

## **An Analysis of the Ability to Understand Mathematical Concepts of Middle School Students in Completing Integer Operations**

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### **Abstract**

Understanding mathematical concepts is a crucial skill for students to possess because it will make it easier for students to learn and master concepts in mathematics. This study aimed to describe the ability to understand mathematical concepts of junior high school students in solving integer arithmetic operations. This type of research was descriptive qualitative. The subjects in this study were seventh-grade students in one of the public junior high schools in Purworejo district in the 2020/2021 academic year with a good understanding. The technique of selecting the subject was purposive and snowball. The data analysis technique employed was the analysis technique of Miles & Huberman; data reduction, data presentation, and conclusion drawing. The results of this study indicated that students' understanding of mathematical concepts in completing arithmetic operations were as follows; students could restate a concept in writing, students could provide examples and not examples of a concept they have learned, students could use and choose certain operations in solving mathematical problems, students could not present concepts in the form of mathematical representations in the form of pictures, students could not classify objects according to certain properties according to the concept, and students could not apply the concept algorithmically to problem-solving.

**Keywords:** Operations to Count Integers, Understanding Mathematical Concepts, Mathematical Representation

### **Abstrak**

Pemahaman konsep matematis menjadi hal penting yang sebaiknya dimiliki oleh peserta didik. Karena akan memudahkan peserta didik untuk belajar dan menguasai konsep-konsep dalam matematika. Tujuan penelitian ini adalah mendeskripsikan kemampuan pemahaman konsep matematis siswa SMP dalam penyelesaian operasi hitung bilangan bulat. Jenis penelitian ini adalah penelitian kualitatif deskriptif. Subjek dalam penelitian ini adalah siswa kelas VII di salah satu SMP Negeri yang berada di kabupaten Purworejo tahun pelajaran 2020/2021 yang memiliki pemahaman baik. Teknik pengambilan subjek pada penelitian ini adalah dengan *purposive* dan *snowball*. Teknik analisis data yang digunakan yaitu teknik analisis dari Miles & Huberman yaitu reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian ini menunjukkan bahwa pemahaman konsep matematis siswa dalam menyelesaikan operasi hitung bilangan sebagai berikut, yaitu mampu menyatakan ulang sebuah konsep secara tertulis, mampu memberikan contoh dan bukan contoh dari suatu konsep yang telah mereka pelajari, mampu menggunakan dan memilih operasi tertentu dalam menyelesaikan masalah matematika, tidak mampu menyajikan konsep dalam bentuk representasi matematis berupa gambar, tidak mampu mengklasifikasikan objek-objek menurut sifat-sifat tertentu sesuai dengan konsepnya, dan tidak mampu menerapkan konsep secara algoritma pada pemecahan masalah.

**Kata Kunci:** Operasi Hitung Bilangan Bulat, Pemahaman Konsep Matematis, Representasi Matematis

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## INTRODUCTION

Mathematics has a vital role in advancing human thinking and is the basis for the development of modern technology at this time (Arifin & Herman, 2018). In the future, humans can create technology, so they need a strong mastery of mathematics (Ginanjar, 2019). Mathematics learning is the process of providing learning experiences to students through a series of planned activities so that students gain competence about the mathematics they have learned (Muhsetyo, 2008). One of the goals of learning mathematics is to understand concepts (Kartika, 2018). Concept understanding is the competence shown by students in carrying out procedures (algorithms) in a flexible, accurate, efficient, and precise manner (Lestari, 2018; Wardhani, 2008). Conceptual understanding refers to an understanding integrated with ideas to enable them to learn new ideas by connecting old ideas that they already know (Killpatrick, 2001). Therefore, understanding concepts is important to be mastered by students, especially understanding mathematical concepts in learning mathematics.

Understanding mathematical concepts are the ability to understand mathematical concepts as a form of achievement in learning mathematics by showing understanding of the concepts they learn, explaining the linkages of concepts, and applying concepts flexibly, accurately, and efficiently in solving mathematical problems (Handayani, 2016; Anggraeni, 2016; Sari, 2017). Understanding mathematical concepts is the process of individuals mastering by receiving information obtained from learning which is seen through the ability to behave, think and act. Students evidence it by understanding the definition, special characteristics, nature, and core/ content of mathematical material and choosing and using procedures efficiently and appropriately (Afifah & Sopiany, 2017). On the other hand, the research results on the ability of junior high school students to solve integer arithmetic operations questions are classified as very low (Karuru, 2014). It shows the low ability of students to solve integer arithmetic operations questions.

