CHARACTERISTICS REPRESENTATION OF EQUATION MATHEMATICS PROBLEMS SOLVING IN STUDENTS

by Ajeng Gelora Mastuti

Submission date: 01-Jan-2023 06:31AM (UTC+0700)
Submission ID: 1987689570
File name: 2021-Juni._CHARACTERISTICS_REPRESENTATION.pdf (310.96K)
Word count: 3635
Character count: 21378

ISSN 2303-0992
ISSN online 2621-3176
Matematika dan Pembelajaran
Volume 9, No.1 , June 2021, h. 43-54

CHARACTERISTICS REPRESENTATION OF EQUATION MATHEMATICS PROBLEMS SOLVING IN STUDENTS

Syukma Netti[1], Ajeng Gelora Mastuti[2]
[1]*Universitas Bung Hatta*
[2]*Institut Agama Islam Negeri Ambon*

syukmaneti@bunghatta.ac.id

Abstract

This study aims to describe the representative characteristics of the equation in class VII students in solving mathematical problems. The research subjects were four seventh grade students of SMP Negeri 14 Padang. The research method used is qualitative. Data on students' mathematical representational abilities were obtained by asking students to work on one math problem. The results of student work were analyzed by paying attention to the theorems and algorithms written by students and data from interviews. Interviews were conducted to confirm the students' work. This study concludes that students have not produced external representations well, although almost all students can understand mathematical problems in their minds (have internal representations). The form of the solution created by students does not have a perfectly correct representation of the student's equation. Judging from the combination of students' internal and external representations, it is was found that there were two forms of student equation representation characteristics, namely, the correct representation was not appropriate and the incorrect representation was not appropriate.

Keywords: mathematical representation; mathematics problems.

Citation: Netti, S., Mastuti, A.G. 2021. Characteristics Representation of Equation Mathematics Problems Solving in Students. *Matematika dan Pembelajaran*, 9(1), 43-54. DOI: http://dx.doi.org/10.33477/mp.v9i1.1866

INTRODUCTION

There are several forms of mathematical representation, namely visual representation, verbal (written text), equations or mathematical expressions (Lestari & Yudhanegara, 2015). Among the many forms of representation, the structure of representation of an equation or mathematical expression is the form that most often used. Almost every material and at every level of mathematical representation used. It starts from the simplest things when writing things that known from a question and the things that asked to the complete procedure.

Meanwhile, data from the results of the Trends in International Mathematics and Science Study (TIMMS) research in 2007 was still far from satisfactory, where junior high school students in Indonesia were ranked 36 out of

39 countries. Students are still unable to solve problems correctly, one of which is thought to be due to a lack of mathematical representation ability. We can also see this from students' daily work, as conveyed by the mathematics teacher at SMP Negeri 10 Padang. The results of student work tend to be short, and in fact, some students only make the final result. This is inseparable from the teacher's perception of mathematics. Some teachers view mathematics as separate objects (Harel, 2008) and teachers teach the definition of mathematics intuitively rather than deductively (Netti & Juhaevah, 2019). As a result, students tend to accept material as an object. Separated so that students cannot understand the relationship between objects and procedures correctly. (Subanji, 2015). We can see this student's misunderstanding from the mathematical representations they use when solving problems.

Given many problems that arise regarding the representation of equations made by students, the researcher feels the need to investigate the characteristics of the representation of equations. Knowing this can provide assistance and treatment to students to improve their ability to represent equations. Thus, the purpose of this study was to describe the characteristics of the representation of equality of seventh-grade students of SMP Negeri 10 Padang.

Abstract objects dominate mathematics lessons, so learning always involves various representations. Representations play an essential role in students' learning of mathematics: "An important educational goal is for students to learn to use different forms of representation in communicating with one another." (Greeno & Hall, 1997, p. 363)

There are many forms and types of representations discussed by experts in learning mathematics. Four main ideas can be extracted from various conceptualizations of representation. First, representations can be broadly considered mental states or images or internal representations that are mental images, such as a set of objects consisting of five objects. Second, a more narrow representation is considered a "mental reproduction of a previous mental state" (Seeger, 1998, p. 311). Here, the number, 5, or the number, five, are examples. Finally, the last two formulations include the presentation of a structurally

equivalent through image, symbol or sign, and something that replaces something else (Seeger, 1998, p. 311). For example, such a layered graph that students use to understand and discuss the relationship between river discharge and the amount of pollutants in the water illustrates a conceptualization.

