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Assessing Mathematical Understanding in Fourth-Grade Students: A Focus on Multiplication and Division Skills

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ABSTRAK

Pemahaman matematis siswa di sekolah dasar tergolong masih sangat rendah, hal ini mendorong peneliti untuk mengkaji hal-hal yang menjadi penyebabnya. Faktor penting yang harus dikaji adalah kemampuan guru dalam mengajarkan matematika di sekolah dasar, karena guru lah yang bertanggungjawab terhadap sampainya Pemahaman matematis siswa di sekolah. Sebelum mengkaji lebih jauh terkait peran penting guru di sekolah maka pada penelitian ini, peneliti ingin mengkaji terlebih dahulu terkait Pemahaman matematis itu sendiri, sehingga analisis lebih lanjut berkenaan dengan peran guru di sekolah akan lebih komprehansif. Penelitian ini dilaksanakan di salah satu sekolah dasar di kecamatan leuwigoong dengan menjadikan siswa kelas IV sebagai subjek penelitian. Penelitian ini menggunakan metode penelitian kualitatif deskriptif dengan penyebaran angket, tes terlulis, wawancara, dan observasi terhadap para siswa sebagai teknik pengumpulan data penelitiannya. Dari hasil pengolahan data selama penelitian diperoleh kesimpulan bahwa siswa dengan kemampuan awal tinggi, dapat memenuhi seluruh indikator kemampuan pemahaman matematiks, sedangkan siswa dengan kemampuan awal sedang dan rendah masing-masing dapat memenuhi dua indikator Pemahaman matematis. Hal ini menunjukan bahwa diperlukan peran serius seorang pendidik untuk dapat menyampaikan materi pembelajaran secara profesional.

Kata Kunci: Kemampuan Pemahaman matematis Siswa; kualitatif deskriptif; siswa SD.

ABSTRACT

Elementary school students' understanding of mathematics is still very low, this encourages researchers to study the causes. An important factor that must be studied is the skill of teachers to teach mathematics in elementary schools, because teachers are responsible for achieving students' understanding of mathematics in schools. Before studying further regarding the important role of teachers in schools, in this study, researchers want to first study the understanding of mathematics itself, so that further analysis regarding the role of teachers in schools will be more comprehensive. This research was conducted in one of the elementary schools in Leuwigoong District by making grade IV students the subjects of the research. This study uses a descriptive qualitative research method by distributing questionnaires, written tests, interviews, and observations of students as data collection techniques for its research. From the results of data processing during the study, it was concluded that students with high initial skills can meet all indicators of mathematical understanding skill, while students with moderate and low initial skills can each meet two indicators of mathematical understanding. This shows that a serious role is needed for an educator to be able to deliver learning materials professionally.

Keywords: Students' mathematical understanding skill; descriptive qualitative; elementary school students.

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1. INTRODUCTION

Mathematics contributes to every aspect of life, whether consciously or not, as almost nothing in human life is exempt from the significant role of mathematics (Maulana, 2024). Religious, national, and state life all undoubtedly involve the contribution of mathematics. The government has made mathematics one of the compulsory subjects in schools, taught at every educational level, from elementary school to senior high school. As a branch of knowledge that deals with ideas, concepts, and systematically organized principles, mathematics plays an essential role in shaping students' cognitive frameworks (Prabawati, 2018).

Bloom's Taxonomy in the cognitive domain includes: (1) knowledge, (2) comprehension (or understanding), (3) application, (4) analysis, (5) synthesis, and (6) evaluation (Ulfah & Arifudin, 2023). This has been revised by replacing the nouns with verbs to form the following: (1) remembering (C1), (2) understanding (C2), (3) applying (C3), (4) analyzing (C4), (5) evaluating (C5), and (6) creating (C6) (Mahmudi et al., 2022). These six competencies represent the stages of a student’ s cognitive skills from C1 (lower-order thinking skills, or LOTS) to C6 (higher-order thinking skills, or HOTS) (Adiwijaya & Palupi, 2024).

The author identifies a phenomenon in the field regarding the misunderstanding of LOTS as a low-level competency that is often underestimated by some teachers, who assume that students have already mastered these skills without the need for significant effort (Miatun & Ulfah, 2023). This underestimation of LOTS is, however, misguided, as LOTS serve as the foundation for the development of HOTS. In fact, few researchers have focused on analyzing the importance of LOTS skills, with more attention given to HOTS as a high-level competency essential for navigating life in the 21st century.

