

Students' conceptual understanding in learning mathematics through scientific approach with mind mapping

Dewi Agustiani, Rahmah Johar, Bahrn¹

Abstrak: Kemampuan siswa dalam memahami konsep matematika masih bermasalah padahal pemahaman konsep merupakan bagian paling penting dalam pembelajaran matematika. Dalam hal ini, salah satu upaya untuk mengembangkan pemahaman konsep dengan melibatkan siswa secara aktif dalam pembelajaran yaitu menerapkan pendekatan saintifik berbantuan *mind mapping*. Penelitian ini bertujuan untuk menganalisis perkembangan pemahaman konsep siswa SMP melalui pendekatan saintifik berbantuan *mind mapping* pada materi barisan bilangan. Penelitian ini menerapkan pendekatan kualitatif deskriptif yang melibatkan 24 siswa kelas IX. Dua siswa (S-1 dan S-2) yang masing-masing mewakili kemampuan rendah dan sedang dalam matematika dari 24 siswa tersebut dijadikan sebagai fokus investigasi. Kedua siswa tersebut dipilih berdasarkan hasil tes awal dan konsultasi dengan guru. Pengumpulan data dilakukan melalui pemberian tes pemahaman konsep dan wawancara semi-terstruktur. Hasil tes dan transkrip wawancara dianalisis berdasarkan indikator pemahaman konsep untuk menganalisis perkembangan pemahaman konsep barisan bilangan. Hasil penelitian menunjukkan bahwa S-1 memenuhi indikator pemahaman konsep untuk semua pertemuan, sedangkan S-2 hanya memenuhi indikator pada pertemuan ketiga. Namun, hasil post-tes menunjukkan capaian pemahaman konsep yang lebih baik dari kedua siswa. Penelitian ini menunjukkan bahwa penerapan pendekatan saintifik dengan *mind mapping* dalam pembelajaran matematika mendukung pengembangan pemahaman konsep siswa.

Kata kunci: *Pemahaman konsep, Pendekatan saintifik, Mind mapping, Barisan bilangan*

Abstract: Students' ability to understand mathematics concepts remains problematic even though conceptual understanding is critical in learning mathematics. Indeed, one of the efforts to develop conceptual understanding by actively engaging students in mathematics learning is to apply the scientific approach with mind mapping. This study aimed to investigate the development of secondary students' conceptual understanding through the use of the scientific approach with mind mapping in the number sequences topic. The present study employed a qualitative descriptive approach which involves 24 ninth-grade students. Two students (S-1 and S-2) who respectively represent low and mid-achieving groups of mathematics ability were selected as the subjects for the focus of the investigation. They were purposively selected based on the results of preliminary test and teacher consultation. Data were collected by administering a conceptual understanding test and semi-structured clinical interview. The results of the test and transcript of the interview were analyzed based on the indicators of conceptual understanding to investigate the students' development of number sequences concepts. The results showed that S-1 fulfilled the indicators of conceptual understanding in all lessons, while S-2 only met one indicator in the third lesson. However, the post-test revealed that the students show significant progress in conceptually understanding the number sequence. The present study concludes that applying scientific approach with mind mapping support students' development of conceptual understanding.

Keywords: *Conceptual understanding, Scientific approach, Mind mapping, Number sequences*

¹ Department of Mathematics Education, Universitas Syiah Kuala, Jl. Teuku Nyak Arief No.441 Banda Aceh, Indonesia, rahmah.johar@unsyiah.ac.id

A. Introduction

Conceptual understanding is the ability to understand concepts, operations and relations in mathematics (Afrilianto, 2012; Kilpatrick, Swafford, & Findell, 2001). It is an essential foundation for students in learning mathematics since the concepts in mathematics are interrelated (Zulkarnain & Sari, 2014) and as one of the strands of mathematical proficiency (Kilpatrick et al., 2001). Therefore, in mathematics teaching and learning, students should be encouraged and supported to develop a conceptual understanding with the provision of conducive and engaging learning atmosphere.