In mathematics, representations can be thought of as internal cognitive schemas or abstractions of mathematical ideas constructed through experience. On the other hand, external representations, such as graphs, tables, diagrams, and charts, "act as stimuli to the senses" and can be thought of as "embodiments of ideas or concepts" (Janvier, Girardon, & Morand, 1993, p. 81). Representation also refers to the act of externalizing internal mental abstractions (Pape & Tchoshanov, 2001). Furthermore (Pape & Tchoshanov, 2001), there is an interaction between internal and external representations, facilitating children's ability to understand a concept. The term representation also refers to processes and products. For the act of capturing a mathematical concept or the relationship of some form and the form itself. A new process allows students to be able to:

1. Create and use representations to organize, record, and communicate mathematical ideas;
2. Select, apply, and translate among mathematical representations to solve problems;
3. Using representational models and interpreting physical, social, and mathematical phenomena (.p . 67)

It is important to note that the representations referred to in each of these statements can be regarded as internal cognitive schemas or externalizations of these mental constructs. That is, students can formulate internal representations to organize mathematical ideas or to solve problems. Likewise, students can generate external representations to perform the same process. The following chart illustrates the interaction between internal and external representations in processing a form in students' minds, this chart bag.

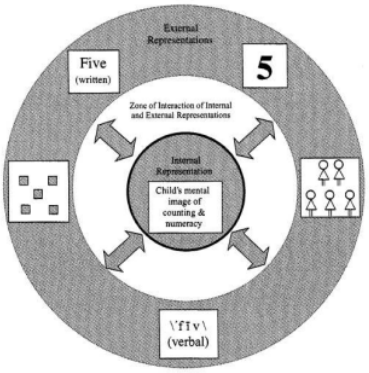


Figure 1. The relationship between internal and external representations in developing children's understanding of numeracy concepts (source Pape & Tchoshanov, 2001)

Goldin (1998) states two representations, namely the external representation system and the internal representation system. The external representation system includes conventional representations, which are usually symbolic, while the internal representation system created in a person's mind used to assign mathematical meanings. Examples of external representations include mathematical equations, algebraic expressions, graphs, geometric types, and number lines. In addition, external representations include writing and speech, while examples of internal representations include a person's notation system, visual images, and problem-solving strategies.

This study wants to reveal students' internal and external representations in solving a mathematical problem. Mathematical problems are designed to give rise to representations of equations. Equation representation is one of 5 forms of mathematical representation, namely visual representation, images, written text, equations or mathematical expressions. In general, representation plays a very important role in the development of optimizing students' abilities. NCTM (2000) suggests that: Representation is central to the study of mathematics. Students can develop and deepen their understanding of mathematical concepts and relationships to create, compare, and use various representations. This shows that the excellent

representation ability of students shows that students have a deep understanding of the material. Students can present the results of their understanding in various forms. The mathematical representation ability, including the representation of equations, is a mental picture of the learning process that can be understood from the mental development within a person (Judge, 2017). Therefore, the appearance of student representation can be a measure of how well students understand the material they are working on. On the other hand, representation ability can support students in understanding the mathematical concepts being studied and understanding the relationship between concepts to communicate their mathematical ideas (Hudiono, 2005).

METHOD

The method used in this study is a qualitative research method. Moleong (2012) suggests that qualitative research intends to understand the phenomenon of what is experienced by research subjects (p.6). The research subjects were students of class VII SMP Negeri 14 Padang as many as 30 students. Creswell (2012) explains that the term in qualitative research used for sampling is a purposive sample. Purposeful sampling is when the researcher deliberately selects individuals and places to study the phenomenon. The standard used in selecting subjects and venues is whether they are "information rich". In this study, interviewed six students to obtain more in-depth data regarding the characteristics of their representations.

In qualitative research, the main instrument is the researcher himself. Researcher as a key instrument (Craswell, 2010, p.227). The supporting instruments needed are test sheets and interview guidelines. The form of the test used in this study is a matter of description (essay) because it can make it easier to identify the research's problems—test questions about integers and fractions based on indicators of mathematical representation ability. The representation test questions are taken from the student's handbook designed so that the questions given can be seen in the following picture.

