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Analysis Of Mathematic Representation Ability In Online Learning

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ABSTRACT

The outbreak of the corona virus has had an impact on various sectors, especially the education sector. The application of online learning has been implemented in almost all schools in Indonesia. However, judging from the results of various studies and some experiences, the online learning process in Indonesia has previously been carried out well. Mathematical representation skills are needed so that students understand mathematical concepts well. This study aims to analyze the ability of mathematical representation in online learning. The method used is descriptive qualitative type. The instrument used is a mathematical representation ability test and interview guidelines. The data analysis technique used is the stages of data reduction, data display and making overall conclusions. Data analysis of test results was used to determine the level of students' mathematical representation abilities, while interviews were to strengthen test results and determine student learning constraints. Based on the results of the study, it was found that students' visual representations were more dominant than other types of representations. The students' mathematical visual representation ability is in the sufficient (moderate) category, while the students' symbolic representation ability is very poor and the students' verbal representation ability is in the poor category.
Keywords : Mathematical Representation Ability, Online Learning, Descriptive Qualitative

ABSTRAK

Merebaknya virus corona telah berdampak pada berbagai sektor, terutama sektor pendidikan. Penerapan pembelajaran daring telah diterapkan di hampir seluruh sekolah di Indonesia. Namun, dilihat dari hasil berbagai penelitian dan beberapa pengalaman, proses pembelajaran daring di Indonesia sebelumnya telah terlaksana dengan baik. Kemampuan representasi matematis sangat dibutuhkan agar siswa memahami konsep matematika dengan baik. Penelitian ini bertujuan untuk menganalisis kemampuan representasi matematis dalam pembelajaran daring. Metode yang digunakan adalah tipe deskriptif kualitatif. Instrumen yang digunakan adalah tes kemampuan representasi matematis dan pedoman wawancara. Teknik analisis data yang digunakan adalah tahapan reduksi data, tampilan data dan pengambilan kesimpulan secara keseluruhan. Analisis data hasil tes digunakan untuk mengetahui tingkat kemampuan representasi matematis siswa, sedangkan wawancara untuk memperkuat hasil tes dan menentukan kendala belajar siswa. Berdasarkan hasil penelitian ditemukan bahwa representasi visual siswa lebih dominan dibandingkan jenis representasi lainnya. Kemampuan representasi visual matematis siswa berada dalam kategori cukup (sedang), sedangkan kemampuan representasi simbolik siswa sangat buruk dan kemampuan representasi verbal siswa berada dalam kategori miskin.
Kata kunci: Kemampuan Representasi Matematika, Pembelajaran Online, Kualitatif Deskriptif.

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PRELIMINARY

The Covid-19 outbreak in several countries has caused several countries to close their areas to minimize the spread of covid. Indonesia's efforts to minimize the spread of COVID-19 are to apply the concept of *physical distancing* . This policy applies to all fields, including education. This is the basis for the Minister of Education and Culture to issue circular letter No. 4 of 2020 which states that all teaching and learning activities from elementary schools to universities are carried out online. Online learning can make teaching and learning activities unhindered by time and place (Shukla et al., 2020) . Online learning is a challenge for the implementation of education, especially teachers and students. In face-to-face learning, teachers can explain mathematical calculations, answer student questions that are still not understood and interact directly with each other. However, in online learning there is a distance between teachers and students, even though students are required to have mathematical abilities.

According to NCTM (NCTM, 2000) there are five standard mathematics learning processes that must be mastered by students, namely: (1). Problem solving skill; (2). Mathematical reasoning ability;(3). Communication skills; (4). Connection ability and (5). Mathematical representation ability. Mathematical representation ability is an important aspect in learning mathematics. Because mathematical representation ability is a basic ability that must be possessed by students to express their ideas in the form of symbols, words or graphics (Rezeki, 2017; Lette & Manoy, 2019; Khairunnisa et al., 2020) . In addition, representation abilities are needed so that students understand mathematical concepts well (Hadi, 2018) . Furthermore, mathematical representation skills are also important because they have a close relationship with students' communication and problem solving skills (Firdaus & Oktaviana, 2020; Sabirin, 2014; Lisarani & Qohar, 2021) according to their understanding (Oktaria et al., 2016) .

