MATHEMATICAL DISPOSITION OF SLOW LEARNERS' CONCEPTUAL UNDERSTANDING USING BRUNER'S THEORY

Abstract

This study aims to analyze the relationship between mathematical disposition on the slow learners' understanding of mathematical concepts in mathematics based on Bruner's theory. This study used a qualitative method with a descriptive approach. The subjects were five slow learner students at Junior High School 3 Ciawigebang. Data were collected by documentation, tests and interviews. The results of the study revealed that there was a relationship between mathematical disposition and understanding of mathematical concepts of slow learner students in answering questions using Bruner's theory, namely the symbolic and the iconic stages. Slow learners with a high level of mathematical disposition can solve all questions correctly and have met the indicators of understanding the mathematical concepts used in this study. Meanwhile, the slow learner with a moderate mathematical disposition can solve the questions given, but still have misconceptions in responding to some questions. Then, slow learners with a low mathematical disposition only understand some of the questions and have misconceptions in solving the question.

Keywords: Bruner's Theory; Mathematical Disposition; Mathematical Understanding Ability; Slow Learners.

INTRODUCTION

Mathematics is one of the sciences related to logical thinking which plays an important role in the development of science, technology, and other disciplines, and as the basis of knowledge (Ayu et al., 2021; Ranti & Kurniati, 2020; Wijayanto & Munandar, 2021). The prototype curriculum (2022) has some characteristics, for example, (1) the learning process is designed based on projects to improve soft skills and character (faith, piety, and noble character; cooperation; global diversity; independence; critical thinking; creativity), (2) focus on basic or essentials material so that there is time to deepen the learning of basic competencies such as literacy and numeracy, and (3) flexibility for teachers in carrying out learning according to student's abilities (teach at the right level) and adapt to local contexts and content (Supangat, 2021). Based on the prototype curriculum (2022), one of the objectives of learning mathematics is to understand or study mathematics materials in the form of facts, concepts, principles, operations, and mathematical relations and apply them flexibly, thoroughly, efficiently, and specifically or precisely to solve mathematical problems (mathematical understanding).

Conceptual understanding in learning mathematics is the first step to solving questions or problems, therefore the ability to understand concepts is vital in learning mathematics. Understanding mathematical concepts are the basic foundation for students to continue learning at the next level so that they will not face obstacles in the learning process (Aulia et al., 2019; Ranti & Kurniati, 2020). Conceptual understanding is an important basis and stage for understanding principles and theories in mathematics, in other words, to understand principles and theories, students must first understand the concepts that make up the theory (Diana et al., 2020; Khoirunnisa & Soro, 2021). The ability to understand concepts is vital in the mathematics learning process as it will support the ability to think in other mathematics (Nurani et al., 2021; Ranti & Kurniati, 2020; Ruswana, 2019; Syahri et al., 2021). However, it is in contrast to reality. Studies by Aulia et al (2019) and Suraji et al (2018) prove that students are unable to determine examples and non-examples, have problems in the form of mathematical symbols, can't determine the appropriate procedure to use, and can't choose the right procedure to solve problems, can't apply the concepts that have been taught for questions in the form of stories, and have difficulty solving questions that are different from the examples given. These problems and lack of development of students' conceptual understanding have caused students' low ability to understand mathematical concepts.

Mathematics learning equips students with ways of thinking, reasoning, and reasoning through certain mental activities that can build a continuous flow of thinking and results in the formation of a flow of mathematical understanding such as universal facts, concepts, principles, operations, relations, problems, and mathematical solutions. This mental process is to improve the students' mathematical disposition to feel the meaning, benefits, and moral values in learning mathematics. Adhiyati (2020) states that mathematical disposition is important to create and stimulate the course of cognitive aspects starting with interest, curiosity, and a tendency to see the benefits of learning mathematics. The prototype curriculum (2022)

mentions that one of the goals of learning mathematics at schools is to have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, and being persistent, creative, independent, patient, open, diligent, tough, tenacious, and confident in solving problems. Students have to possess mathematical dispositions as they become one of the success determinants in learning, and the low mathematical dispositions will also have an impact on low learning outcomes (Lestari & Andinny, 2020; Mardiah et al., 2020).

