UJMER 9 (2) (2020) 199 – 207

Unnes Journal of Mathematics Education Research

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

Mathematics Representation Ability Viewed from *Adversity Quotient* in SAVI Learning

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Article Info

Article History:
Received 28 June 2020
Approved 12 September 2020
Published 23 December 2020

Keywords:
Kemampuan Representasi Matematis, *Adversity* Quotient, Model Pembelajaran SAVI

Abstract

This research aims to describe mathematics representation ability of students seen from three categories of adversity quotient in Somatic, Auditory, Visualization, and Intellectual (SAVI) of eighth graders. This sequential explanatory typed mixed metod selected its subjects based on three categories of adversity quotient: quitter, camper, and climber. Technique of collecting data used mathematics representation ability test, adversity response profile questionnaire, and interview. The findings showed that the students taught by SAVI achieved actual minimum passing grade with descriptions of representation mathematics skill on visual representation, mathematical expression representation, and written text representation seen from quitter, camper, and climber during SAVI learning, resulted to various results for each category of AQ.

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

INTRODUCTION

Education is a universal activity in human life and can also create people into skilled human resources in their fields. In the 21st century the development era and technology is so rapid, stimulate the progress in education. It was found that the technological environment changes rapidly when mathematics education takes place (Goldin & Kaput, 1996). Mathematics is the queen of science because the topic of mathematics can be developed without the intervention of other sciences and mathematics is a servant of sciences because mathematics is needed by all sciences. Mathematics subjects need to be provided to all students to equip students with the ability to think logically, analytically, systematically, critically, creatively, and the ability to cooperate (National Education Standards Agency, 2006); Suyitno, 2006).

One of the abilities demanded in mathematics learning is the ability of mathematical representation (NCTM, 2001). A student must be able to express his ideas in a configuration that can present things in a certain way (Nadia, Waluyo, & Isnarto, 2017). The ideas of representation are broadly related to mathematics, the psychology of mathematics learning and problem solving, children's mathematical growth and development, the teaching of true classroom mathematics by students will help students make mathematical ideas more concrete. Mathematical ideas representation can be interpreted as a form or arrangement that can describe, represent, or symbolize something in a way or basis on how people understand and use their ideas. When students have the opportunity to master mathematical representations, express ideas and use representations to understand mathematical concepts or relationships students have used representations as a tool to expand their capacity to support mathematical understanding. (Supandi et al., 2016); (Permata, Sukestiyarno, & Hindarto, 2017).

Representation mathematics means that students are able to present mathematical problems in an easily understood language. Students need to observe and find specific patterns in the problem. The numbers applicable in mathematics writing are formal and impersonal, reflecting the view of the mathematics characteristics to support students because they learn to write their own investigations (Morgan, 2014); (Supandi et al., 2016).

Jitendra, Nelson, Pulles, Kiss, & Houseworth (2016) revealed that representation can support learning when instruction supports understanding before using it to explain mathematical concepts. Based on this opinion it can be said that it is need to give a picture to students about mathematical representation before starting to invite students to apply mathematical representation in solving everyday problems.

The formulation process carried out by students in articulating and reflecting on the same problem with different perspectives from images, symbols, tables, diagrams or other media in mathematics. The students' ability to represent mathematical ideas is different. There are students who tend to give up easily and vice versa, there are students who will continue to try to explore mathematical ideas to find solutions to their problems. The teacher needs to know the students' struggle when facing problems in order to make it easy to take the right steps to help students come up with mathematical ideas.

The students' struggle in dealing with problems is called the adversity quotient. Adversity Quotient (AQ) is one of the things that need to be considered to determine one's success, especially the success of students in learning mathematics (Ardiansyah, Junaedi, & Asikin, 2018). Adversity Quotient in the education perspective is one's ability to struggle to face and overcome problems, obstacles or difficulties they have and will turn them into opportunities for success (Stoltz, 2000); (Matore, Khairani, & Razak, 2015). So Stoltz (2000) argues that students who have a high adversity quotient will direct all the potential they have to provide the best results, and will always be motivated to be success. So, if a student has a high adversity quotient, then he will be more motivated to direct himself to the best results with optimal efforts to take advantage of opportunities and be active in acting.

