Learning Obstacle of Addition Operation Whole Number in Elementary Schools

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Abstract. This study aims to analyze the learning obstacle of students in elementary schools on the addition operation whole number. The research method used is a qualitative descriptive research method. The subjects of this study were 15 elementary school students who were selected using a purposive sampling technique. Data collection techniques include non-participatory observation, test of addition operation whole number in the form of story questions, unstructured interviews, and documentation studies. The results showed that there were learning obstacle for elementary school students found in the addition operation whole number including: 1) students had difficulty understanding the meaning of the questions; 2) students have difficulty understanding the concept of place value; 3) students have difficulty translating questions into math sentences; 4) students have difficulty doing addition calculations, other than the pattern a+b= ?; 5) students have difficulty giving conclusions from the results of their work; and 6) students do not have confidence in solving problems. This study concludes that students experience three types of learning obstacles, namely: ontogenic obstacle, didactical obstacle, and epistemological obstacle. The implications of the results of this study can be used as an analysis of student learning needs and the factors that affect student learning difficulties, especially in mathematics.

1. Introduction
Mathematics is seen as an activity that is often encountered in everyday life. Mathematical activities include interpreting, predicting, proving, concluding, compiling, explaining, predicting, generalizing, classifying, finding, and solving problems [1][2]. It differs from the view that mathematics is dominated by calculations and rules without reason [3]. A person's views and one's experiences of mathematics affect students' perceptions of mathematics. This will later affect the achievement of mathematical competencies at the next level, as well as other fields that require mathematical skills [4][5].

Mathematics should be seen as a concept that is connected to the context of everyday life and other disciplines [3][6] and can enable students to express the meaning of what they are learning in their own language [7]. Mathematics learning is basically related to three factors, namely students, teachers, and material [2][8]. The delivery of material greatly affects the quality of learning obtained by students. For example, if the material is too difficult, the student learning process will experience obstacles, and if the material is too easy, the development of students' intellectual capacity will be hampered. This is in line with Vygotsky's theory that the learning process occurs when students reach the Zone of Proximal Development (ZPD) [7].

In practice, many students experience learning barriers. This is in line with the theory which states that every individual has the potential to experience obstacles in learning, as well as in learning
To achieve ZPD and minimize obstacles to the learning process, it is necessary to prepare carefully, including starting from the identification of learning barriers by the class teacher. This obstacle consists of four parts, namely didactic obstacles, epistemological obstacles, cognitive obstacles, and psychological obstacles [10]. The learning barriers analyzed in this study included: ontological obstacle, didactic obstacle, and epistemological obstacle [9].

Barriers to learning can be seen directly from the motor, cognitive and affective aspects as well as the learning process and results achieved [11]. Barriers to learning in the long term can lead to stagnation or even decrease in student knowledge [12]. This is in line with Pia's opinion which states that learning barriers cause a learning condition that is not good or it should result in students producing low learning achievement. Furthermore, learning barriers can cause a person to have difficulty absorbing abstract concepts, poor memory skills, slow work, and less thoroughness in details [10][13]. Taking into account the dangers of learning difficulties if not handled immediately, it is necessary to have a diagnostic study of learning difficulties. Diagnostic learning difficulty here is the process or effort in understanding the types and characteristics of the difficulties and what factors are behind the learning difficulties. This activity is intended to seek and find solutions to problems in learning difficulties experienced by students.

One of the basic mathematics materials that often experience learning difficulties is the material of adding whole numbers. Based on the background explanation above, this study aims to analyze the learning barriers experienced by students in the summation material.

### 2. Method

This research is part of a qualitative descriptive study. The study participants were 15 students of grade II at elementary schools who were selected using a purposive sampling technique. Data collection techniques include non-participatory observation, tests with the sum of the form of the story, unstructured interviews, and study documentation. The data analysis technique used in this research is an interactive analysis [14]. The interactive analysis is used because this type of research is qualitative research whose purpose is to emphasize extracting information in-depth, describing, exploring, and interpreting research data, so the use of interactive analysis is felt to be very supportive of the research objectives. The stages of data analysis are data validity, data collection, data reduction, data presentation, and drawing conclusions [15]. Research procedures carried out: first, students are given the addition test questions adopted from the structure of the joint and separate addition problem. [3] (table 1); second, the results of students' answers were analyzed (documentation study), and third, interviews as confirmation of the results of students' answers. The following is a description of the sum test questions given.

| Addition Type          | No | Item Questions                                                                 |
|------------------------|----|-------------------------------------------------------------------------------|
| A + B = ?              | 1  | Geri has 7 marbles. Sidik gives 8 of his marbles to Geri. How many Geri marbles are there? |
| ? + B = C              | 2  | Geri has 26 marbles. Sidik gave Geri some of his marbles. Now Geri has 53 marbles. How many marbles did Sidik to Geri? |
| A + ? = C              | 3  | Geri has several marbles. Sidik added 78 of his marbles to Geri. Now Geri has 102 marbles. How many marbles were Geri before? |
| A + B = ? (> 1 digit)  | 4  | Geri has 107 marbles. Sidik gives 74 of his marbles to Geri. How many Geri marbles are there? |

