Analysis Difficulty Understand The Mathematical Concept of Integers Viewed from the Metacognitive Abilities of Class VII Students of Private Junior High Schools Dwiwarna Medan

Yulinar Sari Simamora[1], Bornok Sinaga[2], Anita Yus[3]

{yulinarsari93@gmail.com[1]}

Universitas Negeri Medan[1], Universitas Negeri Medan[2], Universitas Negeri Medan[3]

Abstract. This study aims to analyze: (1) the level of difficulty in understanding students' mathematical concepts on integer material in terms of students' metacognitive abilities; (2) describe the process of students' answers in understanding students' mathematical concepts on integer material in terms of students' metacognitive abilities. This research is a qualitative research with a descriptive approach. The instrument of this research is the ability test of Concept Understanding, Learning Implementation (RPP), Student Books, and Student Worksheets (LKPD). From the results of the study, it was found that: The level of understanding the concept in terms of students' metacognitive abilities from 25 students with 'high' abilities as much as 8%, namely 2 students, then 'medium' abilities as much as 40%, namely 10 students. Then, the 'low' ability was 28%, namely 7 students, and the 'very low' ability was 16%, namely 4 students.

Keywords*:* Understanding of Mathematical Concepts, Integer, and Metacognition Ability

1 Introduction

Education is very important for humans, because with education humans can gain knowledge and skills and can develop their abilities, attitudes and behavior. Some of the challenges in the 21st century are climate change (climatechange), global poverty (global poverty), population growth (population growth), wars in the 21st century (all out war), species extinction (losing species), creativity, transhumanism , and the divide between skills and wisdom (skills and wisdom gap) (Martin, 2007)[1].

Education is the process of changing the attitudes and behavior of a person or group of people in an effort to mature humans through teaching and training efforts. Education This is an important thing and must be taken by everyone.

Mathematics is one of the disciplines that is part of the educational process in schools and has an important role in all kinds of dimensions of student life which serves to develop the ability to calculate, measure, and so on that are needed in everyday life.

[1] Marti n, J, The 17 Great Challenges of The Twenty-First Century. (2007)

AISTEEL 2022, September 20, Medan, Indonesia
Copyright © 2022 EAI
DOI 10.4108/eai.20-9-2022.2324523

Learning mathematics is a process of acquiring knowledge that is built by students themselves and must be carried out in such a way as to provide opportunities for students to rediscover mathematical concepts.

The Ministry of National Education (2007) stated that there are several aspects that need to be developed in learning mathematics, including understanding concepts, problem solving as well as reasoning and communication. While mathematics is considered a basic science that is very important for human life.

This is in accordance with Erman's statement (in Ella, 2006) that mathematics is growing as a service provider for the development of other sciences so that understanding the concept of a material in mathematics must be placed on top priority.

According to Sanjaya (2006) Concept understanding is the ability of students in the form of mastery of a number of subject matter, where students not only know or remember a number of concepts learned, but are able to express them again in other forms that are easy to understand, provide data interpretation and are able to apply concepts in accordance with its cognitive structure[2].

TIMSS (*Trends in International Mathematical and Science Study)* in Ella, 2016) and *STUI* International *on* mathematics achievement show the fact that in Indonesia there are still many students who have difficulty understanding mathematical concepts, to be exact, Indonesia is ranked 36th out of 49 countries.

According to Sumarmo (2011), broadly speaking, basic mathematical abilities can be classified into five standards: (1) Knowing , understand, apply mathematical concepts, procedures , principles, and ideas. (2) Solve math problems. (3) Mathematical reasoning. (4) Make mathematical connections. (5) Mathematical communication. One of the basic skills of mathematics is the ability to reason mathematics[3].

Asrul (201) states that to achieve conceptual understanding, problem identification can help create an atmosphere of thinking for students. Cleanliness in learning is largely determined by the state of the applied learning process. But for this era, students' understanding of mathematical concepts is getting less and less which causes difficulties in learning solve math problems. The difficulty can be seen both in the results and in the process of solving mathematical problems. This is where we need metacognition in a student.

Metacognitive ability according to Mutjis (in Rahayu, 2015) is an ability to understand and determine a person's cognitive activity in the learning process. With metacognitive abilities, students can find out how students learn, know their abilities and learning modalities and know the best learning strategies for affective learning.

Metacognition from an educational point of view according to Alzahrani (2017) [4]refers to one's knowledge and monitoring and controlling one's systematic cognitive activity that requires certain metacognitive skills such as planning and evaluation .

