

Need Assessment Device Development of Measurement Test of Connection and Mathematics Representation of Class XI

Sofi Saifiyah^{1, a)} and Heri Retnawati^{2, b)}

¹*Postgraduate of Research and Education Evaluation, Yogyakarta State University, Jl. Colombo No.1, Karangmalang, Yogyakarta, Indonesia*

²*Department of Mathematics, Faculty of Mathematics and Natural Science, Yogyakarta State University, Jl. Colombo No.1, Karangmalang, Yogyakarta, Indonesia*

^{a)}sofisaiifiyah.2017@student.uny.ac.id

^{b)}heri_retnawati@uny.ac.id

Abstract. The ability of connections and mathematical representation are the two abilities of the five mathematical abilities which in the process standard according to NCTM (National Council of Teachers of Mathematics) are important for students to possess. However, the development of mathematical problems that can measure the ability is not yet available. The purpose of this need assessment is to describe the needs of teachers regarding the development of questions to measure the ability of connections and mathematical representations that do not yet exist. The method is used descriptive of qualitative exploratory. The participants involved are some of senior high school mathematics teachers with their data collection through WhatsApp social media. The result of the analysis shows that, during this time the teacher just only adopted the question from the package books, some teachers also have been designing their own question, it's just the teacher is not accustomed to make the question by classifying what kind of mathematical ability to be on the students, which can measure connection capability and representation indispensable. Based on the results of this analysis, it is necessary to develop a test device for connection capability and mathematical representation.

INTRODUCTION

Mathematics is one of the subjects that have an important role in the world of education so that must be given at all levels of education from elementary school to college level. The importance of the role of mathematics in education because mathematics is closely related to everyday life and also has relationships with several other disciplines. To be able to relate mathematics to mathematics itself or between mathematics and other disciplines, a student must master some mathematical abilities. Mathematical ability is the ability to deal with various problems in the world of mathematics. As for the mathematical abilities that became the goal of mathematics learning there are five standard processes. According to NCTM (National Council of Teachers of Mathematics) [1], the five process standards are problem solving, reasoning and proof, communication, connections and representation.

One of the mathematical abilities to relate between mathematical topics with mathematics itself or even with other disciplines related to everyday life is the understanding of the ability of mathematical connections. Mathematical connections are very useful for students, if students can connect between mathematical ideas, then their mathematical understanding will be stronger. Not only interpersonal ideas alone, students can also connect between mathematical ideas and other disciplines. That way, the understanding students have learned will not be easy to lose as it will continue to be used to understand the next material.

Facts according to Yenni [2] in mathematics learning, when students are given problems or questions by teachers, in solving the problem, students tend to solve it in the same way as the example given by the teacher. As a result, students only imitate and memorize the way that teachers have given. This is because they assume that the answer given by the teacher in the example is the only correct answer. In addition, the teacher does not try to tell that the answer has more than one possible solution, which results in the students' ability to express low mathematical ideas.

Another mathematical ability which is also of particular concern to this research is the ability of representation. The ability of representation is closely related to communication skills. To be able to communicate something especially mathematical problems, students must master the ability of representation in the form of pictures, graphs, diagrams, and others. The ability of representation is needed to express and re-reveal ideas or ideas that students have. The importance of representation skills for students is to assist students in solving math problems either in the form of drawings, diagrams, mathematical ideas, and sentences.

Based on the surey results conducted by TIMSS (Trends in International Mathematics and Science Study) in 2015, Indonesia occupies the number 45 of 50 countries with an average score of 397 [3]. The survey results show that the mathematical ability of students in Indonesia is still categorized as low. One of the causes of such low mathematical ability is because students are not yet accustomed to practicing problems whose solutions are required to use standard mathematical abilities. In general, students are also not accustomed to solve problems or math problems related to everyday life and can only solve the problem in accordance with the ever exemplified by the teacher. So when it comes to having a different shape from the sample because it is modified, students have difficulty completing it. This means students are less likely to develop ideas and concepts that they have, which results in their mathematical representation capabilities not well-developed.

Based on the results of interviews with several high school math teachers in Cirebon district of West Java, the students' connection and mathematical representation so far have not been specifically measured. This is because the students are only accustomed to solving the problems that come from the handbook of students and teachers, and some of the problems made by the teacher without knowing what mathematical ability will be measured. Looking at the situation and seeing the importance of connection capability and mathematical representation is very necessary to have students, it is necessary to develop a test device that can be used to measure the ability of connections and mathematical representation of students, especially in high school students XI. While the common problems that occur in students according to Sukmaningthias and Hadi [4] are students have different levels of ability caused by different thinking processes in solving mathematical problems. So it is necessary alternative activities that can improve the ability of mathematical representation.