As stated earlier, students must possess mathematical disposition abilities. Sari and Sutirna (2021) revealed that students' mathematical disposition in Indonesia is still relatively low. Moreover, a study by Kesumawati in Mahmuzah and Ikhsan (2014) found that 297 students from 4 junior high schools in Palembang City obtained an average mathematical disposition score of 58%. It proves that the students' mathematical disposition level in Indonesia is still relatively low. Besides, Sukamto in Dina (2019) argues that the students' mathematical disposition level is 61.9% which is considered in the low category.

The ability to understand concepts is closely related to the students' mathematical disposition levels. Students' low mathematical abilities and skills highly affect their mathematical disposition level as mathematical abilities and mathematical dispositions are interrelated and support each other (Miatun & Khusna, 2020). The higher the students' understanding of mathematical concepts, the more confident the students are in mastering mathematics so that students can be more responsible, persistent, and diligent in solving math problems (Bernard, 2015).

In the learning process at school, each student has different abilities in understanding the subject. In other words, educators need to deal with varied students' characteristics, for example, students who are responsive, happy, and difficult to understand the material (Afan & Wikan, 2021; Richardo et al., 2018). Students who have difficulties in understanding the material, have problems understanding the material and have a lower mathematical ability than others. In education, these characteristics are known as slow learners. Slow learners are students who have low learning achievements compared to the average, so they need more time to understand something but they do not experience mental retardation (Amelia, 2016; Hadi, 2016; Sakiinatullaila et al., 2020). Slow learners have an IQ level with a range of 70-85 (Kaznowski, 2004) or 70-89 (Najma et al., 2012). In general, the IQ of slow learners is in the range of 70-90 (Dirgantoro, 2018; Krishnakumar et al., 2011). With IQ levels below the average, it causes slow learners to take a longer time to understand material or concept, have a low memory because of the difficulty of recording information in the long term, and have a low level of concentration and attention to the information conveyed (Hasibuan et al., 2020; Tran et al., 2020).

Bruner's theory is one of the mathematics learning theories that believe in students who create and design new concepts or ideas from previously acquired knowledge and it is easier to remember concepts if students get the concepts themselves in the learning process, so using the Burner theory, students are expected to increase their achievement (Unaenah et al., 2020; Yusri & Arifin, 2018). Bruner proposed three stages of learning based on the students' intellectual development, namely (1) the enactive stage, learning while doing direct or concrete activities, (2) the iconic stage, learning using visualization and images, and (3) the symbolic stage, learning through words, numbers or symbols (England, 2006). Previous studies that applied Bruner's learning theory can help students recognize and understand the material which can increase students' conceptual understanding and learning outcomes (Bisri, 2020; Enggaringtyas et al., 2019; Unaenah et al., 2020).

Students in the slow learner category are closely related to mathematical dispositions in which if slow learners have a positive view of mathematics in acting and thinking, they can learn mathematics. They will slowly understand mathematical concepts well and students build themselves through three stages as proposed by Bruner although it takes quite a long time.

Based on the explanation above, the ability to understand mathematical concepts is the first step in solving mathematical problems and is the foundation of learning mathematics. Students need to possess mathematical dispositions as it is important to create and stimulate the course of cognitive aspects starting with interest, curiosity, and a tendency to see the

benefits of learning mathematics. Using Bruner's theory, students in the slow learner category can understand mathematical concepts well. This study aims to analyze the relationship between mathematical dispositions and conceptual understanding of slow learner students in learning mathematics using Bruner's theory.

METHOD

This descriptive study used a qualitative approach. The qualitative approach tries to describe an event according to the conditions in a population. This study describes the mathematical disposition of slow learners' understanding of mathematical concepts using Bruner's theory. The subjects were determined using the purposive sampling technique. In this technique, the researcher determined the sample according to certain considerations (Sugiyono, 2013). The subjects were five students in slow learner category in grades VII and VIII of Junior High School 3 Ciawigebang, Kuningan District. Most of the subjects were categorized into dyslexia and dyscalculia based on the results of the assessment by the school.

