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The Understanding Abilities of Real Number Concepts For Primary School Student

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Abstract: The purpose of this study was to determine the characteristics of relational elementary students in understanding the concept of real numbers. This research is an exploration of the research subject. The subjects of this study were students of MIN 2 Bengkulu Selatan. There is one realistic student in this research. The researcher is the main instrument in this research which is supported by an interview guide and an assignment sheet on the concept of real numbers. The data were analyzed qualitatively. The results of this study are that students with relational abilities can combine separate pieces of information to produce the completion of a task. Therefore it is suggested to teachers and researchers of mathematics education to explore students' mathematical cognitive processes before determining the learning strategies to be carried out.

Keywords: Understanding; the Concept of Real Numbers

INTRODUCTION

Numbers are one part of the content of learning mathematics in elementary schools. The aim of mathematics education is as a dynamic political, social, historical and cultural endeavor that aims at the creation of a dialectical of reflexive and ethical subjects that critically position themselves in historical and cultural forms and discourse and practice of mathematics is always developing (Radford, 2013).

Mathematics learning includes an activity of abstraction, idealization and generalization. The general framework of abstraction cannot cover all the complexities of the learning process and knowledge in mathematics. On the other hand, in investigating the nature, form, and emergence of bits and pieces of knowledge, various micro-genetic learning theories could be developed, which would be very specific to a particular mathematical concept, individual, and the reasoning strategy underlying it. As a result, the complexity of the process of knowing and learning mathematics cannot be explained or explained by only one framework. On the contrary, we acknowledge that comprehensive understanding of cognition and learning in mathematics refers to various theoretical frameworks about abstraction (Scheiner & Pinto, 2017).

Mathematical objects include concepts, relationships, structures, and processes. In mathematics learning, the term abstraction is used in two senses: Abstraction is a mental representation of a mathematical object. Abstraction, without articles, is the mental process by which one constructs such abstractions. Compression involves taking complex phenomena, focusing on important aspects that are interesting to understand as a whole in order to be available as an entity for thought. Although other species have such mechanisms to function in their own context (Gray & Tall, 2007).

All mathematical concepts except the primitives have a definition. Many of them are introduced to high school or college students. However, students do not need to use this definition to decide whether an idea is or is not an example of the concept(Rasslan & Tall, 2002).

Homo-sapiens has tools that allow it to understand complex situations, reflect on them at different levels of sophistication and to communicate with other people: language. An important feature of this tool is to name a phenomenon as a word or phrase, to allow a name to be pronounced when referring to that phenomenon and then to use language to discuss its various aspects and to focus on its various properties and relationships with other phenomena. We use the term 'conceivable concept' to refer to some of the phenomena that have been named so that we can talk about and think about them. It can be part of any speech, and may refer to any phenomenon, such as numbers, food, warmth, rain, mountains, triangles, siblings, fear, black, love, mathematics, category theory. The phrase 'conceivable concept' is, of course, a tautology, since a named phenomenon is a concept and therefore can be thought of. However, given the many meanings of the term 'concept', we have chosen to use the term 'conceivable concept' here to emphasize its particular use within this theoretical framework (Gray & Tall, 2007).

The pre-structured, unistructural, multistructural, and relational hierarchical levels have emerged from the SOLO analysis of five questions. The last extended abstract level does not appear before, nor after student interactions(Padiotis & Mikropoulos, 2010). Learning outcomes are statements that indicate what students will know, appreciate, or can do at the end of the course. They are assessable educational goals, written from a student's point of view, focusing on what students can expect to achieve if they have studied successfully. In order to be assessed, they must determine things that can be observed, which are public, and not activities or situations that are in the minds of students(Potter & Kustra, 2012). The Observed Learning Outcomes Structure (SOLO) describes an increasingly complex level of understanding, through five general stages intended to be relevant to all subjects in all disciplines. At SOLO, understanding is understood as the increasing number and complexity of connections students make as they progress from disability to expertise. Each level is intended to cover and exceed the previous level (Potter & Kustra, 2012).