The ability of students to solve problems is crucial in learning mathematics because students need to have an understanding of concepts to solve problems (Rismawati & Hutagaol, 2018). Therefore, understanding concepts in learning mathematics is essential (Sari, 2014). Through understanding the ability, students are expected to understand mathematical concepts well (Hikmah, 2017). So the need for understanding students' mathematical concepts in solving integer arithmetic operations shows the low ability of students to solve integer arithmetic operations questions.

The students' activities in solving mathematical problems can be seen from the ability of students' mathematical concepts through its mastery indicators. According to Handayani & Aini (2019), indicators of understanding mathematical concepts include restating a concept, classifying objects according to certain properties of its concept, giving examples and not examples of a concept, presenting concepts in various forms of mathematical representation, developing necessary conditions and concept, using and utilizing and choosing certain procedures or operations, and applying concepts or algorithms in problem-solving. Whereas in NCTM (2000), students' understanding of mathematical concepts can be seen from students' ability to define concepts in speaking and writing,

identify and create examples and examples of disclaimers, use models, diagrams, and symbols to represent a concept, changing one form of representation to another, recognizing various meanings and interpretations of concepts, identifying the properties of a concept and recognizing the conditions that determine a concept, and comparing and contrasting a concept. Therefore, based on the indicators of understanding mathematical concepts above, the indicators in this study are being able to restate a concept in writing, classify objects according to certain properties according to the concept, and give examples and not examples of a concept they have learned, able to present concepts in the form of mathematical representations or images, able to use and select certain operations in solving mathematical problems, and able to apply concepts algorithmically in solving mathematical problems.

The importance of understanding mathematical concepts for students is that mastery of concepts will make it easier for students to learn mathematics. With good mastery of concepts, students have reasonable basic provisions to achieve basic abilities (Hartati, et al, 2017). One of the abilities to understand mathematical concepts that seventh-grade junior high school students must master is to complete integer arithmetic operations. Based on the description above, understanding the importance of students' mathematical concepts and the concepts of integer arithmetic operations are necessary to conduct a study to understand mathematical concepts in solving integer arithmetic operations. This study aimed to determine the ability to understand mathematical concepts of junior high school students in completing integer arithmetic operations.

## METHODS

This study employed a qualitative method with a descriptive approach. Qualitative research intends to understand the phenomenon of what is experienced by research subjects (Moleong, 2014). Whitney (1960) states that the descriptive method is fact-finding with the correct interpretation. This research was conducted in Seventh Grade in one of the public junior high schools in the Purworejo district.

The subject selection utilized purposive and snowball samplings. According to Sugiyono (2016), purposive sampling is a subject collection technique with certain considerations. The subjects of this study were seventh-grade students of junior high school and obtained a good understanding. Students with good understanding were obtained by categorizing students' abilities according to Arikunto (2018) in Table 1.

**Table 1.** Boundary criteria for research subject groups

Value Criteria	Category
$x > \bar{x} + SD$	High
$\bar{x} - SD \leq x \leq \bar{x} + SD$	Medium
$x < \bar{x} - SD$	Low

From Table 1, students with good understanding were selected from students in the high category. According to Sugiyono (2016), snowball sampling is a technique for collecting data sources initially small in number but eventually become large. Students who met the criteria were administered with a test after obtaining the research results. Data collection was conducted repeatedly to get the similarities, then at least two subjects were selected for analysis.

Sugiyono (2016) suggests that data collection techniques are an essential part of a study to obtain data that meets the data standards set. This research's data collection techniques were test methods, field notes, interview methods, and documentation. In qualitative research, the main instrument is the researcher himself (Sugiyono, 2016). The researcher used supporting instruments in descriptive questions about integer arithmetic operations (see Figure 1) and interviews. The instrument was developed based on the indicators used in this study. To obtain an optimum written test result, the items are consulted with the validator. In this study, the validity of the instrument employed was content validity. The validity test was carried out by examining the items by expert validators, namely lecturers in mathematics education. The results of the content validity obtained that the instrument used was valid. The following is Figure 1 of the test instrument for understanding mathematical concepts in integer arithmetic operations.

