The analysis further revealed that conceptual understanding was the most achieved indicator, followed by contextual connection, while reflective ability showed the lowest level of attainment. These results suggest that although students are generally capable of solving numerical problems correctly, meaningful learning—characterized by contextualization and reflective reasoning—has not yet been fully developed. Variations in student profiles, including the presence of anomalous cases, highlight that procedural proficiency does not always correspond to meaningful understanding.

This study contributes to the field of mathematics education by providing empirical evidence that meaningful learning in elementary mathematics is a multidimensional construct encompassing conceptual, contextual, and reflective dimensions. The findings reinforce theoretical perspectives on meaningful learning by demonstrating that procedural mastery alone is insufficient to ensure deep understanding.

Methodologically, this study offers a descriptive framework for analyzing meaningful learning in the context of numbers and operations at the elementary level, integrating test results, questionnaires, observations, and student work documentation. Practically, the study provides insights for educators and curriculum developers by highlighting the need to shift mathematics instruction from a predominantly procedural focus toward learning experiences that emphasize meaning-making, contextual application, and reflective explanation.

Based on the limitations and findings of this study, several directions for future research are recommended. First, future studies should involve larger and more diverse samples across multiple schools or regions to enhance the generalizability of the findings.

Second, longitudinal or experimental research designs are recommended to examine the development of meaningful learning over time and to assess the effectiveness of specific instructional interventions.

Additionally, future research may explore the role of affective and motivational factors in shaping students' meaningful learning of mathematics. Investigating instructional approaches such as problem-based learning, realistic mathematics education, or reflective learning strategies may also provide deeper insights into how meaningful learning in mathematics can be systematically fostered in elementary classrooms.

REFERENCES

Andrews, P., Xenofontos, C., & Sayers, J. (2023). *Developing conceptual understanding in mathematics education*. Routledge.

Ausubel, D. P. (2000). *The acquisition and retention of knowledge: A cognitive view*. Springer. https://doi.org/10.1007/978-94-015-9454-7

Bakker, A., Cai, J., Zenger, L., & Rasmussen, C. (2021). Meaningful learning in mathematics: A multidimensional perspective. *Educational Studies in Mathematics, 106*(2), 213–234.

Can, D., & Yetkin Özdemir, İ. E. (2020). An examination of fourth-grade elementary school students' number sense in context-based and non-context-based problems. *International Journal of Science and Mathematics Education, 18*(7), 1333–1354. https://doi.org/10.1007/s10763-019-10022-3

Chang, H., Yang, Y., & Li, X. (2020). Cross-national comparisons of primary grade mathematics performance. *ZDM Mathematics Education, 52*(6), 1123–1137.

Dewi, N. R., & Surya, E. (2021). Contextual mathematics learning to support students' conceptual understanding. *Journal of Physics: Conference Series, 1957*(1), Article 012034.

Hiebert, J., & Grouws, D. A. (2021). The role of conceptual understanding in mathematics learning. *Journal for Research in Mathematics Education, 52*(2), 121–145.

Islam, M. S., Rahman, M. M., & Rahman, M. A. (2024). Procedural fluency and conceptual understanding in elementary mathematics learning. *International Journal of Educational Research, 121*, Article 102196.

Keguruan, A., Suparno, D., & Hasan, M. (2022). Meaningful learning theory in elementary education: An Ausubelian perspective. *International Journal of Instruction, 15*(4), 921–936.

Kemendikbudristek. (2022). *Kebijakan asesmen nasional dan Asesmen Kompetensi Minimum (AKM)*. Badan Standar, Kurikulum, dan Asesmen Pendidikan.

Majid, A., Rahman, A., & Nurhadi, M. (2020). Contextual mathematics learning to enhance conceptual understanding of elementary students. *Journal on Mathematics Education, 11*(2), 295–308.

Novita, R., Zulkardi, Z., & Hartono, Y. (2021). Students' difficulties in solving contextual mathematical problems. *Journal on Mathematics Education, 12*(2), 271–286.

Powell, A. B. (2023). Enhancing students' fraction magnitude knowledge: A study with students in early elementary education. *The Journal of Mathematical Behavior, 70*, Article 101042. https://doi.org/10.1016/j.jmathb.2023.101042

Prastiyo, A., Zulkardi, & Putra, Z. H. (2024). A systematic literature review of contextual teaching and learning in mathematics education. *Journal on Mathematics Education, 15*(1), 1–18.

Putra, Z. H., & Zulkardi. (2019). Designing contextual mathematics problems for improving students' conceptual understanding. *Journal on Mathematics Education, 10*(3), 403–416.

Rasmini, N. P., & Antara, P. A. (2023). Learning process quality and its influence on students' conceptual development in primary education. *Jurnal Pendidikan dan Pembelajaran, 30*(3), 201–214.

Rittle-Johnson, B., & Schneider, M. (2015). Developing conceptual and procedural knowledge in mathematics. In R. C. Kadosh & A. Dowker (Eds.), *The Oxford handbook of numerical cognition* (pp. 1102–1118). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199642342.013.014

Sari, V. P., & Prabawanto, S. (2020). Students' procedural and conceptual understanding of number concepts in elementary school. *Journal of Physics: Conference Series, 1521*(3), Article 032014.

Silviyanti, D., Kartikasari, D., & Widodo, A. (2023). Students' difficulties in learning fractions: A conceptual and representational analysis. *International Journal of STEM Education, 10*(1), Article 58.

Sugiyono. (2020). *Metode penelitian kualitatif, kuantitatif, dan R&D* (2nd ed.). Alfabeta.

Suryadi, D., & Herman, T. (2018). Contextual mathematics learning and students' cognitive engagement. *Journal on Mathematics Education, 9*(2), 187–198.

Tall, D. (2013). *How humans learn to think mathematically: Exploring the three worlds of mathematics*. Cambridge University Press. https://doi.org/10.1017/CBO9781139565202

Widodo, A., & Kartikasari, D. (2025). Contextual mathematics instruction and its effect on higher-order thinking skills. *International Journal of STEM Education, 12*(1), Article 45.

Yani, M., Bernard, M., & Senjayawati, E. (2025). Reflective contextual learning and its effect on sustainable conceptual understanding in mathematics. *Journal of Educational Research and Evaluation, 9*(1), 33–47.

Zulkardi, Putra, Z. H., & Hartono, Y. (2017). Developing mathematics teaching through contextual and realistic approaches. *Journal on Mathematics Education, 8*(1), 1–16.