"When entering winter, temperatures in European countries often drop drastically. Every 1 hour, the temperature drops 3 degrees Celsius. If at 18.00 the temperature there is 12 degrees Celsius. Determine the temperature at 24.00 local times?"

Ketika memasuki musim dingin, suhu di negara Eropa seringkali turun drastis. Setiap 1 jam suhunya turun 3°C. Jika pada pukul 18.00 suhu disana adalah 12°C. Tentukan suhunya ketika pukul 24.00 waktu setempat.

Figure 1. Mathematical Problems

The results of student work were analyzed with reference to mathematical concepts and principles and procedures, namely the algebraic properties of real numbers (Bartle & Sherbert, 2011), to obtain the characteristics of student representation of equations. In addition to work results data, there is also interview data to confirm student work data so that there are no errors in interpreting student work.

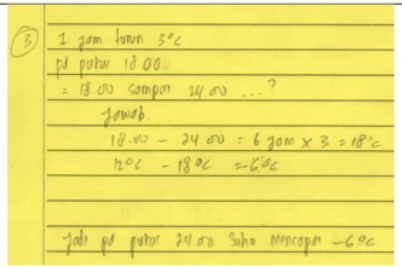
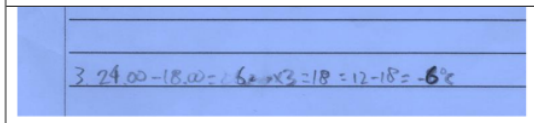
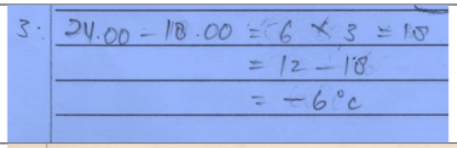
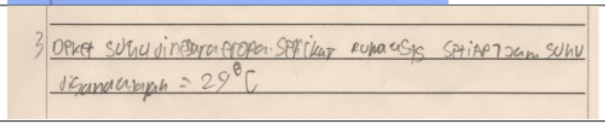
RESULT AND DISCUSSION

Data retrieval of student equation representation was done by giving math problems to 23 students of class VII5 students of SMPN 10 Padang. Based on students' work in solving mathematical problems and supported by data from interviews, it is generally obtaining that almost all students dominantly use internal mathematical representations. However, students do not write down the results of their interpretation in writing or pictures as stated by their teacher. Students often answer with short answers, even though the teacher has often asked students to answer questions with complete steps and stages. It needs our attention. Why do almost all students not write down the stages of the problem-solving procedure completely. None of the students' representations matched the concepts and principles of mathematics from all the students' work.

From 23 students' work, after observing the patterns and characteristics, it found three forms of equation representation characteristics, namely (1) correct and appropriate, (2) correct but not appropriate, and (3) incorrect and inappropriate. The following is a table of student representation data. These three characteristics

are obtained by looking at their suitability with the algebraic properties of real numbers.

Table 2. Forms of Student Mathematical Representations

Student	Characteristics of student representation ability	Student Work	Incompatibility with Mathematical concepts and principles	Correct and appropriate representation of the equation
S1	*correct but not appropriate*		18.00-24.00 = 6 hours (wrong in finding the time difference) the result of the time difference directly equated with: 18.00-24.00 = 6 hours x 3	time difference = 24.00-18.00 = 6 hours Total reduced temperature = 6 hours x 3 =18°C Temperature at 24.00 = 12°C- 18°C= - 6°C
S2			all results of arithmetic operations directly connected with the equal sign in one line	
S3			The same as the discrepancy in S2, Only the representation is not in one line.	
S4	*Incorrect and not appropriate*		no representation of the equation can be made	

The conclusion of this study was obtained by analyzing the results of students' internal and external representations. The results of external representations are seen from the results of student work, while students' internal representations obtained through interviews with students. Based on the data on students' work in solving math problems and based on the results of interviews, it is known that each student has different uniqueness. In general, almost all students have difficulty or not accustomed to producing excellent and complete external representations. Many found that students' minds' internal representation was correct but did not match what was written, or the external representation did not match.

Each answer given is the result of the learning process that students have experienced. Thus, it aligns with what was conveyed by Shulman in Harris et al. (1992) that identifying representation as part of the teacher's pedagogical knowledge. He defined representation I as several forms, including analogy, illustration, example, explanation, and demonstration - in other words, a way of representing and formulating a subject that makes it understandable to others.