In elementary school mathematics learning, the skill to remember, understand, and apply knowledge is critical and requires more time to master (Afriansyah et al., 2024). For example, in the process of memorizing multiplication and division concepts at the elementary level, especially in stage B, repetition is necessary to help students remember these concepts. Particularly, when memorizing multiplication tables from 1 to 10, students require more time to practice repeatedly to commit these to memory. This aligns with the findings of a study (Fahrurrozi et al., 2022) which indicates that the drill method can have a positive impact on mathematics learning in elementary schools, as reflected in improved mathematics learning outcomes among students in several elementary schools in Indonesia, both in lower and upper grades.

One of the competencies that students are expected to master by the end of stage B is the skill to demonstrate an understanding and intuition of numbers (number sense) up to 10,000. Students should be able to perform addition and subtraction operations with numbers up to 1,000, multiplication and division with numbers up to 1,000, fill in unknown values in mathematical sentences, and identify, replicate, and develop simple geometric or numerical patterns related to addition and subtraction up to 100. A student's understanding and intuition of numbers are influenced by various factors, including both internal and external factors. Internal factors encompass: (1) physical barriers, and (2) psychological barriers. External factors include: (1) educators (teachers), (2) the school environment, and (3) family (Sitorus et al., 2022).

Among the various factors influencing mathematical understanding, the teaching methods employed by educators during instruction must be given serious attention. This factor is critical as it is the key to effective teaching strategies that lead to high-quality education (Magdalena et al., 2021). It is important for researchers to analyze which of the various methods identified by experts is most suitable for use in the classroom.

From the above discussion, the author concludes that an analysis of students' mathematical understanding is necessary to determine the most appropriate teaching strategies to be applied in the learning process.

2. METHOD

The research conducted in this study is qualitative with a descriptive approach. Qualitative research aims to understand social realities by viewing the world as it is, not as it should be. Therefore, the researcher must possess an open-minded attitude. The research process begins with the formulation of basic assumptions and the rules of thinking that will be applied. In this study, the researcher aims to analyze students' mathematical understanding in the context of multiplication and division of natural numbers for fourth-grade elementary school students, using indicators of mathematical understanding skills.

This research was conducted at an elementary school in the Leuwigoong District, Garut Regency, West Java Province. The researcher chose this location due to the observed issues regarding the importance of mathematical understanding. Based on initial interviews with one of the fourth-grade teachers, it was found that students were not performing optimally in solving mathematical problems. There was also a positive reception from the school principal and teachers regarding the proposed research. Additionally, the location was strategically convenient, being close to the researcher’ s residence, and there had been no similar studies conducted at this school.

The research was carried out during the even semester of the 2023/2024 academic year, from January to June. The stages of the research are outlined in the following Table 1:

Table 1. Research stage schedule

No	Research Stages	Implementation's Time	Note
1	Development of Research Instruments	30 May 2024	Implemented
2	The implementation of tests at school	5 June 2024	Implemented
3	The Implementation of Interviews and Student Response Observations	12 June 2024	Implemented
4	Analysis of interview results and preparation of research report	19 June s.d 24 July 2024	Implemented
5	Report Submission	25 July 2024	Implemented

The object of this research is students' mathematical understanding in the context of multiplication and division of natural numbers, while the subjects of this study are fourth-grade students at an elementary school in Leuwigoong District. The selection of subjects used the technique of saturated sampling, where the information gathered by the researcher reaches saturation. The selection of students was based on their initial skill levels, determined by the results of a previous test. Each skill group consists of two students as representatives. If the information obtained does not meet the expected criteria, the researcher will add more subjects until saturation is achieved.

Data collection techniques refer to the methods used to gather data. In this research, the researcher employed tests, interviews, and documentation as data collection techniques. The test consists of questions on the concepts of multiplication and division operations that include indicators of mathematical understanding. Tests are used to assess the skills or skills possessed by each individual or group. The data collection through tests was conducted by providing a set of test items. Before administering the test, the researcher used data from the students' Initial Mathematical Skill (IMA) to gain an understanding of the students' skills prior to the study. The IMA data was obtained from the results of previous lessons. In this research, interviews were conducted with the fourth-grade students, as the subjects, to discuss descriptive questions based on indicators of mathematical understanding. The interviews were conducted directly at the school with each research subject. Documentation was used to gather information about specific events and can take the form of written records, images, or other significant works from an individual. Document studies complement the data collection techniques of observation and interviews in qualitative research. The documents required for this study include the names of students and their daily test scores. These test scores were used as a basis for grouping students according to their initial skill levels (high, medium, and low) based on their IMA.

