UJMER 8 (2) (2019) 213 – 219

Unnes Journal of Mathematics Education Research

http://journal.unnes.ac.id/sju/index.php/ujmer

Analysis of Mathematical Representation Skills Based on Student Learning Activities in Hands on Activity Assisted PBL Learning Model

Beny Meilon [1]✉ Scolastika Mariani[2], Isnarto[2]

[1.] SMA N 1 Wonotunggal, Batang, Indonesia
[2].Universitas Negeri Semarang, Indonesia

Article Info

Article History:
Received 15August 2018
Accepted 15 January 2019
Published 23 December 2019

Keywords:
Mathematical Representation Skill; Learning Activity; Problem Based Learning; Hands on Activity

Abstract

Mathematical representation is an important aspect in learning mathematics. Problem based learning, one of the learning models that can be applied to improve the ability of mathematical representation and student learning activities. The objectives of this study were (1) to test and analyze the effectiveness of PBL learning assisted by hands on activity on students 'mathematical representation abilities, (2) to describe the ability of students' mathematical representation based on learning activities. This research uses mixed method research with concurrent embedded design. Quantitative research and qualitative research go hand in hand with quantitative research as the primary method. The research subjects were class X students of SMA 1 Wonotunggal. The results of the study show that the class with PBL learning assisted by hands on activity achieves an average, and complete classics reaching more than 75%. The mean difference test shows the students' mathematical representation of classes with PBL learning assisted hands on activity better than classes with expository learning methods. Subjects who have high and moderate activities are able to fulfill all indicators of mathematical representation ability. Subjects who have less activity have not been able to meet the indicators of mathematical representation ability. Indicators that have not been fulfilled are symbolic and verbal representations.

✉ Alamat korespondensi:
Siwagu, Wates, Wonotunggal, Kabupaten Batang, Jawa Tengah 51253
E-mail: benymeilon@gmail.com

p-ISSN 2252-6455
e-ISSN 2502-4507

INTRODUCTION

Mathematics has an important role in advancing human thinking. Therefore, mathematics subjects need to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, and creatively, and the ability to cooperate. Competence is needed so that students can have the ability to obtain, manage, and use information to survive in an ever-changing, competitive situation (BSNP, 2006).

NCTM (2000) also explained the goals of mathematics learning, including developing abilities: (1) mathematical communication, (2) mathematical reasoning, (3) mathematical problem solving, (4) mathematical connections, and (5) mathematical representations. In line with the objectives of mathematics learning, it cannot be denied that to understand a mathematical concept and solve mathematical problems requires an ability that can express mathematical ideas or ideas in finding solutions related to mathematical problems faced. The ability in question is the ability of mathematical representation.

NCTM (2000) explains that representation is needed by students in understanding mathematical concepts and relationships between mathematical concepts. Representation allows students to communicate mathematical approaches, arguments, and understandings to themselves and others. Representation also allows students to recognize connections between related concepts and apply mathematics to realistic problems through modeling. NCTM also explains the standard of representation ability for pre-kindergarten to 12th grade student learning programs. The standard of mathematical representation ability is to enable students to: (1) create and use representations to organize, record and communicate ideas mathematics; (2) choose, apply and translate mathematical representations to solve problems, and (3) use representation for model and interpret physical, social and mathematical phenomena.

According to Sabirin (2014: 33) that representation is expressions of an idea displayed by students as a model or substitute for a problem situation used to find a solution or interpretation of his mind. For example, a problem can be represented by objects, pictures, words, or mathematical symbols. The same thing Flores , et al (2015) states that students engage in mathematics through representation to visualize, simplify and communicate mathematics, such as diagrams, tables, images, graphics, mathematical statements, written texts, or a combination of all of them.

Every students have way that different for construct his knowledge. In this case, very make it possible for students for try various kinds of representations in understanding a concept. Besides it's representation too play a role inprocess settlement problem mathematical. As stated Brenner that process solving problem that success depend on to skills representation problem as construct and use representation mathematics in in words, chart, table, and equations, completion and manipulation of symbols (Neria & Amit, 2004: 409).