---

[2] Sanjaya, W. *Learning Strategies oriented to the standard of the educational process.* (Jakarta, Prenada Media Group, 2010)

[3] Sumarmo, Utari.. Berpikir dan Disposisi Matematik (Bandung, 2010)

[4] Alzahrani, Assessment of the burden on caregivers of patient with mental dissonders in Jeddah, (Saudi

Sjutz (in Fauziana, 2008) describes strategies that can be used to control the steps of metacognition including: planning, monitoring, and assessment. The success of students in solving problems is very dependent on their awareness of thinking. A person's thinking awareness can be observed so that the level of students' thinking awareness can be observed in the steps he takes in solving a problem.

This is in line with the opinion of Anderson and Krathwhol (2001) because someone uses *metacognition control and self-regulation* in their thinking processes including the use of other dimensions such as *remember, understand, apply, analyze, evaluate and create* in the category of cognitive processes in the previous Bloom's taxonomy. Therefore, one aspect of the knowledge and skill dimensions that is interesting to study more deeply, especially in learning mathematics is the metacognitive aspect.

According to Kurniasih & Sani (2014) discovery learning is defined as a learning process that occurs when learning material is not presented in its final form, but students are expected to organize themselves. A further statement was put forward by Hosnan (2014) that discovery learning is a model for developing an active way of learning by finding it yourself, investigating it yourself, then the results obtained will be faithful and long-lasting in memory.

Through discovery learning, students can also learn to think analytically and try to solve the problems themselves. The discovery model is a learning that emphasizes direct experience and the importance of understanding the structure or important ideas of a discipline, through the active involvement of students in learning. Teaching materials are presented in the form of questions or problems that must be solved. So students acquire knowledge that they do not know not through notification, but through self-discovery.

2 Research Method

The type of research used in this research is descriptive qualitative research . According to Moleong (2007)[5] that "Qualitative research is research that aims to understand what phenomena are experienced by research subjects. For example, behavior, perception, motivation, action, and others. Holistically and by way of description by utilizing natural methods .

In this research, the steps or designs in this research will be described as follows : Observation , Compiling Research Proposals , Validation of learning tools and research instruments carried out by validators (expert validation) , Implementation of learning with the *Discovery Learning learning model* , Implementation of interviews , Data analysis and research findings , Report Writing n.

Arabia. *BMC Psychiatry* , 2017)

[5] Moleong, Lexy J, *Qualitative Research Methodology* .(Bandung , PT. Offset Rosdakarya Youth, 2013)

3 Results and Discussion

3.1 Level of Understanding of Students' Mathematical Concepts

Based on the results of the test of understanding mathematical concepts in terms of the metacognitive abilities of 25 students, the students' metacognitive ability levels are spread across five levels . Here's the table:

Table 1. Level of Understanding of Mathematical Concepts

No.	Score Interval	Amount	Percentage	Rating Category
1	0 KCM< 45	4	4%	Very low
2	45 KPKM< 65	7	7%	Low
3	65 KCM 80	10	40%	Currently
4	80 KCM 90	2	8%	Tall
5	90 KCM 100	2	8%	Very high

From the 25 students, it turned out that the level of understanding of mathematical concepts in terms of metacognitive abilities of moderately capable students had the highest proportion and was followed by low-ability students. The level of understanding of mathematical concepts in terms of students' metacognitive abilities with 'very low' abilities as much as 16%, 'low' abilities as much as 28%, 'medium' abilities as much as 40%, 'high' abilities as much as 8% and 'very high' abilities as many as 8 %.

3.2 Students' Mathematical Metacognition Level

The level of students' metacognition in the ability to understand students' mathematical concepts was obtained from the tests given after carrying out the *Discovery Learning learning model.* The results of students' metacognition are presented in Table 2 below:

Table 2. Effectiveness Test Data

No.	Score Interval	Metacognition Level	Total students	Percentage
1	3.41 - 4.00	*Reflective Use*	4	16%
2	2.67 - 3.40	*Strategic Use*	11	44%
3	1.33 - 2.66	*Aware Use*	6	24%
4	0.00 - 1.32	*Tacit Use*	4	16%
Total students			25	100%

Based on Table 2 above, it can be seen that the percentage level of *Reflective Use* and *Tacit Use* has a lower proportion than the level of metacognition *of Strategic Use* and *Aware Use.*