Tahap Simbolik

1. Dinda membeli 3 buku tulis dan 5 pensil dengan harga Rp 42.000. jika harga sebuah buku tulis adalah 3 kali harga sebuah pensil. Tentukan harga 4 pensil dan 5 buku tulis!

Penyelesaian :

Figure 1. A question of mathematical concept understanding at the symbolic stage

Tahap Ikonik

1. Perhatikan tabel dibawah ini!

Barang	Harga
	Rp42.000
	Rp.....???

Berapa harga 5 buku dan 4 pensil?

Penyelesaian :

Figure 2. A question of mathematical concepts understanding at the iconic stage

The non-test instrument was in the form of a questionnaire. The questionnaire was to measure the level of students' mathematical dispositions including (1) self-confidence, (2) flexible thinking, (3) active and persistent in learning mathematics, (4) interested, curious, and creative, (5) reflection or monitoring, (6) appreciating the usefulness of mathematics, and (7) appreciating mathematical functions (Choridah, 2013). The questionnaire covered positive and negative statements consisting of 28 statements related to mathematical dispositions with 4 score categories of (1) Strongly Disagree, (2) Disagree, (3) Agree, and (4) Strongly Agree. The questionnaire was developed by the researcher based on the indicators to be achieved. Both instruments have been validated by expert lecturers so that they are valid and reliable. Data were collected by observation, tests, interviews, and documentation. The data were analyzed using a model developed by Miles and Huberman covering data collection, data reduction, data presentation, and drawing conclusions.

RESULTS AND DISCUSSION

The students' mathematical disposition was viewed from the questionnaire scores obtained by each student. The mathematical disposition questionnaire consisted of positive and negative statements with a total of 28 statements according to the mathematical disposition indicators used. The indicators were (1) Confidence in solving problems using mathematics, connecting mathematical ideas and providing arguments, (2) Thinking flexibly in exploring ideas and trying alternative ways of solving mathematical problems, (3) Being active and persistent in doing mathematics assignments, (4) Have interest, have curiosity, and creativity in mathematical activities, (5) Reflecting and Monitoring thinking and performance, (6) Appreciating the application of mathematics in other disciplines or daily life, and (7)

Appreciating the role of mathematics as a tool and language (Choridah, 2013). The results of the students' mathematical disposition questionnaire can be seen below.

Table 1 Results of the mathematical disposition questionnaire

No.	Subject	Score	Category
1.	AJ	66	Moderate
2.	DH	80	High
3.	FD	63	Moderate
4.	HD	59	Low
5.	RN	68	Moderate

The student's understanding of mathematical concepts in solving algebraic questions can be seen from the results of the conceptual understanding test using Bruner's theory. The student was provided 30 minutes for solving each question. The mathematical test used Bruner's theory covering the symbolic stage, the iconic stage, and the enactive stage. In the first stage, students were given questions in written form like questions in general (symbolic stage), if they could not understand and solve problems in accordance with the allotted time, they would be given the same questions but in different forms, namely in the form of pictures (iconic stage), and if they still could not solve the question (iconic stage), they will be given questions in the form of concrete objects (enactive stage). The conceptual understanding test instrument was based on the indicators of the conceptual understanding that would be studied, namely, (1) restating a concept, (2) determining the examples and non-examples of a concept, (3) presenting concepts in various forms of mathematical representation, and (4) utilizing and choosing a particular procedure or operation. The results of the students' understanding of mathematical concepts with high, medium, and low mathematical disposition categories can be seen below:

1. **Students with a high mathematical disposition level (DH)**

The results of the conceptual understanding test of students with a high level of mathematical disposition can be seen below:

Figure 3. DH's answer to the first question of the conceptual understanding test at the symbolic stage

At the symbolic stage, DH has not been able to correctly solve the question. However, DH could understand a little about the questions as he could write down the information contained in the questions.

