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Research Article

Students' mathematical representation ability in terms of field dependent and field independent cognitive styles of Quadrilateral Flat material

Nasrullah*
State University of Malang, Malang, East Java, Indonesia, 65145
*Corresponding Author: nasrullah.1921038@students.um.ac.id

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ABSTRACT

Eld-independent cognitive styles in solving problems on rectangular shape material. This type of research is descriptive qualitative research, namely by interpreting data with the stages of image analysis, interviews, observation, and documentation. The subject of this study was taken by purposive sampling after carrying out the GEFT test in class V where 4 samples were taken based on field dependent and field independent cognitive styles. The instruments prepared in this study were GEFT test questions and mathematical representation questions. From the results of this study it shows that: 1) students who have a field dependent cognitive style carry out mathematical representations visually students are not always able to make pictures and symbols of a problem and in mathematical expression students can make mathematical models and can perform calculations according to what has been taught by the teacher accurately or always think globally without making new discoveries and in written expression students are less able to make solutions in logical and systematic written words. 2) students who have a field independent cognitive style make mathematical representations in solving problems with visualization stages can understand the problem and change it in the form of images and symbols in accordance with the problems that are understood and in mathematical expression students and can make plans for solving with mathematical models and can carry out calculations in their own way in accordance with their experience which is considered fast average in written expression students are able to express solutions in written words in a systematic and logical manner.

Keywords: Mathematical Representation; Cognitive Styles; Quadrilateral

1. INTRODUCTION

Mathematical representation is one of the components that students must have in learning mathematics and has been stated as one of the process standards that students must achieve through learning mathematics (Adnan et al., 2019; Fonna & Mursalin, 2018, 2019; Maulidawati et al., 2020; Mustangin et al., 2020; Nurzannah et al., 2021; Rahmawati et al., 2017; Samsuddin & Retnawati, 2018). Based on (National Council of Teacher of Mathematics, 2000), in the implementation of mathematics learning in schools, teachers must pay attention to five mathematical abilities, namely: problem-solving, reasoning, communication, connection, and representation skills. The idea of mathematical representation in Indonesia has been included in the objectives of mathematics learning in schools in Permendiknas No. 23 of 2016 (Depdiknas, 2016). In line with this (Fonna & Mursalin, 2018; Rahmawati et al., 2017; Samsuddin & Retnawati, 2018; Zulfakri et al., 2019; Anwar &; Rahmawati, 2017) states that Mathematics really needs representation because one can obtain mathematical ideas, one of which is through representation, representation is seen as an important part of mathematical activities and a means to capture mathematical concepts. Therefore, representation is a fundamental process to develop students' mathematical thinking skills and is parallel to other process components, so that representation ability is one of the students' abilities that needs to be developed and must be owned by every student (Fonna & Mursalin, 2018, 2019; Maulidawati et al., 2020). The ability of representation is a way that a person has to stating and re-expressing ideas that are owned (Adnan et al., 2019; Maulyda et al., 2019; Mustangin et al., 2020). The ability of representation has an important role in learning mathematics because it can train students to improve the ability to solve problems with various forms including pictures, diagrams, mathematical expressions, and words or written text (Mursalin, 2019; Nuraina & Mursalin, 2018; Paroqi et al., 2020). Minarni &; Napitupulu (2017) explained that mathematics requires representation because the abstract nature of mathematics is such that people have access to mathematical ideas only through representation of those ideas.

Representation plays a role in efforts to develop and optimize students' mathematical representation skills. Representations that emerge from students are expressions of mathematical ideas conveyed by students in an effort to find

solutions to the problems they are facing (National Council of Teachers of Mathematics, 2000). Different ideas from each student will give rise to various representations, especially if students are given freedom in expressing their ideas (Apriani, 2016). Of course, students have various reasons to determine which representation to use. From the ideas expressed in mathematical representations, it can be known the student's mathematical comprehension ability. In addition, from the various kinds of mathematical representations used by students, it can also be known how students use their knowledge to deal with mathematical problems. The low mathematical ability of elementary school students in Indonesia is shown in the results of the international survey Trends in International Mathematics and Science Study (TIMSS). The results of a 2015 survey showed that the average achievement score of Indonesian students in mathematics was 397, while the international average standard was 500 (Mullis et al., 2016). One of the causes of Indonesia's low level of achievement in TIMSS is also due to the decreasing level of representation ability. The ability of mathematical representation is one that students must have in solving the problems encountered. Because in the fact that students are only introduced to some representations in solving a problem.