### 3. Results and Discussion

In this study, to find learning obstacles from the addition material, four addition test questions were given with different types for each question. The following is an analysis of students' answers to each type of question given.
3.1. Students’ Answers to Type 1 Questions

In question type 1, the addition problem with type \( a + b = ? \). From the results of the students’ answers, it was found that the students answered correctly the problems given. But the drawback is that students do not provide conclusions on the results of solving the questions. Even though procedurally in solving the story problem, a conclusion is needed at the end of solving the problem. To confirm the results of students’ answers, interviews were conducted with students and teachers. Based on the results of interviews with students, it was found that the students did not understand the last number as a result of the calculation which was the number of marbles. Students only carry out calculations and cannot conclude. Students also admitted that they forgot to conclude at the end because students were not familiar with the story questions. They mostly operate the addition directly and rarely do the story problems. Furthermore, the results of the interview with the teacher showed that the teacher practiced compound addition more often so that students were good at arithmetic compared to giving story questions related to the addition of whole numbers. The teacher guides the students to read the questions first, focuses the students on what is being asked then immediately operates the additions. This shows that the teacher does not train students to draw conclusions.

Based on the results of the interview, it can be concluded that students more often do addition which directly involves numbers in a short structured manner. On the other hand, the teacher does not place too much emphasis on the importance of a conclusion, but rather on the results of calculations. This is in line with several theories which state that a common mistake of students in solving math problems is drawing conclusions [16][17][18]. Furthermore, this is supported by the theory which states that the teacher’s mistake in teaching mathematics is not deepening the concept but going straight to the technicalities and getting instant answers [19][20].

After being confirmed through student and teacher interviews, this problem was also seen from the textbooks used. It turns out that in textbooks from grade I elementary school, students have been facilitated to learn to conclude a problem as shown in picture 2, but in textbooks for grade II elementary school students are not facilitated to conclude answers as shown in picture 3.

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**Picture 1.** Examples of student answers to type 1 questions

(a) \[7 + 8 = 15\]  
(b) 

**Picture 2.** One of the materials in the textbook for grade 1 elementary school students
Based on the results of the document study, it can be concluded that textbooks, especially in grade 1 elementary schools, have been facilitated to conclude the answers to the calculation results. However, some materials in grade 11 elementary school students are not facilitated to learn to conclude the answer to the calculation results. This lack of clarity can lead to failure in providing adequate learning resources for students and will have a negative impact on student learning in the future [21].

In the findings of the first question, based on the results of analyzing student answers, interviewing students and teachers, and looking at teaching materials (books), it was found that students had minimal experience working on story questions and concluding answers from story questions. Actually, the student's experience was appropriate to meet the criteria for answering the questions given, but there was a shift or gap in the delivery of teaching material which was initially accustomed to concluding problems, but in fact, this did not happen as expected. Then in learning, students rarely do math problems in the form of stories but instead use numbers directly, which means that students' experience in working on story problems is very lacking. This condition causes students to experience a learning obstacle with the types of ontogenic obstacle and didactical obstacle [9]. This contrasts with the theory which states that learning is an effort to provide a learning experience that encourages students to experience more (do or observe), interact, communicate, and provide feedback so that students can construct their own meaningful knowledge [22][23].

3.2. Students' Answers to Type 2 Questions

Based on the answers given, the picture above shows the students answered with different solutions. Student answers with graded addition and student b answers with graded subtraction. To confirm students' answers, the following interviews were conducted.

\[ P : \text{This is why it was added?} \]
\[ S : \text{This is a "give". (S while pointing to the word give in question)} \]

After being confirmed why answering with a structured summation procedure, a student gives a reason because there is the word "give". Students assume that if given then the number will increase. This shows that students can interpret the word, but do not see the situation given in the question so there is confusion. [24] and [25] in his research also states that the learning difficulties that students often experience in solving the story is the difficulty of understanding sentence by sentence and the meaning of the question. On the other hand, students b already understand if what they are looking for is the difference between the final number and the initial number of Geri marbles. However, there is an error in performing the calculation operation. Although students may try to use other summation...
strategies such as the concept of counting on and counting back as another alternative in completing summation operations [3]. To confirm the students' answers, the following interviews were conducted.

\[ P: \text{Is it true that his writing is like this? (P indicates S answer)} \]

\[ S: \text{Yes... (S smiling)} \]

\[ P: \text{Where is the answer from five hundred and sixteen? (P indicates S answer)} \]

\[ S: \text{Six are lowered, three minus two, five are lowered. (S while pointing to the answer)} \]