Figure 4. DH's answer to the first question of the conceptual understanding test at the iconic stage

When given the same question in different forms, namely in the form of pictures, DH could understand and solved the questions correctly. DH could fulfill the first indicator of understanding mathematical concepts, namely restating a concept. The evidence is the fact that DH can rewrite algebraic forms and solve the questions correctly and precisely.

Figure 3. DH's answer to the second question of the conceptual understanding test at the symbolic stage

The same with the previous question, DH has not been able to solve the questions correctly. However, DH has a little understanding of the questions as he can write down the information contained in the questions.

Figure 6. DH's answer to the second question of the conceptual understanding test at the iconic stage

At the iconic stage, DH could solve and understood the problem well. DH could identify examples and non-examples in the form of algebra given by selecting items or foods that can or cannot be purchased on the question by circling the list of available menus on the question. Then, DH fulfills the second indicator of the understanding of the mathematical concept.

Figure 7. DH's answer to the third question of the conceptual understanding test at the symbolic stage

In the third question, DH could understand and solve the questions using the symbolic stage correctly. It can be seen in Figure 5 in which DH can understand the question by writing down the information contained in the question. Then, DH can solve the question correctly. This proves that DH fulfills the third indicator of understanding mathematical concepts, namely presenting concepts in various forms of mathematical representation by changing the algebraic form to the simplest form and changing the story questions into algebraic form. In other words, DH meets the third indicator of understanding mathematical concepts.

Figure 8. DH's answer to the fourth question of the conceptual understanding test at the symbolic stage

In the fourth question using the symbolic stage, DH has not been able to solve the problem correctly. And almost the same as the previous question, DH can only write down the information contained in the question but DH has not been able to solve it.

Figure 9. DH's answer to the fourth question of the conceptual understanding test at the iconic stage

Figure 7 shows that when given a question in the form of a picture, DH could understand and solved the question correctly. It is showed when DH could write down the information contained in the questions and then solve the questions with the information obtained from the questions. DH fulfills the fourth indicator of understanding mathematical concepts, namely utilizing and selecting certain procedures or operations. It means that DH can use the concepts of multiplication, subtraction, and addition in the algebraic form to solve problems.

Based on the results of the interview, DH stated that by presenting the questions in the form of pictures, it will be to understand and solve the questions as the questions presented in written form are rather difficult to understand and sometimes even misunderstand the question.

Based on the results of tests and interviews, students' mathematical disposition levels affect students understanding of mathematical concepts. It is in line with a previous study (Kandaga, 2017) that there is a relevant relationship or link between students' mathematical dispositions and understanding of concepts. And the use of Bruner's theory can improve students' conceptual understanding (Enggaringtyas et al., 2019).

2. Students with a moderate mathematical disposition level (AJ, FD, RN)

The results of the conceptual understanding test of students with a moderate mathematical disposition level are presented below.
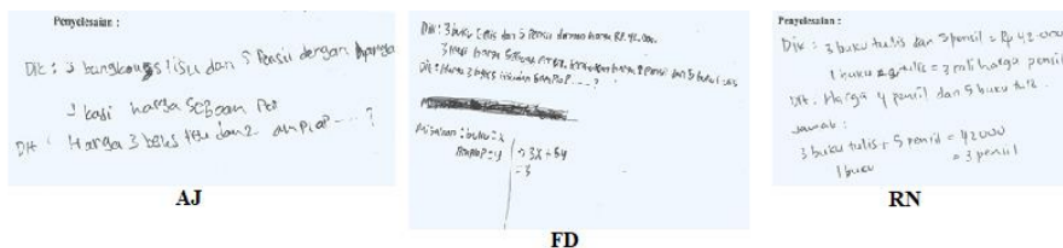

Figure 10. Answers of AJ, FD, RN to the first question of the conceptual understanding test at the symbolic stage