The learning process in each primary and secondary education unit must be interactive, inspiring, fun, challenging, and motivating students to actively participate and provide sufficient space for initiatives, creativity and independence in accordance with the talents, interests and physical and psychological development of students (Permendiknas RI No. 41, 2007: 6). If examined what is stated in the Permen shows that the active role of students in learning is a must. This shows that learning activities designed by teachers must be oriented to student activities.

To develop students' mathematical abilities, the learning environment must be arranged so that students can be actively involved in many useful mathematical activities (Henningsen & Stein, 1997). The role of the teacher is very valuable in designing a learning

process that can guide students to construct their knowledge so that the resulting representation is in line with what is expected by the teacher and is able to condition students to be active in learning mathematics.

One effort to develop students' representational abilities is to improve the learning process. The learning process can be improved using learning models recommended by experts and researchers. The learning model that can be used is the problem of base learning.

Problem base learning helps students to apply the understanding of a concept, by first being given problems at the beginning of learning to be discussed and resolved together. The problem given is adjusted to the range of thoughts and needs.

Students' activities in learning are expected to be optimal when equipped with hands on activity students. Kartono (2011: 23) states that the hands on activity is designed to involve child in explore information and ask questions, move and find, collect data and analyze and make conclusions on their own. Through hands on activity student learning activities will increase. Students obtain this knowledge directly through their own experience. Everystudents have chance for presenting own representation. So that the ability of students' mathematical representation can develop.

METHODS

The type of research used is mixed method with concurrent embedded design. This design can also be characterized as a mixed method strategy that applies one stage of quantitative and qualitative data collection at one time (Creswell, 2004). Quantitative research as a primary method while qualitative research as a secondary method. There are two stages of research where research begins preliminary studies in order to identify problems in the field by conducting studies on data, interviews with teachers, and studies in the literature. In stage two, the researcher conducts quantitative and qualitative research simultaneously. Quantitative research to determine the effectivenessof hand on activity assisted PBL models against mathematical representation ability while qualitative research to determine the ability of students' mathematical representation based on student learning activities.The population in this study was 10th grades students of SMA N 1 Wonotunggal. There are five classes of 10th grades students. One of them was selected as an experimental class which was given a problem based learning learning model and one class another was selected as a control class which was given learning ekspositori. In qualitative research, the research subject used was only the class that received the intervention model of learning problem based learning, namely the experimental class. Qualitative data analysis is carried out to describe mathematical representation ability students during mathematics learning with learning models problem based learning assisted hands on activity on 6 selected students in the experimental class selected based on the results of student learning activities (high, medium, low), with each criteria is represented by two students.

The data sources in this study were students where they were obtained from the results of student representation ability tests , the results of the scale of learning activities , interview results sheets, mathematical representationabilities. The research instrument consisted of test and non-test research instruments. The test instrument was a test of mathematical representation ability. Non-test research instruments included the scale of learning activities , theinterview guidelines for students' mathematical representation abilities.

Each - each instrument feasibility analysis which conducted the test instrument construct validity, content validity and piloting. The interview guideline instrument is only construct validation and content validation. Data analysis

in quantitative research there are two analyzes, namely initial data analysis and final data analysis. Preliminary data analysis included normality tests, homogeneity tests and two average similarity tests. Final data analysis includes normality test, homogeneity test, precision test n. Qualitative data analysis follows the concept given by Milles & Huberman (2007), namely data reduction (data reduction), data display (data presentation), and conclusions : drawing /verification.

RESULTS AND DISCUSSION

From 32 students in the experimental class,each category of learning activity is selected 2 students to be analyzed in her mathematical representation skills. The selection of low category students was obtained from 2 students with the lowest learning activity score , the selection of students in the medium learning activity category obtained from 2 students with a learning activity score in the middle, and the selection of high learning activitystudents obtained from 2 students with a learning activity score highest.