Student success factors in solving problems are influenced by several things, one of which is the level of student difficulty (Dina, Amin, & Marsiyah, 2018). The fact that there are students today who give up easily in working on math problems is due to difficulties in the process of solving the problems they face (Hidayat, Wahyudin, & Prabawanto, 2018). The existence of AQ in the classroom helps students improve their abilities and learning achievements (Ismawati, Mulyono, & Hindarto, 2017). So the need to know the adversity quotient of students in order to help students to explore mathematical ideas in solving mathematical problems. Maria in Rosita & Rochmad (2016) also showed that AQ students play an important role in achieving effective learning, a learning is expected to optimize AQ so that the development of student learning achievement is more maximal.

Representation cannot be separated from mathematics because it is multiple concretizations of concepts that can facilitate a person and make mathematics more interesting (Novikasari & Fauzi, 2019). The ability of representation is less attention in the learning process even though the ability of representation can support other competencies in mathematics. Mathematical representation plays a role in improving understanding of mathematical concepts and solving students' mathematical problems (Supandi, Waluya, & Rochmad, 2018); (Junita, 2016); (Narulita, Mulyono, & Sunarmi, 2013); (Supandi et al., 2016). Suryowati (2015) revealed that students still did not understand how to represent real world problems into representation mathematical problems. Minarni, Napitupulu, & Husein (2016) found that student achievement in understanding mathematics and representation tests was in the low category.

Learning in the school environment must be designed to make learning independent and use a scientific approach (Giyarsih, 2016). The use of appropriate mathematical models as a form of representation will help understanding concepts to express students' mathematical ideas (Sternberg, 2012). The teacher's knowledge of the different adversity quotient students can help to determine the right learning model. Model selection must be able to provide opportunities for students to play an active role in the classroom, obtain more information by trying, asking and clarifying the information they have. As well as students doing physical activities by moving and doing to dig up more information, this is expected to be able to encourage students to have power.

SAVI is a learning model that involves movements, such as the physical movements of certain limbs, speaking, listening, seeing, observing, and using intellectual abilities to think, describe, connect and make conclusions (Lestari & Yudhanegara, 2015); (Wijayanti & Sungkono, 2017); (Rosalina & Pertiwi, 2018).

Based on the description above, researchers want to conduct research to examine more deeply how students' mathematical representation ability in terms of adversity quotient in somatic learning, auditory, visualization, intellectually (SAVI).

METHOD

This *mixed method* research with *sequential explanatory* type took the population from eighth graders of JHS 16 Semarang in academic year 2018/2019. The sample was taken by *cluster random sampling.* There were two classes as samples: VIII C as control group and VIII D as experimental group. The subjects in VIII D were selected by *purposive sampling.* Based on the objectivves of the research, the subjects were categorized into three categories of *adversity quotient*: *quitter, camper,* and *climber* based on *adversity response profile* (ARP) questionnaire which was modified for educational world and was validated by experts.

The data in this research were mathematics representation ability test (MRAT), *adversity quotient* questionnaire data, and interview. The analysis of MRA of the students refered to indicators of MRA as stated based on Lestari & Yudhanegara (2015). They are: (1) ability to draw geometrical figure to explain problem and facilitate solution (IMRA 1) on visual representation aspect, (2) ability to create equation or mathematic model from the given problems or information (IMRA 2) on mathematical expression representation aspect; (3)

ability to create interpretation from a representation (IMRA 3), and (4) writing solution steps of the given problem (IMRA 4) on written text representation aspect.

The quantitative techniques of analyzing data were normality, homogeneity, and completeness test. The qualitative techniques of analyzing data were data validity, reduction, presentation, and conclusion (Sugiyono, 2013; B. Mathew & Huberman, 1992). The data validity on data credibility used triangulation by crosschecking the same data source with different techniques, interview and test.

