

Second-grade Difficulties in Understanding Place Value

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Abstract. The concepts in mathematics education are interrelated and taught from the easiest one to the most difficult. One of the fundamental concepts taught to students is the concept of place value. If students do not understand place value, they will face difficulties in the following mathematics materials, especially in the topic of numbers. Therefore, this research aims to describe students' understanding and the mistakes they make in understanding the concept of place value. The research method used in this study is a descriptive method with a sample of 20 second-grade students. Based on the test results, 75% (15 students) have reached the minimum passing score with an average test score of 70, while 25% (5 students) scored below the average. To enhance students' understanding of place value, special attention is needed to ensure that no students find difficulties in said material. This research aims to assist teachers in anticipating students' understanding of the place value concept.

Keywords: Mathematics, place value concept, learning difficulties, descriptive method, multirepresentations

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INTRODUCTION

Mathematics is an abstract science. Therefore, in studying mathematics, it requires a high level of cognitive ability to connect various concepts. As conveyed by several experts Abrar (Abrar, 2015, p. 52), Suherman (Nasaruddin, 2013, p. 63), Rusfendi (Astuti & Supriyono, 2020, p. 52), mathematics has characteristics that include being abstract, using symbols with empty meanings, maintaining consistency in its system, considering the universe of discourse, having both deductive and inductive aspects, relying on agreements, and following a progressive, spiral method of teaching adapted to students' cognitive development. On the other hand, Sumarmo (Sugeng, 2009, p. 527) emphasizes the importance of the deductive process in mathematics, although in some cases, an inductive approach can be used based on observational data.

One of the fundamental concepts in mathematics is the concept of place value. Place value is the value of a digit in a number seen based on its (Astuti, 2017; Mathematics in the New Zealand Curriculum (Matitaputty et al., n.d.). This concept, also known as the multidigit concept, states that the more digits there are, the greater the value (Putri in Khaira, 2020). You can determine the place value of a number by looking from right to left. The rightmost place has the smallest place value, which is the units place. For example, you can determine the place value in the number 278. In the number 278, the digit 2 has a place value in the hundreds, with a numerical value of 200, the digit 7 has a place value in the tens, with a numerical value of 70, and the digit 8 has a place value in the units, with a numerical value of 8. So, as you move from right to left in the number, the place value increases, and vice versa. The hierarchy of place value starts with units, then tens, hundreds, thousands, ten thousands, hundred thousands, millions, ten millions, hundred millions, billions, ten billions, hundred billions, and so on.

Understanding the concept of place value is a crucial prerequisite for comprehending other mathematical concepts. Several experts such as Lestari (2019, p. 62), Ho dan Cheng (Yusri & Sari, 2018), Fuson (Yusri & Sari, 2018), as well as Van de Walle (Matitaputty et al., n.d.) emphasize the importance of a deep understanding of the place value concept in the context of mathematics education. This understanding is a critical prerequisite for comprehending addition and subtraction operations, serves as the foundation for understanding the number system, and aids in developing strategies for adding and subtracting multidigit numbers. While this process may

take time, place value is acknowledged as a fundamental basis for constructing a strong mathematical understanding. To comprehend this concept, it is essential to integrate the concept of grouping by tens with procedural understanding of numerical representation in place value format, as well as understanding how to write and pronounce numbers. Therefore, students must grasp the concept of place value

However, there are still issues with students not fully understanding the concept of place value. This can be observed when students are working on addition and subtraction problems and making mistakes. Students do not yet grasp that in addition, ones added to ones become tens, tens added to tens become hundreds, and so on. Similarly, in subtraction, hundreds subtracted from hundreds become tens, tens subtracted from tens become ones, and so forth. Upon further investigation, it appears that students have not fully understood the position of place value. Some students also struggle with counting numbers correctly. For example, the number 273 should be read as "two hundred seventy-three." However, some students disregard the place value, reading it as "two seven three." Clearly, this does not align with the concept of place value as it should

This happens because the current mathematics education still does not sufficiently support students in developing their understanding of the concept of place value. As a result, some students still struggle to grasp the fundamental concept of place value in mathematics. According to Sri (2021, p. 1616), Kholil (2019), Raharjo (2021), Yeni (2015), and Utari (2019), learning difficulties in mathematics can be attributed to two factors: internal factors originating from students themselves (physical health, intelligence, interest, and motivation) and external factors coming from outside students (family environment, the use of learning media, and the community environment). According to Lerner (in Asdar, 2021, 3; (Siskanti et al., 2021; Amanilah et al., 2020; Nari et al., 2016; Magdalena et al., 2020), learning difficulties in mathematics encompass struggles related to spatial relationships, difficulties in visual perception, challenges in visual-motor coordination, problems recognizing and understanding symbols, and difficulties in language and reading.

