An Analysis of Sociomathematical Norms of Elementary School Students Through Collaborative Problem Solving Learning

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Article Info

Abstract

In Collaborative Problem Solving (CPS) learning, there is a problem-solving discussion which will bring to student interaction in solving the problems, these interactions are governed by a norm, the norm governing mathematics learning is the norm called as sociomathematics, in term of non ambiguity norm, third person comprehension, justification mathematical norm, differentiation mathematical norm, validation norm, relevance norm. This research has purpose to describe the application of sociomathematics norms in the learning of CPS. This research was a qualitative descriptive study by using subjects of elementary school students of SDN Jatingaleh 01. The total numbers of samples taken were 32 students who were divided into 13 male students and 19 female students. The data collection technique was by using observation, interview and documentation, whereas, the data analysis techniques was done by using triangulation technique. The results showed that the application of sociomathematics norms in SDN Jatingaleh 01 Semarang was quite well with the total percentage of 13% of students or 4 students considered in a good category, there are 59% or 19 students was in moderate category, and there was 28% or 9 students who considered in the less category in applying the sociomathematics norm. Meanwhile, the indicator of sociomathematics norm which is most widely adopted by students is Validation Norm where the majority of students agree that the solution chosen by the group to be applied in resolving a problem. Whereas, the norm which is less applied by the students in the mathematical problem solving process is Relevance Norm, this indicated that the fifth grade students have not been able to express or convey the suitability of the solutions offered by the existing problems.

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INTRODUCTION

Students learn mathematics at school to obtain several competencies, such as, the ability of logical thinking, analytical, systematic, critical, and creative as well as the ability to cooperate (Daryanto & Raharjo: 2012). In mathematics, students are also required to solve mathematical problems that involve problem-solving ability (Anisa, 2014, Abdullah, 2015). As listed in the Attachment of Regulation of the Minister of National Education (Permendiknas) Number 20 of 2006 on the Content Standards, noted that the study of mathematics aimed in order that students have the capability of which is capable of solving problems that include the ability to understand the problem, devised a mathematical model, solve the model and interpret the results obtained (Lester, 2016). Therefore, it can be said that the problem-solving ability to be one important ability possessed by the students (Santosa, 2013, Mariya, 2013). The importance of solving these problems make the development of problem solving skills are also important since it becomes the focus of education in Indonesia (Vendiagrys, 2015).

According to Vygotsky, one of the way to develop a mathematics problem-solving ability is to increase the level of problems given to students (Warsono & Haryanto: 2014, Prabawa, 2017). Students can solve a problem with low levels individually but when students are required to resolve issues with a high level, then they will find it difficult and require the assistance of another person, such as peers or teachers to be consulted (Haqiqi, 2017). Therefore, the students problem-solving process will involve an exchange of ideas through discussion which has purpose to increase knowledge or deepen the concept of which is owned by each student (Lestanti, 2016).

Discussions in solving mathematical problems will cause an interaction between students (Sefiany, 2016). In mathematics, the interactions that arise based on social norms and sociomathematics norms (Wijaya, 2012). Social norms are norms that are not directly related to mathematics, whereas, the sociomathematics norm is the norms that specifically applied in mathematics (Yackel & Paul, 1996). Sociomathematics norm is related to the knowledge of mathematics, which is on how students can put themselves in social interaction, such as in a group, to jointly build mathematical knowledge (Soviawati, 2012).

According to Young (2002), the sociomathematics norm affects the state of students, where students express opinions, decide and determine differences in mathematical discussion. As an example of sociomathematics norm is how the students interact and negotiate to understand mathematical concepts (Gerson, 2010). Therefore, sociomathematics norm in this research is related to how students interact in problem-solving activities through mathematical communication to find solutions that are considered effective.

Tatsis (2008) formulated the aspect of Sociomathematics Norm into several indicators as can be seen in the following Table 1.

Table 1. Sociomathematical Norms

Sociomathematical norm	Indicator
Non-ambiguity Norm (NAN)	Students are able to express opinions clearly. Students use mathematical symbols to express their opinions.
Third Person Norm Comprehension (TPNC)	Students repeating the opinion of members of the group as a form of response to their understanding.
Justification Mathematical Norm (JMN)	Students give logical reasons for the opinion delivered.
Differentiation Mathematical Norm (DMN)	Students are able to explain the concepts of mathematics. Students express differences/ similarities of opinions expressed by members of the group.
Validation Norm (VN)	Students' mathematical expression.
Relevance Norm (RN)	Students express/ respond to the suitability of the solutions offered by the existing problems properly.