In solving mathematical problems, everyone has a different way and style of thinking because not everyone has the same mathematical representation ability (Dahliana et al., 2019; Maulidawati et al., 2020; Mursalin, 2019; Sarah et al., 2021; Yarmasi et al., 2020). Ayvaz et al. (2016) states that everyone has specific ways of acting, expressed through consistent perceptual and intellectual activities. Perceptual and intellectual aspects reveal that each individual has distinctive characteristics that are different from other individuals. In accordance with the review of these aspects, it is argued that individual differences can be expressed by cognitive types known as cognitive styles. Cognitive Style (Valencia-Vallejo et al., 2018) is a way of functioning fixed characteristics shown by an individual in his perceptual and intellectual activities to determine a person's habit of perceiving, remembering, thinking and solving problems. Cognitive style is a characteristic of a person in receiving, analyzing, and responding to a given cognitive action. The classification of cognitive styles consists of: (1) differences in psychological cognitive styles including field dependent and field independent cognitive styles; (2) conceptually tempo cognitive style differences include: impulsive cognitive style and expulsive cognitive style; (3) differences in cognitive styles based on ways of thinking include intuitive-inductive and logical-deductive cognitive styles (Wright, 2015). Field Independent cognitive style tends to be more analytical in looking at a problem, someone will be easier to parse complex things and easier to solve problems, learning natural science and mathematics is not difficult and usually more successful to do alone. While a person's Field Dependent cognitive style is stronger in remembering information or interpersonal conversations, it is easier to study history, literature, language and social sciences (Prayekti, 2018).

Mathematical representation is very important for students to help understand concepts in the form of pictures, symbols, and written words (Sari &; Darhim, 2020). Representation is an important element for students because it supports the relationship between students' understanding and reasoning (National Council of Teacher of Mathematics, 2000). The use of correct representations by students can help students make more concrete mathematical ideas so that they can help students more easily solve the problems found. In line with this presentation, research conducted (Chinnappan &; Ghazali, 2018) shows that the representation ability of students in solving mathematical problems is still limited. While based on the cognitive style of students research by (Ayvaz et al., 2016) found that students with field dependent and field independent cognitive styles there were significant differences, students with field dependent cognitive styles spent more time in completing reduction operations at a large number. Based on the previous description, the purpose of this study is to describe the mathematical representation ability of students in terms of field dependent (FD) and field independent (FI) cognitive styles. The results of this study are expected to provide benefits for teachers, after knowing the ability of mathematical representation students are expected to be able to design or structure learning that can improve and develop students' mathematical representation abilities so that students more easily understand the problems encountered in the form of diverse representations. For other researchers who have read this study, it is hoped that they can gain experience and can develop to conduct other research that focuses on training students' representation skills.

2. RESEARCH METHOD

This study is a qualitative research described the analysis of students' mathematical representation ability in solving problems on quadrilateral flat material when viewed from the cognitive style of students, in wich the research procedure produces description data in the form of-written or spoken words of the subject under study. The type of research used in this study is a type of descriptive qualitative research, namely by interpreting existing data with the aim of obtaining information about students' mathematical representation abilities in solving problems on quadrilateral flat material in terms of students' cognitive styles. The selection of research subjects using purposive sampling techniques, that is, subjects were selected based on their cognitive styles, namely field dependent (FD) and field independent (FI) based on the results of the GEFT test by classifying students into FD students with a score range between 0-11 and FI students with a score range of 12-18 so that 2 groups of students were obtained, namely the FD group and the FI group. The instruments used in this study were GEFT test questions, mathematical representation questions, and interview sheets. The prepared instruments are then validated internally to experts and external validation carried out with students in addition to

observations to obtain the validity of the test instruments. The data collection techniques used in this study were test and non-test techniques. Test techniques are used to determine students' cognitive styles and tests get students' work results in representing problems, while non-test techniques use documentation and interview methods to gain credibility of test data. After conducting a mathematical representation test, qualitative data analysis will be carried out, namely: data reduction, data presentation, and conclusions.