Considering this, mathematics education, especially concerning the concept of place value, should be given special attention to ensure that no more students encounter difficulties with this topic. Mathematics is an essential subject and is crucial to be taught to students, particularly the concept of place value, which serves as the foundation for other mathematical concepts. Therefore, if students do not grasp the concept of place value, they will likely struggle with other mathematical concepts.

Based on this background, this research aims to identify students' difficulties in understanding the concept of place value. The concept of place value chosen for this study is limited to hundreds as it aligns with the cognitive development level of second-grade students.

The focus of this research is to determine the common mistakes students make when working on exercises related to the concept of place value and to understand how students approach and answer questions concerning place value. This information will help educators anticipate the mistakes made by students and gain insights into students' comprehension of the place value concept.

METHOD

The approach used in this research is a qualitative approach with a descriptive method. Descriptive research is a type of research that aims to depict problem-solving based on collected data. The process involves data collection, data analysis, and data interpretation (Dewi, 2022). The descriptive method was chosen by the researcher with the aim of revealing students' understanding of the concept of place value, especially among 2nd-grade elementary school students. This research took place in one of the elementary schools in the city of Bandung. The sample in this study consists of 20 2nd-grade students. These students were given a test on the concept of place value, and their errors and their understanding of the place value material were analyzed.

The research instrument used in this study is a test instrument. This test instrument aims to identify children who have difficulty with the place value material. The test questions or material included in the questions are as follows: in question number one, students are asked to

determine the number of blocks in the picture. Questions number two to four require students to determine the place values of hundreds, tens, and ones. In questions number five and six, students are asked to write how to read the place value. In questions number seven and eight, students are asked to write the numeral representation. In question number nine, students are asked to determine which number is greater/less than, equal to. Finally, in the last question, students are asked to arrange numbers from the largest to the smallest.

RESULTS

Based on the test results, 75% (15 students) have reached the minimum score limit with an average test score of 70, while 25% (5 students) are still below the average score. Considering this, there are still students who find difficulty in mathematics, especially in the concept of place value.

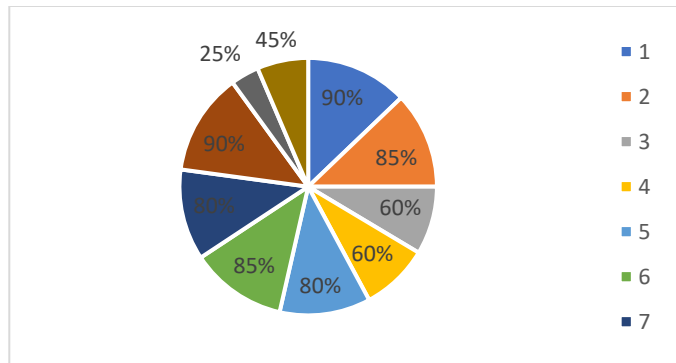


Figure 1 Analysis of student answer

Based on the analysis of the questions, for questions number one and eight, 90% of students were able to answer the questions, which involved determining the number of blocks in the picture and writing numerical symbols. Moving on to questions number two and six, 85% of the students were able to answer the questions, which were about determining the place value of hundreds, tens, and ones and writing how to read the place value. Similarly, for questions number five and seven, 80% of the students were able to answer the questions, which were about writing how to read the place value and writing numerical symbols.

However, for questions number three and four, only 60% of the students were able to answer the questions, which involved determining the place value of hundreds, tens, and ones, indicating a higher level of difficulty. The most common mistakes made by students were in questions number nine and ten, with only 25% and 45% of the total students being able to answer the questions related to determining the largest, smallest, or equal value and sorting a set of numbers.

For question number one, students were asked to count the number of blocks in the picture. The correct number of blocks in the picture is 171 (one hundred seventy-one). However, some students made mistakes in counting the blocks in the picture. Here is an overview of the mistakes made by the students:

1. 