Many students do not create problem situations based on the data or representations provided, do not write down the steps for solving mathematical problems in words and do not answer questions using words or written text. Our guess might be this, one of the reasons is that during learning, the teacher does not familiarize and train students to discuss questions in sentences or other words with the same intent and purpose. This condition opens up opportunities for us to research further.

Two very striking things that must be addressed and considered are that almost all students have internal representations with different percentages. There are students whose 100% mathematical representation is internal, only exists in mind, solves mathematical problems with a bit of doodle on opaque paper so that only the final results are written. Half of the students had an internal representation of 50% of the total representation they made. Thus, it is caused by no student work that is correct and follows mathematical concepts and principles. There are only two characteristics of student equation representation, namely *correct but not appropriate* and *incorrect but not appropriate*. The following is an explanation and discussion of the two characteristics of student equation representation.

1. *Correct but not appropriate*

The results of student work with these characteristics (table 2 no. 1,2, and 3) Students have a good understanding and can solve problems. Still, they cannot write with good and correct mathematical symbols. He writes the way he likes without paying attention to the rules and laws that apply. This also shown from the results of interviews with these students, such as the following excerpts of the conversation:

P : *Now about question number 3, right?*
S2 : *(reread the question)*
P : *Can you tell me how you solved this problem?*
S2 : *what asked is the temperature at 24.00. the known temperature at 18.00. from 24.00, I subtract it from 18.00, thump. So it's 6 hours. Because the temperature drops for 1 hour, it's 3 ℃I multiply 6 hours by 3 the result is 18 thumps. Then 12 minus 18 then the result is -6 , thump. Is it wrong?*
P : *No, it's not wrong*

The interview excerpt above is representative of the three subjects. All three of them are equally good at a given problem. They can explain the solution process orally, but they have the same error in writing the equation representation of the given problem. The form of discrepancy in the representation of these three subjects represents the discrepancy made by other students. Thus is our joint task in finding out where the problem is and finding ways to overcome this problem.

2. *Incorrect but not appropriate*

The mathematical representation of students with these characteristics is wrong in writing but does not have sufficient knowledge to solve the given mathematical problem. Students do not know what to do in solving the problem so that no representation can be made. In this case, students only guess and write answers based on estimates only. When interviewed with those with the same form of error, almost all of them said they did not know the question's meaning and did not have to write anything. There were 20% or five students with the same error.

Based on the findings above, we can realize that what is conveyed by mathematics education experts is about the importance of mastery of representation for teachers in learning. Harris (1992) also identifies the skills

and knowledge needed by teachers in considering the suitability of certain representations, as certain representations will bring the instructor deeper so that efforts to explain the material to be studied can be consistent and useful. Therefore, the effective use of representation requires that teachers have a 'deep understanding of the topics they teach. Representation also plays an essential role in mathematics learning by students. An important educational goal is for students to learn to use various forms of representation in communicating with each other.

Mathematics made up of a large set of interrelated abstractions. If teachers do not know how to translate those abstractions into a form that allows students to relate mathematics to what they already know, they will not learn by understanding.

CONCLUSION

Based on the findings and discussion, it can conclude that students' external representation in the form of equations is very low. Almost all students have an internal equation representation. Students' mathematical representations have two characteristics; the correct representation is not appropriate, and the incorrect representation is not appropriate.

Following the conclusions of this study, it can suggest that the teacher pay more attention to the mathematical representations made by students and provide direction if a mathematical representation found that is not following mathematical concepts. Teachers also asked to familiarize students with presenting ideas in various forms of representation. Further research can be done regarding the internal representation and the causes of the low representation of student equality.

REFERENCES

Bartle, R. G & Sherbert, D. R., 2011. *Introduction To Real Analysis* edisi keempat. John Wiley & Sons, Inc. United States

Creswell, J. W. (2010). *Research Design : Pendekatan Kualitatif, Kuantitatif, dan Mixed.* Yogyakarta: Pustaka Pelajar.

Greeno, J.G., & Hall, R.P. (1997). Practicing representation: Learning with and without representational forms. Phi Delta Kappan, 78, 361-367.