SOAL	Translation:
1. Apa yang kalian ketahui tentang bilangan bulat? Serta berikan contoh dari bilangan bulat dan bukan bilangan bulat!	1. What do you know about integers? And give examples of integers and non-integers!
2. Suhu disuatu tempat A adalah $4^{\circ}\text{C}$ di bawah nol. Suhu disuatu tempat B adalah $10^{\circ}\text{C}$ di atas nol. Jika suhu disuatu tempat C adalah tepat diantara suhu tempat A dan B, maka berapakah suhu tempat C?	2. The temperature at place A is $4^{\circ}\text{C}$ under zero. The temperature somewhere B is $10^{\circ}\text{C}$ above zero. If the temperature at place C is exactly between places A and B, what is the temperature of place C?
3. Jika $a = -5, b = -2, c = 3$ dan $a(b + c) = -5(-2 + 3) = -5(1) = -5$ . Adakah cara lain untuk menentukan hasil yang sama pada operasi hitung tersebut? Jika ada bagaimana caranya?	3. If $a = -5, b = -2, c = 3$ and $a(b + c) = -5(-2 + 3) = -5(1) = -5$ . Is there another way to determine the same result in the arithmetic operation? If so, how?
4. Seorang peserta ujian masuk perguruan tinggi. Seorang peserta ujian masuk perguruan tinggi menjawab 39 soal dengan benar dan 12 soal salah dari 60 soal yang diberikan. Jika setiap jawaban benar diberi skor 5, jawaban salah diberi skor -3, dan soal yang tidak dijawab diberi skor 0. Berapa skor yang diperoleh peserta ujian tersebut?	4. A senior high school student register to university. He gives 39 correct answers and 12 incorrect answers out of 60 questions available. If each correct answer has 5 scores, the incorrect answer is -3, and the blank answer is 0. How many scores did the examinee obtain?

**Figure 1.** Concept understanding test questions

From Figure 1, for question number 1, students were expected to restate a concept in writing and give examples and not examples of a concept they have learned. In question number 2, students were expected to present concepts in the form of mathematical representations in the form of images.

In question number 3, students are expected to classify objects according to specific properties according to the concept. In question number 4, it is expected that students can use and choose certain operations in solving mathematical problems and can apply concepts in an algorithmic way to solve mathematical problems.

For the interview, the method used was an unstructured interview. The data analysis technique in this study was based on qualitative descriptive data analysis. According to Miles & Huberman (Sugiyono, 2016), it was conducted through three stages; data reduction, data presentation, and conclusion drawing. The researcher used the triangulation technique, namely analyzing data based on the results of the mathematical concept, understanding tests on the completion of integer arithmetic operations, and interviews.

## RESULTS AND DISCUSSION

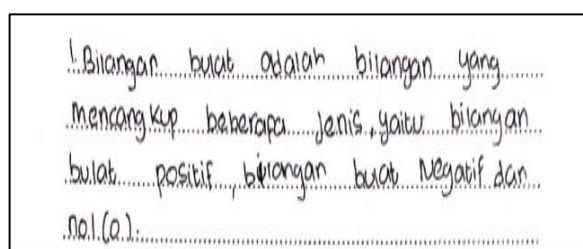
The following shows the results of the categories of students in the high, medium, and low ability groups. This data was obtained through the results of students' test scores in VII grade on mathematics.

**Table 2.** Criteria for boundary groups of research subjects

Value Criteria	Category	The number of students
$x > 84,325$	high	7
$48,675 \leq x \leq 84,325$	medium	19
$x < 48,675$	low	6

Based on Table 2, there were 32 students included and 7 students were in high category students, 19 students were medium level, and 6 students were included in the category of low skill students. The researcher took seven students with high ability as prospective subjects to work on integer arithmetic operations.

From the results of student answers on the ability to understand mathematical concepts in solving integer arithmetic operations, several identical answers later became the subject of this study, including Sj1. The following is a picture of Sj1's answer to question number 1.

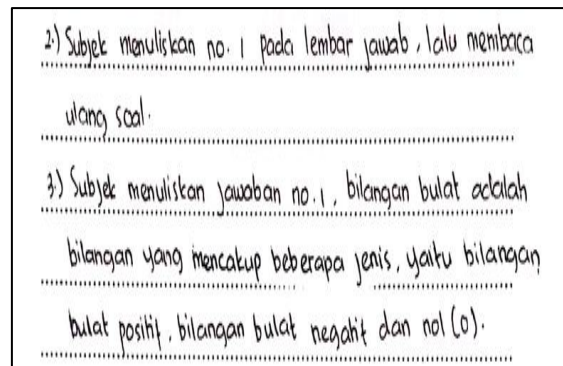


**Translation:**

1. Integers are numbers that include several types, namely positive integers, negative integers and zero

**Figure 1.** Results of Sj1's answer writing the definition of integers

From Figure 2, it can be seen that S<sub>j1</sub> writes down the meaning of integers, namely "an integer is a number that includes several types, such as positive integers, negative integers and zero (0). Based on the results of S<sub>j1</sub>'s answer on the answer sheet, it can be seen that S<sub>j1</sub> answered correctly regarding the meaning of integers. The picture of the results of the researchers' field notes on S<sub>j1</sub>.