Figure 2 Student responses

The error that occurred in question two is that the students made a mistake in determining the hundreds place. In the question, students were asked to determine the hundreds place in the number 345, which is 3 hundreds + 4 tens + 5 ones. However, the students wrote it as 300 hundreds, and this writing error significantly changes the meaning of the hundreds place. Here is an overview of the errors made by the students:

2. $345 = \underline{300}$ ratusan + 4 puluhan + 5 satuan

Figure 3 Student responses

The error that occurred in question three is that the students made a mistake in placing the place value. Students incorrectly wrote the numbers requested in the question. The place value of 175 as requested in the question is 1 hundred, 7 tens, and 5 ones. However, the place value written by the students is 100 hundreds, 70 tens, and 5 ones. Obviously, the student's answer differs in the meaning of the place value. Here is an overview of the errors made by the students:

3. **Tulislah nilai tempat ratusan/puluhan/satuan pada bilangan 175!**

$$\underline{100} \text{ Ratusan} + \underline{70} \text{ Puluhan} + \underline{5} \text{ satuan} = \underline{175}$$

Figure 4 Student responses

The error that occurred in question number four is that the students couldn't differentiate between the hundreds, tens, and ones places. The number 7 in the number 374 should have been in the tens place. However, there are still students who answered differently from the tens place. Here is an overview of the errors made by the students:

4. **Angka 7 pada bilangan 374 menempati nilai tempat** satuan

4. **Angka 7 pada bilangan 374 menempati nilai tempat** 70tUS

Figure 5 Student responses

In question number five, students were asked to write how to read the place value of the number 232. The number 232 is read as "two hundred thirty-two." However, some students wrote it incorrectly as "two hundred three two." This is, of course, an error in understanding place value. Here are the students' mistakes:

5. **232 dibaca** dua ratus tiga dua

Figure 6 Student responses

In question number six, the question is similar to question number five, which is to write how to read the place value of the number 111. The number 111 is read as "one hundred eleven." However, some students wrote it incorrectly as "one hundred ten one" and some wrote it as "eleven one." This, of course, results in a different interpretation of the value and number as intended in the question. Here are the students' mistakes:

6. **111 dibaca** seratus seratus satu

6. **111 dibaca** seratus satu

Figure 7 Student responses

Questions number seven and eight are the opposite of questions number five and six. In questions number five and six, students are asked to write how to read a number. In questions number seven and eight, students are asked to write the numeral representation of the numbers. In question number seven, students are asked to write the numeral representation of "seratus lima belas," which is 115. In question number eight, students are asked to write the numeral representation of "enam ratus tujuh puluh lima," which is 675. However, some students wrote the numeral representation incorrectly as 151, 3151, and 60075. Errors in writing the numeral representation of a number result in a different meaning of the number. Here are the mistakes made by the students:

7. **Seratus lima belas ditulis** 151

7. **Seratus lima belas ditulis** 3151

8. **Enam ratus tujuh puluh lima ditulis** 60075

Figure 8 Student responses

In question number nine, students are asked to determine which number is greater, smaller, or equal between two given numbers, especially in choosing the correct mathematical symbols to answer the question. The symbols used in the question are less than (<), greater than (>), and equal to (=) symbols. The error found in this question is that students are not yet able to distinguish mathematical symbols. Students often confuse between writing the less than symbol

and the greater than symbol. As a result, the answers written by the students have different meanings and are incorrect.

9. Tunjukkanlah bilangan berikut yang termasuk dalam bilangan kurang dari (<) atau lebih dari (>) atau sama dengan (=)!
- a. 455 $\underline{>}$ 546
- b. 228 $\underline{\leq}$ 221

Figure 9 Student responses

In question number ten, students are asked to arrange numbers from largest to smallest. The mistake made by the students is that they cannot determine whether the number is greater or smaller than the next number. Students cannot distinguish that the value of 354 is greater than 313. This can be seen from the larger tens digit. The value of 5 tens is greater than 1 ten. Students are also confused in reading the question, which should have been written from the largest to the smallest, but students wrote the numbers from the smallest to the largest. Both answers given by the students are certainly not in line with what the question asked. Here are the mistakes made by the students:

10. Urutkanlah bilangan 354, 313, 464, 224 dari yang terbesar ke yang terkecil!
- Handwritten student response:* 464, 313, 354, 224
10. Urutkanlah bilangan 354, 313, 464, 224 dari yang terbesar ke yang terkecil!
- Handwritten student response:* 224 313 354 464

Figure 10 Student responses

DISCUSSION

The mistakes made by students in answering these questions prove that there are still aspects of place value learning that have not been understood or are even challenging for learners to work on. These difficulties will undoubtedly impact other mathematical learning materials because place value is a fundamental concept in mathematics. Furthermore, in mathematics education, the topics taught are interconnected and often, even simple concepts serve as prerequisites for understanding more complex ones, as stated by Matitaputty (n.d.). If students do not grasp the fundamental concepts in mathematics, it is not impossible for them to face difficulties in understanding other concepts.