Wijaya (2009) mentions the importance of sociomathematics norms that can improve interpersonal intelligence as one of the intelligence in the theory of multiple intelligences. This intelligence is related to one's ability to work

(corporate) in one team. The essence of such cooperation is the ability to communicate effectively and empathize easily (Wijaya, 2016). The existence of a social norm is absolutely necessary to establish an effective communication and empathy in a social interaction (Kadir, 2008). Known that communication, particularly communication which is very important in learning mathematics (Asikin, 2013; Jewel, 2015). Sociomathematics norm development is also important to help to understand the progress of students in developing a mathematical disposition, and enhance intellectual autonomy in mathematics (Noriza, 2015).

Based on the preliminary observations in SDN Jatingaleh 01 Semarang, discussions were less applied in mathematical problem solving. This happened since the preparation and implementation that takes a long time. Lack of application of mathematical problem solving discussions showed a lack of opportunities for students to learn to interact in the problem solving process. It also showed a lack of familiarity of students with the sociomathematics norm. The condition is very unfortunate given the importance of the sociomathematics norm in the development of students.

In fact, conditions at field, prompting the author to conduct a research on how the sociomathematics norms applied by elementary school students, particularly in SDN Jatingaleh 01. The learning method involves a problem solving discussion is the learning method of Collaboratiive Problem Solving. This method combines collaborative or cooperative methods with methods of problem solving or solution (Uswati, 2014). This method lead to interaction which can bring to sociomathematics norm. Three important components in the learning of Collaborative Problem Solving according to PISA (2015), namely establishing and maintaining a common understanding; take appropriate measures to solve the problem; as well as building and maintaining community-based organizations.

Problem that used in this research was an open-ended approach to the problem. This problem can support optimal problem-solving process that involves communication and mathematics (Fauzi, 2018).

The purpose of this research is to describe the implementation of sociomathematics norms applied by the elementary school students in the learning of Collaborative Problem Solving of the fractional arithmetic operation topic.

METHODS

This research was a descriptive study with a qualitative approach. Descriptive research method is a method of research which is trying to describe the object or subject under study according to the fact, with the aim of systematically describe the facts and characteristics of the object under study accurately (Moleong, 2010). This research was conducted at SDN 01 Jatingaleh Semarang, by using purposive sampling to obtain the data sources. Subjects applied in this research were students of elementary school of grade V-A directed by principal. The number of students taken was 32 students. The research subject was encoded with R1, R2, R3, ... R32. This research was conducted by classifying students into 8 groups. Each group consists of 4 students who were randomly selected without regard to gender and any ability. The data collection techniques used was observation, interview and documentation.

The data obtained in this research was about the implementation of sociomathematics norms that take place in the learning of Collaborative Problem Solving. Indicators of sociomathematics norms were encoded with NAN (Non Ambiguity Norm); TPNC (Third Person Norm Comprehension); JMN (Justification Mathematical Norm); DMN (Differentiation Mathematical Norm); VN (Validation Norm) and RN (Relevance Norm). Students discuss problem solving through worksheets consisting of 6 questions based on CPS competencies according to PISA. The data obtained was then analyzed by using the technique proposed by Miles & Huberman in (Sugiono: 2012) through the steps in data

processing of data reduction, data presentation, drawing conclusions or verification.

RESULTS AND DISCUSSION

Results of analysis of sociomathematics norm in each group as follows:

1. Group 1

Data obtained from the observation of sociomathematics norms of students of group 1 had an average score of 10.5 in the application of sosiomathematics norm, therefore, it is considered in the moderate category. There are three students who get moderate category R1, R3 and R4, whereas, students with R2 respondents code were in the less category. The data obtained from the observation indicated that in the problem solving discussions, R2 was considered passive in the process of discussion; it is shown with the advent of indicators of 3.1 and 4.2 of the expression and conveys logical reasoning in solving problems.

2. Group 2

Data obtained from the observation of sociomathematics norms of students of group 2 had an average score of the application of the sociomathematics norms reached to 12.25, therefore, this group was considered in a good category. This group is a group with the highest average application of sociomathematics norms compared to other groups. There are 3 student who considered in the moderate categories and one student who considered in a good category. Two students achieved an average score above 8.0, whereas, two students obtained an average score of 6,9. R6 as respondents with good criteria play an active role in problem solving discussions, indicators of sociomathematical norm that is often raised is 1.1, 3.1, 4.1 and 4.2. R6 capable to express opinion and give a logical reason in every opinion and supported the active role of members of the group so that the learning process is going well.