RESULTS AND DISCUSSION

Based on quantitative analysis with pre-requirement test showed that MRA of experimental and control group students were normally distributed. It could be seen from the calculation of lilifors test on experimental group with $L_{count} = 0.124 < L_{table} = 0.149$ and the control group with $L_{count} = 0.095 < L_{table} = 0.149$. It could be concluded that the MRA of both groups were normally distributed. The homogeneity calculation test of both groups gained F_{count} = 1.2077 and gained score of F_{table} = 1.79 with $\alpha = 5\%$, meaning that $F_{count} < F_{table}$. It meant that the MRA of both groups were homogeneous. The average of completeness test of the MRA for SAVI group students gained t_{count}= 3.719 > t_{table}= 1,68. It meant that the average of MRA had met the minimum criteria or passed the minimum criteria of actual passing grade.

The qualitative analysis of ARP questionnaire consisted of 34 students of VIII D of SMP N 16 Semarang. The results sowed that from 34 students, there were 2 students categorized *quitter,* 24 *camper,* and 8 *climbers.* After selecting the subjects, there were analysis of MRA of the students seen from three *AQ*: *quitter, camper,* and *climber* as shown below.

Table 1. Summary of MRA Analysis Seen from Adversity Quotient
Remarks:

Category AQ	Students	Aspect 1	Aspect 2	Aspect 3
Quitter	1	√	√	-
	1	√	-	-
Camper	13	√	√	√
	6	√	√	-
	4	√	-	√
	1	√	-	-
Climber	7	√	√	√
	1	√	√	-

Aspect 1 – Visual Representation Aspect;
Aspect 2 – Matematical Expression Representation Aspect;
Aspect 3 – Written Text Representation Aspect

MRA of *Quitter* Students

The *quitter* typed students tended to stay away from problems and minimally struggled to solve the problems. One of the answers is presented in Figure 1.

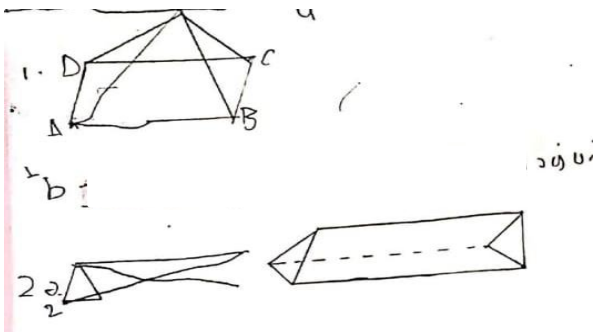

Figure 1. Example of *Quitter* Subject's Answer in Visual Representation Aspect

The categorization of AQ showed that there were two *quitter* typed students. They had various Mathematics representation ability. The *quitter* students were able to meet the visual aspect. They could draw the geometrical picture to explain and facilitate the solution. The figure had been in line with the question. The students also labeled their pictures as the given question. During the interview, the students gave explanation of the size of the

triangle prism by showing length of the base, height of the triangle, and heighth of the prism to facilitate the solution. However, the process of answering required longer time and repeated question. It was in line with Stoltz (2000) when *quitter* students were faced on difficult question. They tended to ask again what was being thought and feeling powerless to answer. Thus, they needed longer time to answer. Generally, the *quitter* students could draw the figure to explain and facilitate the solution completely.

The MRA aspect was met by one of *quitter* students. The test result showed that MRA of the *quitter* students met mathematical expression representation aspect. It was shown by their capability to crate mathematics model and other representations. The given equation and mathematical models were in line with the question although there were incomplete answers. During interview, the students had difficulty to understand the story question and tried to re-understand the question by drawing figures and imagining the geometrical figures. So, they could formulate the formula from the given question but they were not carefully solve it. The MRA test showed that *quitter* students did not meet mathematical expression representation aspect. They showed that all equation or mathematical models were not in line with the question. They did not want to redo to understand the question because they thought powerless to solve it.

Based on the findings toward interpretation of writing ability of certain representation, both *quitter* students were not able to write the interpretation of the given question. They could write the description or information of a pyramid and its space diagonal by using words but they were not accurate. There were also students who did not write the information on the answer sheet. After interviewing them, the results showed that they only remembered the shape of a pyramid but did not undertand the concept of space diagonal within a geometry.

