5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Should We Diagnose Difficulty Connections, Reasoning and Mathematical Proof to High School Students?

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Abstract. There are five required process standards in the mathematics learning formulated by NCTM (National Council of Teachers of Mathematics) namely connections, reasoning and mathematical proof. Both standards require students in relating mathematical concepts with one another, the field of study of mathematics and other fields, and application in the real life. Reasoning and proof are required by students in solving problems start from constructing conjectures to drawing conclusions in a logical way by giving reasons or evidence to the truth of a statement. This article aims to describe the urgency of the diagnosis of connections difficulty, reasoning and proof in mathematics learning. The research method used literature review. Based on the results of previous research shows that the ability of mathematics connections of high school students is still low with an indication of lack of basic knowledge of students in relating the concept. Then, there are high school students who still think concretely, when they should think abstractly as their stage of the age through deductive reasoning. That facts is a gap that needs to be revealed through a diagnostic assessment. Diagnostic assessment is an integral part of mathematics learning to measure the extent to which student achievement and the type of difficulty students encounter. Thus, diagnostic assessment is expected to be a benchmark in determining the right effort for students who have difficulty in learning mathematics.

Keywords: mathematical connection, reasoning and proof, diagnosis of learning difficulties

INTRODUCTION

There are five standard processes that students must comprehend in mathematics learning formulated by NCTM (1) problem solving, (2) reasoning and proof, (3) mathematical communications, (4) mathematical connections, and (5) mathematical representation. Two of them are connections, reasoning and proof. NCTM states on its website that both material standards and process standards are collectively the essential skills and understanding that these students need in this 21st century.

Students' proficiency in solving mathematical problems, influenced by their ability in understanding mathematics. The ability of reasoning plays an important role in understanding mathematics. Mathematical reasoning is a habit of thinking, and like a habit, reason must be a consistent part of every student mathematical experiences. From the early experiences of students learning mathematics material, it is important for teachers to help students understand that affirmations should always have a reason. These reasons are the underlying proofs of basic or early knowledge of the students.

Mathematical connections are important part of emphasis at every level of education (NCTM, 1989). Mathematical connection are the relationship between mathematical topics, the relationship between mathematics with other disciplines and the relationship of mathematics with the real world or in everyday life. In fact, the curriculum of mathematics today is seen as a collection of a number of topics or materials, so that each topic tends to be taught

separately. So, it makes the student must remember the concept too much and do not recognize the general principles that are relevant to various fields. Therefore, the curriculum should help students to be able to see how mathematical ideas are related. If the mathematical idea is associated with the day-to-day experience of the student then the student will appreciate the usefulness of mathematics.

Of the above two statements about the ability of mathematical connections, reasoning and proof indicates that they are an urgency that needs to be highlighted by teachers in schools, especially in learning mathematics. For that, it needs a way that can provide information to the teacher that the extent to which the ability of mathematical connections, reasoning and proof that exist in the students. Assessment is an integral part of mathematics teaching, which contributes significantly to all students' mathematics learning.

When teachers have useful information about what students are learning, teachers can support students' progress toward mathematical significant goals. Instructional decisions made by teachers - such as how and when to review prerequisite materials, how to revisit a difficult concept, or how to tailor tasks for struggling students or for those in need of enrichment - are based on conclusions about what students know and what which they need to learn. Assessment is the main source of evidence on which this conclusion is based, and the decisions made by the teacher are only in accordance with the evidence obtained. The question are, do teachers have to assess the ability of mathematical connections, reasoning and proof? What kind of assessment is appropriate to obtain information about the extent of the abilities that students have achieved and the difficulties students experience? Has the teacher done the assessment? Here are some questions that will be discussed in this article.

THEORY REVIEW

Connections Mathematic

The purpose of mathematical connection according to NCTM (1989: 146) is that students can:

1. Recognize the equivalent representation of a similar concept.
2. Recognize the relationship of a single representation procedure to an equivalent representation procedure.
3. Using and assessing the connection of several mathematical topics.
4. Using and assessing the connection between mathematics and other disciplines.

Based on the above NCTM information, then the mathematical connection can be divided into three aspects of the connection group, namely:

1. Aspects of connection between mathematical topics
   This aspect can help students connect mathematical concepts to solve a situation of mathematical problems. Example: to calculate the rest of the polynomial $f(x) = 3x^3 - 2x^2 + x - 5$ by $x - 1$, then the settlement step can be done through the process of algebra (substitution) or through the process of chart (stacked division).
2. Aspects of connection with other disciplines.
   This aspect shows that mathematics as a discipline, in addition can be useful for the development of other disciplines, can also be useful to solve a problem related to other fields of study. Example: to solve problems related to parabolic motion in the field of physics studies, i.e., calculate the furthest distance from a stone thrown by a child with a certain initial velocity and angle of elevation. This problem is concerned with the concept of a double angle in trigonometry in mathematics.
3. Aspects of connection with real-world students / connections with everyday life.
   This aspect shows that mathematics can be useful for solving a problem in everyday life. Example: to solve problems related to social arithmetic, for example calculate and determine the profit or loss of a sale and purchase transactions. Through the three aspects of mathematical connections above and for example, students will increasingly realize that mathematical concepts are interconnected and they will also understand how important math is to solve everyday problems both in school and outside of school.

Reasoning and Proof

Killpatrick and Findell (2001: 130) suggest that students can demonstrate reasoning ability when encountering three conditions, namely: (1) having sufficient basic knowledge, these students have sufficient prerequisite knowledge before entering new knowledge; (2) tasks that are understood or understood and can motivate students; and (3) the

context presented is well known and enjoyable for students. Priatna (2012: 7) defines that reasoning is a way of thinking that links between two or more things based on certain qualified traits and rules by using evidentiary steps to reach a conclusion. Then, Keraf (1999: 16) argues that reasoning is a process of thinking that seeks to relate facts that have been known to a conclusion or an activity, process or activity of thinking to draw conclusions or to make a new statement based on some statement of truth has been demonstrated or assumed before.