On the other hand, various studies (e.g., Zulkarnaen & Sari, 2014; Fadillah & Susiaty, 2019) reveal that students often have conceptual issues in learning mathematics. Ningsih (2016) reported that the average of students' mathematics conceptual understanding is adequate. However, students lack the ability to present concepts in various forms of mathematical representation. delMas et al. (2007) found an increase in students' misunderstanding in particular statistical concepts. Moreover, Martinie and Bay-Willimas (2003) identified sixth-grade students' gaps in understanding of decimal numbers.

A number of studies (e.g., Green, Piel, & Flowers, 2008; Koklu & Topcu, 2012; Dobbins, Gagnon, & Ulrich, 2014; Crompton, 2015; Fadillah & Susiaty, 2019) proposed various approaches to solve the issues of students' conceptual understanding or misconceptions in the mathematics classroom. For example, Green et al. (2008) applied manipulatives to help students eliminate misconceptions in arithmetic. Crompton (2015) used context-aware ubiquitous learning to facilitate students' understanding of geometry. Moreover, Fadillah and Susiaty (2019) utilized refutation texts to correct students' understanding of integers operations. These studies inform that provide students with appropriate learning strategies could help them resolve the problems of misconceptions or support their conceptual understanding.

As part of the studies which attempt to support students' conceptual understanding of numbers sequence, the present study implemented scientific approach combining with mind mapping. The scientific approach is a recommended learning approach to support the implementation of Curriculum 2013 (K13) in Indonesia (Kemdikbud, 2016). It is one of the learning approaches which emphasize students' activities through observing, questioning, experimenting, associating, and communicating (Mahmudi, 2015). Mind mapping is a well-known tool in educational practices to help students or teachers organize ideas or concepts related to various subjects. Buzan (2012) asserts that it is creative and effective writing to map the ideas. Mind mapping is a writing technique using words, colours, lines, symbols, and pictures by combining and developing brain action potential to enable someone to organize and memorize all kinds of information. This fun and creative way of writing, facilitating students on understanding the concept can help students have meaningful and useful learning outcomes.

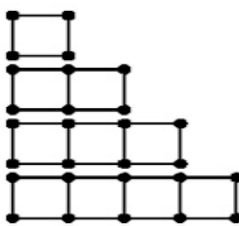
Agustina, Darmawijoyo, and Aisyah (2018) reported that learning using the scientific approach influences the students' conceptual understanding. Zevika, Yarman, and Yerizon (2012) found that the students' understanding of mathematical concepts using the cooperative learning model and mind mapping technique is better than those using direct learning. Furthermore, Utami, Asnawati, and Gunowibowo (2016) showed that students experiencing the mind mapping technique show greater improvement in mathematical concepts understanding with higher compared to those in conventional learning. However, those prior studies have not focused on the scientific approach using mind mapping to examine the development of students' conceptual understanding. Therefore, the present study aimed to investigate how students

develop conceptual understanding of number sequence topic by implementing the scientific approach with mind mapping.

B. Methods

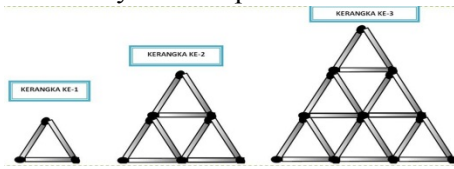
The present study is a descriptive study with a qualitative approach (Creswell & Creswell, 2014). It was conducted in one of lower secondary schools in North Aceh, Indonesia and 24 ninth-grade students were involved. Before the learning, all students had pre-test related to conceptual understanding consisting of five problems. The test covered the topic they had learned, namely radical forms, probability, and the congruence of plane geometry. Four indicators were used to examine students' answers of the pre-test, namely: 1) restating the concepts learned, 2) applying the concept algorithmically, 3) developing necessary and sufficient condition of a concept, and 4) connecting various concepts (internal and external mathematics). Using the results of the pre-test test, students were grouped into three: low (score less than 53), medium (score 53-87), and high (score greater than 87). Based on the pre-test and discussion with mathematics teacher, six students were selected, two of each category of high, medium, and low-achieving students. As for qualitative analysis related to students' conceptual understanding, this paper focused only on two students, each representing medium (S-1) and low-achieving students (S-2). The subjects were chosen by considering the students' willingness to participate. The high-achieving students were not involved since they had achieved conceptual understanding.