Figure 8 shows that when AJ, FD, and RN received given questions in written form (symbolic stage), they could understand the questions but were not able to solve the questions correctly. They only wrote down the information contained in the questions.
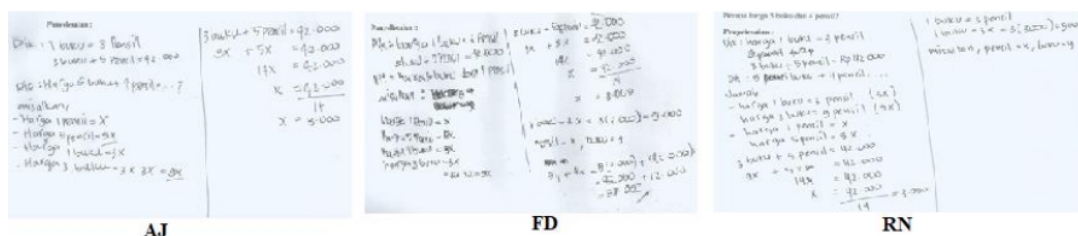

Figure 11. Answers of AJ, FD, RN to the first question of the conceptual understanding test at the iconic stage

In the iconic stage, FD could solve the question correctly. Meanwhile, AJ only found the value of x. RN also has not completed the answer in which RN only determined the value of x and would like to find the value of y. AJ and RN have not been able to solve the question because of the limited time to work on the questions. Indeed, they already understood the questions. At this stage, FD fulfills the first indicator of the understanding of mathematical concept. AJ and RN have understood what is meant by the problem but have not been able to solve it on time.

Figure 4. Answers of AJ, FD, RN to the second question of the conceptual understanding test at the symbolic stage

In the second question, AJ and RN have not been able to solve the question. They only wrote down the information contained in the question. Meanwhile, FD could only rewrite the questions without writing down the information contained. The questions in this symbolic stage have not made the students solve the problems correctly.
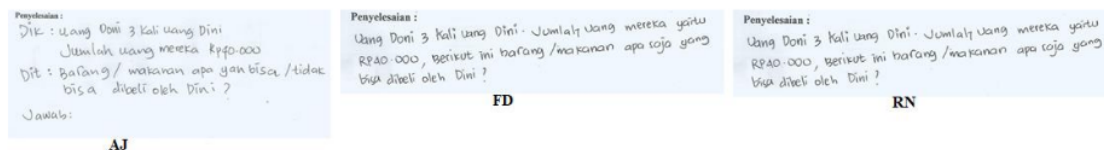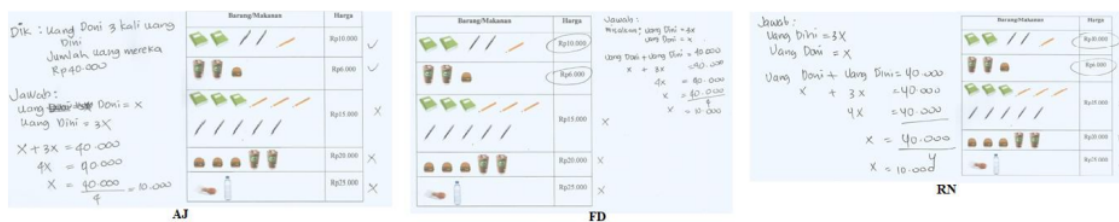
Figure 5. Answers of AJ, FD, RN to the second question of the conceptual understanding test at the iconic stage

