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Semiotic Mathematics Representation Ability Based on Symbolic in Solving SPLSV Problems in Class VII Students

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Abstract: Mathematical semiotic representation is the ability to analyze and express mathematical ideas or notions of a phenomenon and everyday problem situations into the form of signs, images, symbols, and symbols that represent them and provide meaning and explanation to a package of verbal sign messages. The symbolic stage is the stage where students have understood the symbols and concepts and have ideas that are strongly influenced by language and logic skills and students are able to manipulate symbols or symbols of a particular object. The purpose of this study was to determine the representation of symbolic-based mathematical semiotics in seventh grade students of MTS Al Barokah Ajung Jember on SPLSV material using qualitative descriptive method. The instrument used by researchers in the form of written test questions consisting of two questions tailored to the symbolic representation that has two indicators that use mathematical symbols to solve problems and interpret mathematical symbols. From the results of research that has been done obtained the error of representation on indicators using mathematical symbols to solve the problem of 100% and error of representation on indicators interpreting mathematical symbols of 0%. Several studies have been carried out to explain the mistakes that students make in representation skills. This paper presents the ability of mathematical symbolic semiotic representation of students who are more specific in solving SPLSV problems that can be considered by teachers in designing learning about the ability of mathematical semiotic representation and information for observers of mathematics education.

Abstrak: Representasi semiotika matematis adalah kemampuan menganalisis dan mengungkapkan gagasan atau gagasan matematis dari suatu fenomena dan situasi permasalahan sehari-hari ke dalam bentuk tanda, gambar, simbol, dan simbol yang mewakilinya serta memberikan makna dan penjelasan terhadap suatu paket pesan tanda verbal. Tahap simbolik merupakan tahap dimana siswa telah memahami simbol dan konsep serta mempunyai gagasan yang sangat dipengaruhi oleh kemampuan berbahasa dan logika serta siswa mampu memanipulasi simbol atau lambang suatu benda tertentu. Tujuan penelitian ini adalah untuk mengetahui representasi semiotika matematis berbasis simbolik pada siswa kelas VII MTS Al Barokah Ajung Jember pada materi SPLSV dengan menggunakan metode deskriptif kualitatif.

Instrumen yang digunakan peneliti berupa soal tes tertulis yang terdiri dari dua soal yang disesuaikan dengan representasi simbolik yang memiliki dua indikator yaitu menggunakan simbol matematika untuk menyelesaikan masalah dan menginterpretasikan simbol matematika. Dari hasil penelitian yang telah dilakukan diperoleh kesalahan representasi pada indikator penggunaan simbol matematika untuk menyelesaikan masalah sebesar 100% dan kesalahan representasi pada indikator menafsirkan simbol matematika sebesar 0%. Beberapa penelitian telah dilakukan untuk menjelaskan kesalahan yang dilakukan siswa dalam keterampilan representasi. Tulisan ini menyajikan kemampuan representasi semiotika simbolik matematis siswa yang lebih spesifik dalam menyelesaikan masalah SPLSV yang dapat menjadi bahan pertimbangan guru dalam merancang pembelajaran tentang kemampuan representasi semiotika matematis dan informasi bagi pemerhati pendidikan matematika.

Keywords: Mathematical Representation, Semiotic Representation, SPLSV, Mathematics

INTRODUCTION

Mathematics is a science that contains many ideas (Arifin, 2020). Mathematics schools also play a role in preparing students to be able to face changing circumstances in their lives through mathematical thinking patterns (Azkiah & Sundayana, 2022). In studying mathematics, students must have mathematical skills that can support them in learning mathematics, one of which is the ability of mathematical representation. The ability of mathematical representation is central to learning mathematics (Alifa et al., 2022). Representation is an important element in teaching and learning mathematics. The use of various representations in the teaching and learning of mathematics is a major topic in mathematics education that has become very important in recent decades (Mainali, 2021). The ability of mathematical representation is also one of the general objectives of mathematics learning in schools. This ability is very important for learners and is closely related to communication and problem-solving skills. Someone needs representation in the form of images, graphs, diagrams, and other forms of representation to be able to communicate something (Suningsih et al., 2021).

