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Model Mental Transition-Attempting: The Case of Beginners Students In Understanding The Concept of Integers

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Abstract

A mental model is a concept that exists in students' minds and is used to describe and explain a phenomenon. This study aims to describe the transition-attempting mental model of students in understanding the concept of integers. This study uses a qualitative approach and the type of research conducted is descriptive. The subjects of this study amounted to 58 students in class VII. Subjects were given a test to determine their understanding of the concept of integers. They were collecting data in this study using test questions and interviews. Data analysis used five steps, namely 1) data transcoding; 2) reviewing data; 3) data reduction; 4) presenting data; 5) analyzing the process of forming mental models; and 6) verifying the findings. This study indicates that students can compare negative integers and positive integers for symbols of different quantities. However, this finding cannot be categorized into the level of the mental model that already exists, so in this study, we solve the mental transition I model into a transition-attempting mental model. Based on the research results found, the mental transition-attempting model can be seen from the information held by students and stored in long-term memory before they are faced with certain concepts.

Keywords: Mental model, Student, Concept, Integer

Introduction

Integers are cloth contained in arithmetic, and the subject is important for college kids to research due to the fact with the aid of understanding integers, you could solve various issues in everyday life (Musser dkk, 2011; Nasrullah & Zulkardi, 2011; Kabael & Ata Baran, 2019; Muslimin & Aisyah, 2020; Gulburnu & Yildirim, 2021). students will discover problems concerning integers in diverse contexts (Cengiz, 2018). in order that calls for them to apprehend integers.

In Indonesia, this cloth is supplied at the standard faculty level, however this fabric is to aid the continuity of in addition getting to know at the junior to senior excessive college stage (Nicole, 2019). In Indonesia and numerous other nations, which include Singapore and Japan, the material for integers is in 7th grade. So the researchers conducted interviews with several students in 7th grade and arithmetic instructors in junior high faculty. although arithmetic is a complicated issue for college students (Kuzu, 2021), this number cloth is pretty hard to understand, in particular regarding the operation of numbers involving terrible numbers. in contrast to positive numbers, negative numbers do now not have an obvious reference. therefore, college students should try harder to recognize poor numbers (Blair et al., 2012; Nicole, 2019).

This is regular with severa cases that severa researchers have located (Vlassis, 2008; Bofferding, 2010; Bofferding, 2014; and Van de Walle et al., 2013). Vlassis (2008) additionally explains using the image adapted to the context as it could have an effect on college students' understanding of the idea of integers. in the meantime, Bofferding (2010), at the same time as college students perform integer addition operations, college students interpret the photograph as a symbol for subtracting or along with bad symbols into their solutions. Then Bofferding (2014) makes use of the time period "minus" in fashionable to consult the photograph "", "subtraction sign" to consult the binary that means of the minus signal, and "terrible sign" to refer to the unary which means of the minus sign. furthermore, college college students moreover often have difficulty figuring out large and smaller numbers and acting mathematics operations on integers (Van de Walle et al., 2013).

To overcome the troubles confronted by those students required an expertise of the idea. If now not mastered nicely through college students, current understanding related to mathematical principles will hurt the topic being studied (Hamzah et al., 2021). that is very important for students

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to research standards in various (Carey, 2000; Shu, 2015; Kardeniz, 2017). understanding ideas is typically explained through definitions or examples in actual-life contexts (Shen et al. 2017; Nongkhunsarn et al. 2019). this is achieved so that someone can easily take delivery of new statistics to offer insight into a idea as an effort to technique conceptual change (Rathgeb-Schnierer & green, 2013; Cebola & Brocardo, 2021).

One manner to construct conceptual alternate in college students is through intellectual fashions. due to the fact students' fundamental knowledge may be made and developed thru intellectual models (Chiou, 2013; Bishop et al., 2014; Prayekti et al., 2019), because mental fashions can act as someone's reasoning process whilst looking to recognize, are expecting, or explain a concept while fixing a problem to reach an understanding (Fazio et al., 2013; Halim et al., 2013; Prayekti et al., 2020a).

students can form intellectual models from their memories, outside cultural factors, and symbolic representations due to the fact a flexible learner's cognitive tool can give a boost to the shape of records illustration from inner and out of doors factors (Park & Oh, 2013; Batlolona, 2020; Prayekti et al., 2020b; Kaharu & Mansyur, 2021). inner representations of gadgets, ideas, and strategies that appear at some level inside the cognitive characteristic to explain, provide an reason behind or expect a phenomenon may be called highbrow fashions (Scot et al., 2016). A intellectual model is a shape of person mind or mind that can describe, explain, and decide on superb matters (Jansoon, 2009; Uitdewilligen, 2013; Jones et al., 2011). moreover (Senge, 2004; and van Schijndel et al., 2018) give an explanation for that a highbrow model is an inner photograph of the manner topics work, which limits someone to assume and act. someone regularly does not comprehend that information a mental model will affect himself and his behavior.