3. Group 3

Data obtained from the observation of sociomathematics norms of students of group 3

showed an average score of 7.0, therefore, the application of sociomathematics norm is considered in the less category. This group is the group with the lowest average score and the only group with less category. There are 3 students with less category and one student with moderate category. Based on the data observation showed that R9, R10 and R12 did not raise the indicator 4.1 and 4.2 on MDN, those respondents were passive in discussions, and only approve the opinion of R11. This is resulted in the lowest score of problem solving discussion.

4. Group 4

Data obtained from the observation of sociomathematics norms of students of group 4 had an average score of the application of sociomathematics norms reached to 10.5, which is considered in the moderate category. There are 3 students with moderate category and one student with less category. Respondent R14 was not able to express opinions and offer different solutions to the problems, respondents indicated the suitability of the opinion occasionally offered other respondents without express differences of each solution offered.

5. Group 5

Data obtained from the observation of sociomathematics norms of students of group 5 had an average score of the application of the sociomathematic norms reached to 10.0, therefore, the students were considered in the moderate category. Respondents in this group all categorized simply by the application of the most common indicator of 5.1 which agreed to the mathematical opinion of the group, meanwhile, the norm which is less appear is responding to the suitability of the proposed solutions. Only R19 who gave rise to this indicator, however, the answer was incorrect.

6. Group 6

Data obtained from the observation of sociomathematic norms of students of group 6 had an average score of the application of sociomathematics norms reach to 9.75, considered in the moderate category. There are 3

student who were in the moderate category and one student who considered in the less category. The respondent's code of R24 has the lowest score in the sociomathematics norm in this group, the respondent only repeated opinion of group members without providing a logical reason.

7. Group 7

Data obtained from the observation of sociomathematics norms of students in group 7 had an average score of the application of the sociomathematics norms reach to 9.25 which is considered in the moderate category. There is one student included in a good category, two students were in the moderate category, and one student was in the less category. Sociomathematics norm indicators which is frequently appear in this group is VN, where students agree to the mathematical opinion of group members. Respondent code of R28 dominated the process of problem solving discussions in order to be included in a good category.

8. Group 8

Data obtained from the observation of sociomathematics norms of students of group 8 had an average score of the application of sociomathematics norms reach to 11.25 which considered in the moderate category. This group is the second group with the highest average score after group 2. There is one student with good category, two students with moderate category and one student who was in the less category. Respondent code of R32 has the highest value of the sociomathematics norm, obtained a score of 15 with an average score of 1.88 which is considered in a good categories.

The following figure presents the result of problem solving with group categories that apply good sociomatematics norm.

The Figure 1 is the result of group 2 that applaying good sociomatemic norms. In the first question, this group wrote the complete answer by stating the name of the picture and the fraction value. On the second question, the group was able to answer the question with right answer and the good reasons. Respondents were able to express fractions according to the picture, then they were able to analyze using the concept of fractions worth to give the right reasons.
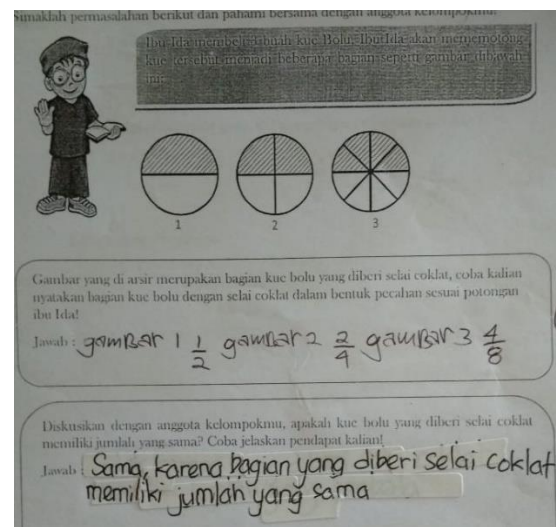

Figure 1. Worksheet of Group 2

The following figure presents the results of problem solving with group categories that apply less sociomatematics norm.
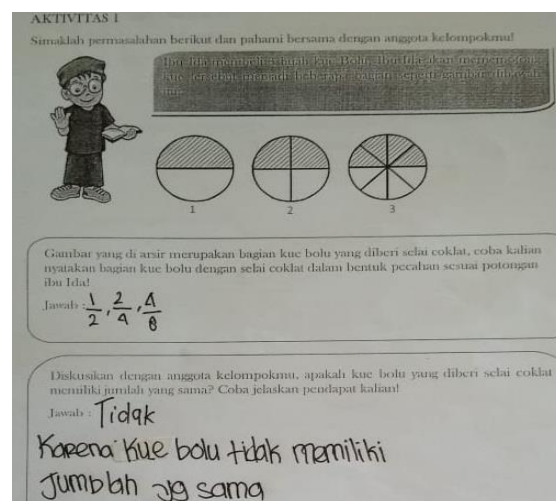

Figure 2. Worksheet of Group 3

The Figure 2 is the result of group 3 that applaying less sociomatemic norms. In the first question, this group only writes the fraction value without the image name. In the second question, this group is not able to answer questions and provide reasons correctly.