The ability of mathematical representation is needed by students to find and create a tool or way of thinking in communicating mathematical ideas from abstract to concrete nature, so that they are easier to understand (Rianti et al., 2018) . Thus, in order to master

mathematical concepts, communicate mathematical ideas and solve mathematical problems, mathematical representation skills are required.

A problem from a complex question will be simpler and easier to understand with the ability to represent students in accordance with their understanding. For students, representation serves to assist them in finding solutions to a mathematical problem (Sulistyowaty et al., 2019) . There are several factors that affect the ability of mathematical representation, namely the use of learning media and appropriate learning methods/approaches (Adhar, 2012) . Furthermore, the ability of representation is also influenced by the teacher. Teachers who teach in a way that is in accordance with the learning material can improve students' mathematical representation abilities (Damayanti & Afriansyah, 2018) . In addition to the teacher factor, the previous student's learning experience also influences.

Several studies related to mathematical representation stated that most students still have low mathematical representation abilities. Because they have difficulty understanding the problem and writing equations correctly (Utami et al., 2019) . But from previous research, no one has discussed mathematical representation skills when learning online. Analyzing the ability of mathematical representation when online learning needs to be done, because it is to determine the level of mathematical representation ability and the obstacles experienced by students during online learning. So that it can be used as an evaluation material in the next learning process.

The indicator of mathematical representation ability used in this study refers to the representation indicator according to the NCTM with the form of representation according to Villegas:

1. mathematical ideas in the form of pictures/graphics.
2. Symbol representation: Create mathematical models by applying symbols and mathematical expressions to solve problems
3. Verbal representation: Using written words/text in solving problems.

Based on previous research, students' mathematical representation ability in solving problems is still low because students have difficulty understanding problems and writing equations correctly (Nizaruddin et al., 2017 ; Pratiwi, 2016) . Research of representation ability with the use of Cabri 3D software is better. Cabri 3D has several *tools* to design learning to be more interesting. In addition, students' difficulties in imagining

mathematical concepts can be led to the same understanding, so that students do not fail to understand material concepts (Hikmah et al., 2019) .

This study aims to describe the ability of mathematical representation through online learning. Analyzing the extent of students' mathematical representation abilities with the application of online learning.

METHODS

The research method used is a qualitative research with a descriptive approach, because this study aims to analyze the mathematical representation of students in solving two-variable linear equation system (SPLDV) problems. The subjects of this study were 9 students of class X MIA, totaling 24 people.

The research instrument used includes a mathematical representation ability test in the form of a description and interview guide. Researchers are the main data collection instrument in qualitative research (Sugiyono, 2018) in addition, researchers are assisted with data collection instruments in the form of tests and interviews. The instrument was validated by 2 lecturers of IAIN Kerinci and 1 mathematics teacher, so the instrument was suitable to be used to collect data in the field.

This research uses triangulation technique to get the suitability of test and interview data. So that will be reached at the conclusion. The analysis technique was carried out by collecting data, namely the results of tests and interviews. Furthermore, reducing selecting and summarizing the things that are included in the research focus based on the results of tests and interviews. In this study, the display (presentation) of the data was done by combining the results of tests and student interviews. The next step is drawing conclusions about the ability of mathematical representation through online learning.

Scoring guideline data to measure students' mathematical representation ability (visual representation, symbolic representation and verbal representation) using the guidelines on the Table 1.