Table 1. Problems for formative test

No.	Problems	Targeted indicator of conceptual understanding
1	In the pattern of triangular numbers, how many dots are on the 16 th term? Draw the term up to the 4 th !	Applying the concept algorithmically
2	Given the number sequences of 4, 7, 12, 19, ... a. Determine the formula of the n th term! b. Determine which term of the sequences that is 199!	Idem
3	The 10 th and 14 th terms of the arithmetic sequences are 7 and 15. Determine the first term, the difference, and the 20 th term of the sequences!	Idem
4	Determine the formula of the n th term of the geometric sequences of 9, 3, 1, 1/3, ...!	Idem
5	The figure below shows the number sequences which each term consisting of the square made of the matchsticks.  a. Create a table representing the relationship between the number of squares and the matchsticks! b. Determine the n th formula of the number sequences!	Linking various concepts (internal and external mathematics) and applying the concepts algorithmically

The students had five lessons in which the scientific approach with mind-mapping was implemented. The number pattern, the number sequence, the arithmetic sequences, and the geometry sequences were the topics for lesson 1 to 4, respectively, while students worked on enrichment problems in lesson 5. At the end of each lesson, students created a mind mapping and did the formative test (Table 1). After five lessons, all mind mappings were combined into one unit. A post-test (Table 2) was given once after all lessons completed.

Table 2. Problems for post-test

No.	Problems	Targeted indicator of conceptual understanding
1	<p>Amir tries to create a tower from matchsticks. The tower made by Amir is presented below.</p>  <p>a. Create a table showing the number of matchsticks used to create the towers of one, two, and so on up to eight levels!</p> <p>b. How many matchsticks does Amir use to make 10 level towers?</p>	<p>Linking various concepts (internal and external mathematics) and applying the concepts algorithmically</p>
2	<p>The formula of the n^{th} term of a sequence is $U_n = an^2 + bn$. The 2nd and 7th term of the sequences are 8 and 63, respectively!</p> <p>a. Find the first term and the difference!</p> <p>b. Find the 10th term!</p>	<p>Linking various concepts (internal and external mathematics)</p>
3	<p>Every day Orlyn saves the remaining of her allowance. On the first day, she saves Rp 500.00 and the savings increase by Rp 500.00 every day. How to find out how much money Orlyn saved on the 6th day?</p>	<p>Developing necessary and sufficient condition of a concept</p>
4	<p>When an employee starts working, his monthly salary is Rp 700,000.00. The following year, the monthly salary keeps increasing by Rp 125,000.00. What is the monthly salary of the employee for the 9th year of his tenure?</p>	<p>Applying the concepts algorithmically</p>
5	<p>Create a <i>mind mapping</i> based on the number sequences and series you have learned!</p>	<p>Classifying objects based on whether the requirements to create the concepts being fulfilled and provide the examples of the concepts</p>

The instruments used were a conceptual understanding test and semi-structured interview. The test aimed to obtain data about students' conceptual understanding of number sequence topic during the learning process implementing a scientific approach using mind mapping. The test was validated beforehand by a mathematics educator and two mathematics teachers. The interview was aimed at confirming and clarifying the students' works on the formative test and post-test to further examine their conceptual understanding. It was administered after the students finished the tests.

The indicators of conceptual understanding by Kilpatrick et al., (2001) were referred and used in this study: (1) restating the concepts learned, (2) classifying objects based on whether the requirements to create the concepts being fulfilled, (3) applying the concept algorithmically, (4) providing examples and counter-examples of the concepts learned, (5) presenting a concept in various mathematics representations, (6) connecting various concepts (internal and external mathematics), and/or (7) developing the necessary and sufficient conditions of a concept. All these indicators were utilized to evaluate students' works in the post-test. Two indicators (3 and 5) were used to examine students' conceptual understanding at the end of each lesson.