With the same questions but presented in different forms, namely in the form of pictures (iconic stage), AJ, FD, and RN could understand the question and then solved the question correctly. It means that presenting the question in the picture makes students to better understand the question and helps them solve the question. This proves that they have fulfilled the second indicator of the understanding of the mathematical concept, namely providing examples and non-examples of a concept. In other words, the student can select the menu list by ticking or circling the menus that can be purchased and crossing the menus that cannot be purchased.
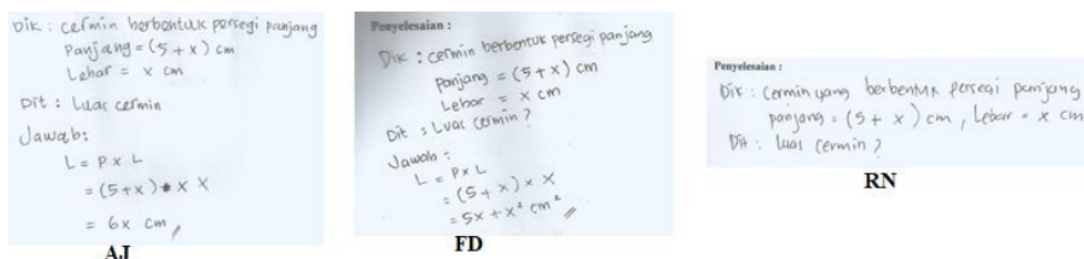

Figure 6. Answers of AJ, FD, RN to the third question of the conceptual understanding test at the symbolic stage

AJ could understand and solve the third question. However, AJ's answer is incorrect. AJ should have solved it rainbow multiplication with the result of $5x + x^2 cm^2$. Then, FD could understand and solve the question correctly. In this symbolic stage, RN could only write down the information contained in the question and had not been able to solve it. It means that FD has fulfilled the third indicator of the understanding of the mathematical concept, while AJ has understood the question but incorrectly provide the answer. RN has not been able to fulfill the third indicator of understanding of the mathematical concept as RN has not been able to solve the question correctly.
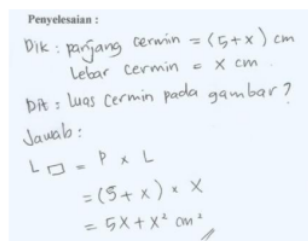
Figure 15. RN's answer to the third question of the conceptual understanding test at the iconic stage

In the iconic stage, RN could solve the question correctly as in the previous symbolic stage RN could understand the question well. Presenting the questions in the form of pictures makes it easier for RN to understand the length and width of a rectangle. It means that RN has met the third indicator of the understanding of the mathematical concept.
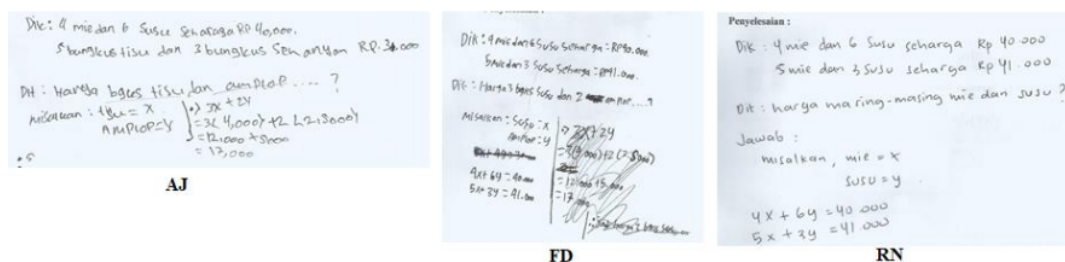
Figure 16. Answers of AJ, FD, RN to the fourth question of the conceptual understanding test at the symbolic stage

In the fourth question, AJ was confused because what is known and what is in AJ's answer are not the same. AJ also only guessed the price of noodles and milk according to reality. It means that AJ has not fully understood the question. Meanwhile, FD has little understanding of the question as FD has assumed x and y although they are not the same as what is known in the question. FD has written an algebraic equation. The same with FD, RN has little understanding of the question and has written equations in algebraic form.
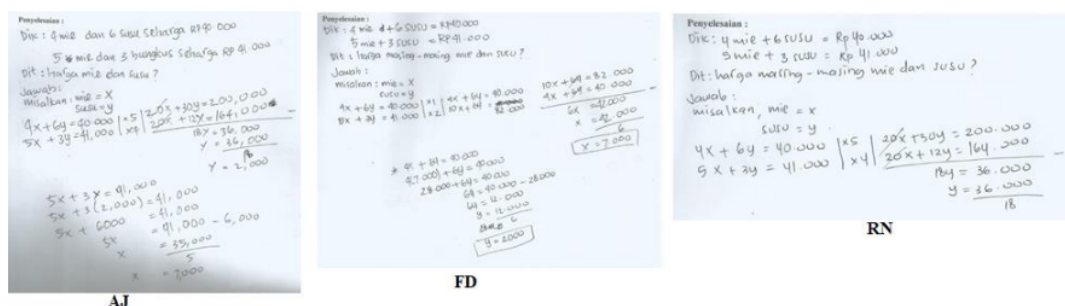
Figure 7. Answers of AJ, FD, RN to the fourth question of the conceptual understanding test at the iconic stage