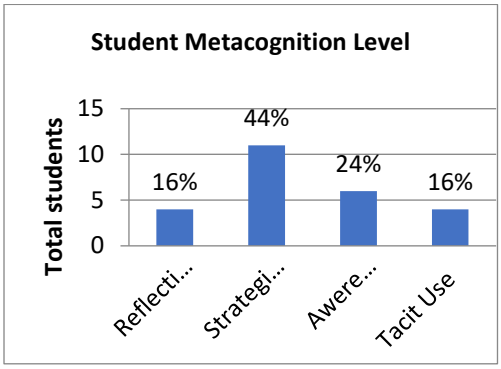

Figure 1. Students' level of metacognition

Based on Figure 1 above, students who have metacognition with *Reflective Use level* are 4 people (16%), *Strategic Use level* is 11 people (44%), *Awere Use level* is 6 people (24%) and *Tacit Use level* is 4 people (16%).

Analysis of Difficulty in Understanding Mathematical Concepts in terms of Students' Metacognitive Ability. Difficulty in understanding mathematical concepts in terms of the metacognitive abilities experienced by students during the learning process which is applied to the *Discovery Learning learning model* as follows:

Table 3. Students' Difficulties in Understanding Mathematical Concepts

No.	Difficulties Experienced by Students	Indicator	Total students	Percentage
1	Fact	Students are unable to understand the use of symbols, notations, and mathematical facts in solving problems	10	40%
2	Draft	Students are not able to apply the concept of integers	9	36%
3	Principle	Students are not able to apply mathematical formulas (rules) in solving problems	17	68%
4	Procedure	Students are not able to apply the steps in understanding mathematical concepts in sequence and correctly Students are not able to develop strategies to understand mathematical concepts well	21	84%

From Table 3, it is found that 10 students (40%), who have metacognitive difficulties in understanding mathematical concepts, have 9 students (36%), who have metacognitive

difficulties in understanding mathematical principles. as many as 17 people (68%), and students who experience metacognitive difficulties in understanding mathematical procedures are 21 people (84%).

The Process of Student Answers on the Test of Understanding Mathematical Concepts in terms of Students' Metacognitive Ability. From the results of the students' answers above, we can analyze the results of students' metacognition in understanding mathematical concepts in high-ability students according to the following metacognitive indicators:

Results of the Answer Process of Students with High Metacognitive Ability

Table 4. Results of Student Answer Process

Criteria Aspect Achievement Indicator	**Restate a concept**	**Give examples of concepts and not examples of concepts**	Applying concepts in problem solving
explain the reasons for the solution made based on his own understanding of what he learned	*Reflective Use*	*Reflective Use*	*Reflective Use*
interpret the results of the answers obtained in accordance with the context of the problem to the mathematical model and provide arguments appropriately	*Reflective Use*	*Reflective Use*	*Reflective Use*
explain in part what is learned from solving problems that have been made correctly.	*Strategic Use*	*Strategic Use*	*Strategic Use*

Metacognition Results of Students with Medium Ability

Table 5. Process Results of Students with Medium Ability

Criteria Aspect Achievement Indicator	**Restate a concept**	**Give examples of concepts and not examples of concepts**	Applying concepts in problem solving
explain the reasons for the solution made based on his own understanding of what he learned	*Strategic Use*	*Aware Use*	*Strategic Use*
interpret the results of the answers obtained in accordance with the context of the problem to the mathematical model and provide arguments appropriately	*Aware Use*	*Aware Use*	*Aware Use*
explain in part what is learned from solving problems that have been made correctly.	*Aware Use*	*Strategic Use*	*Aware Use*

Metacognition Results of Students with Low Ability

Table 6. Results of the Answer Process of Students with Low Ability

Criteria Aspect Achievement Indicator	**Restate a concept**	**Give examples of concepts and not examples of concepts**	Applying concepts in problem solving
explain the reasons for the solution made based on his own understanding of what he learned	*Aware Use*	*Aware Use*	*Strategic Use*
interpret the results of the answers obtained in accordance with the context of the problem to the mathematical model and provide arguments appropriately	*Aware Use*	*Strategic Use*	*Aware Use*
explain in part what is learned from solving problems that have been made correctly.	*Aware Use*	*Aware Use*	*Aware Use*

3.3 Analysis of Students' Difficulties and Interviews in Understanding Mathematical Concepts

High Ability Students. From the results of the interview above, it can be seen that the subject understands what he wrote by showing his ability to provide arguments to support his thoughts. Based on the triangulation of data obtained from the description of the answer sheets and the results of interviews with students in terms of subjects with the ability to understand mathematical concepts in the high-ability category, the metacognitive characteristics are:

1. The subject is aware of the abilities he already has
2. The subject generally knows what to do
3. Subjects can provide an argument that supports their own thinking
4. The subject is able to provide an explanation to convince what he will do.