Data were analyzed through three stages; data condensation, data display, and drawing conclusion (Miles, Huberman, & Saldana, 2014). Firstly, we summarized and simplified the results of the tests, mind mapping, and the transcripts of the interview, which refer to the indicators of conceptual understanding. Secondly, we thoroughly described the results of data condensation regarding the students' conceptual understanding. Lastly, a conclusion about students' conceptual understanding of number sequence topics was drawn.

C. Findings and Discussion

In this part, we present and analyze students' works on the test at the end of each lesson, post-test, and excerpts of the interview then the findings of students' development of conceptual understanding on number sequences were drawn and discussed.

Students' conceptual understanding in each lesson

At the first lesson, the indicator *applying concepts algorithmically* was measured through the problem related to triangular numbers pattern (Table 1). S-1 and S-2 solved problem 1 (Figure 1) as follows.

Polanya segitiga.

$u_1 = 1$
 $u_2 = 3$
 $u_3 = 6$
 $u_4 = 10$

banyak hitungnya adalah
 $U_n = \frac{1}{2} n (n+1)$
 $u_{16} = \frac{1}{2} \cdot 16 \cdot (16+1)$
 $= 8 \cdot (17)$
 $= 136$
 jadi, $u_{16} = 136$

(S-1)

$u_1 = 1, u_2 = 3, u_3 = 6, u_4 = 10$

pola ke-16 $\rightarrow u_{16} = \frac{1}{2} (n+1)$
 $u_{16} = \frac{1}{2} (16+1)$
 $u_{16} = \frac{1}{2} (17)$
 $u_{16} = 8,5$

(S-2)

Figure 1. The answer of S-1 and S-2 on problem 1

During the interview, S-1 was able to argue her answer, while S-2 still made a mistake, as revealed by the following excerpt of the interview.

- R : *Are you sure of your answer?*
 S-2 : *No*
 R : *What is your difficulty?*
 S-2 : *When I made the pattern for the triangular number, I am not sure whether that is a triangular number pattern.*

Referring to the students' answer in Figure 1 and the interview, we found that S-1 was able to correctly determine the number of dots in the 16th term. The pattern of the triangular numbers described and U_n formula for the 16th term was correct. In contrast, S-2 did not correctly solve the problem. She made a mistake in determining the term of triangular numbers from term 1 to 4 and in writing U_n formula to determine the 16th term. In addition, S-2 misrepresented the triangular number pattern.

At the second lesson, the same indicator as in the first lesson was measured through the problem related to sequences (Table 1). One of the students' answers to problem 2 (Figure 2) is presented below.

Barrisan bilangan 4, 7, 12, 15.

4 7 12 15

$$\begin{aligned}
 U_1 &= 4 \\
 b &= 7 - 4 = 3. \\
 U_n &= a + (n-1)b \\
 &= 4 + (4-1)3 \\
 &= 4 + 3 \cdot 3 \\
 &= 4 + 9 \\
 &= 13.
 \end{aligned}$$

Figure 2. S-2's answer to problem 2

The interview revealed that S-1 was able to determine the formula for the n^{th} term and find the term whose number is 199, while S-2 still made a mistake as revealed by the following interview excerpt.

- P : *Are you sure with the answer?*
 S-2 : *It seems correct, but when looking for the difference, it must be the same for all. In this sequence, the difference is not the same. So, I am confused about what to do next, because I do not pay much attention. Finally, I just made what was known.*

S-1 could determine the n^{th} term formula by examining the difference of the given number sequences and finding which term (n) in the sequence that is 199 utilizing the n^{th} term formula. Figure 2 and the excerpt of the interview reveal that S-2 was not able to correctly determine the n^{th} term formula as she committed an error in finding the term of 199.

At the third lesson, the indicator *applying concepts algorithmically* was measured through the problem related to arithmetic sequences (Table 1). One of the students' answers to problem 3 is displayed in Figure 3. During the interview, S-1 and S-2 were able to correctly determine the first term, the difference and the 20th term as revealed by the following interview excerpt.