As explained in "Mathematics in the New Zealand Curriculum" (Matitaputty et al., n.d.) and Putri (Khaira, 2020), place value is a multidigit concept determined by its position, where the more digits there are, the more place values there are. It is evident that students make mistakes in determining the position of the requested digits in questions 2, 3, and 4.

The learning difficulties identified align with the views of Lener (in Asdar, 2021, 3; Siskanti et al., 2021; Amanilah et al., 2020; Nari et al., 2016; Magdalena et al., 2020) regarding learning challenges. In question number ten, which pertains to ordering numbers, students exhibited spatial relationship difficulties. Question number one, which requires determining the number of blocks in an image, indicated that students had learning difficulties related to visual perception and visual-motor association. Meanwhile, questions number two, three, four, and nine, involving the concept of place value (hundreds, tens, and ones) and comparisons of numbers, revealed that students faced challenges in recognizing and comprehending mathematical symbols. As for questions number five, six, seven, and eight, which deal with reading place values and writing numerical symbols, students demonstrated difficulties in language and reading comprehension.

One of the teaching approaches that can assist students in understanding the concept of place value is sequential and multi-representational-based learning. Teaching students using a sequential approach is expected to make it easier for students to comprehend the subject matter. As explained earlier, mathematics should be taught starting from the simplest to the most complex concepts and progressively bertahap (Abrar (2015, p. 52); Suherman dalam (Nasaruddin, 2013,

p. 65). Therefore, a sequential teaching approach that starts from concrete to abstract concepts can undoubtedly help students understand mathematical content.

Multi-representational-based learning is designed to enhance students' representation abilities. Multi-representation is the capability of students to demonstrate the same concept in different forms (Maula & Astuti, n.d.). This representation skill is a vital aspect of developing students' thinking skills (Handayani & Juanda, 2018). Representation ability is how students interpret problems and utilize tools to find solutions (Handayani & Juanda, 2018; Maula & Astuti, n.d.; Sabirin, 2014). With this skill, students can more easily tackle mathematical problems by expressing their ideas through verbal, symbolic, or visual means.

Therefore, systematic and multi-representational-based learning is an effective solution in helping students understand the concept of place value. The principles of starting with simpler concepts and progressing to more complex ones, aligned with the characteristics of progressively taught mathematics, play a crucial role in assisting students in grasping this concept.

CONCLUSION

One of the fundamental concepts in mathematics is the place value concept. This concept is crucial for students to grasp before delving into other numerical concepts. However, issues with students' understanding of the place value concept persist, leading to mistakes in solving mathematical problems related to addition and subtraction.

Based on test results, 75% of the students (15 students) have achieved the minimum passing score with an average test score of 70, while 25% (5 students) are below the average score. Analysis of the specific questions indicates that the majority of students have been able to answer questions number one and eight (90%), which involve determining the number of blocks in a picture and writing numerical symbols. Furthermore, in questions number two and six (85%), students can determine the place value of hundreds, tens, and ones and write how to read place values. However, questions number three and four (60%), which involve determining the place value of hundreds, tens, and ones at a more advanced level, still pose difficulties for some students. The most frequent errors occurred in questions number nine and ten, with only 25% and 45% of students providing correct answers. These mistakes primarily involve identifying the largest or smallest value in a number and arranging numbers in order. Students' struggles with understanding the place value concept can affect their comprehension of other mathematical topics, as mathematical concepts are interconnected, and simple concepts can serve as prerequisites for understanding more complex concepts. There are five types of math learning difficulties: difficulties with spatial relationships, visual perception difficulties, visual-motor association difficulties, difficulties recognizing and understanding symbols, and difficulties with language and reading.

To enhance students' understanding of the place value concept, a more appropriate teaching approach is needed to address the level of difficulty experienced by students. One of the teaching methods that can assist students in comprehending the place value concept is sequential and multi-representational-based learning. This topic should also receive increased attention in the mathematics curriculum because it serves as a crucial foundation for mathematics education.

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