From the results of the interview, it is seen that students understand the meaning of the given question but make mistakes in solving the question. Such errors include difficulties in linking the concept of place value in problem solving. Next to confirm the student learning experience, an interview with the teacher was conducted. The results of the interviews show that teachers rarely give story questions because many students have not read and written fluently. Learning is also given without the context of the story but directly using numbers or pictures such as circle pictures. This is in line with the fact that there are still students who do not read fluently, so it affects when understanding the question. Students 'inability to read causes students' inability to understand the sentences and context of the question and the long-term effects of students can not understand the next material so that learning is difficult to control [26]. Then, to confirm the type of summation that students learn, the following textbooks are analyzed.

![Picture 5. Textbook for grade 1 elementary students](image)

The previous textbook analysis (picture 2) shows the sum of the \( a + b = c \) types, and again found in the sum of the textbooks the sum of the types is a similar, \( a + b = c \), so that students do not have the experience to work on type 2 questions. Then, to confirm the students' experience of the following place values that we found in the textbook.

![Picture 6. Place value material grade II elementary students](image)

Based on the analysis of teacher interviews and textbooks, our learning obstacle type is indicated into two types, namely ontogenic obstacle, and epistemological obstacle [9]. The ontogenic obstacle can be seen from the fact that students have not mastered learning and misconceptions about the value of place and there is no teacher anticipation in this lesson. This is supported by the results of the study that there is a misconception of place values in elementary school students [27] [28]. In addition, students experience an epistemological obstacle due to the lack of learning experience related to solving math problems. Students' experiences in obtaining material also have an effect on solving the problems given (epistemological obstacle). The experience of students in this study is still limited to the type of addition \( a + b =? \), Even though the concept of \( a + b =? \) can it be changed to the equation \( a +? = c \) or \( c -? = a \), these
two equations represent the concept of addition according to the situation at hand [3][29]. This is in line with the research results that the act of joining is not always addition, and the act of separating or removing does not always mean subtraction [29]. This is because the concept of addition goes hand in hand with subtraction, which is the opposite of one another.

3.3. Students' Answers to Type 3 Questions

From student a's the answer, it was found that the students understood the problem, the students solved the problem by finding the difference between 102 and 78. However, there was an error in writing the place value that caused the calculation to be wrong. Following are the results of interviews with student a.

\[ P : \text{Where did the 382 come from?} \]
\[ S : \text{One hundred and two minus seven eight} \]
\[ P : \text{How?} \]
\[ S : \text{Hmmm... (S smiled while scratching his head). It drops by two because there are no friends (S points to number 2). Eight were taken down. Ten is reduced to seven.} \]
\[ P : \text{What about zero?} \]
\[ S : \text{Hmmm, zero doesn't exist.} \]

From the results of the interview, students gave reasons if number 2 did not have a computation partner so that it could be rewritten, 0 was meaningless, and the number 10 was minus 7. Meanwhile, student b gave the reason for the number 78 plus 102 because in the question there was the word "add". In addition, a similar case was found in student b's answer, in which students experienced errors in writing place values. According to the students, they were not familiar with story problems, so they experienced confusion. Usually, math problems are presented directly in the form of numbers. This causes students to have difficulty interpreting mathematical problems, especially the form of story problems, and finally experiencing some difficulties and errors in solving math problems. [13, 14, 15, 16]. The following are the results of interviews with students.

\[ P : \text{Why was this added?} \]
\[ S : \text{Hmmm (looks like S is reading the question again), right? There's the word "add".} \]
\[ P : \text{Ok, if this is eight hundred and eighty-two from where?} \]
\[ S : \text{Two down, eight plus zero to eight, seven plus one to eight.} \]

The problems found from students' answers to type 3 questions were the same as problems in type 2 questions, students still had difficulty performing addition count operations other than the form \( a + b = ? \). Difficulty applying place values to problem-solving, and focusing on certain words such as "give" and "add" regardless of the context of the whole problem. The results of interviews with the teacher showed that the teacher only used textbooks as a learning resource, used a model that was not varied, did not use any learning media, and did not ensure that students really understood. Teachers must have creativity, dare to innovate, be full of obsession and be able to teach themselves to apply learning models, media, and learning resources in order to provide a fun, active, inspirational, and imaginative learning. [30][31].

The teacher's approach to the learning process greatly influences students' thinking skills in understanding learning (didactical obstacle). In solving math problems, the teacher can lead students to create different computational methods, in addition, the material can use number lines or trace place values [3][32]. This is because basically, the value of a procedure must be based on accuracy and efficiency [3]. Furthermore, the problem-solving in the third problem can be broken down into a
continuous subtraction and calculated based on the place value. As has been described in the student
textbook as follows.