- R : What did you do to solve problem 3? Are you sure about your answer?
- S-1 : To determine the first term and the difference, re-expand the known sequence, that $U_{10} = 7$ and $U_{14} = 15$, so that we will obtain the first term and the difference. The 20th term is obtained from the U_n formula. I'm sure the answer is correct, Miss.

In this lesson, both S-1 and S-2 solved the problem: determine the first term, the difference, and the 20th term of the sequences based on the given term.

Dik = $U_{10} = 7$
 $U_{14} = 15$
 Dit: suku pertama, ~~dan~~ selisih dan ~~suku ke~~ U_{20} ?
 Jawab:
 $U_n = a + (n-1)b$, diperoleh
 $U_{10} = 7 \rightarrow a + 9b = 7$
 $U_{14} = 15 \rightarrow a + 13b = 15$

$$\begin{array}{r} a + 9b = 7 \\ - (a + 13b = 15) \\ \hline -4b = -8 \\ b = 2 \end{array}$$

 substitusi nilai $b = 2$ ke $a + 9b = 7$
 $a + 9(2) = 7$
 $a + 18 = 7$
 $a = -11$
 nilai $a = -11$, $b = 2$ substitusi ke : $U_n = a + (n-1)b$
 $U_{20} = (-11) + (20-1)2$
 $= (-11) + 18 \cdot 2$
 $= (-11) + 36$
 $= 25$,,
 Jadi $a = -11$
 $b = 2$
 $U_{20} = 25$,,

Figure 3. The answer of S-1 on problem 3

At the fourth lesson, the indicator *applying concepts algorithmically* was measured through the problem related to geometric sequences (Table 1). In the interview, S-1 could determine the n^{th} term formula of the sequence while S-2 made a mistake in the solution algorithm as revealed in the following interview excerpt.

- R : Do you understand the problem?
 S-2 : Yes
 R : Do you have any difficulty solving the problem?
 S-2 : Yes, I am confused when simplifying $\frac{1}{3^1}$

In this lesson, S-1 could determine n^{th} term formula of the given geometric sequences by first examining the ratio of the sequences and provide the solution conforming the answer key. S-2 also managed to determine the first term and the ratio of the geometry sequences, but there were some errors in the algorithm of the solution, as shown in Figure 4.

1. 9, 3, 1, $\frac{1}{3}$, ...
 $u_1 = 9$, $u_2 = 3$, $u_3 = 1$, $u_4 = \frac{1}{3}$
 $u_n = ar^{n-1}$ $r = \frac{u_2}{u_1} = \frac{3}{9} = \frac{1}{3}$
 $= 9 \cdot \frac{1}{3}^{n-1}$ $\rightarrow \frac{1}{3} = \frac{1}{3}$
 $= 9 \cdot \frac{1}{3}^{n-1}$
 $= 9 \cdot 3^{1 \cdot n-1}$
 $= 3^2 \cdot 3^{n-1}$
 $= 3^{2+n-1}$
 $= 3^{2+n}$
 rumus suku ke- $n = 3^{2+n}$.

Figure 4. S-2's answer to problem 4

At the fifth lesson, the indicator *linking various concepts* (internal and external mathematics) and *applying the concepts algorithmically* were measured through a problem related to the pattern of the square numbers (Table 1). S-1 and S-2 solved problem 5 (Figure 5). The students' answers (Figure 5) and the interview indicate that S-1 was able to state the relationship between the number of squares and matchstick. While S-2 was not able to express the relationship leading to incorrectly show the number pattern where each term contains a square formed by the arrangement of matches images. The incorrect number pattern caused the error in solving the n -term formula. It can be concluded that S-1 solved the problem and fulfilled the indicators, while S-2 did not, as shown in the interview excerpt below.

- R : What did you do to solve problem 5?
 S-2 : For problem 5a, we first count the number of matches up to the fourth image before creating the table. As for No. 5b, find the formula.
 R : Are you sure that you count the image correctly?
 S-2 : At first, it was correct, but I think the next one is incorrect, so the n^{th} formula was also wrong.

Penyelesaian.