**Translation:**

2. Subject writes no. 1 on the answer sheet, then reread the questions.
3. Subject writes the answer no. 1, integers are numbers that include several types, namely positive integers, negative integers and zero (0).

**Figure 3.** Field Notes S<sub>j1</sub> writing the definition of integers

Figure 3 shows that S<sub>j1</sub> reads the question and S<sub>j1</sub> immediately writes the answer to question number 1, namely the meaning of integers. S<sub>j1</sub> wrote down the meaning of integers: "integers are numbers that include several types, namely positive integers, negative integers, and zero (0). Based on the results of the field notes, it showed that S<sub>j1</sub> could answer correctly and precisely regarding the meaning of integers. The following is an excerpt from the interview result of the researcher (P) with S<sub>j1</sub>.

- P : "Going directly to number one, that's what you guys know about integers. What did you answer earlier?"  
 S<sub>j1</sub> : "An integer is a number that includes several types; positive integers, negative integers and zero".

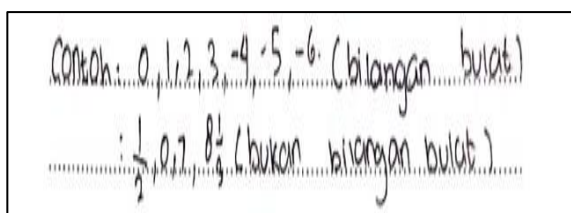
From the excerpt from the interview above, it could be seen that S<sub>j1</sub> directly answered the questions from the researcher. The researcher asked about the answers that S<sub>j1</sub> knew about integers. S<sub>j1</sub> could directly answer the questions asked by the researcher. S<sub>j1</sub>'s answer regarding the meaning of integers is "an integer is a number that includes several types; positive integers, negative integers and zero." Based on the researcher's interview with S<sub>j1</sub>, it could be seen that S<sub>j1</sub> answered correctly and appropriately on the researcher's question about the meaning of integers.

The work results, field notes, and interviews discovered that S<sub>j1</sub> could also restate the meaning of integers in writing. Thus, it could be understood that S<sub>j1</sub> fulfilled the first indicator of concept understanding, namely being able to restate a concept in writing. Subjects were considered capable if they could restate what was understood about integers from previously studied material by writing down their meaning on the answer sheet. Restating a concept meant the ability of students to restate



the concepts that have been studied in their language (Alfiana, 2015). The ability of students to restate a concept was the ability of students to restate the concept in their language (Utomo, 2016).

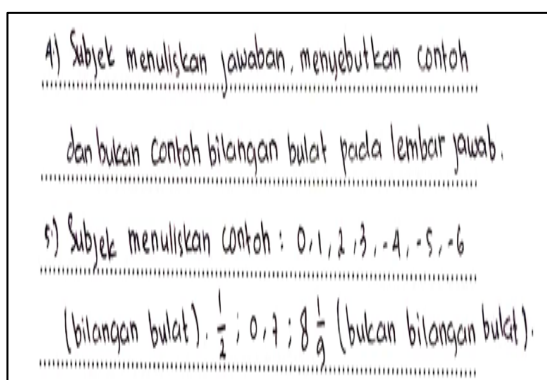
Furthermore, it was still on question number 1; "give an example and not an example of an integer!". The following was a picture of Sjl's answers to question number 1 on the answer sheet.



**Translation:**  
examples:  
0, 1, 2, 3, -4, -5, -6 (integers)  
 $\frac{1}{2}$ ; 0.7;  $8\frac{1}{9}$  (not an integers)

**Figure 4.** The results of Sjl's answer writing examples and not examples of integers

From Figure 4, it could be seen that Sjl writes examples that were included in integers, namely "examples: 0, 1, 2, 3, -4, -5, -6 (integers)" and examples that are not included in integers are "examples:  $\frac{1}{2}$ ; 0.7;  $8\frac{1}{9}$  (not an integers)". Based on the results of Sjl's answer on the answer sheet, it could be seen that Sjl was able to answer correctly regarding giving examples and not examples of integers. It was supported by the results of the researchers' field notes on Sjl. The following is a picture of the results of the researcher's field notes on Sjl.