Table 1 . Scoring Guidelines for Students' Mathematical Representation Ability Test Instruments

Indicator of Mathematical Representation Ability	Score	Information
Visual Representation: Recording and communicating mathematical ideas in graphical form of a two-variable system of linear equations	0	Does not give answers or shows a lack of understanding of the concept
	1	Creating graphs but not complete
	2	Complete graph but still error
	3	Make a complete and correct graph

Indicator of Mathematical Representation Ability	Score	Information
Symbolic Representation: Create a mathematical model by applying mathematical symbols and expressions in solving problems.	0	Does not give answers or shows a lack of understanding of the concept
	1	Make a mathematical model but there are still errors
	2	Make a mathematical model correctly but there is an error in the calculation process
	3	Make mathematical models correctly and perform calculations correctly
Verbal Representation: Using written words/text in solving problems.	0	Does not give answers or shows a lack of understanding of the concept
	1	Writing explanations but not logical
	2	Write logical, correct, but incomplete explanations
	3	Write logical, correct, and complete explanations

RESULTS AND DISCUSSION

Based on the research results obtained regarding the ability of mathematical representation on the material of the two-variable linear equation system (SPLDV) by giving essay test questions. Essay test is used to see students' mathematical representation ability on SPLDV material. The test consists of visual representation skills (questions no 1 and 2), symbolic representation (questions no 3 and 4) and verbal representation skills (questions no 5 and 6). Then, interviews were conducted with each student representative who has visual, symbolic and verbal representation skills.

The test results based on the scoring of mathematical representation abilities in online learning for class X MIA 2 SMA N 13 Kerinci obtained data such as table 2 below:

Table 2 . Mathematical Representation Ability Test Results for Class X MIA 2 SMA Negeri 13 Kerinci

Code Student	Representation Score			Amount	Converted value			Category		
	Visual	Symbolic	Verbal		Visual	Symbolic	Verbal	Visual	Symbolic	Verbal
AG	3	3	2	8	50	50	33.3	K	K	KS
A A	3	0	5	8	50	0	83.3	K	KS	BS
AAA	1	0	1	2	16.66	0	16.66	KS	KS	KS
AGP	6	0	2	8	100	50	33.3	BS	KS	KS
ADY	5	3	1	9	83.33	50	16.66	BS	K	KS
DN	2	2	1	5	33.33	33.33	16.66	KS	KS	KS
DS	6	3	3	12	100	50	50	BS	K	K
DJ	3	4	1	8	50	66.66	16.66	K	B	KS
E	6	5	5	16	100	83.33	83.33	BS	BS	BS
EBD	4	4	2	10	66.66	66.66	33.33	B	B	KS
FAA	2	0	1	3	33.33	0	16.66	KS	KS	KS
FP	2	4	4	10	33.33	66.66	66.66	KS	B	B

Code Student	Representation Score			Amount	Converted value			Category		
	Visual	Symbolic	Verbal		Visual	Symbolic	Verbal	Visual	Symbolic	Verbal
F	4	0	1	5	66.66	0	16.66	B	KS	KS
FA	6	5	5	16	100	83.33	83.33	BS	BS	BS
FF	3	1	0	4	50	16.66	0	K	KS	KS
HK	3	2	5	10	50	33.33	83.33	K	KS	BS
HZ	6	4	5	15	100	66.66	83.33	BS	B	BS
MA	2	0	1	3	33.33	0	16.66	KS	KS	KS
NF	6	4	6	16	100	66.66	100	BS	B	BS
NY	3	0	2	5	50	0	33.33	K	KS	KS
SA	2	3	3	8	33.33	50	50	KS	K	K
PD	3	2	0	5	50	33.33	0	K	KS	KS
RB	6	1	1	8	100	16.66	16.66	BS	KS	KS
WA	2	0	2	4	33.33	0	33.33	KS	KS	KS
Average					**61.80**	**34.72**	**40.96**	**C**	**KS**	**K**

Information:
BS : Very good
B : OK
C : Enough
K : Less
KS : Not once

From table 2 above, there are 8 students (33.33%) whose visual representation skills are very good, namely AGP, ADY, DS, E, FA, HZ, NF and RB. From the data above, it can also be seen that if students have high mathematical visual representation skills, their symbolic and verbal representation abilities are also high. Although there are 3 students whose symbolic representation ability is low, namely AGP, ADY and RB, whose symbolic mathematical representation ability is below 60. In general, the average student's visual representation ability is in the sufficient category, while the average symbolic representation ability is classified as very poor and the verbal representation ability is in the poor category.

