Students’ Learning Obstacles on Generating Function Reviewed from The Characteristics of Thinking

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Abstract. The purpose of this study was to determine the learning obstacle students in terms of characteristic ways of thinking that will be described based on various types of errors in solving generating function. This type of research is descriptive with a qualitative approach, with subject taking using purposive sampling. Subjects in this study there were 4 students in accordance with the characteristics category of ways of thinking. The data analysis technique used in this study is the triangulation method, namely a test and interview method. Data analysis is performed using a fixed comparison method including data reduction, data categorization, synthesis, ending with the working hypothesis. The results of this study are (1) Learning Obstacle students with the characteristics of abstract random thinking on the generating function lies in operating errors and principle errors, (2) Learning Obstacle students with characteristics of concrete random thinking in the generating function lies in concept errors, operating errors and principle errors, (3) Learning Obstacles Student with concrete sequential thinking characteristics in the generating function are located on conceptual errors and operating errors, (4) Learning Obstacles Student with abstract sequential thinking characteristics in the generating function lies in concept errors and operating errors.

1. Introduction

The generating function is one of the materials taught at the STKIP Muhammadiyah Pringsewu Lampung (MPL) Mathematics Education Study Program. The generating function is found in discrete mathematics subjects which are important material that must be conveyed to students, because generating function can be used to solve problems in daily life and learning requires mastering concepts from other materials related to the generating function, for example combinatorial.

[1] found several errors of students in completing combinatorial problems, including errors in receiving information to restate a concept; errors related to concepts in classifying objects according to certain traits; errors related to calculations and procedures; mistakes in applying problem-solving concepts or algorithms. This shows that there are obstacles to learning combinatorial material which in fact the material is a concept to study the generating function. Therefore, researchers are interested in finding out the learning obstacles of students in the learning of the generating functions which in this study will be described in the form of students’ errors in solving problems related to generating function material. Learning obstacles is that hinder the achievement of a thing goals to be achieved in learning.[2] stated that there are three factors causing the emergence of learning obstacle, the barriers ontogeny (mental readiness to learn), didactic constraints (due to teaching or instructional materials) and epistemological barriers (knowledge of students who have limited application context). Epistemological barriers are closely related to cognitive barriers. While cognitive barriers occur when experiencing difficulties in the learning process. The learning process is closely related to teachers, students, and knowledge systems. This is according to what was stated by [3] that there are several factors that determine the learning process, including students, curriculum, learning environment, media, and psychological factors [4].
Psychological factors are the main factor determining the intensity of learning which includes one of them is cognitive ability.

Errors in answering questions vary according to their level of ability. This type of error can be seen from the object of the study. [5] identifies that many mistakes made by students are mastery aspects of subject matter, namely (a) misconceptions are errors in understanding the terms symbols and mathematical symbols, unit selection; (b) a principal error is defined if it is wrong in determining and determining the formula, determining what is known, and wrong in relating the related concepts; (c) operating errors that the student is said to be operating incorrectly when using the count operation incorrectly.

There are many factors that can influence students in learning the material of the generating function both from within the student itself and from outside the student. One of the factors within students is the characteristic of students' way of thinking [6-7]. In learning the generating function material will train skilled students in thinking. Therefore the learning must be designed in such a way so as to stimulate thinking and encourage students to use their minds consciously to solve the problem of generating functions so that in designing learning it is necessary to relate it to the characteristics of the way students think. Characteristics of the way of thinking is a typical way that is used by someone in observing and doing mental activities, namely managing and processing information in the cognitive field [8].

There are four types of characteristics of ways of thinking according to [9-10], the four types are a concrete sequential type, abstract sequential type, abstract type, and concrete random type. The abstract sequential type tends to memorize, preferring concrete things. concrete sequential type likes to think in concepts and analyze information and processes of logical, rational, and intellectual thinking so that they are easier to solve problems. abstract type tends to use feelings in learning. concrete random type tends to be trial and error, happy to find alternatives and do everything in their own way. The different characteristics of the way students think will affect the way they perceive and then take the right strategy according to themselves to complete the task or problem they have. This causes the characteristics of the students' way of thinking to influence student mathematics learning outcomes.