The following is a table of categories of each group based on the average sociomatematics norms score.

Table 2. Group Categories

Group	Average	Category
1	10.50	Enough
2	12.25	Good
3	7.00	Less
4	10.50	Enough
5	10.00	Enough
6	9.75	Enough
7	9.25	Enough
8	11.25	Enough

Generaly, the result of observation of sociomathematics norms of the V grade students of SDN Jatingaleh 01 Semarang can be seen in the following graph.
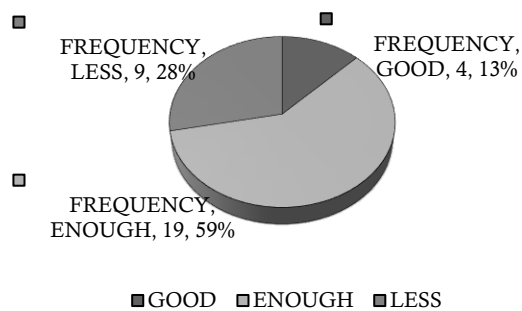

Figure 3. The Percentage of Sociomathematics Norm

The above figure shows the frequency of each category based on the results of observation of sociomathematics norms of the students of grade V. There are 13% of the students or 4 students who got a good category, there are 59% or 19 students were in the moderate category, and there is 28% or 9 students who were in the less category in applying the sociomathematics norm.

The results of data observation showed that students with respondents code R-32 of a group of 8 got the highest score in applying the sociomathematics norm. Students are given a score of 15 with an average of 1.88 and considered in a good category. Students are almost maximum in applying the sociomathematics norm. This is evidenced by the acquisition of a score of 2 on every indicator except on indicators 4.2. Indicator 4 relates to *Differentiation Mathematical Norm*, Students are already good enough in conveying the diverse alternative solutions but students still have not been able to convey the differences and similarities of the solutions so that they cannot

give response concerning the best solution that should be applied.

The data obtained from the observation of sociomathematics norm also showed students with the lowest scores, students with respondents' code of R-24 of group 6 and R-26 of group 7. Both groups obtained a score of 5 with an average of 0.63, therefore, they were considered in the less category.

Students of grade V-A of SDN Jatingaleh 01 apply the sociomathematics norm indicators as on the following table.
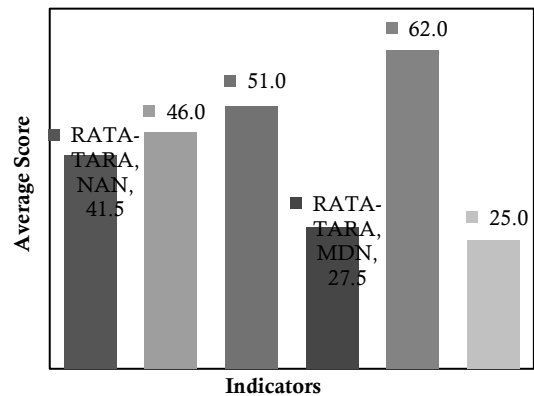

Figure 4. Indicators of Sociomathematics Norm

The above figure shows that the sociomathematics norm which was most widely adopted by students of grade V-A of SDN Jatingaleh 01 is Validation Norm. The majority of students have been doing validation on the solution chosen by the group to be applied to solve the problems.

The norm which is still rarely applied by the students in mathematical problem solving process is Relefance Norm. This indicated that students of grade V-A have not been able to express or deliver the suitability of the solutions offered by the existing problems. Students are still within the search for solutions that may be applicable, but has not been able to explain the reasons why such a solution is the best solution that can be applied to solve the problem.

CONCLUSION

The conclusion of this research is that students of grade V-A of SDN Jatingaleh 01 Semarang has good enough in applying the

sociomathematics norms in solving mathematical problems. There were 4 students of 32 (13%) who included in a good category, 19 students (59%) were in the moderate category and 9 students (28%) were in the less category. The sociomathematics norm which mostly appear during the problem solving process is the norm of Validation Norm, whereas, the norm that still rarely appears during the problem solving process is Relefance Norm.

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