Based on initial data analysis showed that the two groups of samples come from populations with normal distribution, having variances homogeneous, and no different of the average - average between the two groups. This means that the sample comes from the same conditions or conditions.

Table 1. Mathematical Representation Ability Test Results

	Average RM kindergarten grades
Experiment Class	82.44
Control Class	78.25

Statistically, it is analysed by using classical completeness test. From the calculation, it is obtained that $z_{calculation} = 2{,}041$, while by using significance level of 5% it is obtained z table $= 1{,}64$. It can be known that $z_{calculation} > z_{table}$. Therefore, it can be concluded that the proportion of students in class experiment reaches more than 75%. Based on the result of difference mean test, it is obtained that $t_{calculation} = 2{,}871$ while $t_{table} = 1{,}67$ thus $t_{calculation} > t_{table}$, thus it can be seen that the average of mathematical representation ability of class experiment is better than that of class control. Learning from the Hands on Activity Assisted PBL Model has delivered the ability of students' mathematical representation to achieve learning completeness. This is because the learning model of problem based learning provides learning experiences for students to learn through problems given by the teacher where through problem solving activities students build new knowledge by linking the knowledge that he had before. This is in line with Sastrawati et al. (2011) who said that problem -assisted learning is a learning model that is implemented by giving meaningful problems to students where the problem will be used as an investigation material so students can develop their own knowledge, develop higher skills, improve students and increase student confidence. The ability of students' mathematical representation in learning the problem based learning model is more than the ability of students' mathematical representation in ekspositori learning. Students in learning problem based learning models have the opportunity to practice the ability of mathematical representation where students are required to represent problems so that they become more active in the learning process. Many active students ask the teacher to get information about the process of representing the problem. Many students clash with their friends about the representation process. Students who get learning problems based learning models can represent problems better than students with ekspositori learning.

The results of the research obtained indicate that the ability of mathematical representation in the class using PBL learning models with emphasis hands on activity and classes that use different expository learning

methods. Then the results of the follow-up test show that the class uses the PBL learning model with emphasis hands on activity is better than classes that use expository learning methods. There are differences in the ability of students' mathematical representation in both classes because of differences in the treatment or implementation of learning in both classes. Learning activities in classes taught using PBL learning models more interactive because in learning students are involved in the concept formation process. In this class students also carry out media activities themselves and demonstrate them. This is an added value in improving students' mathematical representation skills. According to the research of Pape & Tchosanov (2001: 126) which concludes four implications for the practice of representation in class. First, students must be given the opportunity to practice representation both in producing external representations and the internalization of mathematical ideas through social activities covering a variety of external representations. Second, inherent importance is social activity. Students come to understand both the process of representation and the results through social activities. Third, in order for students to be more competent in mathematics, instructions from the teacher must use various techniques. Finally, representation must be considered a tool for thinking, explaining and deciding.

The results of this study indicate that the subject in solving the problem to find out the ability of mathematical representation produces answers with diverse representations. The diverse representation is a manifestation of the strategy of solving the subject in completing the test questions of the mathematical representation ability given. Based on the table about the results of the percentage of the ability of the mathematical representation of the subjects, it shows that the ability of mathematical representation of subjects is in different categories.

High activity subjects it is seen that it is very capable of using representations to organize, record and communicate mathematical ideas. subjects were able to present problems in the form of visual representations in the form of cubes, beams and pyramid as well as fields. The subjects were able to choose, apply and make equations using the Pythagorean theorem. At the time of interview the subject is able to explain the answers that are less clear on the answer sheet correctly. The subject is able to write steps to solve mathematical problems according to the command questions. At the end of each answer the subject always writes the conclusions of the complete calculation with the unit correctly.

