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Pre-service Mathematics Teacher's Ability to Diagnose Mathematics Learning Difficulties

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Abstract

This article describes the ability of preservice teachers mathematics in diagnosing mathematical learning difficulties using the Newman's Error Analysis (NEA) model. The results indicated that the subject could make a complete and detailed diagnosis of mathematics learning difficulties. Meanwhile, in the aspect of accuracy in using the NEA model, the subjects were not consistent, and it was also found that they combine it with the four-object mathematical structure model

Keywords: preservice teachers, difficulties, NEA

1. Introduction

Students have experienced difficulty learning mathematics generally. Many factors affect student learning difficulties [1], including learning anxiety, negative attitudes towards mathematics, and the lack of school infrastructure [2]. A student can be said to have difficulty learning if, within a certain time limit, the student does not reach the minimum mastery level [3]. Some research results of Trends in International Mathematics and Science Study (TIMSS), Program for International Student Assessment (PISA), The Political and Economic Risk Consultancy (PERC), show that the ability of students in Indonesia, in the field of mathematics is still in the low category

For example, the results of studies from PERC show that education in Indonesia when compared to Vietnam, turns out that Indonesia is still below Vietnam [4].The results of research show that students have difficulty in categorizing to un-categorizable, difficulty in finding solutions from defined to undefined, difficulties in determining relevant resources, and difficulties in complexity to perform operations to find a solution [5].

For this reason, teachers need to have the skills to guide students to overcome learning difficulties. The beginning teacher needs to first make the subject comprehensible [6]. Factors that influence success in learning mathematics from the teacher aspect include the teacher's ability to teach, mastery of the material, including the ability to diagnose student learning difficulties [7]. Diagnosis is an integral part of instructional decision-making [8] [9]. Teachers need to know the process of mistakes made by students in answering questions, which are generally not seen in the conventional assessment model [10]. Meanwhile, Thompson says that teachers still have difficulty interpreting the taxonomic version of thinking skills in Bloom [11].

In determining student learning difficulties, it can be used Polya's problem-solving framework and concepts which consist of understanding problems, making models or solving plans, solving models, and solving actual problems [12]. Often found students who do nothing when experiencing difficulties in solving math problems, they can take steps to identify the information needed, make tables, take pictures, and see patterns.

Another model that can be used to diagnose learning difficulties is error analysis using the NEA (Newman Error Analysis) procedure. NEA is a framework with simple diagnostic procedures, which include decoding, comprehension, transformation, process skills, and encoding. The Newman diagnostic method can be used to identify categories of errors against students' answers from a description test [13]

2. Method

This research is phenomenological research because it has a focus on studying subjectively the behavior of subjects in making a diagnosis of learning difficulties. Data mining through observation or observation and in-depth interviews on the subject to interpret the observed behavior. The data obtained are qualitative data in the form of a description of the ability to make a diagnosis. The purpose of this study is to describe the ability of prospective teacher students in diagnosing mathematics learning difficulties, by determining the types of errors students make in solving math problems. The description of the ability to carry out this diagnosis will refer to 3 aspects, namely accuracy, completeness, and detail. While the error analysis framework uses the Newman or Newman Error (NEA) model.

The subjects of this study were prospective mathematics teacher candidates from STKIP Al Hikmah who were taking the Mathematics Learning Psychology course. The subject selection process is based on students' interest to explore the diagnosis of learning difficulties. To find out these interests students will be given a closed questionnaire. 3 people with the highest interest score will be chosen to be the subject of the study.

The main instrument of qualitative research is the researcher himself. While the supporting instruments of this study consisted of a questionnaire, the task of diagnosing mathematics learning difficulties, and interview guidelines. This questionnaire was developed by researchers to select subjects, namely students who have a high interest in the psychology of mathematics learning. This questionnaire is closed and consists of 10 questions. The questionnaire scoring technique uses a Likert scale. For diagnostic tasks in the form of a guide that must be done by the subject in making a diagnosis. This task was arranged to obtain data about the subject's ability to diagnose mathematical learning difficulties. This task was developed by researchers, as an effort to develop the subject matter of psychology mathematics learning. While the interview guidelines are arranged to obtain more complete and comprehensive data on the subject's ability to make a diagnosis.

There are three data collection techniques in this study, namely giving questionnaire interest in the diagnosis, assigning diagnostic tasks, and unstructured interviews based on the results of the assignment. The results of questionnaire data in the form of student interest scores explore the diagnosis of learning difficulties. The assignment result data in the form of exposure to student work results, analysis of the types of errors, and alternative solutions to help students who have difficulty learning mathematics. Data from interviews in the form of sound recordings will be transcribed for the need for deepening research data taken through the task.

3. Result and Discussion

3.1. Result

The data used to select research subjects are the results of the questionnaire of interest in the psychology of mathematics learning. Questionnaire scores for each subject were recapped and arranged in order based on the highest to the lowest rank. The three highest scores were determined as research subjects, namely subject 1 (S1) with a score of 49, while subject 2 (S2) and subject 3 (S3) each scored 45.