In learning mathematics, there are various signs in it, one of the abilities that students must have is the science of understanding a sign (Loka Dewi & Hakim, 2023). Representation stems from semiotics, then in mathematics it can be referred to as mathematical semiotic representation, where in this mathematical semiotic representation students learn things related to signs on the basis of everyday life problems (Khoiroh, 2021). Semiotics can be known as the science that explores a wide array of events and objects across cultures as signs and semiotics also places great attention on anything that can be said to be a sign. The basic principle of Peirce's semiotics theory is that anything can be a sign, as long as it can represent something for the student to interpret in thinking. Peirce affirmed the theory of signs that focuses on three aspects or trichotomy systems, namely objects, signs, and interpretation (Wulandari Suryaningrum et al., 2023). According to the results of Moyer-Packenham's research in his journal, revealed that the type of semiotic representation most often used by students is the image, followed by the symbol (Moyer-Packenham et al., 2022).

Understanding the concept of mathematical material is highly dependent on the representation and interpretation of the sign (Palayukan et al., n.d.). One of them is the material system of Linear Equations of one variable. The easiest translation, it turns out, is the translation from diagrammatic

representation to algebraic, while the most difficult translation is from table representation to algebraic. Several studies have been conducted to explain the mistakes made by students in representation skills. Students with low ability, difficulty in creating and using symbolic representations and images (Panduwinata et al., 2019). In line with the results of Khoiroh's research in his journal entitled semiotic representation ability analysis of high school students on sequence and arithmetic Series material, students answered the most problems using symbolic means with a percentage of 92%, then an index of 5%, and at least students answered using iconic means with a percentage of 3%. In line with the results of Choiriyaza's research in a journal entitled Can Autograph improve students ' mathematical semiotic representation that students are only able to make symbols without defining them first (Loka Dewi & Hakim, 2023). In recent decades, the role of representation in mathematics education has increased but requires more research to explore different aspects of representation (Mainali, 2021). Therefore, it is very important to analyze the semiotic representation based on the symbolic associated with SPLSV, in order to be more in-depth information for teachers and observers of mathematics education on the representation based on the symbolic students in the material SPLSV.

METHOD

This study uses descriptive qualitative methods. The subjects of this study are 8 students of class VIIB MTS Al Barokah Ajung Jember without any selection of the level of thinking. This research instrument in the form of test questions and interviews. Data analysis in this study using qualitative data analysis stages, namely data reduction, data presentation, and conclusion. This research was conducted by providing test questions and interviews to 8 seventh grade students of MTS Al Barokah Ajung Jember for one day, namely on November 30, 2023. The design of the study used to provide a basic understanding of the material related SPLSV to 8 students of class VIIB MTS Al Barokah Ajung Jember within 20 minutes. Then given the instrument test questions in the form of two questions that have been validated in accordance with the semiotic representation based on symbolic material that refers to the SPLDV presented in Figure 1.

3. Jika diketahui a + 21 = 44, maka nilai a + 19 adalah ....
4. Jika 3 (y + 30) + 2 = 2 (y + 49), maka nilai y + 14 = ...

Figure 1. Question

Test questions are done by students within 30 minutes. Where 4 students work on Problem 3 and 4 students for Problem 4. In taking data semiotic representation of these students researchers only take semiotic representation based on symbolic because based on some research results and statements of mathematics teachers at MTS Al Barokah Ajung Jember that students are still many mistakes in working on problems that require symbolic semiotic representation. After that, interviews were conducted to students to obtain more information related to the steps that students have taken in answering test questions with mathematical semiotic representations based on symbolic. The results of the test questions and interview results were then analyzed based on two indicators of mathematical semiotic representation based on symbolic, namely using mathematical symbols to solve problems for Problem 3 and interpreting mathematical symbols for Problem 4.