![Place value in grade II textbooks](image1.jpg)

Based on the results of the analysis of student answers and teacher and student interviews, then
supported by the analysis of the textbooks used, it was found that in the learning process students
experienced a learning obstacle with the types of epistemological obstacles, didactical obstacle, and
ontogenic obstacle.

3.4. Students' Answers to Type 4 Questions

![Results of Students' Answers to Question 3](image2.jpg)

Picture 8. Place value in grade II textbooks

Picture 9. Results of Students' Answers to Question 3

Picture 8 (a) shows the student's answer is 811. When confirmed, the answer comes from the sum of the
compound \( 7 + 4 = 11 \), \( 1 + 7 = 8 \). The number 0 is not operated because 0 is considered to have no value.
The following are the results of interviews with students.

\( P \): Where did this answer eight hundred and eleven?
\( S \): From one hundred seven plus seven four.

\( P \): Continue to do it?
\( S \): Seven plus four so… (S seems to be counting on his fingers), eleven. One plus seven makes eight.

\( P \): if this zero? (P refers to the number 0 in number 107)
\( S \): There isn't zero.

The error shown from the interview results above is the misconception of place values (ontogenic
and epistemological obstacle) which causes students to have difficulty mastering the concept of addition
[9]. This is similar to the problem in previous studies that students have misconceptions on addition
operations that involve a value of 0 [33]. Students think of the value of the number 0 in different ways,
even though zero is a number, not "nothing" [29]. Based on the results of the interview, the teacher
explained that the delivery of place value material had been done. This is done using the media of place
value blocks, number boards, and colored number cards as follows (example for the number 107).

![Place value of 107](image3.jpg)

Picture 10. Place value of 107
The number 7 occupies the unit value, the number 0 occupies the value of tens, the number 1 occupies the value of hundreds, meaning $107 = 100 + 0 + 7$. To confirm the understanding of the value of this place, the following interview was conducted.

$P : \text{for the number 107, try to answer this question, 1 is called? 0 is called? And 7 is called?}$

$S : \text{1 is tens, 0 is hundreds, and 7 units, so } 10 + 0 + 7$

$P : \text{you know how come 1 tens and 0 hundreds?}$

$S : \text{yes } 10 + 0 = 100$

Then, the way the teacher teaches addition operations with numbers more than one digit usually uses the short-term addition method as follows.

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  107
+  74
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  181
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Starting from the far right (unit), the result is 11, write 1 store 1 tens above 0 tens. So the number $107 + 74 = 181$.

Meanwhile, in student textbooks, to solve addition problems with type 4 this can be done in 2 ways as follows.

**Method 1**

- **Cara panjang**
  - $125 = 100 + 20 + 5$
  - $117 = 100 + 10 + 7$
  - $200 + 30 + 12$
  - $200 + 30 + 10 + 2$
  - $200 + 40 + 2$
  - $242$

**Method 2**

- **Cara pendek**
  - $125 + 7 = 132$
  - $242$
  - $1 + 1 = 2$

![Figure 11. Method to add more than one digits](image)

Based on the results of the analysis of students’ answers and interviews with teachers and students, it was obtained data that during the learning process, especially the addition operation material, students did experience difficulties. the teacher makes the lesson plan as a complement to the administration and does not implement it. Furthermore, the teacher admitted that he had explained the same thing many times but some students did not understand it so the teacher decided to continue the material. Even though the benchmarks for the success of a teaching are measured by the extent to which students can master the subject matter delivered by the teacher [34][35]. In type 4 questions, the learning obstacle found was an ontogenic obstacle and a didactic obstacle.

4. Conclusion

Based on the results of the research analysis, we can provide six conclusions about the learning barriers of elementary students. First, students have difficulty understanding the meaning of the questions. Second, students have difficulty understanding the concept of place values. Third, students have difficulty translating questions into math sentences. Fourth, students find it difficult to calculate addition operations, other than the pattern $a + b = ?$. Fifth, students have difficulty giving conclusions from the results of their work. Finally, students are not confident in solving the questions given. Student learning barriers in the operation of adding whole numbers can be categorized into three types of learning barriers, namely: ontogenic obstacle, didactical obstacle, and epistemological obstacle. The implications of the results of this study can be used as an analysis of student learning needs and the factors that affect student learning difficulties, especially in mathematics. Based on the conclusions of this study, there are several recommendations for teachers to use prior knowledge learning methods, often provide feedback, provide student-centered learning, self-monitoring to reciprocal teaching to overcome student learning
difficulties. Then, for schools, it is expected to be able to overcome learning difficulties faced by students through programs that support to overcome learning difficulties. For further researchers, it is hoped that they can explore and explore the factors that cause learning difficulties and explore indicators that can lead to learning difficulties faced by students so that student learning difficulties can be overcome and student learning achievement can be achieved optimally.

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