Banyak Persegi	Banyak korek api
1	4
2	7
3	10
4	13

b. rumus suku ke-n
 $U_n = a + (n-1)b$
 $= 4 + (n-1)3$
 $= 4 + 3n - 3$
 $= 3n + 1$

(S-1)

Penyelesaian.

Persegi	korek api
4	4
6	6
8	8
10	10

b. $4 \quad 6 \quad 8 \quad 10$
 $+2 \quad +2 \quad +2$
 $U_1 = 4$
 $U_2 = 4 + 2 = 6$
 $U_3 = 6 + 2 = 8$
 $U_4 = 8 + 2 = 10$

(S-2)

Figure 5. The students' answer to problem 5

In five lessons, we found that S-1 was able to solve the problem given at the end of each lesson. Thus, the medium-achieving student could satisfy the indicators of conceptual understanding: linking various concepts (internal and external mathematics) and applying the concepts algorithmically. On the other hand, S-2 (low-achieving student) could only apply the concept algorithmically in the third lesson. S-2 underwent conceptual and operating errors in the other four tests. For example, in the fifth test, S-2 did not understand the problem and miscalculated the answer. In this case, Wijaya and Masriyah (2013) also found that students often made conceptual and operating mistakes in solving problems. Additionally, low-achieving students also often forget the formula to solve the problem. Rumasoreng and Sugiman (2014) explain that the student errors were due to lack of students' understanding of the prerequisite and learned materials, lack of mathematical language comprehension, misinterpreting or misapplying formulas, miscalculations, lack of carefulness, and forgetting the concepts.

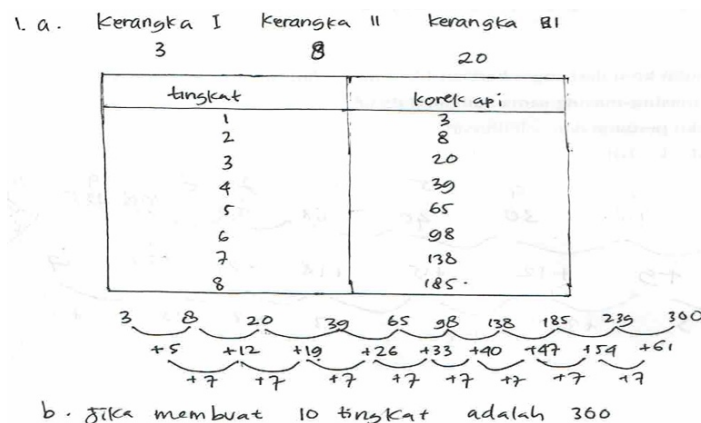
Students' conceptual understanding in the post-test

The students' answer (S-1 and S-2) for problem 1 in the post-test are shown in Figure 6. In the interview, S-1 was able to provide reasoning for her answer while S-2 made a mistake as revealed in the following interview excerpt.

- R : Can you explain how did you create the table to show the number of matchsticks?
- S-2 : I first calculated the number of matchsticks for the first to the third frameworks. Then, I obtained the first term and the difference. Then, I find out the next terms up to the 8th term.
- R : How did you get the U_{10} ?

- S-2 : The 1st to the 8th term and the difference have been identified. Thus, the 10th term is obtained by adding the difference.
- R : If the question is not for the 30th level but the 10th level. How will you find it? Should you calculate it one by one using the difference up to the 30th term? That will undoubtedly be time-consuming.
- S-2 : For many terms, we can use the formula.
- R : What is the formula?
- S-2 : Ehmm... I forgot the formula.
- R : For Problem 2, how did you find the value of a and b? Can you directly guess the value of a?
- S-2 : No, because the 2nd and 7th term has already obtained, we can perform the elimination method to get the 1st term and the difference.
- R : Both Problem 3 and 4 are word problems, are they complicated?
- S-2 : No, they are not, because we know the 1st term and the difference. So, we can substitute them into the formula (showing the answer sheet).
- R : For Problem 5 about creating mind mapping of the topics learned, do you remember the picture or imitate your friend's?
- S-2 : I did it myself