RESULTS AND DISCUSSION

Results

Exposure to the results of Test Questions and student interviews

This study was conducted in class VIIB MTS Al Barokah Ajung Jember students totaling 8 people. Steps in this study using the

instrument questions and interviews. Before giving the question, the researcher also gave an introduction to the material of SPLSV to 8 students of class VIIB MTS Al Barokah Ajung Jember. Based on the results of analysis in the form of written tests from students. Researchers found some students ' misunderstanding of semiotic representation based on symbolic in the form of SPLSV. Indicators that can be seen from the symbolic semiotic representation there are two, namely, 1) using mathematical symbols to solve problems, 2) interpreting mathematical symbols. Below is a table of the results of the analysis of the answers to the representation of the subject. Symbolic representation is also a type of sign that has a convention or rule relationship with the object it represents tends to be in the form of symbols (Palayukan et al., n.d.).

Indicator description	**About to-**	**Many students**	**Presentation**
using mathematical symbols to solve problems	1st	4	100%
interpreting mathematical symbols	2st	4	0%

Seen from the table above, the results showed that the 1st problem with the description of indicators using mathematical symbols to solve the problem four students answered the question correctly all, and on the 2nd problem with the description of indicators interpret mathematical symbols four students answered with all the wrong answers.

3. Jika diketahui a + 21 = 44, maka nilai a + 19 adalah ....

4. Jika 3 (y + 30) + 2 = 2 (y + 49), maka nilai y + 14 = ...

Figure 2. Question

Seen from Figure 1 shows two questions that researchers gave to students of class VIIB MTS Al Barokah Ajung Jember. In the 1st problem is given a problem that will use mathematical symbols to solve the problem and in the 2nd problem is given a problem where students must interpret mathematical symbols to answer the problem in accordance with the indicators of symbolic representation.

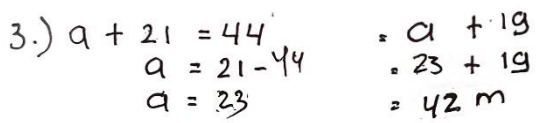

Figure 3. Answer to question 1 S1

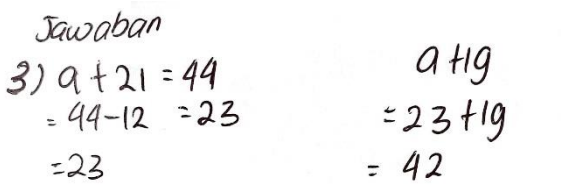

Figure 4. Answer to question 1 S2

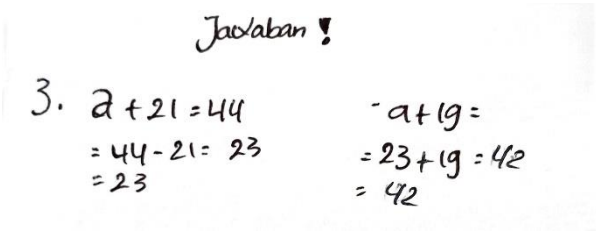

Figure 5. Answer to question 1 S3

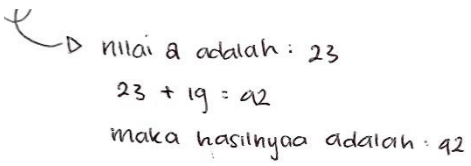

Figure 6. Answer to question 1 S4

In Figure 2, 3, 4, and 5 above presents the answer to the 1st question of the subject (S1, S2, S3, S4) with the correct symbolic representation of all. Where the results of the student's answer using mathematical symbols to

solve the problem is right so that a + 19 = 42 is obtained. As shown in the following interview transcript.

Transcripts of the 1st interview

With S1

Researcher	: "okay, in understanding the problem, do you use mathematical symbols, to help understand the problem?"
S1	: "yes sis, I use mathematical symbols."
Researcher	: "try to explain how you understand the problem so that you can get an answer using mathematical symbols?"
S1	: "I liken the variable A here to the money you will give me and 21 is my initial money, then 44 is the money I get after you give the money. But in this work I still use mathematical symbols sis."
Researcher	: "does that make it easier for you to solve the problem?"
S1	: "yes sis, for me it is easier if I connect in everyday life but still use mathematical symbols in the process."