The instruments in this study consist of the main instrument and supporting instruments. The main instrument is the researcher themselves, as the researcher is involved in all stages of the research from beginning to end, and is responsible for representing the research results. The supporting instruments include the mathematical understanding skill test sheets used by the

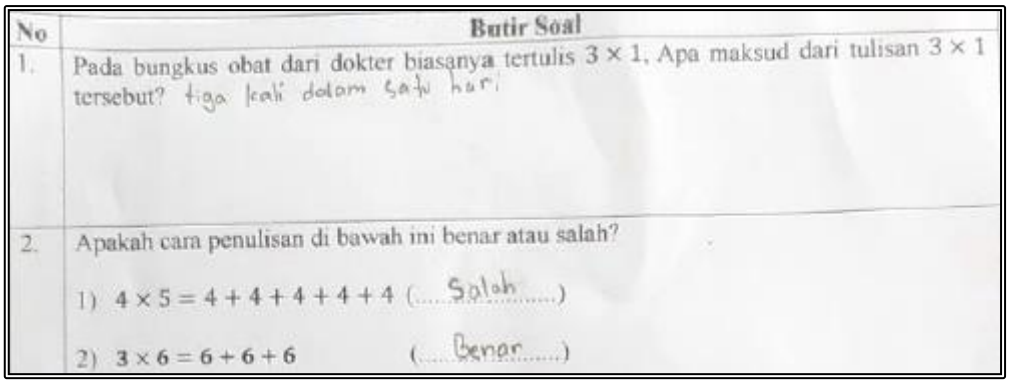
researcher, in the form of descriptive questions. Each question is aligned with the indicators of mathematical understanding, particularly in the topics of multiplication and division of natural numbers. The mathematical understanding test was directly created by the researcher, considering the students' knowledge levels and validating the instrument's appropriateness to ensure the research objectives were achieved. These descriptive tests were given to facilitate the researcher's skill to observe the problem-solving process of students on issues related to mathematical understanding in multiplication and division of natural numbers. To validate the supporting instruments, they were reviewed by a validator. The interview guidelines in this study consisted of questions designed to direct students to describe how they solved the problems based on the indicators of mathematical understanding, as well as the written answers provided by each subject. The purpose of the interviews was to obtain deeper and more comprehensive data regarding students' mathematical understanding in solving mathematical problems related to multiplication and division of natural numbers. The interview guidelines can be found in the appendix.

The analysis of the test results is used to determine the level of students' mathematical understanding. A descriptive test is administered to facilitate the evaluation of students' mathematical understanding in multiplication and division of natural numbers. The test results will be analyzed based on the scoring guidelines created by the researcher. The test scoring guidelines are based on indicators of mathematical understanding. The analysis of students' mathematical understanding test results is conducted by reviewing the test responses and then calculating the scores for each question based on the established scoring guidelines.

There are three stages in the data analysis process in this research: data reduction, data presentation, and conclusion. Data reduction is where the researcher gathers, selects important items, focuses on the key elements, identifies themes and patterns, and eliminates unnecessary data. Data reduction provides a clearer picture and makes it easier for the researcher to organize data collection. In this stage, after the researcher has administered the mathematical understanding test, the data from the test and interviews are summarized and gathered. The data reduction in this study focuses on students who meet the criteria of mathematical understanding indicators based on the classification of their initial mathematical skill from their daily test scores. The next stage, after data reduction, is data display or presentation. Data presentation organizes the data in a pattern of relationships according to levels and categories, making it easier to understand. In data presentation, the results can take the form of narrative text, graphs, or brief descriptions. In this study, the data presentation was based on interview and test results regarding students' mathematical understanding in solving mathematics problems, following the indicators of mathematical understanding, such as linking concepts to previous materials, connecting with other subjects, and relating to real-life mathematical problems.