From numerous research, mental models also have several degrees that previous researchers have studied. The leveling is divided into particular companies in step with the consequences of each researcher as Park & light (1992) leveled the mental model into 5 levels, namely the preliminary mental model that changed into formless or doubtful, the intermediate intellectual version 1, the intermediate intellectual version 2, the intermediate mental version 3, and the goal intellectual model. Then Bofferding (2014) divides the mental version into five, specifically the mental models initial, the mental models transition 1, the mental models synthetic, the mental models transition 2, and the mental models formal. Jaber & Boujaoude [2012] leveled intellectual mental models into high, medium, and coffee categories. furthermore, it changed into advanced by using Utami et al. [2018] into six mental models, particularly, mental models pre-initial, mental models initial, mental models transition I, mental models synthetic, mental models transition II, and mental models formal.

However, primarily based on the level of Bofferding's mental version [2014], in-depth studies nonetheless wishes to be performed to deal with and offer a discussion board for students who have a one of a kind degree of a intellectual model from the preceding concept. this is primarily based on pre-studies, which suggests that students already recognize the contrast of tremendous integers and negative integers and might produce a very last category that is nearly right and cannot be categorised at the intellectual transition model I level. despite the fact that they can compare tremendous and poor integers and terrible integers, they can attain symbols of different quantities.

The researcher breaks down the mental transition version degree I right into a mental transition attempting model to accommodate those conditions. for this reason, the leveling of the theoretical mental version still calls for in-depth studies because it's miles suspected that there may be nonetheless a loss of studies in Indonesia that discusses students' knowledge in comparing integers with symbols of various quantities in order that the outcomes of this observe can be important for overview in classroom mastering performed by way of teachers, by way of supplying expertise to college students to understand the idea of integers.

Method

This research method belongs to the qualitative method type and uses a case study design. The case observed in this study was the student's understanding of comparing integers to symbols of different sizes.

Research Subject

The topics on this have a look at were 58 seventh graders of Junior excessive school, Sekaran District, Lamongan Regency, Indonesia. All subjects have been given check questions related to comparing integers. subjects were requested to compare nice and terrible integers, examine two terrible integers, and encompass motives for every answer. The questions given are supplied in figure1.

Data Analysis

The manner of information assessment in this observe become carried out in steps (Creswell, 2015): (1) transcoding the

1. The liquid, before being heated, has a temperature of −4°C. After being heated, the temperature becomes 9°C. Which liquid is bigger before and after being heated? Give the reason!
2. Compare the following two numbers using the sign "<" (less than) or ">" (more than)! Give the reason!
   a. −7 ... 4
   b. −9 ... 6
   c. 10 ... −3
   d. 5 ... −7
   e. −12 ... −11
   f. −8 ... −4
3. Two kids play a game and try to get the highest score
   a. Bagas got a score of 14, while Yuni got a score of −7. Who is the winner? Give the reason.
   b. Tiwi got a score of −11, while Yuli got a 15. Who won? Give the reason.
   c. Sari got a score of −3, while Santi got a score of −5. Who is the winner? Give the reason.

Fig. 1: Research instruments

information amassed, on this check, transcribing test effects and interviews with topics; (2) reviewing check cease end result information and interview transcripts; (three) carry out facts bargain via method of choosing, focusing and classifying similar information, then simplifying it by way of putting off useless topics. The researcher selects the records generated from the take a look at via the signs that have been formerly determined, then classifies the effects based totally on the level of the transition-attempting mental model of university college students in knowledge the concept of integers and discarding pointless topics; (four) presenting studies facts. in this step, the researcher offered the effects of the scholars' checks at the transition-attempting highbrow model level as well as the effects of interviews to offer an reason behind the effects of their solutions; (5) reading the approach of forming the transition-trying highbrow model of students in understanding the idea of integers. feature with a optimistic framework of reflective-abstraction facts mechanisms, (6) affirm findings and finish. on this step, the researcher confirms the results, in this case, the transition-attempting highbrow version of college college students in understanding the idea of integers, then concludes.