Medium Ability Students. From the results of the interview above, it can be seen that the subject understands what he wrote by showing his ability to provide arguments to support his thoughts. Subjects are also aware of their abilities. The subject showed that the problem solving he made was based on metacognition and had a way of convincing what he was doing. The subject had little difficulty in answering the metacognitive questions given at the stage of applying the concept in problem solving.

Based on the triangulation of data obtained from the description of the answer sheets and the results of interviews with students in terms of subjects with the ability to understand mathematical concepts in the high-ability category, the metacognitive characteristics are:

1. The subject is aware of the abilities he already has
2. The subject generally gives an explanation to convince what he has done
3. The dame subject is aware of his weaknesses to convince what he is doing
4. The subject begins to know what he is not aware of.

Low ability students. Based on the triangulation of data obtained from the description of the answer sheets and the results of interviews with students in terms of subjects with the ability to understand mathematical concepts in the high-ability category, the metacognitive characteristics are:

1. Subjects are less aware of the abilities they already have
2. The subject has a weakness in giving explanations to convince what he has made
3. Subjects are less aware of their weaknesses when solving problems (not realizing that the results they get are not right)
4. The subject does not know that many of the reasons given are meaningless.

Based on the characteristics listed above, the subject of S-22 with a high score of understanding mathematical concepts is at the level of metacognitive ability of *Tacit use* . This is because the characteristics that arise from students' thinking awareness meet the indicators of the *Tacit use level.*

4 Conclusion

Based on the results of the analysis, findings and discussions that have been presented in chapter IV during learning with the *Discovery Learning model* , several conclusions are obtained which are answers to the questions posed in the formulation of the problem. The conclusions are as follows: The level of understanding the concept in terms of students' metacognitive abilities from 25 students with 'high' abilities as much as 8%, namely 2 students, then 'medium' abilities as much as 40%, namely 10 students. Then the 'low' ability was 28%, namely 7 students, and the 'very low' ability was 16%, namely 4 students. The final results of students in metacognition with *Reflective Use level* are 4 people (16%), *Strategic Use level* are 11 people (44%), *Awere Use level* are 6 people (24%) and *Tacit Use level* are 4 people (16%).

The process of students' answers to understanding concepts in terms of students' metacognitive abilities in solving problems: Students explain the prerequisite material to solve the problem. Students explain what needs to be done if they do not understand the problem given , explain the strategy/method used and believe that the answer process is correct. Students also explain the reasons for choosing a resolution strategy, and students also re-examine the answers obtained and conclude the results obtained after solving the problem.

Difficulties in understanding concepts in terms of students' metacognitive abilities experienced by students in solving mathematical problems are: Fact difficulties, namely students' difficulties in understanding the use of mathematical symbols in solving problems and difficulties in presenting symbols to design models mathematics of the given problem. Based on the results obtained, there are 40% or as many as 10 people out of 25 students who have difficulty with facts. Concept difficulties, namely students' difficulties in applying the concept of integer arithmetic operations and fractions to solve the problem . Concept difficulties, namely difficulties in applying the concept of integers . Based on the results obtained, there are 36% or as many as 9 people out of 25 students who have conceptual difficulties.. Principle difficulty, namely the difficulty of students in applying mathematical rules and difficulties in connecting the concepts given to solve problems. Based on the results obtained, there are 68% or as many as 17 people from 25 students who have difficulty in principle. Procedural difficulties, namely the difficulty of students in completing the steps in solving problems, as well as difficulties in formulating strategies in solving problems effectively and efficiently.

References

[1] Marti n, J. (2007). The 17 Great Challenges of The Twenty-First Century. The
[2] Sanjaya, W. 2010. *Learning Strategies oriented to the standard of the educational process.* Jakarta: Prenada Media Group.
[3] Sumarmo, Utari. 2010. Berpikir dan Disposisi Matematik: Apa, Mengapa, dan Bagaimana Dikembangkan pada Peserta Didik. Artikel pada FPMIPA UPI Bandung.
[4] Alzahrani. (2017). Assessment of the burden on caregivers of patient with mental dissonders in Jeddah, Saudi Arabia. *BMC Psychiatry* , 17 (202) .
[5] Moleong, Lexy J. 2013. *Qualitative Research Methodology* . Bandung : PT. Offset Rosdakarya Youth.