Medium activity subjects it is seen that subjects are able to use representations to organize, record and communicate mathematical ideas. the subject was able to present the problem in the form of a visual representation of cubes, blocks and pyramid as well as fields. Subjects have been able to choose, apply and make equations using the Pythagoras theorem. However, Subjects faced difficulty when finding the angle between plane on the pyramid. At the time of interview the subject is able to explain the answers that are less clear on the answer sheet correctly. Subjects have not been able to write steps to solve mathematical problems according to the command questions.At the end of each answer the subject has not written the conclusions of the complete calculation with the unit correctly.

Low activity subjects it appears that the subject hasn't able to use representations to organize, record and communicate mathematical ideas. Subject has not been able to restate the problem in the form of visual representation in the form of cubes, beams and pyramid as well as fields. Subjects have not been able to choose, apply and make equations using the Pythagoras theorem. Subjects faced difficulties when finding the angle between plane on the pyramid. At the time of interview the subject has not been able to explain the answers

that are less clear on the answer sheet correctly. Subjects have not been able to write steps to solve mathematical problems according to the command questions. At the end of each answer the subject has not written the conclusions of the complete calculation with the unit correctly.

CONCLUSION

Based on analysis and discussion obtained conclusions: (1) Problem based learning assisted hands on activity effective on students' mathematical representation abilities; (2) The pattern of mathematical representation ability of low ability students is that students are able to present the problem in the form of visual representations in the form of images, students are quite capable of making mathematical equations to solve problems, students are sufficiently able to compose completion steps with written words or texts; (3) Pattern of mathematical representation ability of students of moderate ability is that students are very capable of presenting problems in the form of visual representations in the form of images, students are able to make mathematical equations to solve problems; students are able to arrange completion steps with written words or texts; (4) Pattern of mathematical representation ability of high ability students is that students are very able to present problems in the form of visual representations in the form of images, students are very able to make mathematical equations to solve problems, students are very capable of compiling completion stepswith words or written text.

REFERENCES

BSNP. 2006. Panduan Penyusunan Kurukulum Tingkat Satuan Pendidikan Jenjang Pendidikan Dasar dan Menengah. Jakarta: Pusat Kurikulum, Balitbang Depdiknas

Creswell, J. W. 2004. Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed. Yogyakarta: Pustaka Pelajar.

Flores, R. Koontz, E. Inan, F. A. & Alagic, M. 2015. "Multiple Representation Instruction First Versus Traditional Algorithmic Instruction First: Impact in Middle School Mathematics education". Educational Studies in Mathematics. Volume 89, Issues 2, hal 267-281

Henningsen, M & Stein, M. K. 1997. Mathematical task and student cognition: classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. Journal for Research in Mathematics Education. 28 (5), hlm. 524-549.

Kartono. 2010. "Hands on Activity pada Pembelajaran Geometri Sekolah sebagai Asesmen Kinerja Siswa". Kreano Jurnal Matematika Kreatif-Inovatif. 1(1): 21- 32.

Milles, M. B., & Huberman, A. M. 2007. Analisis Data Kualitatif. Terjemahan Tjetjep Rohendi Rohidi. Jakarta: UIPress.

NCTM. 2000. Principles and Standards for School Mathematics. Reston, VA: NCTM

Neria, D. & Amit, M. 2004. Students Preference of Non-Algebraic Representations in Mathematical Communication. Proceedings of the 28th Conference of the International Group for the Psychology of Mathematical Education, 2004. Vol. 3 pp 409 – 416.

Pape, S.J. & Tchoshanov, M.A. 2001. "The Role of Representation(s) in Developing Mathematical Understanding". Theory into Practice. Vol. 40. No.2, pp. 118-127. Taylor & Francis Group

Permendiknas RI No. 41, 2007: 6. Tentang Standar Proses.

Sabirin, M. 2014. "Representasi dalam Pembelajaran Matematika". JPM IAIN Antasari. Vol. 01 No. 2 Januari-Juli, hal. 33-34.

Sastrawati, E., Rusdi, M., & Syamsurizal. 2011. "Problem Based Learning, Strategi Metakognisi, dan Keterampilan Berpikir Tingkat Tinggi Siswa". Tekno-Pedagogi, 1:1-19.