One way that can be done to answer the urgency of the needs of teachers and students in accordance with the problems that have been described above is by doing need assessment. So that purpose of the need assessment is to determine the needs or expectations that should be owned by students. Needs are very necessary in the learning process, because with the need means something to be achieved between the purpose of learning with the actual situation. In an effort to achieve the needs in accordance with the objectives, then the role of teachers to be one of the critical success factors to achieve these needs. Teachers are required to have a test device that can train students' mathematical skills.

Due to the absence of a test device devoted to measuring the connection ability and mathematical representation of grade XI students, the results of this needs analysis will be made of a test device. Thus, if compiled a set of test devices that can measure the two mathematical skills, it can help teachers to measure the ability that must be possessed by students, especially on the connection ability and mathematical representation of high school students class XI.

RESEARCH METHOD

The research undertaken on this occasion is a preliminary study of the pre-development stage of research and development (R & D) procedures by Borg and Gall [5]. This study is limited, only at the stage of need assessment (assesment) obtained from interviews with mathematics teachers and studies of the literature relevant to the research undertaken. While the research method used in this research is descriptive qualitative explorative research method. The data collection by conducting unstructured interviews conducted to six math teachers senior high school Cirebon district of West Java. Unstructured interview (free interview) is an interview conducted without a list of questions, so the questioner may ask what is deemed necessary [6]. The interview was conducted through WhatsApp social media, Instagram Direct Messages and Facebook. In addition, interviews were also conducted for some high school students class X, XI, and XII city of Yogyakarta, Bantul district, as well as the district and city of Cirebon as a complement to the data.

With this qualitative method, researchers want to know in depth the needs of students will test devices that can measure the ability of connections and mathematical representation of students of class XI. Through interviews with several math teachers, the writer can find the needs of what is needed by teachers in meeting the needs of students. The data of unstructured interviews with both teachers and students will be analyzed descriptively qualitatively.

RESULTS AND DISCUSSION

Needs assesment necessart to be done to know the condition of the field and also the level of need in the field will be a change. Arifin [7] describes needs assessment as an integral part of the overall learning system, so it can be used to solve learning problems. Thus, Arifin concluded that a process undertaken by a person to identify needs and determine the scale of priority solutions. The main purpose of the need assessment according to Lucian Ciolan [8] there are four of the foundation foundation for development or improvement of an educatinal or social program, restructuring of an organization for improving the performances in relation with the established goals, setting up criteria for contractic services of human resources training and development, identification of a solution for a complex problem or issue. Needs assessment involves identifying needs activities, placing them in order of priority, and choosing the most important and ignoring the unimportant. It is important to note that needs assesment sees needs as a gap in outcomes, not a gap in input or process [9].

There are six kinds of needs commonly used to plan and conduct needs assessment [10] including 1) Normative needs that Compares students with national standards, for example, National Final Exam, National Selection to Enter Public Universities, etc; 2) Competative needs, comparing students to one group with another group at the same level. For example, the result of national exam Junior High School A with Junior High School B; 3) perceived needs, ie the desires or desires of each student that needs to be improved. This need shows the gap between the level of skill or reality that appears with the perceived. The best way to identify this need is by interview; 4) the expressed need, ie the perceived need of a person capable of being expressed in action. For example, students who enroll in a course; 5) future needs, Namely identify the changes that will occur in the future. For example, the application of new learning techniques, etc; 6) urgent incidental needs, ie, negative factors that arise beyond a very influential notion.

Need assesment of the test device based on the results of interviews conducted indirectly to some senior high school mathematics teachers in accordance with one of the various needs put forward by Morrison that is including the type of perceived needs. Where the need is the desire or things that should have students who need to be developed. The importance of students' mathematical abilities that need to be developed is because students are not familiar with the problem exercises that are devoted to measuring the extent of their connection capability and their mathematical representation. One of the teachers from senior high school state Cirebon city said that sometimes the problems that exist in the student's package book, there are already problem that how to solve using the ability of connection and representation, it's just that kind of problem is not much because in the package book used by students the questions available can cover all aspects of mathematical ability that must be mastered by students. While the exposure from the high school mathematics teacher in Cirebon district that the math teacher at the school has never compiled a mathematical problem devoted to measuring certain mathematical skills on the grounds that there are problems available in the package book and also easy to get the questions from the Internet.