The second data was obtained from the task of diagnosing students' mathematics learning difficulties with research subjects. The data is the data on the results of student work to be analyzed for errors, data on the type and location of student errors that are set by the subject, data on the factors that cause errors and mathematical learning difficulties revealed by the subject, data on several alternative solutions offered by the subject that can be used by the teacher to help students, and data on the subject interviews with students in order to deepen the results of the diagnosis. The following data are the results of the diagnoses of learning difficulties made by the subjects of this study summarized in table 1.

Tabel 1: Learning Difficulty Diagnosis Results

Aspect	S1	S2	S3
The results of student work to be analyzed	V	V	V
The type and location of student errors	V	V	V
Causes of student errors and difficulties	V	V	V
Alternative solutions that can be done by the teacher	V	V	V
Results of subject interviews with students	V	-	V

Table 1 presents the types of data generated in this study. The results of student work in the form of student answers in completing daily tests given by teachers at school. The results of this student's work are chosen by subjects who have errors. The second data is the type and location of student errors, which are determined by the subject on student work based on the NEA model. This data is very important because it will be a capital to predict the causes of errors and the types of difficulties experienced by students, as well as to provide alternative solutions that can be used by teachers to help students who experience difficulties. Data-3 causes of errors and difficulties expressed by the subject based on the type of error. The 4th data is an alternative solution that can be done by the teacher to help learning difficulties. While the fifth data all interviews were conducted by the subject on students to deepen the data obtained through student work. These data are used as material for discussion.

3.2 Discussion

S1 subjects diagnose student learning difficulties by presenting data on student work outcomes that have been classified. Subject S1 describes the type of error that is unintentional errors, concept errors, operating errors, and procedural errors. Accidental mistakes can also be called human errors, namely mistakes that occur due to accidental, not because of difficulties.

Accidental errors or human errors are types of errors caused by difficulties, but purely technical factors. This can be known immediately at the time of the interview, students quickly respond that it is wrong, and can immediately correct it. Students do not experience any difficulty in correcting their work. Concept errors occur when students count 3k: 3k = k. The concept error in question is the subject's error in understanding the concept of division of 2 numbers containing variables as if only the number 3 can be divided by 3, while the

element k is considered permanent so the result is written k. This error can also be categorized as an operating error because, in essence, the subject is wrong in calculating the division of two elements. While operating errors and procedural errors are an integral part especially when students carry out operations that also contain procedures.

S2 subjects diagnose students' mathematical learning difficulties by describing three types of errors, namely errors in understanding problems, errors in conducting transformations or determining completion strategies, errors in calculating and operating algebra. Whereas S3 subjects tend to express several types of errors in terms of errors in the work process. In the NEA model, this type of error can be categorized by the type of procedural error.

The results of data analysis that have been described can be presented in table 2 so that it is easy to compare similarities and differences in the characteristics of the ability to diagnose students' mathematical learning difficulties:

Table 2. Diagnosis Characteristics

Characteristics	S1	S2	S3
Accuracy	++	+++	+
Completeness	+++	+++	+++
Detail	+++	+++	+++

Table 2 illustrates that for accuracy characteristics, subject S1 with the ++ sign, means the ability of the subject to use the NEA in making a diagnosis is quite precise, subject S2 with the sign +++, means the ability to make a diagnosis is correct, while subject S3 with the + sign, means the ability to diagnose is still not right.

Based on the analysis of the data above, the findings of this study consist of three parts, namely the first characteristic of the ability to diagnose learning difficulties, the second the ability to diagnose each subject, and thirdly the differences and similarities in the characteristics of the ability to diagnose mathematical difficulties. Characteristics of the ability to make a diagnosis

Learning difficulties of prospective teacher students and are described through three main indicators namely accuracy, completeness, and detail. By using this indicator it can be explained that the ability of subjects to make different diagnoses. The difference between the three subjects is the accuracy of the subject in using the NEA model in diagnosing students' mathematical learning difficulties.

4. Conclusion

The ability of prospective teacher students to diagnose mathematics learning difficulties can be seen through three aspects, namely the accuracy, completeness, and detail. Proper diagnosis means that the diagnosis has been carried out in accordance with the established NEA framework and model. Completeness of the diagnosis means that all types of mistakes made by students have been fully disclosed by the subject. Whereas the diagnostic detail shows that the diagnosis is complemented by the results of student work to be analyzed, the type and location of errors made by students, the causes of errors and difficulties of students, and alternative solutions that teachers can use to help students learning difficulties are presented specifically.

Teacher more self-reflective, and learning to monitor various teaching practices [14]. Need for a more integrated and connected pre-service teacher learning experiences [15]. Prospective teacher students can make a complete and detailed diagnosis of mathematics learning difficulties, but they have different abilities in terms of accuracy. One subject can use the NEA model appropriately, one subject uses the NEA model combined with other models, and one subject is less able to use the NEA model correctly.

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