RESEARCH METHOD

Type of research is exploratory research on the ability to understand the concept of real numbers. It is determined based on the quality of students' responses in understanding the concepts and principles of real numbers based on the SOLO Taxonomy. This research is to determine the taxonomic characteristics of SOLO with natural background.

The subjects of this study were students of Class V MIN 2 Bengkulu Selatan. Subjects were selected in stages based on initial test results and according to needs. To fulfill a fixed comparative analysis, each level must be filled with at least two subjects (see Widada, 2003). Based on the Initial Test and the many levels of SOLO Taxonomy, the first stage was chosen as 8 students. If the selection of the first stage does not meet expectations, then the next stage is selected until it is fulfilled. When each level of SOLO Taxonomy has been fulfilled, subject selection stops. However, what is described in this paper is only one research subject, namely T.

Subject selection is carried out according to needs, namely obtaining SOLO Taxonomy levels which have not been filled by two subjects. Each level must contain two subjects. It aims to carry out the initial process of fixed comparison analysis.

The data collection method uses task-based interviews(Widada, Efendi, Herawaty, & Nugroho, 2020). The interview is used to determine indicators of natural background (naturalistic) that arise from students while responding to the problems given. This aims to test and empirically complement the theory of literature review results. The interview guide used is open.

The main instrument of this research is the researcher himself who is guided by several guideline sheets. The guideline sheet is a student assignment sheet and interview guideline sheet. Student assignments contain problems about the algebraic nature of the set of real numbers. Theguide sheet *interview* contains the technical implementation of the *interview*, and the possibility of unstructured questions. The submission of questions is based on the completion made by the subject in response to the tasks he received.

To obtain examples of data analysis and implementation, an initial survey was conducted. In addition, the SOLO Taxonomy theory is based on the results of theoretical studies, and the assignment sheet is then validated and reviewed by experts who have the competence to be able to assess the theory. The results of validation and review are used as one of the bases for revising the theoretical TSP, assignment sheets, and interview guidelines.

The implementation of this research is as follows. All subjects were given the task to solve the problem *of algebraic properties for the set of real numbers*, and were given sufficient time. After all the subjects have finished working on the assignment, the subject is immediately interviewed one by one by applying *task-based interviews* (Herawaty, Khrisnawati, Widada, & Mundana, 2020).Subjects who have not been interviewed are placed in a separate room so that they do not meet the subjects who have been interviewed. The interview process was recorded using an *audivisual recorder*. From these results, data will be obtained in the form of filling out the assignment sheets, and cognitive processes recorded on video tapes, as well as other notes on the results of observations.

Data analysis was carried out through fixed comparison analysis with the following procedure: Relevant pieces of data were compared with each other to determine subject responses; Subject responses were compared with the hypothetical description of SOLO Taxonomy to determine SOLO Taxonomy levels: Steps 1 to 2 above were repeated until 2 subjects filled each level of SOLO Taxonomy; In each level of the SOLO Taxonomy, the responses of one subject are compared with the responses of other subjects to determine the indicator (pattern of responses) of the relevant level; Summarizing the level indicators generated in the above steps into the SOLO Taxonomy theory.

Results and Discussion

Analysis of data from interviews with subject T during the task-based interview can be done through the following analysis (interviewer in this analysis coded S).

Table 1. The results of T reduction regarding the algebraic properties of the set of real numbers