Based on the results of interviews with students, information was obtained that students prefer to use visual representations because through graphical depictions students can easily understand problems. One of the interview subjects who got a high score on the visual representation indicator said that to solve the visual representation problem it was necessary to be careful, especially in describing the SPLDV graph, because it was a little wrong so the results were not right. In addition, he solves visual representation problems by applying the understanding he has through previous learning experiences. The ability of mathematical representation can be expressed through mathematical ideas that are used to show the results of their work through the learning experiences they have as a result of the interpretation of their thoughts (Kartini, 2009).

Meanwhile , one of the subjects who got a low score said that he had difficulty in understanding the content of the material given by the teacher. This is because the teacher only explains through learning videos and then sends them through *Google Classroom* and students are asked to understand the material provided. Due to the different abilities of students, the content presented by the teacher is difficult for students to understand (Juliya & Herlambang, 2021) . Through the use of appropriate mathematical representations, it can affect students' mathematical understanding, students are better able to find an understanding for themselves so that they can influence their way of thinking, then represent it (Nurdin Muhamad, 2013) . This is confirmed by research (Sari et al., 2020) that representation supports finding solutions to problems by externalizing something that is in the mind that is abstract. If students have good mathematical representation skills, students can find a solution to a problem easily.

In this study, it can be seen that the ability of visual representation is the ability that is more dominated by students. Meanwhile, the use of symbolic and verbal representations is the least preferred form of representation by students. One of the interview informants who got a high score in solving mathematical problems using symbolic representations said that solving problems with symbolic representations required a higher level of concentration and understanding of the basics of the material.

From the results of the research presented, it can be seen that the lack of knowledge and understanding of concepts affects the mathematical representations possessed by students. In representing a problem, it is certainly related to students' knowledge and understanding of a previously known concept (Purnama et al., 2019) . So when students do not understand a concept, the success of students in representing a problem becomes less precise. Representations in learning mathematics can help students build understanding skills and provide an overview of the extent to which students understand the concept of a mathematical material.

The tendency of students to use visual representations is influenced by the representations presented by the teacher when giving the material. According to research results (Abell, 2013) said that the experience of students when learning in class affects their understanding of learning, so that when they learn the material they often use a method similar to how they were taught. This makes it clear that the representation presented by the teacher can affect problem solving when working on questions. When students master some tips in solving problems according to what is taught by the teacher, so students use the same method in working on problems.

Students' mathematical representation ability in visual form illustrate that students are able to present problems into tables, graphs, arrow diagrams correctly and completely. However, there are still errors so that students present the problem in graphical form. As material for analysis, some of the results of student work in solving problems are shown. The test results as shown in the image below are the answers of one student with high visual representation ability in answering questions 1 , 2 , 3 and 4 on the SPLDV material.