Goldin, G. (1998). Representation System, Learning, and Problem Solving in Mathematics. *Journal Math Behav, Representation and the Psychology of Mathematics Educatio: Part II* , 137-165.

Harries, T., Bolden, D., & Barmby, P. 1992. *The importance of using representations to help primary pupils give meaning to numerical concepts,* Durham University (UK)

Hudiono. (2005). Peran Pembelajaran Diskursus Multi Representasi Terhadap Perkembangan Kemampuan Matematik Dan Daya Representasi Pada Siswa SLTP, disertasi. tidak dipublikasikan. Universitas Pendidikan Indonesia

Harel, G., 2008. What is Mathematics? A Pedagogical Answer to a Philosophical Question. In Gold, B. & Simons, R. (Eds) A. Proof and Oher Dilemmas Mathematics and Philosophy. pp 265-290. Mathematical Association of America. DOI: https://doi.org/10.5948/UPO9781614445050.018

Lestari, K. E., & Yudhanegara, M. R. (2015). *Penelitian Pendidikan Matematika.* Bandung: PT. Refika Aditama.

Mudzakkir, H. (2006). Strategi Pembelajaran TTW Untuk Meningkatkan Kemampuan Representasi Matematik Beragam Siswa; Sekolah Menengah Pertama (eksperimen pada siswa kelas II SMP di Kab. Garut). Tidak Diterbitkan. *Tesis SPs UPI*

NCTM. (2000). Priciples and Standards or School Mathematics. USA: Reston, VA: Author.

Netti, S. & Juhaevah, F. 2019. Definition Constructed Process in Mathematics Learning. *Matematika dan Pembelajaran, Volume 7 No.1 Hal 81-90*

Putri. V.W & Hakim L.D. 2019. Representasi Siswa SMP pada Konsep Persamaan Garis Lurus. Prosiding Seminar Nasional Matematika dan Pendidikan Matematika Sesiomedika. hal 1993-1202

Seeger, F. (1998). Representations in the mathematics classroom: Reflections and constructions. In F. Seeger, J. Voigt, & V. Werschescio (Eds.), The culture

of the mathematics classroom (pp. 308-343). Cambridge, UK: Cambridge University Press.

Vellom, R.P., & Pape, S.J. (2000). EarthVision 2000:Examining students' representations of complex data. *School Science and Mathematics*, 100, 426-439..

Villegas, J. L., Castro, E., & Gutierrez, J. (2009). Representations in problem solving: a case study with optimization problems. *Electronic Journal of Research in Educational Psychology. ISSN 1696-2095. No 17, Vol 7* , 287.

CHARACTERISTICS REPRESENTATION OF EQUATION MATHEMATICS PROBLEMS SOLVING IN STUDENTS

ORIGINALITY REPORT

20%	20%	20%	14%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	docplayer.net Internet Source	3%
2	plataforma.ibccrim.org.br Internet Source	3%
3	www.tandfonline.com Internet Source	2%
4	icmseunnes.com Internet Source	2%
5	www.thefreelibrary.com Internet Source	1%
6	Abdillah Abdillah, Ajeng Gelora Mastuti. "Munculnya Kreativitas Siswa Akibat Ill Structured Mathematical Problem", MATEMATIKA DAN PEMBELAJARAN, 2018 Publication	1%
7	Submitted to University of Hull Student Paper	1%
8	Submitted to Monmouth University Student Paper	

		1 %
9	Günhan Caglayan. "Eighth grade students' representations of linear equations based on a cups and tiles model", Educational Studies in Mathematics, 02/26/2010 Publication	1 %
10	bibliomanic.com Internet Source	1 %
11	mail.iainambon.ac.id Internet Source	1 %
12	ejournal.unsri.ac.id Internet Source	1 %
13	Submitted to University of Southern Mindanao Student Paper	1 %
14	core.ac.uk Internet Source	1 %
15	eprints.nottingham.ac.uk Internet Source	1 %
16	F G Putra, Meriyati, V I Safitri, W Nursa'idah, D. Putri, N Mistasari, M Isnaini, Santi Widyawati, Rizki Wahyu Yunian Putra. "The influence of student facilitator and explaining (SFAE) learning model viewed from social skills in improving students' mathematical	1 %

representation ability", Journal of Physics: Conference Series, 2021
Publication

Exclude quotes	Off	Exclude matches	< 1%
Exclude bibliography	On		