With S2

Researcher	: "do you use mathematical symbols, to help understand the problem?"
S2	: "yes, I use it."
Researcher	: "try to explain how you understand the problem so that you can get an answer using mathematical symbols?"
S2	: "I was a little confused at first, then I remembered the explanation you had before giving the question. So the variable A is not yet known, right when we know the result is 44, it means that the value of a was the remainder when 44 was reduced by 21."
Researcher	: "Okay, does that make it easier for you to solve the problem?"
S2	: "Yes sis, because my understanding is like that."

With S3

Researcher	: "Do you use mathematical symbols, to help understand the problem?"
S3	: "yes, of course."
Researcher	: "Try to explain how you understand the problem so that you can get an answer using mathematical symbols?"
S3	: "I'm like this kak, right here the a is not yet known but the results are already known, so I subtract the results from the numbers that are already known to get how much the value of the A was."
Researcher	: "Then why don't you write down the steps of your work here?"
S3	: "Yes sis, I forgot because I did the steps on another paper so I forgot to write it on the answer sheet."

With S4

Researcher	: "Do you use mathematical symbols, to help understand the problem?"
S4	: "yes, use it."
Researcher	: "Try to explain how you understand the problem so that you can get an answer using mathematical symbols?"
S4	: "I use segment displacement to solve it, brother.
Researcher	: "Okay, does that make it easier for you to solve the problem?"
S4	: "Yes, because I think it's easier."

From the answers and transcripts of interviews above, subjects S1, S2, S3, S4 have used mathematical symbols to solve test questions. The four subjects were also different in understanding the test questions but the same

in using mathematical symbols. In addition, the four subjects found it easier to solve the problem using mathematical symbols. Thus obtained a percentage of 100% on the 1st problem.