**Translation:**  
4. Subject writes the answer, mentioning examples and not examples of integers on the answer sheet.  
5. Subject writes examples: 0, 1, 2, 3, 4, -5, -6 (integers).  $\frac{1}{2}$ ; 0.7;  $8\frac{1}{9}$  (not an integer).

**Figure 5.** Sjl Field notes writing examples and not examples of integers

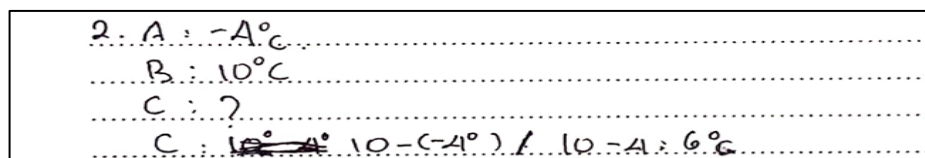
From Figure 5, it can be seen that Sjl immediately wrote the answer to question number 1, namely mentioning examples and not examples of integers on the answer sheet. Sjl wrote examples that include integers "example: 0, 1, 2, 3, 4, -5, -6 (integers)" and examples that were not included in integers were "example:  $\frac{1}{2}$ ; 0.7;  $8\frac{1}{9}$  (not an integer)". Based on the results of the field notes, it could be understood that Sjl was able to answer correctly and precisely regarding giving examples and not examples of integers. The following is an excerpt from the researcher's interview with Sjl.

- P : "Then, the next is the examples of integers. What examples of integers do you mention?"
- Sj1 : "Zero, one, two, three, then negative four, negative five, negative six, and many more."
- P : "Which is not an integer?"
- Sj1 : "What is not an integer is like, for example, a fraction and a decimal number and a percent number, including non-integer numbers."

From the excerpt from the interview above, it could be understood seen that Sj1 directly answered the questions from the researcher. The researcher asked Sj1 about examples and not examples of integers. Sj1 could directly answer the questions addressed by the researcher. Sj1's answer regarding examples that include integers was "zero, one, two, three, then negative four, negative five, negative six, and many more" and Sj1's answer regarding examples that are not integers was "which is not an integer such as, for example, a fraction continues to be a decimal number equal to a percent number including non-integer numbers." Based on the researcher's interview with Sj1, it could be seen that Sj1 answered correctly and appropriately to the researcher's questions about examples and not examples of integers.

The results of their work, field notes, and interviews showed that Sj1 could provide examples and not examples of integers that they learned. Thus, it could be considered that Sj1 fulfilled the third indicator of concept understanding, or capable of providing examples and not examples of a concept they learned. The subject wrote examples included in integers and examples that were not included in integers on the answer sheet. Giving examples and not examples of a concept was the ability of students to distinguish which were examples and not examples of a material that has been studied (Alfiana, 2015). Giving examples and not examples of a concept, namely the ability of students to distinguish between examples and not examples of a material (Utomo, 2016).

In question number 2, here is a picture of the answer from Sj1 on the answer sheet.

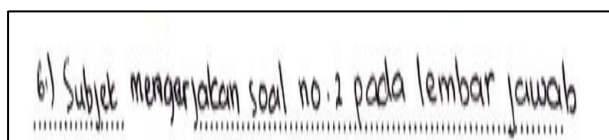


**Figure 6.** Results of Sj1's writing Answer in finding the temperature of a place

From Figure 6, it could be seen that Sj1 wrote the answer to question number 2, namely  $10 - (-4) = 6^{\circ}\text{C}$  Sj1 found the temperature of place C by subtracting the temperature of place B with the temperature of place A, which is already known in the problem. From Sj1's answer in Figure 6, the result of Sj1's answer was incorrect. It should be in question number 2 to find the temperature of a place, namely Sj1 presenting the answer in the form of a mathematical representation in the form of an image (e.g. number line). Based on the results of Sj1's answer on the answer sheet, it could be seen that Sj1 answered incorrectly to find the temperature of a place. It was in line with the results of the



researchers' field notes on Sj1. The picture of the results of the researchers' field notes on Sj1 was as follows.



**Translation:**

Subject works on question no. 2 on the answer sheet.

**Figure 7.** Sj1 Field notes in finding the temperature of a place

From [Figure 7](#), it could be seen that Sj1 immediately worked on question number 2, namely looking for the temperature of a place on the answer sheet. Judging from Sj1's answer on the answer sheet, Sj1 answered incorrectly. Sj1 did not provide answers in mathematical representations in images (e.g. number lines). Based on the results of the field notes, it could be shown that Sj1 answered question number 2 incorrectly. The following is an excerpt from the researcher's interview with Sj1.

