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The 10th Grade Students' Folding Back Process in Solving Decimal Problem with Field-dependent and Field-independent Cognitive Styles

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Abstract

The purpose of this study was to describe the folding back process of 10th grade students with field-dependent (FD) and field-independent (FI) cognitive styles in solving decimal problems. This research was conducted explorative with a qualitative descriptive approach. The subjects in this study were two students grade X at SMA Al Muslim Surabaya. The subjects chosen based on a different of the FI-FD cognitive style was carried out by giving a cognitive style test, then a group of students with a cognitive style of FI and a group of students with a cognitive style of FD were selected. This results is the GFI subject can determine the definition of a decimal number when presenting a decimal number on a ruler and at that time the GFI subject experiences folding back. Folding back also occurs when the GFI subject determines the size ratio of decimals, decimal number operations and when converting decimal numbers into fractions and percentages. Then for GFD subjects must be given a stimulus first using the original numbers given commas and zeros, then the GFD subject changes his opinion on decimal numbers.

Keywords: Folding back, decimal problem, field-dependent (FD), field-independent (FI), cognitive styles

Abstrak

Tujuan penelitian ini adalah mendeskripsikan proses folding back siswa kelas X dengan gaya kognitif field-dependent (FD) dan field-independent (FI) dalam menyelesaikan soal desimal. Penelitian ini dilakukan secara eksploratif dengan pendekatan deskriptif kualitatif. Subjek dalam penelitian ini adalah dua siswa kelas X SMA Al Muslim Surabaya. Pemilihan subjek berdasarkan perbedaan gaya kognitif FI-FD dilakukan dengan tes gaya kognitif, kemudian dipilih kelompok siswa dengan gaya kognitif FI dan kelompok siswa dengan gaya kognitif FD. Hasilnya adalah subyek GFI dapat menentukan definisi bilangan desimal pada saat menyajikan bilangan desimal pada sebuah penggaris dan saat itu subyek GFI mengalami folding back. Folding back juga terjadi pada saat subyek GFI menentukan perbandingan ukuran bilangan desimal, operasi bilangan desimal dan saat mengubah bilangan desimal menjadi bentuk pecahan dan persen.Kemudian untuk subyek GFD harus diberikan stimulus dulu dengan menggunakan bilangan asli yang diberikan koma dan nol, barulah subyek GFD merubah pendapatnya mengenai bilangan desimal.

Kata kunci: Folding back, bilangan desimal, gaya kognitif, field-dependent (FD), field-independent (FI)

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Introduction

There are many opinions about cognitive styles from several researchers, including various forms of cognitive styles that have been found. Saracho (1997) defines that a consistent attitude in the use of cognitive processes is called cognitive style. Thornell (1976) states that cognitive styles can influence learning activities in the classroom. One of the cognitive styles recognized by experts is the classification of cognitive styles introduced by Witkin (1977), namely the field independent and field dependent cognitive styles. There are characteristics that distinguish someone with an FI cognitive style or FD, someone who has an FI cognitive style tends to approach problems and solve problems more

analytically, because they can sort in detail the parts of the problem, so they have a perception that is not easily affected by manipulation of the problem. The situation around him. Conversely, someone with a cognitive style of FD approaches problems and solves problems globally by focusing the problem on the environment as a whole, so that they have perceptions that are easily influenced by the manipulation of the situations around them. These differences in individual cognitive styles with FI and FD allow for differences in the choice of strategies or ways of solving a mathematical problem.

Many people recognize and acknowledge the benefits of mathematics in everyday life according to their level of intellectual development. In fact, the students' low level of mathematical understanding is not only in Indonesia, but also in some developed countries such as Australia, where the average is still low, even lower than other subjects. In this case, the role of the teacher is very necessary to find out whether the material being taught has really been understood by the students or not. It is very important to remember that the mathematics material taught at each level is still interconnected. According to Davis (1997) states that the mistakes of students when working on problems that have a lot of material are the main points for detecting the difficulties experienced by students in understanding mathematical concepts. Most of the students who took the test experienced one of the three wrong rules of the misconceptions that were common to students when doing research using writing instruments, namely: determining the size of the decimal number, performing decimal number operations and determining the density of the decimal number (Stanley and Stacey, 2003).