When conducting an interview with student a grade X senior high school, the student confessed that during this time the teacher only gave the exercise and homework questions from the student worksheet containing the brief material and the exercise questions only, is it to measure the mathematical ability of what kind of students do not know it . One of the students of grade XII senior high school also interviewed the related researcher to solve the mathematical problems that are interrelated between concepts, the student admits that he has difficulty facing such problems. And when asked about mathematics related to everyday life or the real world, he also admitted that at this level of high school rarely find a problem that can be related to the real world, almost all abstract.

Mandur *et al* [11] conducted a study to see the contribution between connection ability, representation, and mathematical disposition of high school student achievement. The results of his research indicate that a) students who have good mathematical connection ability, trying to build a positive disposition or attitude to mathematics, so that high mathematics learning achievement. Thus, mathematical connection ability contributes to learning achievement through mathematical disposition; b) the ability of mathematical representation contribute significantly to the achievement of learning mathematics either directly or indirectly with a large contribution of mathematical representation ability to the mathematics learning achievement of 9.42%. These results indicate that the achievement of mathematics learning achieved by the students is determined by the ability of mathematical representation. Thus, to improve students' mathematics learning achievement it is necessary to improve the ability of mathematical representation; c) the ability of connections and the ability of mathematical representation contribute positively and significantly to mathematical dispositions either individually or simultaneously. The contribution of mathematical connection ability to mathematical disposition is 31.14% and the contribution of mathematical representation ability to mathematical disposition is 16.56%. These results indicate that mathematical connection ability has a greater role in increasing mathematical disposition of students than the ability of mathematical representation. Nevertheless, the ability of mathematical representation must still get emphasis proportionally and can not be separated from mathematics learning.

Given the importance of connection capability and mathematical representation that affect the achievement of student learning outcomes proposed by Morrison et al above, the test device to be developed in this study will also be enabled to measure the two mathematical abilities of the ability of connections and ability of mathematical representation. In order for students to succeed in learning mathematics that will affect the learning achievement, then the students should be more directed and given more opportunities in seeing the linkages or the relationship between one concept with another concept. Although in mathematics learning is divided into several branches, mathematics is not a collection of several separate topics and capabilities [1]. Thus, looking at math as a whole is very important in learning and thinking about connections between topics in mathematics. It is therefore necessary for a student to have adequate mathematical connection ability. The ability of a mathematical connection is the ability to link mathematical concepts both between concepts in mathematics itself and to associate mathematical concepts with concepts in other fields of science [12].

Math connections according to Siagian [13] are indicated in three aspects: interconnection of mathematical topics, connections with other disciplines, and connections with the real world of students or connections with everyday life. Therefore, mathematical connections can be interpreted as a relationship between the concepts of mathematics internally that is related to the mathematics itself or external relationships, namely mathematics with other fields both other fields of study and with everyday life. According to Sumarmo [14], students' mathematical connection ability can be seen from the following indicators: (1) seeking the relationship of various representations of concepts and procedures; (2) understanding the relationship between mathematical topics; (3) applying mathematics in other fields or in everyday life; (4) understanding the equivalent representation of a concept; (5) seeking the relation of a procedure to another procedure in equivalent representation; (6) to apply relationships between mathematical topics and between mathematical topics and topics outside mathematics.

Students' ability to connect interrelationships between mathematical topics and also to connect between mathematics and the real world is considered very important, because it can help students understand the topics that exist in mathematics. With mathematical connections students can pour problems in everyday life into mathematical models, it can help students know the usefulness of mathematics. Thus, the effect of mathematical connection ability for students is that students can know the connection between mathematical ideas and students can know the usefulness of mathematics in everyday life, so that two things can motivate students to keep learning mathematics which can be expected to improve learning achievement.

In addition to connection capability, other mathematical abilities that are also needed to be able to measure students' mathematical abilities are the ability of mathematical representation. Representation is essentially a part of mathematical communication that can be shaped as an ordinary language, mathematical verbal language, symbol language, visual representation, and quasi-mathematical language [15]. According to Sukmaningthias and Hadi [4], mathematical representation is an expression of mathematical ideas used to show (communicate) work in a certain way (by conventional or unconventional means) as a result of the interpretation of the mind.

In general, representation is always used when students study mathematics. With the ability of mathematical representation, can familiarize students in relating mathematical ideas in various topics or with the real world or everyday life. Indicators of mathematical representation according to NCTM [1] include: 1) creating and using representations to organize, record, and communicate mathematical ideas; 2) selecting, applying, and translating mathematical representations to solve problems; 3) using representations to model and interpret the physical, social, and mathematical phenomena.

Representation by Goldin [16] is a very important element to apply in the process of learning mathematics, not only because of the use of symbols in math but also rich in sentences and words, diverse and universal, but also for the following reasons: 1) mathematics has an important role in conceptualizing the real world; 2) mathematics makes homomorphism a decline of the structural other essential things. With representation, students will be helpful in communicating their ideas when faced with a mathematical problem. Students can represent mathematical ideas through images, words (verbally), tables, concrete objects or mathematical symbols.