This examine intends to analyze how university college students build their understanding in information integers constant with Piaget's framework. Utami et al., [2018] states that the development of cognitive structures is resulting from reflective abstraction. to present an reason behind the concept related to mathematics thoughts, Dubinsky, E, and Tall [28] said that there are five constructions in reflective abstraction, namely interiorization, coordination, inversion, encapsulation, and generalization. The definition of constructs on this test improving the ones of Dubinsky, E, and Tall, (2002) are supplied in table 1.

Researchers decided pupil sports at the same time as completing the check questions that have been given. moreover, researchers finished interviews with decided on topics. The records on this have a study have been acquired from take a look at results and interview transcripts with determined on subjects. in this observe, the outcomes of video interviews and written test outcomes have been accrued to ensure the validity and reliability of the examine; records analysis became accomplished by means of using triangulation with the aid of showing video effects and evaluating them with college students' written test consequences. See in element the consequences of the video interviews and the written test effects of college students to decide the extent of know-how of the transition-attempting highbrow model of college college students in expertise the concept of integers and after selecting the traits of the transition-attempting intellectual version, then processing the facts in step with the traits of college students in records the preliminary concept of integers. This categorization is an important step in records evaluation because it permits information interpretation. This categorization comes from a literature assessment, figuring out each interview answer and student test outcomes that constitute the literature evaluate idea

Findings

This have a look at discusses the level of intellectual models which have been formerly studied by (Bofferding, 2014). moreover, in this study, researchers developed a intellectual model of (Bofferding, 2014) in understanding the concept of integers. Of the entire answers of fifty eight prospective subjects, 38 subjects can efficaciously understand the idea of integers, and 20 topics cannot apprehend the idea of integers. based at the answers of 38 subjects, three topics have different answers, and the solutions can be analyzed using a reflective abstraction production according to desk 1 in order that the three subjects can be labeled into the transition-attempting mental model stage. The three subjects on this observe have been given the code of problem 1 (S1), concern 2 (S2), and concern 3 (S3). furthermore, the solutions and interview transcripts of the concern can be defined inside the studies consequences.

The following explains the solutions that display the extent of the transition-attempting intellectual version of university college students in understanding the concept of integers. trouble 1 (S1) solutions and factors are proven in determine Figure 2

In Figure 1, it can be seen that subject 1 (S1) cannot compare negative integers. It can be seen that S1 underwent an interiorization process in which he tried to find information on the problem of comparing negative integers by putting a significantly less than "<," more than "," and equal to "." After

Table 1. Definition of production in studies

Construction Category	*Definition of Construction*
Interiorization	wondering pastime in digging up the required records (differentiating superb and negative integers)
Coordinate	constructing two or more new techniques (substituting domain names into equations)
reversal	construction reversal method (returning the equation to an inequality)
Enkapsulasi	building mental items from mental tactics (drawing on quite a number line)
Generalisasi	making use of the schema to a broader set of phenomena (inferring with the signal less than "<, "greater than ">," and equal to "=")

S1 undergoes an interiorization process, then S1 undergoes a coordination process. In this process, S1 can compare changes in the temperature of the liquid before and after being heated, which is greater than It can be seen that S1 has carried out the coordination process which he tried by giving the reason that is smaller than This is evident in the results of the answer S1 in the Figure 3.

After S1 tried to find out and enjoy the interiorization procedure, S1 also skilled a advent reversal system. The shape of the bring together shared by means of S1 is via the use of deciding on a number of that has a significant charge, then S1 speedy answers that Yuli gets the largest rating. that is glaring within the outcomes of the answer S1 in the Figure 4:

In Figure 4, it can be seen that subject 2 (S2) compared positive integers and negative integers, and two negative integers. It can be seen that S2 undergoes a process of generalizing the scheme by comparing two negative integers by marking "<," ">," or "=." The way that has been done by subject 2 (S2) is part of an effort to compare integers. However, subject 2 (S2) experienced a coordination process by making two completion processes when comparing two negative integers with different symbols of magnitude. Furthermore, the answers to subject 2 (S2) in Figure 5 are as follows:

P : that's more enormous than with the aid of
S1 : bigger , sir.
P : Why is that?
S1 : because 8 is bigger than 4 sir!
P : Are you certain
S1 : sure, sir
P : Then what approximately this one (pointing to the problem), that's the better the liquid temperature before and after heated?
S1 : After being heated .
P : can you give a cause?
S1 : Because is smaller than sir!
P : subsequent on this question (pointing to the question), who gets the highest rating between Bagas and Yuni?
S1 : correct sir.
P : Why is that?
S1 : due to the fact the fee of Bagas is greater than Yuni, sir.

In contrast to difficulty 1 (S1), subject 2 (S2) appears to have handiest skilled assemble procedures. This will be visible when difficulty 2 (S2) is right in comparing nice integers and poor integers with special symbols of value and staining , ,

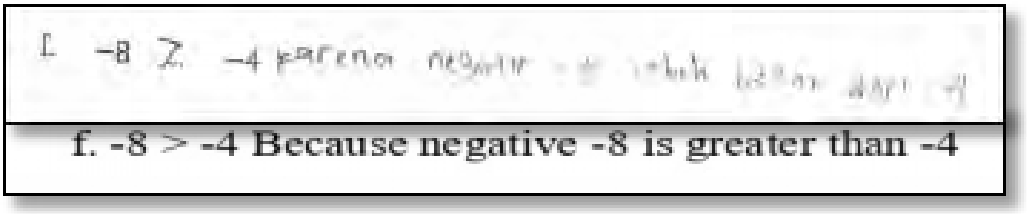

Fig. 2: Answer subject 1

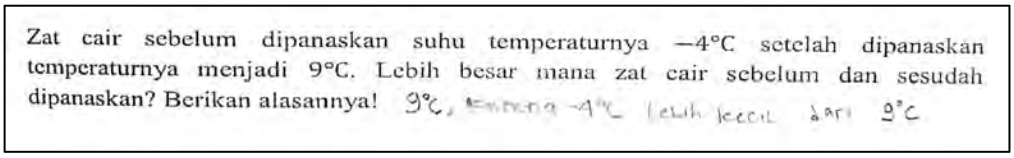

Fig. 3: Answer subject 1

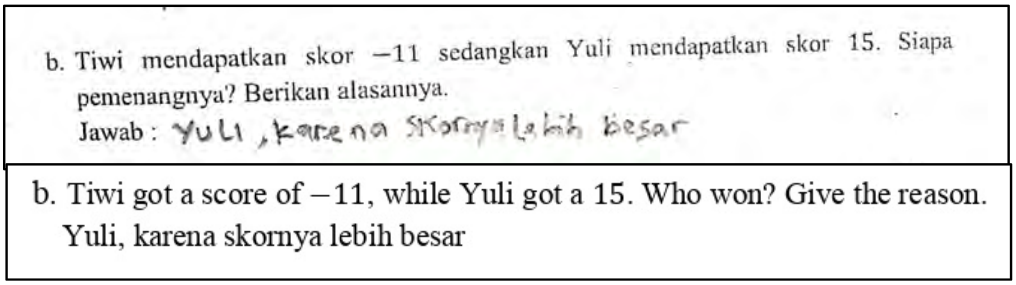

Fig. 4: Answer subject 1

and (observed in discern four). However, it's far nevertheless incorrect to compare poor integers with unique importance symbols in tale issues (see determine 5). The solutions to subject 2 (S2) in parent four are in Figure 5.

In parent 4, it could be visible that situation 2 (S2) changed into able to compare exceptional integers and negative integers and examine awful integers. it could be seen that S2 undergoes a method of generalizing the scheme through evaluating terrible integers by using manner of marking , , or . however, problem 2 (S2) professional coordination thru making very last touch strategies whilst comparing two terrible integers with precise significance symbols. moreover, the answers to problem 2 (S2) in decide five are as in Fgure 6.