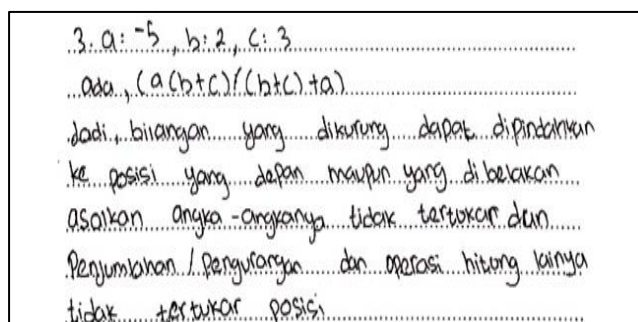
P : "Looking for a place temperature of C? How do you do it?"

Sj1 : "Doing it (silence). It was taught to find in between, so the small number reduced the large number".

From the excerpt from the interview above, it could be seen that Sj1 directly answered the questions from the researcher. The researcher asked Sj1 about how Sj1 worked on question number 2. Sj1 could immediately answer what the researcher asked. Sj1's answer related to finding the temperature of a place is "doing it by reducing large numbers with small numbers". According to Sj1, elementary school taught him how to do it way more concisely. Based on the results of the researcher's interview with Sj1, it could be seen that Sj1 answered incorrectly on the questions addressed by the researcher regarding finding the temperature of a place.

The work results, field notes, and interviews showed that Sj1 did not meet the fourth indicator of concept understanding, namely presenting concepts in mathematical representations of images (e.g. number lines). Sj1 could not present concepts in mathematical representations in the form of images (e.g. number lines).

Here is a picture of the answer from Sj1 for question number 3 on the answer sheet.



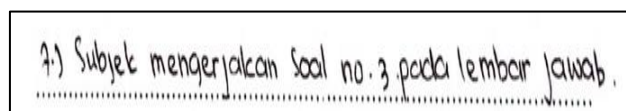
**Translation:**

there is  $(a(b+c)/(b+c)+a)$

So, the bracketed numbers could be moved to the front or the back position as long as the numbers were not mixed up and addition/subtraction and other arithmetic operations were not swapped positions

**Figure 8.** Sj1's writes another way to determine the same result, or it is known as arithmetic operation

From Figure 8, it could be seen that S<sub>j1</sub> wrote the answer to question number 3, namely "there is  $(a(b+c)/(b+c)+a)$ , so the bracketed numbers could be moved to the front or the back position as long as the numbers were not mixed up and addition/subtraction and other arithmetic operations were not swapped positions." S<sub>j1</sub> answered that there was another way to determine the same result by writing "there" and S<sub>j1</sub> writing " $(a(b+c)/(b+c)+a)$ " indicating another way to determine the same result. However, S<sub>j1</sub>'s answer regarding another way to determine the same result was incorrect, and S<sub>j1</sub> did not determine the result, so S<sub>j1</sub>'s answer was wrong. Based on the results of S<sub>j1</sub>'s answer, it could be seen that S<sub>j1</sub> answered incorrectly regarding to show another way in determining the same result. It was supported by the results of the researchers' field notes on S<sub>j1</sub>. The pictures of the results of the researchers' field notes on S<sub>j1</sub> are as follows.



**Translation:**

Subject works on question no. 3 on the answer sheet.

**Figure 9.** Field Note of S<sub>j1</sub> in writing another way to determine the same result or known as compute operation

From Figure 9, it could be seen that S<sub>j1</sub> immediately worked on question number 3, or finding other ways to determine the same result on the answer sheet. Judging from S<sub>j1</sub>'s answer on the answer sheet, S<sub>j1</sub> answered incorrectly. Based on the results of the field notes, it could be understood that S<sub>j1</sub> answered question number 3 incorrectly.

The following is an excerpt from the researcher's interview with S<sub>j1</sub>.

- P : "Okay fine. Continue with question number three? Number three asked to find another way. How do you do it? Is there any other way or not?"
- S<sub>j1</sub> : "From elementary school, it seems like this, the ones that are bracketed can be moved in front and those that are not locked up can be behind or in front".
- P : "What does that mean?"
- S<sub>j1</sub> : "That (silence) there is a commutative or distributive way that can exist".