3. RESULTS AND DISCUSSION

Based on the analysis of the results of the GEFT test questions in class V, 4 students were obtained who had weak field dependent cognitive style categories, strong field dependent, weak field independent, and strong field independent. So that the four students were given test questions that referred to indicators of representation ability, namely, the ability in visualization, mathematical expression and written expression. After completing the test questions, the subject will be interviewed and documentation will be carried out. Based on the results of the description of the mathematical representation analysis of students in terms of field dependent and field independent cognitive styles and the results of data triangulation from the four samples, it can be known the representation ability of each student as follows:

a. Mathematical Representation Ability of Students with Field Dependent Cognitive Style

The following are the activities carried out by Field Dependent students based on the results of data validity, interviews and documentation of the results of completion FD students can: a) Understand the questions from reading the question sheet; b) Pay attention to the asked part of the question without writing down what is known and asked on the answer sheet; c) Make an arrangement of images that correspond to what is known from the problem. Although students do not always make visualizations of every problem; d) Observe the requested part of the problem on a drawing made with symbols known from the problem; e) Make a mathematical model of the solution plan as understood from the question sheet; f) Perform calculations with steps in accordance with what the teacher taught before and can complete calculations with the right results. While the shortcomings of FD students in stating mathematical representations are: a) Unable to make mathematical models of different solutions, other than those taught by the teacher; b) Only explain orally the steps of writing a complete mathematical model, but do not write thoroughly the stages of completion spoken during the interview such as in writing the final unit of answer and writing the symbol of the name of the PQRS parallelogram; c) Unable to prove changes in the shape of the PQRS parallelogram that changes with line display, so that it turns into PTRU with mathematical models and precise drawings and symbols; d) Less able to make solutions with written words logically and systematically on the answer sheet. Based on the results of the analysis above, mathematical representations of students with field-dependent cognitive styles like to think simply in solving problems without paying attention to symbols and always use mathematical models with experience that has been gained from learning that has been given and are less able to express solutions in logical words.

b. Students' Mathematical Representation Ability with Field Independent Cognitive Style

The following are activities carried out by Field Independent students based on the results of data validity, interviews and documentation of the results of completion FI students can: a) Read the question sheet; b) Write down what is known from the problem without giving known information; c) Explain what is asked orally; d) Make pictures with complete symbols and clear descriptions as said; e) Observe the queried part of the drawing made with the known symbols of the problem; f) Make a mathematical model after making drawings and make a completion plan in accordance with what is understood from the drawings made; g) Perform calculations with self-trial steps in calculating solutions; h) Find the correct calculation result with the correct final unit; i) Make mathematical models of solutions by means other than those taught by the teacher, even if some are only verbal expressions; j) Use different symbols from those specified in the problem; k) Completing with the stages of completion by trial and error and a complete and detailed explanation in finding the right calculation; l) Proving changes in the shape of the PQRS parallelogram that changes with the display of lines, so that it turns into PTRU with the appropriate mathematical model and the right drawings and symbols; m) Make a settlement solution with written words logically and systematically on the answer sheet. Based on the results of the analysis above, mathematical representations of students with field independent cognitive styles like to experiment in solving problems with images and symbols made to find new settlement solutions according to their own way of thinking and are not tied to the mathematical model taught by the teacher. So that it can find other solving models according to the new learning experience that is tried by itself and can express the solution with logical expressions of written words.

4. CONCLUSION

Based on the results of the description and analysis of the data in this study, it can be concluded that mathematical representation abilities have a dependent cognitive style: a) visualization of students is not always able to make pictures and symbols of a problem, b) mathematical expressions students can make mathematical models and can perform calculations according to what the teacher has taught correctly or always think globally without making new discoveries

and c) written expressions students are less able to make solutions with written expressions that are logical and systematic. Whereas students who have a field independent cognitive style make mathematical representations in solving problems with stages: a) visualization can understand the problem and change it in the form of images and symbols according to the problems understood, b) students' mathematical expressions can make a settlement plan with a mathematical model and can perform calculations in their own way in accordance with their experience which is considered fast and c) written expression students are able to state solutions in written words systematically and logically.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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