The final stage is conclusion. The conclusions made at this stage are provisional and may change if no strong evidence supporting them is found in the subsequent stages of data collection. However, if the initial conclusions are supported by valid and consistent evidence, they will be considered credible conclusions that have been validated. In this stage, the researcher draws conclusions from the data collection techniques, grouping them according to the categories of students' skills and the indicators of mathematical understanding.

3. RESULT AND DISCUSSION



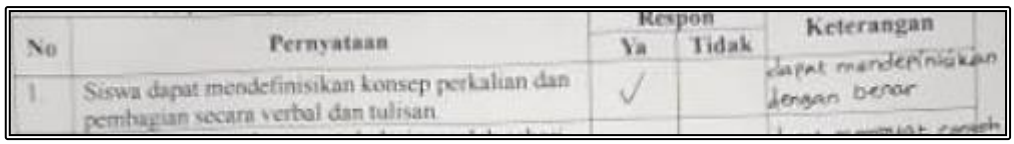
No	Butir Soal
1.	Pada bungkus obat dari dokter biasanya tertulis 3 × 1, Apa maksud dari tulisan 3 × 1 tersebut? tiga kali dalam satu hari
2.	Apakah cara penulisan di bawah ini benar atau salah? 1) 4 × 5 = 4 + 4 + 4 + 4 + 4 (.....Salah.....) 2) 3 × 6 = 6 + 6 + 6 (.....Benar.....)

Figure 1. The answer of student 1 - Defining concepts verbally and in writing

The response from Student 1 Figure 1 shows that they have mathematical understanding skills, as assessed through the indicators of defining concepts both verbally and in writing. Student 1's answer to question number 1 demonstrates that they understand the definition of the operation 3 × 1, while their answer to question number 2 shows that they can distinguish between correct and incorrect concepts. This is further supported by the results of the interview regarding the indicator of defining concepts verbally and in writing, as follows:

R: "Please explain what is meant by the multiplication operation."
S: "Multiplication means adding the same number repeatedly for a certain number of times."
R: "What about division? What do you know about the division operation?"
S: "Division is the same as repeatedly subtracting a certain number from another until it is completely divided or until no further subtraction is possible."

The interview excerpt above shows that Student 1 has mathematical understanding skills, as seen from the indicators of defining concepts both verbally and in writing. In addition to using written tests and interviews, the researcher also asked someone deemed competent to act as an observer to conduct observations while Student 1 was being interviewed. Below is the observation sheet related to the indicators of defining concepts verbally and in writing.



No	Pernyataan	Respon		Keterangan
		Ya	Tidak	
1	Siswa dapat mendefinisikan konsep perkalian dan pembagian secara verbal dan tulisan	✓		dapat mendefinisikan dengan benar

Figure 2. Observation sheet of student 1 - Defining concepts verbally and in writing

Based on the observation sheet (Figure 2), it shows that students can define concepts verbally through interview responses and in writing through written tests.

Figure 3. The answer of student 1 - Identifying and creating examples and non-examples

In the test question (Figure 3), Student 2 provided an illustration of 3 boxes containing 5 marbles each as an example of a multiplication operation in the form of 3 × 5. This is correct and demonstrates that the student can present a real-life example of a multiplication operation. To support the argument above, the following is the result of an interview between the interviewer and the student.

R: "Can you give an example of a real-life problem that involves multiplication?
S: "Yes, sir. For example, if a doctor advises my father to take 2 pills in the morning, 2 pills in the afternoon, and 2 pills in the evening, this represents the multiplication operation 3 × 2. Usually, medication packaging states it as 3 × 2."
R: "Exactly! Can you provide another example?"
S: "When someone counts jengkol beans, they usually count them by taking 5 beans at a time."
R: "Very good. So, if that person takes them 30 times, how many jengkol beans will they have in total?"
S: "That means there will be 30 × 5=150 jengkol beans."

The interview notes above indicate that Student 1 is already able to identify and provide examples and non-examples of multiplication operations.

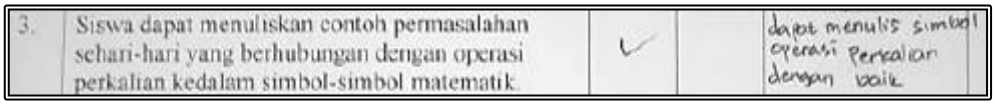


Figure 4. Observation sheet of student 2 - Identifying and creating examples and non-examples

Based on the results of interviews and observations (Figure 4), it was found that students are able to identify examples of phenomena that represent the concept of multiplication. It is evident that students have a good understanding of problem examples related to the concept of multiplication.