For the same question in an iconic form, AJ and FD could solve the problem correctly. They could find the values of x and y. Meanwhile, RN has understood the question but has not been able to solve it correctly due to limited time. RN could only solve it by finding the value of y but has not found the answer. This means that AJ and FD have met the fourth indicator of understanding mathematical concepts. RN has slightly met the fourth indicator of understanding of the mathematical concepts but has not been able to solve the question correctly.

The results of interviews with AJ, FD and RN show that providing mathematical questions in the form of pictures makes it easier for students to understand and solve the question. FD also revealed that the questions given in the form of pictures make him more enthusiastic about working on the question. Furthermore, questions in the form of pictures are more interesting and colorful. In line with FD, RN added that the questions in the form of pictures are not monotonous and do not make them bored. A study by Ardat (2016) showed that using Bruner's theory can improve students' understanding of mathematical concepts, mathematical reasoning, and creativity in solving mathematical questions. Another study by Kandaga (2017) proved that there is an important relationship or link between the ability to understand mathematical concepts and students' mathematical dispositions, and mathematical dispositions have a fairly strong relationship with the understanding of mathematical concepts. The use of Bruner's theory can increase the student's ability to understand mathematical concepts, and the increase in the student's mathematical concept increases the mathematical disposition.

3. **Students with a low mathematical disposition level (HD)**

The results of the conceptual understanding test of students with a low mathematical disposition level can be seen below:

Figure 18. HD's answers to the first question of the conceptual understanding test at the symbolic stage

At the symbolic stage, HD has not been able to solve the question correctly. However, DH could understand a little about the questions as DH has written down the information contained in the questions.

Figure 19. HD's answers to the first question of the conceptual understanding test at the iconic stage

When getting the same question in a different form, namely in the form of pictures, HD still could not solve the question correctly. HD didn't understand the questions. HD should assume 1 pencil with x, then 5 pencils with 5x. Based on the question, 1 book is equal to 3 pencils, so 3 books are equal to 9x. With that answer, HD has not been able to fulfill the first indicator of the understanding of the mathematical concept, namely restating a concept because HD has not correctly answered the question.

Figure 20. HD's answers to the second question of the conceptual understanding test at the symbolic stage

The same with the previous question, HD has not been able to solve the second question correctly, but HD has a little understanding of the questions as HD has written down the information contained in the question.

Figure 8. HD's answers to the second question of the conceptual understanding test at the iconic stage

At this iconic stage, HD could understand and solve the question well. HD could identify examples and non-examples in the algebraic form given by selecting items or foods that can or cannot be purchased by ticking items/foods that can be purchased on the menu list on the question. It means that DH has met the second indicator of the understanding of the mathematical concept.

Penyelesaian :

Pak Kardi memiliki cermin yang berbentuk persegi panjang dengan panjang (5+x) cm dan lebar x cm. Berapakah luas cermin yang dimiliki Pak Kardi ?

Figure 9. HD's answers to the third question of the conceptual understanding test at the symbolic stage

In the third question, HD has not been able to understand and solve the questions using the symbolic stage. HD could only rewrite the questions. A previous study by Sakiinatullaila et al. (2020) found that one of the student learning difficulties categorized as slow learners is the difficulty level of the questions which causes students to sometimes only rewrite the questions. It means that with this symbolic stage, HD has not been able to understand and solve the question correctly.