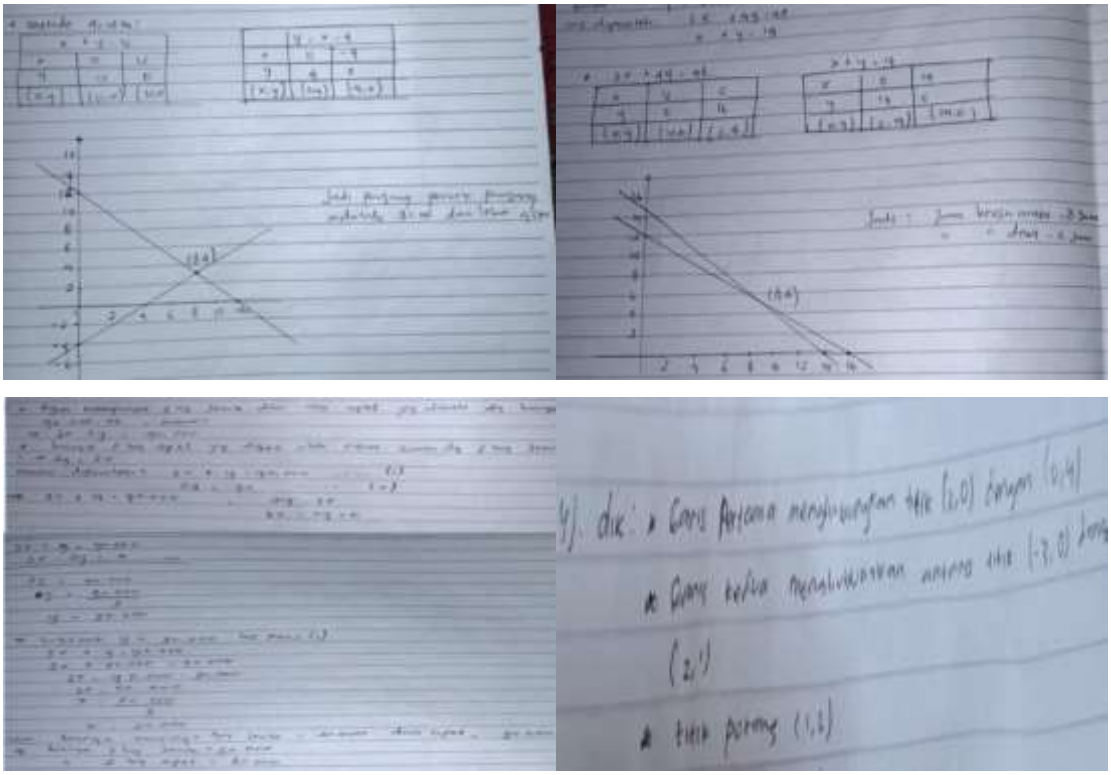

Figure 1. Students' answers to questions Number 1, 2, 3 and 4

Based on Figure 1, students are able to complete visual representation skills for questions no. 1, 2, 3 and 4, where students for questions no. 1 and 2 are able to make graphs completely and correctly and are able to understand problems regarding the formula for the perimeter of a rectangle represented in the SPLDV graph. It means that for questions no. 1 , 2 , 3 and 4, the students' symbolic representation ability is correct, but the verbal representation ability is still lacking, because students write logical, correct but incomplete explanations. For example, for questions no. 1, 2 and 3, it is not explained what is known, what is being asked and the choice of symbols. It can be concluded that these students can complete visual representation skills no. 1, 2, 3 and 4 correctly, symbolic and verbal representation skills are still lacking.

While the results of the answers from students who have high symbolic representation abilities on questions no. 1, 2, 3 and 4 can be seen in Figure 2.