Stacey and Stanley (2004), conducted an experiment regarding the misconception of decimal numbers, in their research they examined how far the children's knowledge of understanding decimal numbers was. In that study they examined several things as follows: providing examples and non examples of decimal numbers, decimal representation, place values in decimals, decimal number operations, size of a decimal, density of a decimal value, equations or their relationship with other numbers, application of decimal numbers. In addition, many studies have produced new theories that explain cognitive development and the development of students' understanding in learning mathematics. Pegg & Tall (2005) identified two types of cognitive growth theories, namely: 1) the global theory of long-term growth of individuals, such as Piaget's theory of cognitive developmental stages, and 2) local theory of conceptual growth such as APOS theory (action, processes, objects, schemes) from Dubinsky. The scope of global theory starts from the physical interaction of individuals with the world around them, then to the use of language and symbols to abstract forms. Pirie and Kieren (1994) have provided a theoretical framework for eight levels of understanding, namely: primitive knowing, image making, image having, property noticing, formalizing, observing, structuring, and inventing. This theory states that "understanding does not always grow linearly and continuously. A person often returns to the previous level (layer) of understanding to advance to the next level of understanding. Pirie & Kieren (1994) and other researchers describe this layer-by-layer indicator of understanding. The primitive knowing layer of understanding is the initial effort made by students in understanding new definitions, bringing previous knowledge to the next level of understanding through actions that involve definitions or represent definitions (Pirie & Kieren, 1994). For example, when the subject is given a problem determining the derivative of an algebraic function in the form of a product of two polynomial functions, if the subject makes an initial effort through an action that involves / represents the required concept, namely the definition of the derivative of the function, the derivative of the product of two functions and the chain rule to find the derivative of the composition function. Then he is on a layer of primitive knowing. Because the action will bring him to understand how to solve the problems he faces. The image making understanding layer is the stage where students make understanding from previous knowledge and use it in new knowledge (Pirie & Kieren, 1994; Mabotja et al, 2018). The layer of understanding image having is a stage where students already have a picture of a topic and make a mental picture of that topic without having to work on examples (Pirie & Kieren, 1994. The property noticing layer of understanding is the stage where students are able to combine aspects of a topic to

form a specific character for that topic (Pirie & Kieren, 1994).

The formalizing layer of understanding is the stage where students make an abstraction of a mathematical concept based on the properties that emerge (Pirie & Kieren, 1994). Students are able to understand a definition or formal algorithm of mathematical concepts (Parameswaran, 2010). The observing understanding layer is a stage where students coordinate formal activities at the formalizing level so that they are able to use them on the related problems they face (Pirie & Kieren, 1994), students are also able to link their understanding of mathematical concepts with new knowledge structures (Parameswaran, 2010). Structuring understanding layer. is the stage where students are able to relate the relationship between one theorem and another and are able to prove it with logical arguments (Pirie & Kieren, 1994). Students are also able to prove the relationship between one theorems axiomatically (Pirie & Kieren, 1994). The inventive understanding layer is the stage where students have a complete structured understanding and are able to create new questions that grow into new concepts (Pirie & Kieren, 1994).

Based on the assumptions of the researcher, it can be taken a view that there is a link between Stacey and Stanley's (2004) research and Piere and Kieren's layers of understanding. The relationship between the two studies is as follows: providing examples and non-examples of decimal numbers (primitive knowing), image making, decimal place values (image having), decimal number operations (property noticing), size of a decimal (formalizing), the density of a decimal value (observing), equations or its relationship with other numbers (structuring), application of decimal numbers (inventising).

Method

This type of research is qualitative, because the data is obtained through a process of observing the subject's behavior which produces descriptive data, in the form of oral, written and other actions. Qualitative research emphasizes processes and meanings in the perspective of the subject. Therefore, the presence of the researcher functions as an instrument as well as an interpreter. Supporting instruments include questions to find derivative functions, task-based interview guidelines. The process and data obtained will be meaningful after being processed and analyzed by researchers. The research approach applied is descriptive because it aims to explore and describe the folding back profile of class 10 students in solving decimal number problems in terms of field independent and field dependent cognitive styles. The research data is in the form of qualitative findings. Obtained from writings, explanations (words) and other actions performed by research subjects. The complex picture of the findings is transcribed, reduced, sorted, coded, categorized and analyzed to reach a conclusion. Researchers are the main instrument in data collection and analysis in this study, because the presence of researchers cannot be represented by other people. The concept of solving the problem of decimal numbers is limited only to the compatibility between Stacey and Stanley's (2004) research and Piere and Kieren's layers of understanding, namely: providing examples and non-examples of decimal numbers (primitive knowing), presentation of decimals (image making), place values in decimals (image having), decimal number operations (property noticing), the size of a decimal (formalizing), the density of a decimal value (observing), equations or their relationship with other numbers (structuring), application of decimal numbers (inventising).