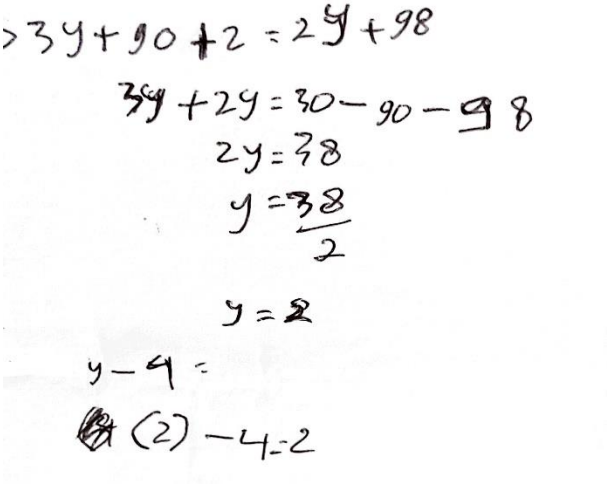

Figure 7. Answer to question 2 S5

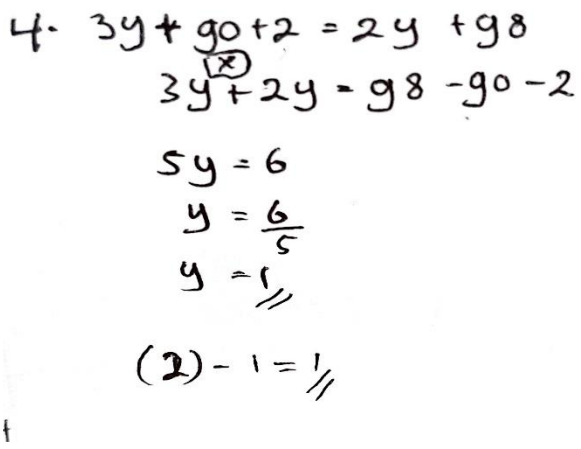

Figure 8. Answer to question 2 S6

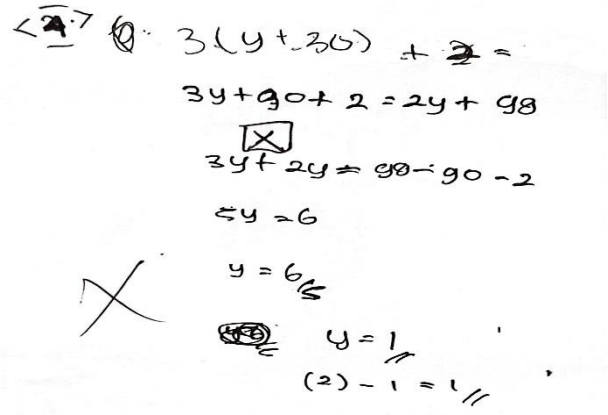

Figure 9. Answer to question 2 S7

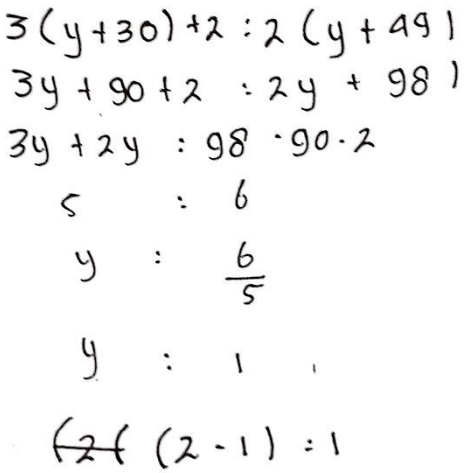

Figure 10. Answer to question 2 S8

Figure 6, 7, 8, and 9 above presents the answer to the 2nd question of the subject (S5, S6, S7, S8) with a symbolic representation of the wrong answer all. Where students are unable to interpret mathematical symbols. Student errors in the work of the 2nd problem is the result of students who can not understand and interpret the meaning of mathematical symbols and have not been able to involve the relationship between mathematical symbols with mathematical concepts that they represent. The ability of students to interpret mathematical symbols is very low according to the results of the analysis of researchers where the four students who were targeted could not answer

the question correctly. So that a percentage of 0% is obtained in the 2nd problem. As shown in the following interview transcript.

Transcript of the 2nd interview

With S5

Researcher : "Do you use mathematical symbols, to help understand the problem?"

S5 : "Yes, I use it."

Researcher : "Try to explain how you interpret mathematical symbols into the problem?"

S5 : "That's my brother using the variable y, then I follow the way you explained earlier to do it."

Researcher : "Okay, does that make it easier for you to solve the problem?"

S5 : "Yes sis, because my understanding is like that."

With S6

Researcher : "Do you use mathematical symbols, to help understand the problem?"

S6 : "Yes, of course."

Researcher : "Try to explain how you interpret mathematical symbols into the problem?"

S6 : "I just directly use the way to solve SPLDV kak.

Researcher : "Okay, does that make it easier for you to solve the problem?"

S6 : "Yes sis, like it's easier."

Researcher : "Then the sign / / what do you use it for?

S6 : "Ohh that's just as a sign of my answer sis."

With S7

Researcher : "Do you use mathematical symbols, to help understand the problem?"

S7 : "Yes sis, I use it here."

Researcher : "Try to explain how you interpret mathematical symbols into the problem?"

S7 : "yes, at first I was confused but finally I chose to do it in this way (pointing to the results of the answer).

Researcher : "Okay, does that make it easier for you to solve the problem?"

S7 : "Yes, sis, because I can do that."

Researcher : "Then the sign / / what do you use it for?

S7 : "Ohh that's just a sign of my answer brother."

With S8

Researcher : "Do you use mathematical symbols, to help understand the problem?"

Q8 : "Yes, the variable y is the symbol, right?"

Researcher : "Yes"

Researcher : "Try to explain how you interpret mathematical symbols into the problem?"

S8 : "That's my brother using the variable y, then I follow the way you explained earlier to do it."

Researcher : “Okay, does that make it easier for you to solve the problem?”

S8 : "Yes sis, because I can understand like that.”

Discussion

Semiotics refers to the study of signs and symbols, as well as their meanings and uses (O’Halloran, 2023). With semiotic approaches can also help compare theoretical frameworks used in Mathematics Education and, at the same level, to overcome some of their limitations for mathematical analysis of cognition and instruction (Godino et al., 2007). Proper understanding and representation of a given problem will help students organize and solve it.therefore, they need a reference or symbol for such purposes as a semiotic source (Susanti, n.d.). However, the ability of mathematical representation of each student is not the same, because the ability of students to receive and process the information that has been given by the teacher during the lesson (Lutfi & Juandi, 2023).