Based on the results of the analysis that has been done can be obtained picture that the teacher still do not know how to measure the ability of connection and mathematical representation. It is an obstacle for teachers to develop test kits that can measure students' connection and mathematical representation. So it is necessary to develop a test device that can help teachers to measure the two mathematical skills of students tersebut. In addition, test kits that will be developed can help students to practice and hone the two mathematical skills.

CONCLUSION RECOMMENDATION

The conclusions of the discussions that have been and presented are:

1. A test kit that is devoted to measuring the connection capability and mathematical representation of grade XI high school students has not been developed by the teacher.
2. The ability of connections and representation of class XI students is still relatively low.

Based on the conclusion that has been presented, it can be taken suggestions as follows:

1. The importance of test devices that can hone the ability of connections and student representation, it is necessary to develop a test device that can measure both students' mathematical abilities.
2. The result of developing XI class test device is expected to be used by the teacher to see the development of connection ability and student's mathematical representation.
3. With the development of test devices for the class XI senior high school, teachers are expected to develop test kits for other classes as well as other mathematical skills.

REFERENCES

1. NCTM (National Council of Teachers of Mathematics), *Principles and Standards for School Mathematics*, (Reston, Virginia, NCTM, 2000), pp. 29.
2. H. W. Yenni, *Multiple Mathematical Representation Profile of Grade VIII Based on Multiple Intelligences*, Proceeding of 3rd International Conference on Research, Implementation and Education of Mathematics and Science, Yogyakarta, (16-17 May 2016, ME-53), pp. 357-358.
3. E. L. N, *The Power of Imagination of Weak Students*, Kompas, (15 December 2016).
4. N. Sukmaningthias and A. R. Hadi, *Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving*, Proceeding of 3rd International Conference on Research, Implementation and Education of Mathematics and Science, Yogyakarta, (16-17 May 2016, ME-66, pp. 449.
5. W. R. Borg and M. D. Gall, *Educational Resarch an Intruduction* (New York Longman, 2003), pp. 570.
6. Nasution. *Research Methods (Scientific Research)*, (Bumi Aksara, Jakarta, 2012), pp. 119.
7. Z. Arifin, *Evaluation of Learning* (PT Remaja Rosdakarya, Bandung, 2013), pp. 89-90.
8. L. Ciolan, *Projects Development and Management As Tools For Quality Policymaking in Education (Needs Assessment and Project definition, Writing successful project proposals)*, Ministry of Education and Sports Republic of Serbia Vocational Education and Training Reform Programme, The European Agency for Reconstruction (2007), pp. 7.
9. N. Sunuyeko, *Analysis of Teacher Needs in the Implementation of Curriculum 2013 In Primary School*, Journal of Elementary School, (No. 1, May 2016), pp. 20.
10. G. R. Morrison S. M. Ross and J. E. Kemp, *Designing effective instruction, 4th edition*, (New York, NY: John Wiley & Sons Inc. 2004), pp. 33.
11. K. Mandur *et al*, *Contribution of Connection Ability, Representation Ability, and Mathematical Disposition on Student Learning Achievement in Private High School Manggarai Regency*, E-Journal Postgraduate Program of Ganesha University's Education Mathematics Study Program, (vol. 2, 2013), pp. 5-8.
12. U. Sumarmo and Y. Permana, *Developing the Ability of Mathematical Reasoning and Connection of High School Students Through Problem Based Learning*, Journal Educationist (Vol. 1, No. 2, 2007), pp. 117.
13. M. D. Siagian, *Ability of Mathematical Connection in Mathematics Learning*, Journal of Mathematics Education and Science, (Vol. 2, No. 1, October 2016), pp. 62.
14. U. Sumarmo, *Character Education as well as Development of Thinking and Mathematical Disposition in Mathematics Learning*, NTT, a paper on mathematics education seminar, (February 25, 2012), pp. 14.
15. S. P. Dewanto, *The Role of Early Academic Abilities, Self-Efficacy, and Other Noncognitive Variables on Achieving Multiple Mathematical Representation Ability of Students Through Problem Based Learning*, Journal Educationist (Vol. II No. 2, 2008), pp. 124.
16. A. Goldin, *Representation in Mathematical Learning and Problem Soling*. In English, L.D (Ed) Handbook of International Research in Mathematic Education, (Nahwah, New Jersey, Lawrence Erlbaun Associated, Inc. 2002), pp. 197-218.