The subject in this study are 2 students class X at SMA al Muslim Surabaya. The selection of research subjects was carried out to go through two tests, mainly math ability tests and the GEFT test to see the cognitive style of all students. The subjects chosen based on a different of the FI-FD cognitive style was carried out by giving a cognitive style test, then a group of students with a cognitive style of FI and a group of students with a cognitive style of FD were selected. The data collection technique

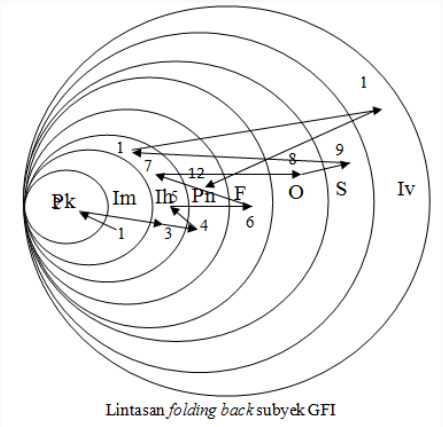
was carried out through task-based interviews. Furthermore, subject work papers and interview transcripts become primary data which will be processed and analyzed to obtain research results.

For the data analysis stage consists of data categorization or classification, data reduction, data presentation, data interpretation and drawing conclusions (Miles & Huberman, 2014). At the categorization or classification stage, the subject understanding data is categorized based on the suitability of the layer by layer indicator and the folding back form indicator that is carried out. At the reduction stage, the data that has been categorized according to the understanding layer and folding back are simplified so that their presentation is easier. In the next stage, the data for each subject is presented. Furthermore, the data is interpreted based on predetermined criteria, so that the similarities and differences in the characteristics of each subject's understanding, and the layers achieved by each subject and the form of folding back carried out by each subject.

Result and Discussion

Based on this data, the results in this study show there is a difference between the folding back of the two subjects in their primitive knowing ability mainly when they are asked to define decimal numbers through the sample and non-sample numbers.

The GFI folding back can be described as follows:



Lintasan *folding back* subyek GFI

Whereas folding back in GFD subjects can be described as follows:

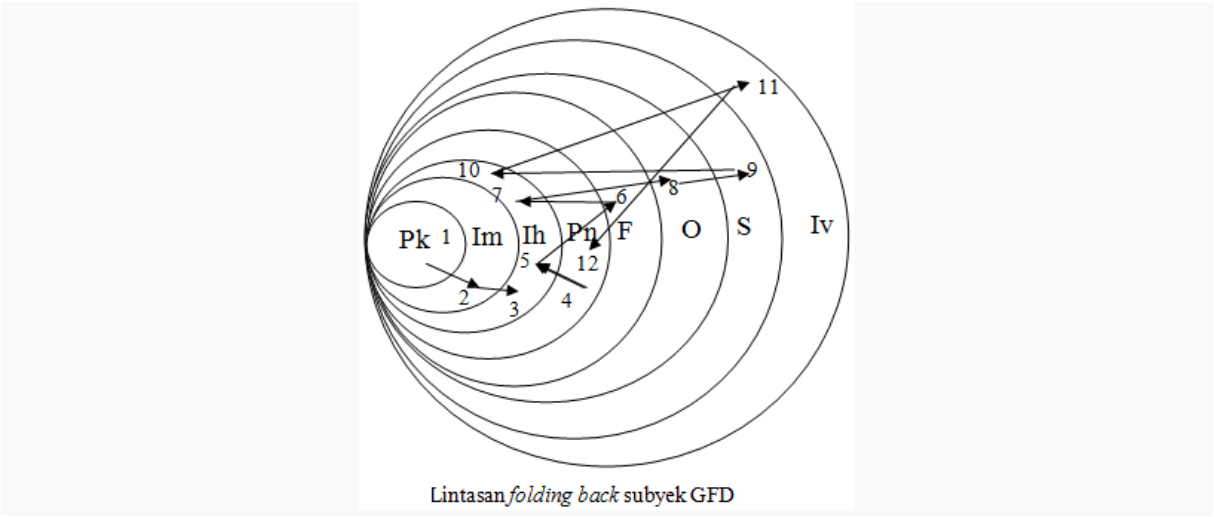


Figure 1. Folding Back in GFI and GFD

The study results were conducted on one subject who had a field-independent cognitive style, which would be called GFI, and one subject who had a dependent cognitive style, which would be called GFD. Wherefrom the triangulation of the data, the results were obtained from the GFI subject. The GFI subject initially could not define the decimal number properly. Because the GFI subject considers that the original number is not part of the decimal number, so it cannot be said to be in the primitive knowing layer of understanding (Pk). When discussing the presentation of decimal numbers and he was faced with a picture of a ruler, where when the subject was asked to present/place the decimal value on the ruler. That's when he came to another conclusion, that natural numbers are also decimals. Because the GFI subject can identify decimal numbers or is in the primitive knowing layer of understanding when he is in the image-making (Im) layer of understanding.