In discern five, it is able to be seen that issue 2 (S2) can not evaluate negative integers. it could be seen that S2 experienced a coordination system; when evaluating the rating acquired by way of Sari with Santi's rating of -five, difficulty 2 (S2) made the coordination system by means of giving a signal. S2 answered that , so S2 answered that Santi's rating became extra good sized than Sari's. the construction procedure that S2 has skilled is supported by way of the outcomes of the interview transcript below:

P : Which is larger through ?
S2 : bigger .
P : Why is that?
S2 : due to the fact is a bad integer, and four is a fine integer. So it is a larger four.
P : Then how approximately this one (pointing to the answer sheet)? Why is that?
S2 : Because is bigger than .
P : Are you positive approximately your answer?
S2 : yes, sir

Furthermore, S3 additionally undergoes the same method as S2, experiencing a coordination technique by way of evaluating two terrible integers. S2 replied that Santi's score changed into better than Sari's. the construction system that S2 has shared is supported by way of the consequences of the interview transcript beneath:

P : How approximately this one? Why do you are saying Santi is the winner?
S3 : because Santi were given a rating of 5 whilst Sari were given a rating of 3 packs.
P : Then what's this signal?
S3 : poor image, sir.
P : "Please read this" (while pointing to the numbers and)
S3 : Negative and negative .
P : "Then, is it equal or specific with between 5 and ; and ."

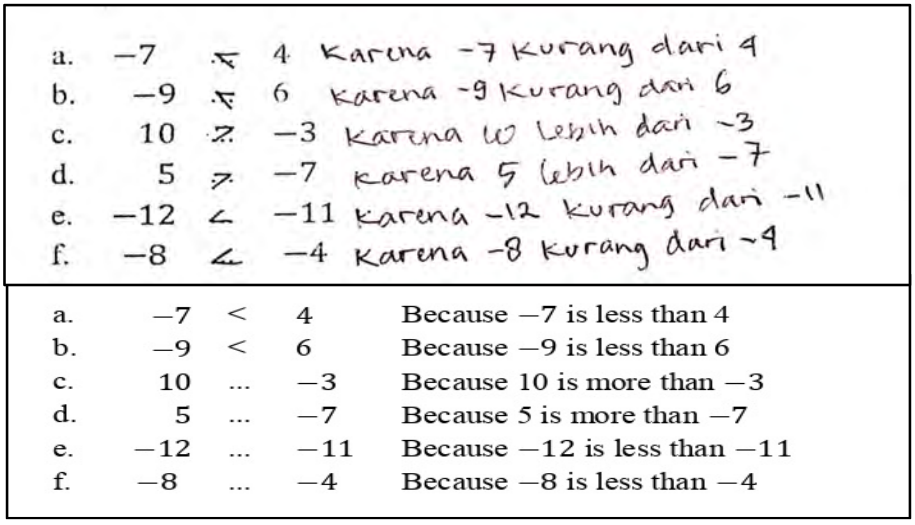

Fig. 5: Answers to subject 2

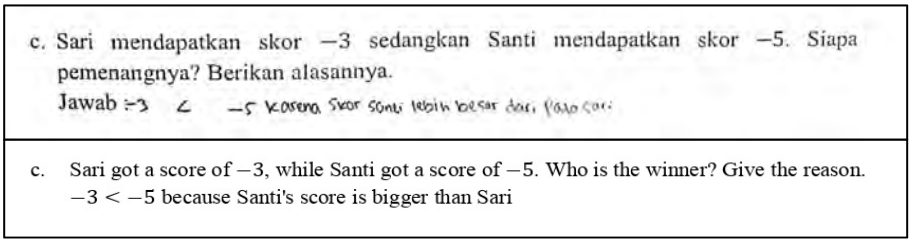

Fig. 6: Answers to subject 2

S3 : "Of route, one of a kind. One with out a bad sign) and the opposite with a poor signal ." (challenge still says 5 is more than three)

However, based on the interview results above, it can be seen that S3 also underwent another process, namely undergoing an encapsulation process with the confidence that S3 determined that -5>-3.

Discussion

The mental model was first developed by (Vosniadou, 1992; Kurnaz & Eksi, 2015) in understanding the concept of the earth and divided the mental model into three levels, namely initial, synthetic, and formal. Meanwhile, Bofferding (2014) found five groups of mental models consisting of initial mental models. Transition I, synthetic mental model, transition II, and formal. Furthermore, Utami et al. (2018) found one mental model level to become six levels of a mental model consisting of pre-initial, initial, transition 1, synthetic, transition II, and formal mental models.