Penyelesaian :
dik : - P = (5+x)cm
      - L = x cm
dit : Luas cermin?

L = P × L
  = (5+X) × X
  = 5x+x+x cm²

Figure 23. HD's answers to the third question of the conceptual understanding test at the iconic stage

On the same question but presented in the form of a picture (iconic stage), HD could understand and solve the question. However, HD did not provide the correct final answer in which the variable x should be multiplied by $(5 + x)$ with the result of $5x + x^2 cm^2$ not $5x + x + x \ cm^2$. It means that HD does not meet the third indicator of changing the algebraic form to the simplest form and converting a story question into an algebraic form. However, HD has understood the questions well, he makes incorrect calculations and final answers.

Penyelesaian : dik: - 4 mie dan 6 susu = 40.000
                    - 5 mie dan 3 susu = 41.000
dit: harga masing-masing mie dan susu
4x+6y = 40.000   × 5 | 20x + 30y = 200.000
5x+3y = 41.000   × 4 |
                     | 20x + 12y = 164000
                     | 18y = 36.000
                     | y = 2000

Figure 24. HD's answers to the fourth question of the conceptual understanding test at the symbolic stage

In the fourth question at the symbolic stage, HD could understand and slightly solved the question. As the time given for each question is only 30 minutes, HD could only solve a part of the question, namely looking for the y value.

Figure 10. HD's answers to the fourth question of the conceptual understanding test at the iconic stage

As at the symbolic stage HD already understand the question and solve a part of the question, it is easier for HD to continue to find the value of x. It has been clarified with questions in the form of pictures that make it easier to answer. It means that HD meets the fourth indicator of the understanding of the mathematical concept of using the concepts of multiplication, subtraction, and addition in the algebraic form to solve questions.

Based on the results of the interview, HD stated that presenting questions in the form of pictures makes it easier to solve the question. Especially for HD who has weaknesses in writing and reading, presenting questions in the form of pictures helps HD a little in understanding and solving the question. HD also stated that he preferred questions in the form of pictures rather than in written form. A study by Sakiinatullaila et al. (2020) found that one of the difficulties experienced by students in the slow learner category is learning that uses a lot of oral and written forms as they have difficulties in recording information in the long term and have a low concentration and attention to the information conveyed (Hasibuan et al., 2020; Tran et al., 2020).

Understanding mathematical concepts are one of the abilities that must be possessed by students as it is the most important factor in achieving meaningful or useful mathematical knowledge (Mulyani et al., 2018). Besides, students have to possess mathematical dispositions because mathematical dispositions and understanding mathematical concepts are interrelated. The results of the present study reveal that slow learner students in dyslexia and dyscalculia categories with a high mathematical disposition level also have a good understanding of the mathematical concept. Enggaringtyas et al. (2019) and Suryaningsih (2011) stated that the use of Buner's theory is proven to improve students' conceptual understanding abilities and student learning activities. Using Bruner's theory in presenting questions helps slow learners understand and solve the question correctly. Besides, it also applies to slow learners with a moderate and low mathematical disposition level. The ability to understand mathematical concepts relates to the student's mathematical disposition level. It means that there is a relationship between mathematical disposition and understanding of mathematical concepts for slow learners in solving the question using Bruner's theory.

CONCLUSION

Based on the results of the study, it can be concluded that there is a relationship between mathematical disposition and understanding of the mathematical concept of slow learner students. Presenting questions using Bruner's stages, namely the symbolic stage and the iconic stage makes it easier for slow learners to understand and solve the question correctly, especially by using the iconic stage. Presenting the questions in the form of pictures makes it easier for students in the slow learner category to understand and solve the question.

RECOMMENDATION

Considering the results of this study, this study is important for educators, especially educators in inclusive schools to master more learning methods in order to achieve learning goals optimally to improve the low learners' ability to understand mathematical concepts. It is

expected that future studies can identify the slow learners' understanding of mathematical concepts and mathematical dispositions deeper by utilizing and combining various and interesting methods, theories, and learning media for students in the slow learner category.

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