In the post-test, S-1 could solve 4 out of 5 problems as she misunderstood problem 1. Meanwhile, S-2 could only solve three problems. For problem 1a, S-2 miscalculated the number of matches used to create level 1 to 8 tower resulting in the incorrect number sequence. Similarly, for problem 1b, the wrong number sequence led to the incorrect 10-level arrangement. For problem 2, errors occurred in calculating the first term and the difference, S-2 did not use the given formula on the problem, and therefore the solution was incorrect. S-2 successfully solved problem 3, 4, and 5. The post-test reveals that S-2 did better than in each lesson test-accomplishing four indicators of conceptual understanding (Table 2). Some indicators were not achieved as the students misunderstood the problems. Indeed, Sidik (2016) found that generally, students have difficulty in understanding the problem. They incorrectly interpret the problem into mathematical models. Therefore, they made mistakes when preparing the problem-solving plan and proceed with the calculation.



(S-1)

1) a

Banyak tingkat	Banyak korek api
1	3
2	6
3	10
4	15
5	21
6	28
7	36
8	45

b. banyak korek api yang digunakan Amir membuat 10 tingkat = 63

(S-2)

Figure 6. Students' answer to problem 1 of the post-test

The interviews with S-2 indicates that in the first and second lesson, S-2 seemed to not directly involved in solving the problems in groups since she was less confident to ask questions to high-achieving students. After being encouraged by the teacher, in the third lesson S-2 was brave to propose questions in the group, so she was directly involved in constructing the knowledge. Indeed, Setiawan and Rahman (2013) argue that students construct knowledge by integrating their ideas.

Overall, based on the results of the test after each lesson and post-test, including mind-mapping, both students accomplished several indicators of the conceptual understanding (Kilpatrick et al., 2001). S-1 was able to classify objects based on whether the requirements to create the concepts being fulfilled, apply concepts algorithmically, provide examples and non-examples of the concepts, develop necessary and sufficient conditions of a concept, and linking various concepts. Similarly, S-2 fulfilled those indicators except for the last one. We argue that linking or connecting various concepts in mathematics problems-solving is not an easy task for students in general and low-achieving student in specific such as S-2. Prior studies (e.g., Baki et al., 2009; Dixon & Brown, 2012; Kenedi et al., 2019) also showed students' deficient ability in this aspect.

The findings of the current study show that the scientific approach helps the students develop a conceptual understanding of number sequence topic since they were actively involved in observing, questioning, experimenting, associating, and communicating. In observing, the teacher provided figures and related number sequence problems to be physically or mentally observed, then they were asked to formulate questions (questioning) drawing from the results of observation. Afterwards, the teacher grouped the students to have an intense discussion and find the formulated answers from various resources, for example, textbooks. In the group discussion, the students also determined the keywords of the number sequence topic to make the mind mapping. The process of questioning and experimenting leads the students to associate the relevant data in solving the problems of number sequence. At last, the group works were communicated in whole classroom discussion. Besides these activities which support students' development of conceptual understanding, mind mapping also strengthens students' understanding since it supports the students to reflect and summarize their knowledge during the learning. Although the medium and low-achieving student showed progress on their conceptual understanding, we note that associating activities have not focused on linking various

mathematics concepts during group discussion. This might be the reason why S-2 was not able to solve the problems which require the ability to link various mathematics concepts.

D. Conclusion

The results of the study reveal that the medium-achieving student met the indicators of conceptual understanding at each lesson while the low-achieving student could satisfy one indicator at the third lesson. However, the post-test unravels that both students show significant progress in conceptual understanding as both fulfil several indicators. The series of activities in scientific approach from observing to communicating support the students to solve the number sequence problems which require them to apply concepts algorithmically, classify objects, provide examples and non-examples of the concepts, and develop necessary and sufficient conditions of a concept. In linking various concepts to solve the number sequence problem, students with different mathematics ability indicate distinct achievement. This implies that associating activities in the group discussion should have more attention from the teachers to facilitate low-achieving students in linking related mathematics concepts for problem-solving. In addition, the make of mind mapping also supports students' development of conceptual understanding since it requires students to summarize and connect what they have learnt visually.

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