The GFI subject goes through step-by-step layers of understanding in solving decimal numbers after that starting from Image having (Ih), where the subject can determine the place value correctly with the correct definition. The property noticing (Pn) stage is where students can perform operations on decimal numbers, addition, subtraction, multiplication, and decimal numbers division. The GFI subject can explain well when the GFI subject performs the addition, subtraction, multiplication, and division operations of decimal numbers. The GFI subject uses his knowledge of the decimal number's place value, which he has in the image having (Ih) understanding layer. When the subject enters the layer of understanding Formalizing (F), the subject can explain the size ratio of a decimal. When explaining this, the GFI subject uses his knowledge of the place value of numbers, namely the knowledge of the subject at the Image having (Ih) understanding layer. Then move to the Observing (O) layer when subjects find a decimal value density between 1.5 and 1.6. At the time the GFI subject changed the decimal number to the fraction form and the percent form in the structuring understanding layer (S) where the GFI subject used his knowledge of decimal place values, which he had in the understanding layer image having (Ih) From all the knowledge the subject had regarding These decimal numbers, the GFI subjects reach the Inventing (I) layer of understanding about decimal numbers, that is when the subject can solve decimal problems related to contextual problems or problems in everyday life.

Whereas in the GFD subject, the GFD subject was not initially able to define decimal numbers well. The reason is that the GFD subject considered that a decimal number and not a decimal number only exists in the presence of a comma or not, so it cannot be said to be in the primitive knowing (Pk) layer of understanding. Then when the stimulus was given by placing a comma and zero behind the original number, the GFD subject changed his opinion about the definition of decimal numbers. So, in

this case, the subject of GFD can be said to be in the primitive knowing (Pk) layer of understanding. When discussing the presentation of decimal numbers and he is faced with a ruler image, where when the subject is asked to present/place the decimal value on the ruler. The GFD subject can present or place the intended decimal number on the ruler, so the GFD subject is at the layer of understanding image-making (Im). The GFD subject goes through step-by-step layers of understanding to solve decimal numbers after that, starting from Image having (Ih). The subject can determine the place value of the number correctly, even with the correct spelling definition. The property noticing (Pn) stage is where students can perform operations on decimal numbers, addition, subtraction, multiplication, and decimal numbers division. GFD subjects can explain well when GFD subjects perform addition, subtraction, multiplication, and decimal numbers division. In which the subject of the GFD uses his knowledge of the place value of the decimal number, which he has in the image having (Ih) understanding layer.

When the subject enters the layer of understanding Formalizing (F), the subject can explain the size ratio of a decimal. When explaining this, the GFD subject uses his knowledge using his understanding of the place value of numbers. The GFD subject uses the understanding of the having (Ih) image layer in strengthening the answer. Then, moving towards the Observing (O) layer of understanding, the subject initially mentioned that only ten decimal numbers exist between 1.5 and 1.6. Through the stimulus by giving a decimal number between 1.5 and 1.6 and has not been cited by the subject, the GFD subjects understand that there is an infinite number of decimal places between 1.5 and 1.6. Thus, it can be concluded that the GFD subjects are in the understanding layer of image-making (Im) with the researcher's stimulus. When the GFD subject changes the decimal number to the fraction form and the percent form in the structuring understanding layer (S), where the GFD subject uses his knowledge of decimal place value numbers, he has in the understanding layer image having (Ih).

Folding back is the primary key in the growth of understanding, the criteria for students to experience problems at specific layers to continue the work (Susiswo, 2014). This decimal number problem is solved using Polya's steps: understanding the problem, planning the solution, implementing the plan, and checking again (Polya 1973). In this case, students also need to explore the growth layer of their understanding of decimal numbers. The layers of understanding growth suggested by Piere-Kieren (1994) are primitive knowing (Pk), image-making (Im), image having (Ih), property noticing (Pn), formalizing (f), observing (O), structuring (S), and inventising (Iv).

Based on the results above, the students did not always go through problem-solving stages in each step of problem-solving. The problem-solving stage does not always go through layers of understanding coherently and precisely (Piere-Kieren, 1994). The layers of understanding growth they go through also vary between students (Meel, 2003; Martin et al, 2005; Piere-Kieren, 1994).

Conclusion

From the study results, there are differences between the two subjects in the folding back process. For subjects with field-independent cognitive style (GFI), which previously had succeeded in solving decimal numbers, namely TPMBD 1 and TPMBD 2, by using Polya's solving steps. In this results seen of interviews regarding the description of GFI subjects in solving decimal number problems. Folding back also occurs when the GFI subject determines the size ratio of decimals, decimal number operations, and converting decimal numbers into fractions and percentages. The GFD subjects must be given a stimulus first using the original numbers given commas and zeros, and then the GFD subject changes his opinion on decimal numbers.

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