Based on the description, the researcher wants to conduct research that aims to find out the learning obstacle of students in learning the material of the generating function in terms of the characteristics of the way students think.

2. Research Methods
Type of research is descriptive with a qualitative approach. Through this qualitative approach, all facts both oral and written from the observed data sources and other related documents are described as is. Researchers will plan, design, implement, collect, analyze data, conclude, and make research reports [8].

The subjects in this study were 4 students of the sixth semester of the STKIP MPL mathematics education study program which were in accordance with the characteristic categories of ways of thinking. Sampling was done by purposive sampling. The main instrument in this study is the researcher himself. While the instruments of his assistants are questionnaires on the way of thinking, identification tests learning obstacle, interview guidelines and Digital Voice Recorder for recording.

The data collection procedure starts with giving a questionnaire about the characteristics of the way of thinking, then analyzed it is obtained by students with categories of each characteristic, obtained by the research subjects. After that the subject was given an identification test learning obstacle, then the researcher analyzed the results of student work. Then the researchers studied more deeply the results of the work and conducted interviews with the research subjects. The next step is to analyze the data using triangulation methods. The triangulation method is comparing two different methods to guarantee the accuracy of the data.

Data analysis is performed using a fixed comparison method because, in data analysis, it is constantly comparing one datum with another datum, then constantly comparing categories with other categories. In general, the data analysis process includes data reduction, data categorization, synthesis, ending with a working hypothesis. Data reduction aims to facilitate understanding of the data that has been collected from the results of field notes by identifying the smallest parts found in the data that have meaning if linked to the focus and research problems. Categorization is an attempt to sort out each unit into parts that have similarities. Synthesis means finding links between one category and another. Preparing a working hypothesis, this is done by formulating a proportional statement. This working hypothesis is already a
3. Research Results And Discussion

Based on the results of the identification test learning obstacle on the generating function and the interviews that have been conducted by the researcher to the research subject, the following data is obtained:

3.1 Subjects with random thinking abstract characteristics

From the identification test results of the learning obstacle and interviews obtained the following data: (1) in problem number 2, it shows that the subject is working on the problem is not right, the subject is wrong in manipulating algebra in order to form and generating exponential function and subject do not complete the work; (2) in the case of number 3, errors made by the subject, namely in determining the Taylor series in order to determine the formula of the generating function; (3) in question number 4 the subject can do the problem correctly, but not complete.

3.2 Subjects with characteristics of concrete random thinking method

From the results of the identification test learning obstacle and interviews obtained the following data: (1) in the number 2 problem the work of the subject shows the series writing error in the formula of the exponential generator function (the series done by finite subject, this is not appropriate with what is asked) and cannot calculate (wrong in calculating multiplication) and cannot distribute multiplication of addition; (2) in question number 3, the subject cannot understand the conditions given in the problem to form a Taylor series of ordinary generating functions; (3) in matter number 4 the subject cannot calculate the operation of the rank.

3.3 Subjects with concrete sequential ways of thinking characteristics

From the identification test results learning obstacle and interviews, the following data were obtained: (1) in the number 2 problem the work of the subject showed that there were not many errors, the subject did not complete the work because he could not continue the next step because there were no example; (2) errors made by the subject in question number 3, namely the use of symbols; (3) the subject cannot solve problem number 4 because he cannot operate the next step.

3.4. Subjects with abstract sequential thinking characteristics

From the identification test results learning obstacle and interviews obtained the following data: (1) in the number 1 problem the work of the subject shows that there are not many errors, but have not been able to finish answering what was asked; (2) errors made by the subject in question number 3, namely the use of symbols; (3) the subject cannot solve problem number 4 because he cannot operate the next step.