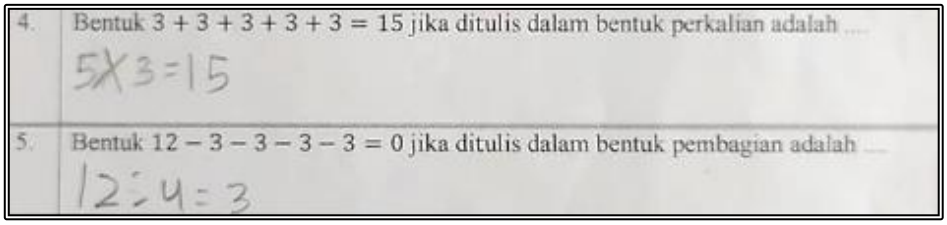


Figure 5. The answer of student 3 - Transforming one form of representation into another form of representation

The response from Student 3 (Figure 5) indicates that they have understood repeated addition as the concept of multiplication. Student 3 has also grasped the concept of repeated subtraction as division. However, the interview results revealed that Student 3 struggles with expressing multiplication in the form of repeated addition and division as repeated subtraction.

R: "Did you encounter any difficulties in converting multiplication into repeated addition?"
S: "Yes, Ma'am."
R: "How were you able to answer the test question correctly?"
S: "I got the information from my deskmate."
R: "As a way to confirm your understanding, how would you write 4 × 8 as repeated addition?"
S: "It means the number 4 is added 8 times, Sir."
R: "That's not quite correct, dear!"

The results of Student 3's comprehension test and the interview conducted are not yet fully consistent. It is suspected that Student 3 answered the test questions by looking at their seatmate's work. This is indicated by the correct answers on the test, whereas the interview responses suggest that the student still lacks a proper understanding of the concepts studied.

4.	Siswa dapat menuliskan bentuk penjumlahan berulang ke bentuk perkalian atau sebaliknya.	✓		dapat menyusun penjumlahan berulang
5.	Siswa dapat menuliskan hubungan antara penjumlahan berulang dengan operasi perkalian		✓	belum dapat menuliskan hubungan

Figure 6. Observation sheet of student 3 - Transforming one form of representation into another form of representation

Based on the results of the interview and observations conducted (Figure 6), the observer found that Student 3 is unable to express multiplication as repeated addition. Therefore, the observer concludes that Student 3 has not yet mastered the ability to convert one form of representation into another.

8. Apa persamaan antara konsep perkalian dan pembagian?
Sama² berulang

9. Jelaskan perbedaan antara konsep perkalian dan konsep pembagian!
Perkalian itu penjumlahan berulang
Pembagian itu pengurangan berulang

Figure 7. The answer of student 1 - Comparing and distinguishing concepts

The answer provided by Student 1 (Figure7) indicates that they have a clear understanding of the difference between the concepts of multiplication and division. This is further supported by the results of the interview conducted between the interviewer and Student 1 regarding the indicator of comparing and distinguishing concepts. Below is an excerpt from the interview between Student 1 and the interviewer:

R: "Did you find any similarities between the concepts of multiplication and division operations?"

S: "Yes, Ma'am."
R: "Then, what are the similarities between these two concepts?"
S: "Both concepts involve repeating the operation of a number."
R: "Now, what are the differences between these two operations?"
S: "Multiplication is the repeated addition operation, while division is the repeated subtraction operation."
R: "You're amazing, my dear!"

The interview notes above show that Student 1 answered the interviewer's questions fluently. They also answered all of the questions correctly.

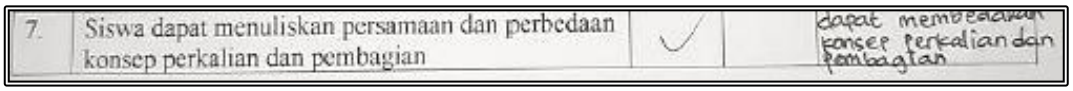


Figure 8. Observation sheet of student 1 - Comparing and distinguishing concepts

Based on the results of the tests, interviews, and observations of Student 1 (Figure 8), regarding the indicator of comparing and differentiating concepts, Student 1 is able to compare and differentiate the concepts of multiplication and division. Therefore, Student 1 has successfully achieved the indicator of comparing and differentiating concepts effectively.