Subject's verbal	activity Physical activity (performance) and writing subject
S Are you ready to give the task to solve problem 1?	
T.01: Yes Sir,…	-T Nodding
S OK… please do this question (H gives student assignment sheet, question 1)	-T doing the task given about 14 minutes ………………………………………….
…………………………………………… ...	………………………………………….
……… …………………………………… ...	-T shows the worksheet
S (after 14 minutes)… Have you finished the task of question1? ...	
T.02:… just like this Sir!	-T pauses for a moment
S okay… will you do it again?	
Q.02.1:… [pauses and gets no result]	
S okay then, try to explain what you wrote?	
Q.03: Given that a> b and a, are real numbers. We will prove that a> 1/2 (a + b)> b.	
S Okay,…. How is the proof!	-T shows the first line of completion on the student assignment sheet
T.04: based on 3a) obtained 2a> a + b and a + b> 2b. then each inaccuracy is multiplied by ½.	-T also shows the second row of completion places on the student assignment sheet.
S why multiplied by ½?	
Q.05:… because 2 is not zero, and ½ is also not zero	
S Why is 2 not equal to zero, and ½ also not zero?	
Q.06: Since 2 natural numbers mean 2 positive numbers, this is consistent with the statement 2), and from 3c) has the result ½ positive.	-T shows statement 2), and statement 3c) on the student assignment sheet.
S OK ...	
T.07: Then from multiplying by ½ it is obtained a> 1/2 (a + b) and ½ (a + b)> b. and based on these two things it is obtained a> 1/2 (a + b)> b, meaning that it is proven.	
Why do you get that?	
Q.08: ... because from statement 1) it is obtained ½.2 = 1 ...	-T shows the line corresponding to T.08retries
S Okay ... how about question b.	
Q.09:… I haven't thought yet, because… those statements seem right to prove.	
S ... you will give another reason?	
Q. 10: I think it's cool, because I need to read and study again…	
S Yes… I have. How about part c?	

Q.11:… I also can't find a new statement yet, it might take some time and study again.	
S OK… I got a chance for you to think?	
Q.12:… Yes, I want to try again…	
H. [after 5 minutes]… how did it go?	
Q.13:… I don't seem to have succeeded in making the statement you asked for.	-T[about 5 minutes]
S Why?	
Q.14:… I was experimenting like this, but I'm sure!	
S Have you noticed?	
Q.15:… this is Sir… I am only picky about certain real numbers, then I try, like this sir… 4> 1/2 (4 + 2)> 2.	-T shows the result of the work -T shows
What's your conclusion?	
Q.16:… The a) statement is also true for negative numbers.	that 4> ½ (4 + 2)>
S Are 2 and 4 not real numbers?	
Q.17: oh… yes… then I can't finish it, and I think that's enough, Sir.	-T explains the concluding stroke of section c
	-T submits and doesn't want to anymore went on and felt enough that he did.

Furthermore, T work can be presented regarding the task of solving problems regarding the algebraic nature of real number sets, see Figure 1 below:

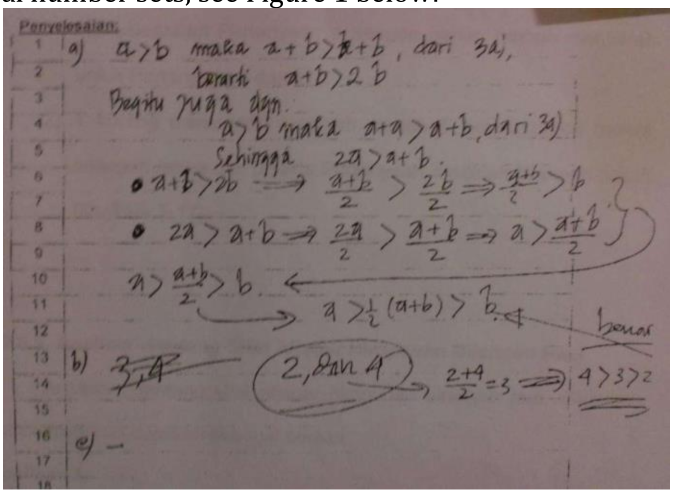

Figure 1. Completion of Tasks by T

Based on the results of data reduction above, further analysis will be carried out about T through data exposure and data verification as follows : T gives up easily [see Q.02.1, T.13 and Q.17], T is able to solve question a correctly, but gives up on questions b and c. T does not understand the problem, because T assumes that the real numbers a and b in question a are positive numbers.

Analysis of the algebraic properties of the set of real numbers is carried out through the following snippets.