The results of writing solutive step ability of mathematics problems by words, both of students could write the solutions correctly but incomplete. They wrote the solution by appropriate words to the solutions of the given questions but missing several solutive steps. After interview, the students could not re-explain the steps completely and correctly since they thought the answers had represented the given questions. It was in line wit Stoltz as quoted in Suhartono (2016) that quitter students were inviduals whom easily gave up while facing challenges. They are individuals who stop solving problems although the problems have not been completely solved. They feel like not being able to solve it nor continue their struggles.

Based on the analysis, it was gained two *quitter* typed students. One of them met two indicators of MRA on visual representation and mathematical expression representation aspects. The other student could only meet one indicator of MRA, the visual representation aspect.

SAVI learning influenced students' reasoning process during solving problem. *Quitter* students tended to stay away from problems and had minimal effort to solve the given problems. However, by SAVI learning, there were *quitter* students whom were able to implement *somatic, auditory, visualization,* and *intellectual* aspects in solving problems by looking up the question and drawing visual figure to facilitate the solution process on mathematical expression representation aspect.

MRA of Camper Students

This type of students tended to have trial effort in solving problems. The *camper* students tended to have satisfied with any effort they did although they were not in line with the achieved target. The AQ categorization results showed there were 24 *camper* students. Each student had various mathematical representation ability.

Those 24 *camper* students met visual representation aspect. Based on the results, the students were generally able to draw geometry picture to explain the problem and facilitate in solving the question with IMRA 1. Several of those students drew complete figures by naming the pyramid in accordance to the instruction. They also provided remarks about length of the base, height of the prism, and height of the triangle on the prism to

ease the solution. Some of the students only drew complete figures without any remark or label.

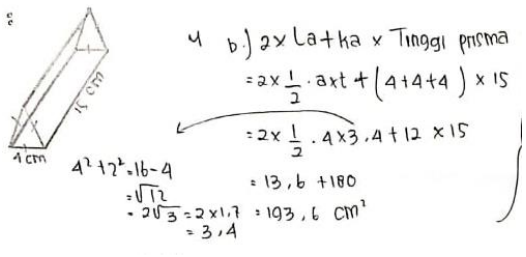

Figure 2. Example of Camper Student Answer in Matematical Expression Representation Aspect

There were 19 *camper* sudents met mathematical expression representation aspect. Based on the findings toward ability of creating equation or mathematical model from other presented representation, the students could make it. The students wrote the used formula to solve but missing several stages to be written. Some of the students felt they had struggled solving the question without paying attention on the completeness of the solution stages. After being asked to be more systematic, they could redo the process from writing its mathematics formulation idea until the solution stage. It was in line with Rosita & Rochmad (2016) that *camper* students were in their safe zone and felt satisfied when they had achieved something although it was not maximum. There were 5 *camper* students who did not meet mathematical expression representation aspect. Some of them had tried to create model by writing the formula but it was not accurate and incorrectly answered..

There were 17 *camper* students meeting written text representation aspect. In this aspect, there are two indicators to measure. Based on the results of the current aspect from a representation, the students could write the description or interpretation of the correlation between information of the pyramid and space diagonal with complete and correct words. They were able to write the solution of mathematics problems by words. They wrote all stages of the question solution which had correlation to volume of the pyramids by using words which were in line with the solution of the given question. Some of them did not write the answer sheet because they were not carefully reading the question and writing them on paper. They could re-explain when they were interviewed. There were 7 camper students whom were incapable of writing interpretation of a representation. They showed ideas by writing the description or interpretation of pyramid and diagonal space information by words but it was not accurate. Some of them understood the poin of the given question but they were confused to explain diagonal space of a pyramid and bricks. They could not write the solution stage of the given question. Several of them were difficult to write the stages so their answers were in complete. It was in line with Stoltz (2000) telling that *camper* were poor to respond challenges.