The following is a presentation of the research findings based on the outcomes of the tests, interviews, and observations that were done on the study's subjects (see Table 2):

Table 2. Percentage of Mathematical Understanding Indicators Attained

No	Indicator	S-1	S-2	S-3	Percentages
1	Defining concepts verbally and in writing	V	X	V	66%
2	Identifying and creating examples and non-examples	V	V	V	100%
3	Transforming one form of representation into another form of representation	V	V	X	66%
4	Comparing and distinguishing concepts	V	X	X	33%
Percentage per student		100%	50%	50%	

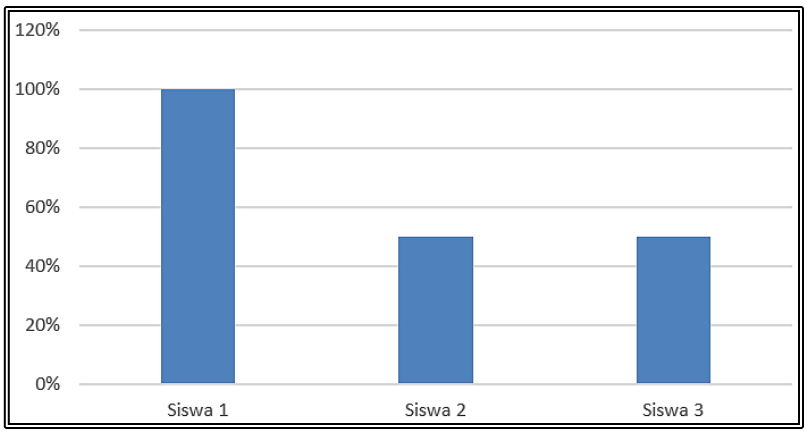


Figure 9. Achievement Chart of Each Student

It is evident from the accompanying Figure 9 that Student 1 has a higher percentage of mathematical understanding skill than Students 2 and 3. The percentage of Student 1 is 100%,

as is well known. In contrast, 50% of Student 2 and 50% of Student 3 are represented. With all signs fully satisfied, Student 1 meets more mathematical comprehension skill indicators than the other students. In the meantime, Student 2 and Student 3 are able to meet 50% of the observed indications; however, the achievement diagram for each indicator below shows that their skills differ.

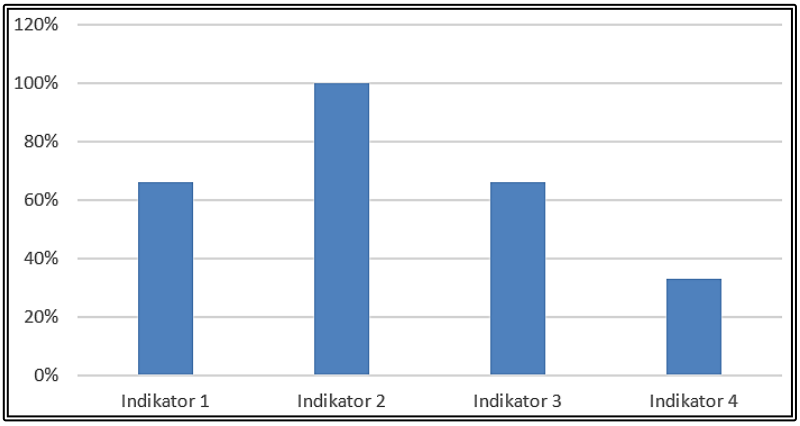


Figure 10. Achievement Chart of Each Indicator

Based on the Figure 10, it is evident that the percentage of mathematical understanding skill according to the indicators shows that Indicator 2 outperforms Indicators 1, 3, and 4. It is known that the percentages for Indicator 1 and Indicator 3 are both 66%, Indicator 2 is 100%, and Indicator 4 is 33%. For Indicator 4, only Student 1 meets this indicator. Meanwhile, Indicator 2 is met by all three observed students. Indicators 1 and 3 are each met by two students.

Based on data reduction, it was found that each student met different indicators of mathematical understanding skill. Student 1 met more indicators of mathematical understanding skill than others. Meanwhile, Student 3 met only one indicator. Student 1 met the indicator of defining concepts verbally and in writing (Indicator 1), identifying and giving examples and non-examples (Indicator 2), converting a form of representation into another (Indicator 3), and comparing and contrasting concepts (Indicator 4). Student 2 met Indicator 3 and Indicator 4, while Student 3 met Indicator 1 and Indicator 2.