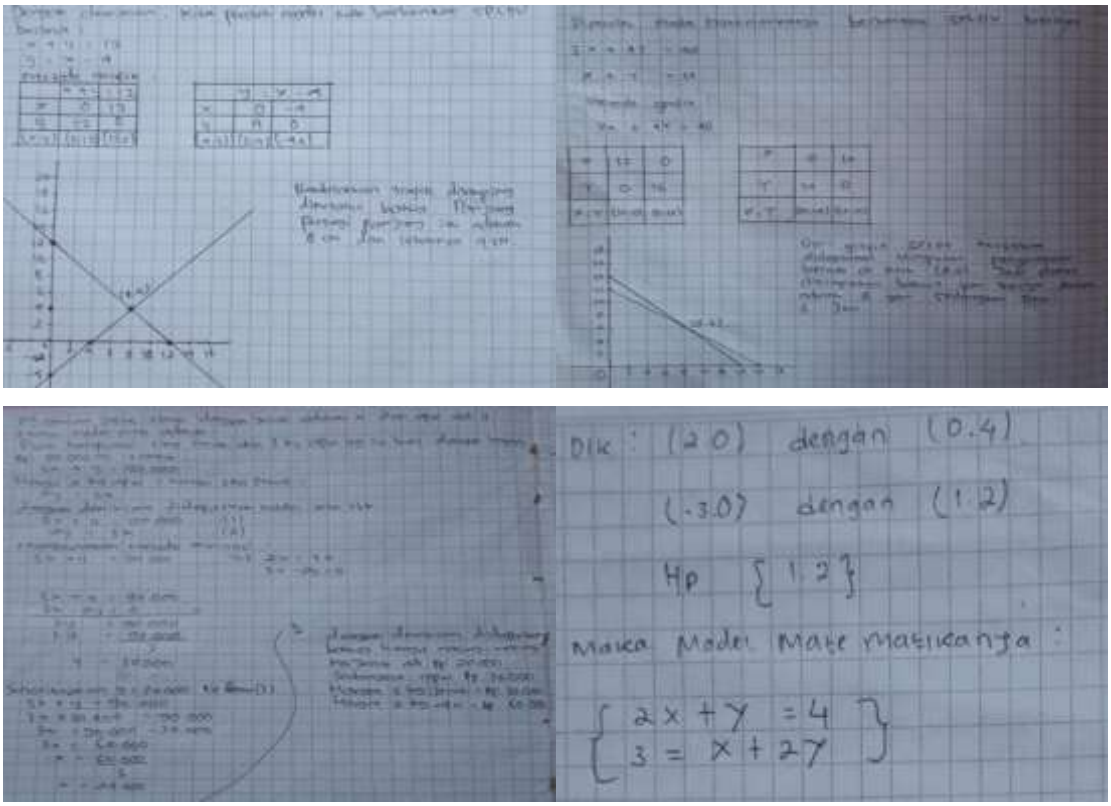

Figure 2. Students' answers to questions Number 1, 2, 3 and 4

Based on Figure 2, students solve problems 1, 2, 3 and 4 using visual representations correctly and appropriately. Meanwhile, symbolic and verbal skills are still lacking. Because it has not explained in detail what is known, what is being asked and why is the use of symbols used x and y. In question no 4 students did not complete it completely. From the data obtained that the results of students' verbal representation abilities are classified as lacking, this can be seen from the results of interviews with several students, to determine the extent of students' understanding of the answers they have given. The results show that only some students are able to interpret the results of their mathematical calculations logically and systematically. Students do not write calculations into steps in the form of words but do calculations using formulas only. This problem emphasizes interpretation or making conclusions from the results of data manipulation to solve problems. Verbal representations are rarely encountered because students are accustomed to using verbal representations (Sari et al., 2020) .

Based on the data and answer sheets, it was shown that during the COVID-19 pandemic, although there were students who had high visual, symbolic and verbal representation skills, overall visual representation skills were in the sufficient category. Likewise with the ability of symbolic representation, although there are students who have

high symbolic ability, the average symbolic representation ability in general is in the very poor category and in general the verbal representation skill is in the poor category.

CONCLUSION

The mathematical representation ability of students in class X MIA 2 SMAN 13 Kerinci at the time of online learning is included in the sufficient (moderate) category for visual representation, while the ability for symbolic representation in the category is very poor and verbal representation skills in the poor category.

The results of data analysis showed that students were more dominant in answering representational ability test questions in the form of visuals/graphics with the use of the technology used to display more accurate graphic visualizations . Then the visual representation gets a moderate average. Symbolic representation is the lowest compared to visual and verbal representations, this is because there are still many students who have difficulty in writing down the steps of mathematical problems and using mathematical symbols.

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