Snippet 1

S : Would you like me to give the task to solve question 1?
Q.01 : Yes Sir…
S : Ok… please do this question [H gives student assignment sheet, question 1]
S : [after 14 minutes]… have you finished working on Question 1?
Q.02 :… just like this Sir?
S : OK… will you do it again?
T.02.1 :… [pauses and gets no results]

[Analysis: T has the willingness to solve the given questions, but T easily gives up, which is represented in writing on paper (see snippet 1 and figure 4.1.8)]

Snippet 2

S : Alright then, try to explain what you wrote?
T.03 : note that a> b with a, a real number. We will prove that a> 1/2 (a + b)> b.
S : Okay… how is the proof!
Q.04 : Based on statement 3a) 2a> a + b and a + b> 2b are obtained then each inequality is multiplied by ½.
S : why multiplied by ½?
Q.05 :… Because 2 is not zero, and ½ is also not zero.
S : Why is 2 not equal to zero, and ½ also not zero?
Q.06 : Since 2 natural numbers mean 2 positive numbers, this is consistent with the 2) and from 3c) statements resulting in ½ positive.
S : OK…
T.07 : then from multiplying by ½ then we get a> 1/2 (a + b) and ½ (a + b)> b. and based on these two things it is obtained a> 1/2 (a + b)> b, meaning that it is proven.
S : why do you get that?
T.08 : ... because from statement 1) it is obtained ½.2 = 1 ...

[Analysis: T can represent all statements given and make interconnection between these statements so that the correct answer / proof is obtained, and an integrated entity is obtained (see snippet 2)]

Snippet 3

S : okay… what about question b.
Q.09 : ... I have not thought about it, because ... those statements that seem appropriate to prove,
S : ... you have other reasons?
Q. 10 : I think that's enough, because I need to read and study again…
S : yes,… I have. How about part c?
Q.11 :… I haven't been able to find the Beau statement either, it might take some time and study again.
S : okay… I give you a chance to think?
Q.12 :… yes, I want to try again…
S : [after 5 minutes]… how did it go?
Q.13 :… I don't seem to have succeeded in making the statement you asked for.
S : why?
Q.14 :… I was dabbling like this, but I'm not sure!
S : will you show it?
Q.15 : ... this is sir ... I am only picky about certain parts of the estate, then I try, like this sir ... 4> 1/2 (4 + 2)> 2.
S : what is your conclusion?
Q.16 :… statement a) is also true for negative numbers
S : are 4 and 2 not real numbers?
Q.17 : oh ... yes ... if that's the case I can't finish it and I think that's enough, sir.

[Analysis: T does not find new principles, even T has a wrong conception of real numbers. He tried to expand through a special case but was successful [see snippet 3]

Based on the above analysis, the following conclusions can be made: 1) T can represent all the statements given and make interconnection between these statements so that the correct answer / proof is obtained, and obtained integrated entities. 2) T does not find new principles, even T has a wrong conception of real numbers. He tried to expand through special cases but was unsuccessful.

Based on 1) to 2) above, according to the SOLO taxonomic level indicator that T is at a relational level. T gives up easily, T can finish question a correctly, but gives up on questions b and c. T doesn't understand the problem, because T assumes that the real numbers a and b in the statement a are positive numbers. Yet T denotes the full connection made, and the synthesis of the parts with the meaning of the whole. Thus the description of relational student abilities is to be able to combine separate pieces of information to produce the completion of a task.

The results of this study contribute to and reinforce the results of previous studies such as students responding to questions, students' answers at the relational level will provide explanations that connect and integrate relevant details, often expressed in terms of abstract ideas that unite concrete facts. Relational answers can also bring previous knowledge (knowledge that students had before they entered the course) to add to their explanation and provide context(Potter & Kustra, 2012). Students who are at the sub-rational level, get a greater benefit for students classified at the prestructural and unistructural knowledge levels, because the number of unresolved questions or completely wrong answers is dramatically reduced. It occurs because it uses SOLO to evaluate educational virtual environments in technology education settings (Padiotis & Mikropoulos, 2010). Thus, the SOLO taxonomy can be an evaluation tool about the quality of student responses in mathematics learning, and an increase in mathematics understanding will be better if students are taught through student context-based virtual learning.

CONCLUSIONS AND SUGGESTIONS

The quality of student responses in understanding the concept of real numbers can be described through SOLO taxonomy. Students with relational abilities are able to combine separate pieces of information to produce the completion of a task. Therefore it is suggested to teachers and researchers of mathematics education to explore students' mathematical cognitive processes before determining the learning strategies to be carried out.

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