From the excerpt from the interview above, it could be seen that S<sub>j1</sub> directly answered the questions from the researcher. The researcher asked S<sub>j1</sub> about how S<sub>j1</sub> worked on question number 3. S<sub>j1</sub> could immediately answer what the researcher asked. S<sub>j1</sub>'s answer regarding another way to determine the same result was "from SD (Elementary School) it looks like this, what is in the bracket can be moved to the front and bracketless can be behind or in front." When S<sub>j1</sub> was asked by the researcher why the results were not sought, S<sub>j1</sub> replied that when he was working and didn't think about it, he only focused on writing. S<sub>j1</sub>'s answer was incorrect. Based on the interview results, it could be seen that S<sub>j1</sub> answered incorrectly about other ways to determine the same result. Based on the work results, field notes, and interviews, it showed that S<sub>j1</sub> did not meet the second indicator of concept understanding, namely classifying objects according to certain properties of the

concept. S<sub>j1</sub> is not able to classify objects according to certain properties according to the concept. Next to question number 4, here is a picture of the answer from S<sub>j1</sub> for question number 4 on the answer sheet.

Jumlah Soal : 60	Betul Skor : 5
Benar : 39	Salah Skor : -3
Salah : 12	Tidak dijawab Skor : 0
Tidak dijawab : $60 - (39 + 12)$	
: $60 - 51$	
: 9	

Jumlah nilai : skor betul + skor salah + skor tidak dijawab

$$: (39 \times 5) + (12 \times -3) + (9 \times 0)$$

$$: 39 \times 5 + -36 + 0$$

$$\begin{array}{r} 195 \\ -36 \\ \hline 159 \end{array}$$

**Translation:**

Number of questions : 60      Correct score : 5  
 Correct : 39      Incorrect score : -3  
 Incorrect : 12      Unanswered score : 0  
 Unanswered :  $60 - (39 + 12) = 60 - 51 = 9$

**Total value :**

correct score + incorrect score + unanswered score

**Figure 10.** Results of S<sub>j1</sub>'s writing answer in finding the scores obtained by exam participants

From [Figure 10](#), it could be seen that S<sub>j1</sub> wrote the answer to question number 4 and looked for the score obtained by the examinee. It was conducted by adding up the scores for answering questions correctly, answering questions incorrectly, and unanswered questions. Previously, S<sub>j1</sub> multiplied the correct score by the number of questions answered correctly, the incorrect score by the number of questions answered incorrectly, and the score for unanswered questions by the number of unanswered questions. Then after being multiplied, S<sub>j1</sub> added up each score to get the result "159". Based on the answers, it could be seen that S<sub>j1</sub> answered correctly regarding finding the scores obtained by the examinees.

However, in [Figure 10](#), S<sub>j1</sub> did not write the answer algorithmically. S<sub>j1</sub> immediately answered question number 4 by counting to determine the result. Based on the answers, it could be understood that S<sub>j1</sub> could not answer question number 4 algorithmically. It was supported by the results of the researchers' field notes on S<sub>j1</sub>. The pictures of the researchers' field notes on S<sub>j1</sub> are as follows.

8.) Subjek membaca soal, lalu mengerjakan soal no. 4.

9.) Subjek menuliskan jumlah soal = 60, benar = 39, salah = 12, tidak dijawab =  $60 - (39 + 12) = 60 - 51 = 9$ , betul skor = 5, salah skor = -3, tidak dijawab skor = 0.

10.) Subjek mengerjakan soal no. 4, untuk menentukan jumlah nilai, subjek menjumlahkan skor betul + skor salah + skor tidak dijawab.

11.) Subjek menuliskan  $(39 \times 5) + (12 \times (-3)) + (9 \times 0)$ . lalu subjek menuliskan  $39 \times 5$  dengan cara bersusun ke bawah.

12.) Subjek menuliskan  $195 + (-36) + 0$ , sehingga hasilnya 159.

### Translation:

8. Subject reads the question, then works on question no. 4
9. Subject writes number of questions = 60, correct = 39, incorrect = 12, unanswered =  $60 - (39 + 12) = 60 - 51 = 9$ , correct score = 5, incorrect score = -3, unanswered score = 0.
10. Subject works on question no. 4, to determine the total values, subject add correct score + incorrect score + unanswered score.
11. Subject writes  $(39 \times 5) + (12 \times (-3)) + (9 \times 0)$ , then subject writes  $39 \times 5$  by stacking down.
12. Subject writes  $195 + (-36) + 0$ , so the result 159.