Based on the data analysis results as presented, the researcher will present the research findings using descriptive analysis. Below are the results of the written tests and interviews on the topics of multiplication and division of natural numbers for the fourth-grade students, based on mathematical understanding skill:

a. High Skill Category

In the indicator of defining concepts verbally and in writing, Subject S1 was able to understand the question, grasp the concept presented in the question, and demonstrated their skill to define the concept both verbally through interviews and in writing through the written test. In the indicator of identifying and giving examples and non-examples, Subject S1 was able

to provide examples of the concepts of multiplication and division operations. In the indicator of converting one form of representation to another, Student 1 was able to convert multiplication into repeated addition very well. In the indicator of comparing and contrasting concepts, Student 1 was able to clearly distinguish between the concepts of multiplication and division. Overall, the high-skill students were able to solve the problems well according to the indicators of mathematical understanding. Since all indicators were met, the students with high skills also had strong mathematical understanding. This aligns with the research by Maret & Syarifuddin (2021), which states that students with high skills are capable of effectively using their mathematical understanding skills.

b. Medium Skill Category

In the indicator of defining concepts verbally and in writing, the subject completed the given question but was unable to define the concepts of multiplication and division in detail. Based on the test and interview, the subject could not answer the question according to the indicator of defining concepts verbally and in writing. In the indicator of identifying and giving examples and non-examples, the subject was able to complete the given question. According to the test and interview, Student 2 could identify examples and non-examples of multiplication and division concepts. This meets the indicator of identifying and providing examples and non-examples. In the indicator of converting one form of representation to another, Student 2 was able to complete the question well. Based on the test and interview, the student could understand the question and represent the concept in another form. However, in the indicator of comparing and contrasting concepts, Student 2 made errors in comparing the concepts of multiplication and division. Therefore, students with medium skills did not fully demonstrate strong mathematical understanding. This is consistent with the research by Maret & Syarifuddin (2022), which states that students with medium skills possess moderate mathematical understanding.

c. Low Skill Category

In the indicator of defining concepts verbally and in writing, the subject completed the given question and was able to define the concepts of multiplication and division well. Based on the test and interview, the subject could answer the question according to the indicator of defining concepts verbally and in writing. In the indicator of identifying and giving examples and non-examples, the subject was able to complete the given question. According to the test and interview, Student 3 could identify examples and non-examples of multiplication and division concepts. This meets the indicator of identifying and providing examples and non-examples. However, in the indicator of converting one form of representation to another, Student 3 was not able to complete the given question well. Based on the test and interview, Student 3 could not understand the question thoroughly or represent the concept in another form. In the indicator of

comparing and contrasting concepts, Student 3 made mistakes when comparing multiplication and division concepts. Therefore, students with low skill were not able to demonstrate sufficient mathematical understanding. This aligns with the research by Maret and Syarifuddin (2022), which states that students with low skill lack sufficient mathematical understanding.

This is not entirely consistent with the findings of Maret and Syarifuddin (2022), which state that students with high skills in problem-solving meet all mathematical understanding indicators, students in the medium category meet two indicators, and students in the low category fail to meet three mathematical problem-solving indicators. In this study, students with low initial skills still met two mathematical understanding indicators.

Additionally, one of the mathematical understanding indicators that particularly intrigued the researcher is the indicator of defining concepts verbally and in writing. The reason for choosing this indicator is that students with medium skills could not meet this indicator, while students with low skills were able to meet it. Based on the interviews, one reason why students with medium skills could not answer the questions correctly was their difficulty in recalling definitions provided by the teacher. In contrast, students from the low-skill group were able to remember the definitions well.

4. CONCLUSION

This study highlights the varying levels of mathematical understanding among fourth-grade students in multiplication and division. Students with high skills demonstrated a strong grasp of all mathematical understanding indicators, while those with medium and low skills met fewer indicators. Notably, students with low skills were able to define concepts verbally and in writing, unlike students with medium skills, who struggled with this task. The findings suggest that basic mathematical understanding plays a crucial role in developing higher-order thinking skills, and emphasizes the need for teaching strategies that address foundational concepts to support students at all skill levels.

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