This integer material is crucial to analyze. So that in this observe, college college students are confronted with a check query associated with contextual (Kaharu & Mansyur, 2021). In knowledge the idea of integers, the check questions relate to actual contexts to help university students apprehend integers (Akyus & Stephan, 2012; Whitacre, et al, 2012; Jessica, 2016). So the researchers designed a contextual test to observe modifications inside the temperature of the liquid in advance than and after it become heated and to acquire the best rankings received from the two children. The researcher observed that most university college students have to take a look at bad and first rate integers with specific amount symbols.

Based on the test results, the subject cannot be classified at the level of the mental model that has been developed by Utami et al. (2018). In certain aspects, they can understand positive integers and negative integers and produce a final category that is almost right and cannot be categorized at the mental transition model I level. Although they can compare positive integers and negative integers, they can reach symbols of different magnitudes. To accommodate these conditions, the level of mental transition model I is broken down into a mental transition attempting model in this study. This is based on the analysis results, which have found that the subject understands that positive integers are more significant than negative integers. Another factor that influenced the results of this study was the experience and habits often carried out by the subject, who tend to assume that positive integers are always greater than negative integers (Bofferding, 2014; Eko et al., 2021).

On this take a look at, the ranges of the structure and mechanism of mental fashions were completed regarding the principle of APOS, projected to apprehend the mechanism of reflective abstraction, as introduced with the aid of way of Piaget (Dubinsky, 2002). Of the five styles of reflective abstraction inside the production of intellectual structures, specifically movement, manner, object, and Scheme (Arnon et al. 2014; Monica et al. 2012). every scholar who has the gadget ability to are looking for reality is described thru the shape of highbrow fashions and scholar mechanisms at the same time as building mathematical information primarily based on APOS idea in know-how integers, that is shown in (Figure 7) discern 7, which modifies from (Kurniati et al., 2018).

Based on the results of the analysis of answer sheets and interviews. The researcher concludes in Figure 6 above that all subjects at this level have tried to carry out the interiorization process by digging up information about the difference between positive and negative integers. To understand this, the subject must first understand the concept of negative integers to easily distinguish between positive and negative integers (Ural, 2016). After the interiorization process was passed, the subject continued the coordination process by coordinating the results of the interiorization and building a new concept; besides that, the issue in this process checked the number less than "" or more than "" between two integers. In the following procedure, the subject performs generalization. Subjects construct mental objects from mental processes and can explain how to compare positive and negative integers by using less than ", "greater than "" and equal to "" signs. This ability is shown in the results of the subject's work on the three components of the test questions that the researcher has prepared.

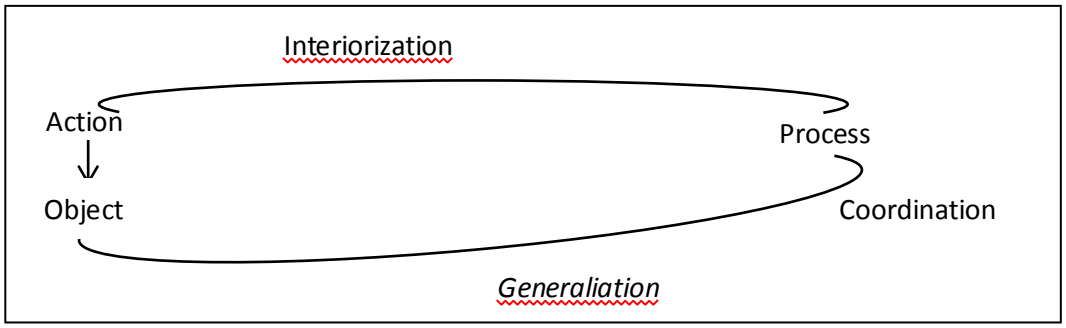

Fig. 7: The Mechanism and structure of S1, S2, and S3 intellectual models in information Integers

Conclusion

Based on the research results on the Transition-Attempting mental model of class VII students, it was concluded that the Transition-Attempting mental model could be seen from the information held by the students stored in long-term memory before they were confronted with the concept. It can be seen that students already understand positive integers and negative integers with different quantity symbols. The characteristics of students' mental models in understanding the concept of integers are appropriate in using the sign less than "<,"more than ">," and equal to "=." The researcher recommends further researchers dig deeper into whether other levels of mental models can be developed. Before the synthetic mental model, a group precedes it, namely the transition-Attempting mental model level.

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