**Figure 11.** Sjl field notes in finding Scores obtained by exam participants

Figure 11 discovered that Sjl read the questions and then worked on question number 4, namely looking for the scores obtained by the examinees. Sjl wrote "Number of questions = 60, correct = 39, incorrect = 12, unanswered =  $60 - (39 + 12) = 60 - 51 = 9$ , correct score = 5, incorrect score = -3, unanswered score = 0". Sjl added up the correct scores, incorrect scores, and unanswered scores. Then Sjl wrote " $(39 \times 5) + (12 \times (-3)) + (9 \times 0)$ " and Sjl wrote down the results of the counting to determine the score obtained by the examinees, which was 159. Sjl's answer from the counting process until the results were correct. Based on the results of the field notes, it could be shown that Sjl answered correctly regarding finding the scores obtained by the examinees.

However, in Figure 11, Sjl did not write the answer algorithmically. Sjl immediately answered question number 4 by counting the total score to determine the result. Based on the results of Sjl's field notes, it could be seen that Sjl could not answer question number 4 algorithmically. Similar to the interview results with Sjl, the following were excerpts from the researcher's interview with Sjl.

- P : "Continue to question number four, okay? What did number four ask for?"
- Sjl : "Score earned."
- P : "How do you solve it?"
- Sjl : "Doing it (silence) the number (silent) of the number of correct plus the number of incorrect scores equals to the score unanswered."
- P : "Can you explain the results of your work? Try to explain."
- Sjl : "Of the sixty questions, thirty-nine were correct, twelve were wrong, and nine were unanswered."
- P : "Yes."

- Sj1 : *"Then the way is thirty-nine, if the score is correct from one question, five, if one of the questions the score is negative three, otherwise the answer is zero. So thirty-five (silence) thirty-nine times five."*
- P : *"Continue?"*
- Sj1 : *"Fri (silence) earlier the number was one hundred and ninety-five. Then twelve times negative three, the number is negative thirty-six. Negative thirty-six plus nine times zero. The number is zero. Then one hundred ninety-five plus negative thirty-six plus zero."*
- P : *"What's the amount?"*
- Sj1 : *"One hundred and fifty-nine."*

From the excerpt from the interview above, it could be seen that Sj1 directly answered the questions from the researcher. The researcher asked Sj1 about how Sj1 worked on question number 4. Sj1 could immediately answer what the researcher asked. Sj1's answers were related to finding the scores obtained by the examinees, namely Sj1 adding up the correct scores, incorrect scores, and unanswered scores. The researcher asked Sj1 to explain his work; according to Sj1, it was solved by thirty-nine times five, and the result was one hundred and ninety-five, then twelve times negative three, so the result was negative thirty-six, then nine times zero result is zero. Then, one hundred ninety-five plus negative thirty-six plus zero was one hundred and fifty-nine. Sj1's answer from calculating the result was correct and precise. Based on the results of interviews with researchers with Sj1, it can be shown that Sj1 answered correctly and correctly regarding finding the scores obtained by the examinees.

However, judging from the excerpt from the interview above, Sj1 immediately answered the questions from the researcher. Sj1 does not answer algorithmically. Sj1 immediately answered question number 4 by counting the total score to determine the result. Based on the interview results, it could be understood that Sj1 could not answer question number 4 algorithmically.

The work results, field notes, and interviews showed that Sj1 fulfilled the fifth indicator of concept understanding, namely using, utilizing, and choosing certain operations in solving mathematical problems. The subject was considered to be able to use and choose certain operations in solving mathematical problems if the subject could use and choose certain operations (such as addition, subtraction, and multiplication) to solve mathematical problems. Using, utilizing, and selecting certain operations were the ability of students to solve problems by choosing and utilizing predetermined procedures (Alfiana, 2015). Using and choosing certain operations were the ability of students to solve problems correctly (Utomo, 2016).

Furthermore, based on the results of the work, field notes, and interview results, the subject did not apply the concept algorithmically to problem-solving; namely, the subject did not answer algorithmically in problem-solving, calculating the scores obtained by the examinees. Thus, based on the work results and the interviews, it revealed that Sj1 did not meet the sixth indicator of concept understanding, namely applying concepts in an algorithmic way in solving mathematical problems.

## CONCLUSION

Based on the results of data analysis of the research, it can be drawn that students' understanding of concepts in working on problems on integer arithmetic operations material were: being able to restate a concept in writing, being able to provide examples and not examples of a concept they have learned, being able to use and choose certain operations in solving mathematical problems, unable to present concepts in the form of mathematical representations in the form of images, unable to classify objects according to certain properties according to their concepts, and unable to apply concepts algorithmically to problem-solving. The researcher suggests exploring more into understanding mathematical concepts in students with low and moderate abilities and different materials.

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