Based on the analysis, there were 24 students categorized as *camper.* 13 of them could meet MRA aspects especially on visual representation, mathematical expression representation, and written text representation aspects. There were 10 students were able only to meet two aspect of MRA – 6 of them meeting visual representation and mathematical expression representation aspects. Four of them met visual representation and written text representation aspect. A student could meet one MRA aspect, the visual representation aspect.

During learning process, there were different responses of *climber* students during SAVI learning model. Such students were able to meet three aspects of MRA. They were more active to ask and share opinion during learning than *climber* typed students who met only two aspects of MRA. The *climber* students who could only meet one indicator in learning since they did not understand. Unfortunately, they did not want to write the discussion result and the answer completely. Based on the analysis, it was gained that SAVI learning could influence reasoning process of the students in solving mathematical representation problems when *camper* typed students followed the learning well and active.

MRA of Climber Students

The *climber* students tended to be full of effort in solving problems. They struggled until their objectives were achieved.

The AQ categorization showed that there were 8 *climber* students. Each of them had various MRA. The students were able to meet visual representation aspect. Based on the results, the students could draw appropriate geometrical figure based on the question. They could explain the problem an facilitated the solution completely, started from naming the pyramid as instructed, remarking the size of base length, prism height, and the triangle height on triangle prism to ease the solution.

All *climber* students could meet mathematical expression representation aspect. Based on the findings on equation or mathematic model creation ability from other presented representation, the students could make the equation from other given representation. They had ideas to solve problems by creating equation or mathematical model from problems and determining formula and solution step correctly and completely. There were still scratches on the paper during solving process. The students solved mathematics representation problems by understanding the questions. They were then determining the next step to do and determined the formula. It was in line with Stoltz (2000) that *climber* students were thinkers. They would think various possibilities.

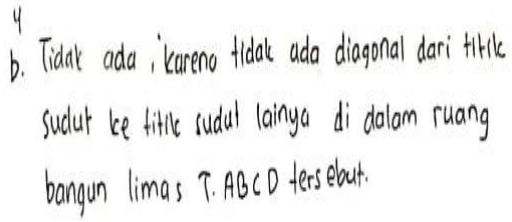
4
b. Tidak ada, karena tidak ada diagonal dari titik sudut ke titik sudut lainya di dalam ruang bangun limas T. ABCD tersebut.

Figure 3. Example of *Climber* Typed Students' Answers in Written Text Representation Aspect

There were 7 *climber* students whom were able to meet written text representation. The students could write the interpretation from a representation. They could draw or interpretation information correlation of pyramid and diagonal space with their own words and they could write the solution of mathematics problems by their words. They wrote all solution stages whose correlation to volume of pyramids with their words based on the solution of the given question. Several of them could write the poin on the paper. Some of them only thought solution stages and directly wrote them.

Based on the analysis of the 8 students, seven of them were able to meet MRA on visual representation, matehamtical expression representation, and written text representation aspects. Only a student was only able to meet two aspects: visual representation and mathematical expression representation aspects.

During learning process, *climber* students were aware when the teacher was explaining. They asked question when they were given chance to ask. They were active in group work. They would directly asks when they had difficulties and dared to try varrous solutive ways. They tried to re-understand the question to trigger mathematics representation ideas. They could do all given question until finish. It was in line with Rosita & Rochmad (2016) that *climber* preferred challenges and was not easy to give up facing challenges.

CONCLUSION

Based on the findings and discussion, it was concluded that SAVI group student had achieved actual minimum passing grade. SAVI learning could facilitate students in developing students' abilities to trigger mathematical representation ideas in solving problems. The result of MRA description seen from *adversity quotient* showed various results. The *quitter* students met two MRA aspects: visual and mathematics expression representation aspects. There was also student who could meet visual representation aspect only. *Camper* typed students could meet three aspects of MRA: visual, mathematical expression, and written text representation aspects. However, there was only one student meeting two aspect: visual and mathematical expression representation aspect.

Only one *camper* student could meet visual representation aspect only. The *climber* students met three aspects: visual, mathematical expression, and written text representation aspects. There were also students who could achieve two aspects: mathematical expression and visual representation aspects.

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