Based on the results of the study, for subjects with the characteristics of abstract random thinking in problem number 2 and number 3 is wrong in using the equivalent formula. This is a principal error. The principal error is defined if it is wrong in setting and determining the formula, determining what is known, and wrong in connecting the related concepts. Example: (1) False in determining what is known; (2) Wrong in setting the formula used; (3) Incorrect in applying the formula and changing the equivalent formulas; (4) Cannot relate the concept of multiplication to other interrelated concepts. For questions number 2 and number 4, the subject's error with the characteristics of abstract random thinking is that it cannot continue the next step, including the operation error. The student is said to be in a wrong operation if wrong in using the count operation. For example (1) Incorrect in operating numbers; (2) Wrong in using the count operation; (3) Wrong in determining the formula. In this case, the operation error made by students with the characteristics of abstract random thinking is seen from their inability to continue the next operation so that the problem is not solved completely. Learning obstacle Student with the characteristics of abstract random ways of errors in principles and operations in accordance with the characteristics of abstract random thinking. Nurmitasari (2014: 36) Students who have the characteristics of AA thinking have characteristics that tend to be spontaneous, flexible, imaginative, like things that are connected, more oriented to others.

Subjects with characteristics of concrete random thinking, errors found in problem number 2 and number 3 are wrong in using the equivalent formula, in problem number 3 also found errors in determining which is known, wrong in determining the formula used, and cannot connect the concept interrelated.
These errors are included in the principal error. For questions number 2 and number 4 found errors in operating numbers which are operating errors, then the error of not understanding the definition of the generating function found in problem number 2 is a conceptual error. Concept errors are errors in understanding the terms symbols and mathematical symbols, unit selection. For example (1) False in understanding the definition and definition of variables, coefficients, constants, similar terms and coefficients of variables; (2) Wrong in understanding the mathematical terms used; (3) Not understanding mathematical terms; (4) Wrong in understanding symbols. Learning obstacle is shown by students with the characteristics of concrete random thinking in accordance with the characteristics of the concrete random thinking method that is willing to try, intuitive, curious, realistic, creative, innovative, likes to do things in their own way, adventurous, more oriented to the process rather than results, (Nurmitasari, 2014: 36), with the trial and error attitude that causes students to make a lot of mistakes.

For subjects with concrete sequential characteristics found errors in problem number 2 and number 4 that is unable to continue the next step, including the operation error. In the number 3 problem errors made by the subject with the characteristics of a concrete sequential way of thinking that is wrong in understanding the symbol which is a misconception. This is in accordance with Nurmitasari, (2014: 36) which states the characteristics of the concrete sequential way of thinking characteristics that regulate their tasks regularly, prefer things related to real objects, students who are hard-working, like directing, accurate, tend to memorize.

For subjects with the characteristics of abstract sequential ways of thinking found errors in problem number 1 and number 4 that is not able to continue the next step, including into operating error. Then in the number 3 problem errors made by the subject with the characteristics of an abstract sequential way of thinking that is wrong in understanding the symbol which is a misconception. This is consistent with the characteristics of the abstract sequential way of thinking characteristic of Nurmitasari (2014: 36), which is analytic, tends to think critically and think from important, knowledgeable, structured, systematic, logical, rational and intelligent points.

4. Conclusion

Based on the data analysis and discussion described in chapter IV, the conclusion is:

a. Students’ Learning Obstacle with the characteristics of abstract random thinking on the generating function lies in operating errors and principle errors. The principal error lies in the error in changing the equivalent form formula. The operating error lies in its inability to continue the next operation so that the problem is not solved completely.

b. Students’ Learning Obstacle with the characteristics of concrete random thinking in the generating function lies in conceptual errors, operating errors and principle errors. Concept error lies in its inability to understand the definition of the generating function. The principal error lies in the incorrect use of the equivalent formula, errors in determining what is known, incorrect in determining the formula used, and not being able to relate the interrelated concepts. The operating error lies in the error operating the number.

c. Students’ Learning Obstacle with the characteristics of concrete sequential thinking in generating function lie in conceptual errors and operating errors. Concept errors lie in the use of symbols. The operating error lies in its inability to continue the next operation so that the problem is not solved completely.

d. Students’ Learning Obstacle with the characteristics of abstract sequential thinking in generating function lies in concept errors and operating errors. Concept errors lie in the use of symbols. The operating error lies in its inability to continue the next operation so that the problem is not solved completely.

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