Both of expert opinions above about the definition of reasoning, was not much different. It shows that reasoning is a way of thinking of a person to draw a conclusion based on known (inductive) facts and predefined (deductive) preceding attributes or rules. Therefore, the reasoning in this article is a way of thinking to draw conclusions based on the relationship between known facts or the nature and rules that the truth has been proved before.

Proof is the argument from a premise to a conclusion that can convince others to accept the new conclusion. Therefore, mathematical proof must be based on two very important things. The first proof must be based on clear statements and definitions. Second, the proof must be based on a valid inquiry procedure. Knowing two proof procedures, namely direct proof and indirect proof.

In real life everyday indirect proof utilization (indirect proof) is often used although not realized as indirect proof. According to Cooney, Davis, and Henderson (1975: 313), indirect proof is a strategy that is caused because the reasoning can be used to validate almost any statement. All three (1975: 313) states: "A special form of indirect proof is reductio ad absurdum".

RESULT AND DISCUSSION

Based on the results of interviews to three respondents in Mathematics study teachers from three different schools. Selection of schools based on the average value of the National Examination Mathematics of each one of the schools of high, medium and low groups.

Teacher respondents from school A (low group) stated that ideally in teaching mathematics teachers apply five principles of ability in NCTM. However, the facts on the ground indicate that there are still many students who have difficult with prerequisite materials, making it difficult for students to link from one concept to another. For example, in the matter of quadratic functions, students still find difficulties in factoring and quadratic equations. Though the two concepts have been taught in junior high school, so the teacher took more hours to explain again about the material prerequisite. The effort that teachers have done in school A to train mathematical connections is by linking each stage in solving problems with certain algorithms. However, this is still considered not able to generate mathematical connection power of students due to absorption of students who are still low. As for reasoning ability and proof, students in school A still low ranges below 60%. This is shown from the results of student learning that have not reached KKM standards on issues related to reasoning and proof. So far, teachers have made a diagnostic assessment using the Student Worksheet containing the questions. The reason is to train students independently in search of previously learned concepts. Implementing a diagnosis of learning difficulties is necessary, but again to each student. If the analogy, students are like patients who are sick and teachers as doctors to provide medicine to the patient who was sick. However, the patient does not want to take the medicine, so the drug is given in vain. So, according to teacher at school A give diagnosis of student learning difficulties less effective because student response at school A is less and low student learning interest.

Teachers 'respondents from school B (medium group) state that the students' mathematical connections in the classroom are often associated with apperception or pre-paid materials. Teachers usually provide a diagnosis assessment of students' learning difficulties only orally by sharing methods or frequently asked questions about concepts that have or have not been known to some students in the classroom. If some children are able to answer then the teacher concludes that the mathematical connection power of students on the material is good. While the ability of reasoning and proof of students in school B is still low, several factors such as lack of care, misconception and mastery of prerequisite materials are still lacking. For example, in the matter of quadratic function of students is still weak in proof algebra that is the concept of quadratic equation. When in this step students do not have or forget the concept of quadratic equations, then one step could not be done so that the effect on the next step. This shows that the concepts in the algorithm that have not been dominated by the students. The teacher constraints in providing diagnostic tests to students is the lack of time hours while the material demands are very much, so the lack of motivation of teachers to provide diagnosis tests to students.

Teacher respondents from school C (high group) stated that he often trained students' mathematical connections in the classroom using both digital and non-digital media. For example, the quadratic curve, the descending function,

the student is taught how the function descends and the function rises, the equation of the curve using the software. However, there are still obstacles that are often faced when trained mathematical connection power, reasoning and proof of a variety of learning styles. Meanwhile, teachers have limited both space and time to be able to meet the different learning styles of students. For example, students who are happy with visual learning styles will find it difficult when teachers provide an auditory learning style. Barriers are not enough there, there are still two or three students who do not yet understand basic material operations such as reduction in fractions. In addition, every change of curriculum or syllabus, school C always follow the rules so that more and more material demands while the allocation of time is less, making it difficult for teachers to be able to deliver as much detail as possible related to the power of mathematical connections, reasoning and proof. The diagnostic tests of learning difficulties that are usually given by teachers in school C is only once at the time of entering mathematics learning at the beginning of the semester. According to him, the diagnostic test is very important to know the extent to which the initial knowledge of students, the usual problems are always related to the concepts that have been studied students, but the numbers used vary, for example the concept of Pythagoras Theorem by giving the number of decimal forms. Not only the test in the form of a matter of course, but also varied with an open questionnaire located under the problem by providing questions to students such as, whether students like math lessons ?, what kind of value students expect in math lessons ?, and so on.

CONCLUSION

The diagnosis of learning difficulties is so important and should be given to students. Based on the results of interviews to the three teachers from each school A, B and C have their own way of doing diagnosis of learning difficulties. As with teachers coming from school A, conduct a diagnostic assessment using a Student Worksheet containing the questions. Whereas teacher from school B gives an assessment of the diagnosis of students' learning difficulties only orally by sharing method or question and answer about concepts that have been or have not been known to some students in class. The diagnostic tests of learning difficulties that are usually given by teachers in school C is only once at the time of entering mathematics learning at the beginning of the semester. The three teachers also face some problems that become obstacles in making diagnosis of student learning difficulties. The same problems faced by all three are the lack of early knowledge of the students and the inadequate allocation of lesson time and other factors that could not be controlled. This makes the teacher's lack of motivation in diagnosing the difficulty of mathematical connections, reasoning and verification to students continuously.

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