Here the researcher will discuss the results of the analysis of students on the ability of semiotic representation based on symbolic. Of the two indicators in the semiotic representation based on symbolic. The first indicator is to use mathematical symbols to solve the problems contained in the 1st Test Questions with subjects S1, S2, S3, and S4. All four subjects have used the same mathematical symbols in answering the problem but with different understanding they can answer the problem correctly. According to the four subjects, the use of symbolic semiotic representations makes it easier to work on problems. This proves that representation plays an important role in solving mathematical problems. By using representations, problems that initially seem difficult and complicated can be seen more easily and simply. (Suryaningrum & Ningtyas, 2019), and for the second indicator is interpreting mathematical symbols to solve problems contained in the 2nd Test Questions with subjects S5, S6, S7, S8. The four subjects had used the same mathematical symbols in answering the questions, but the four subjects did not understand the interpreted symbols. The inability to interpret or translate a concept or problem is a significant factor affecting the learning and performance of mathematical problem solving (Dahiana et al., 2023). So that the answer to the fourth subject present all wrong.

Learning in the virtual classroom greatly affects the learning process, especially student learning outcomes (Siraj & Nuriadin, 2022). According to Bhesh Mainali in recent decades, the role of representation in mathematics education has increased. But in reality, the difficulty is still felt by students when dealing with the problem of mathematical representation skills. Students still feel confusion in representing a meaning to the form of a symbol or mathematical form (Triono, 2017). According to Lestari, students ' mathematical representation skills become less developed because students only record the formulas written by the teacher on the blackboard, receive explanations of the material as in the package book and are given example problems (Lestari & Palupi, 2023).

Based on the results of the analysis above, the ability of students to use mathematical symbols to solve the problem is appropriate so that the results of the analysis of the four students obtained a percentage of 100% and inversely proportional to the ability of students to interpret mathematical symbols are very low in accordance with the results of the analysis of researchers where the four students targeted can not answer the question correctly. So that a percentage of 0% is obtained in the 2nd problem. The results of this percentage are in line with the results of the study Roberto in his journal, that the results of the observation of the test results produced by the students appear that difficulties arise in the transition between the different semiotic registers. The students have

difficulty both in moving from the graphic or symbolic register to the textual register of the list, and vice versa(Capone et al., 2021). According to the results of research Ratumanan in his journal, the ability of symbolic representation, 10% are in the good category, 10% in the medium category, 7.5% in the poor category, and 72.5% in the very poor category(Ratumanan et al., 2022). According to the results of Hadiastuti's research in his journal, students who have extraordinary symbolic abilities are students who think with concrete random student type (CR)(Indah Hadiastuti & Soedjoko, 2019). Higher mathematical abilities are still concerned with the representation of elementary numbers. So that the ability to sort symbolic numbers can be a stepping stone from the representation of approximate numbers to mathematical competence and can be a symbol reference for purposes as a symbolic source. the fact that symbolic mathematics is a rather new invention of human culture(Lyons & Beilock, 2011). The low ability of mathematical representation is caused by two main things, namely (1) relatively low prerequisite knowledge and (2) mathematics learning which is dominated mainly by learning teachers does not provide opportunities for students to develop mathematical representation skills(Ratumanan et al., 2022). According to the results of Hidayati's research in his journal, educators can maximize students representation skills by increasing interest in reading through activities reading habits at school(Wahyu Hidayati & Wahyuni, 2021). The researcher has not found the same study so cannot compare this percentage with the study that analyzed the ability of students ' semiotic representation based on symbolic in SPLDV material. With the results of the analysis of the ability of semiotic representation based on symbolic on the material SPLDV contrary between indicators 1 and 2, the researchers hope for further analysis in other areas in order to strengthen the results of the analysis of the ability of semiotic representation of students based on symbolic on the material SPLDV. So that it can be more accurate information for teachers and observers of mathematics education and can be used as consideration for teachers in designing learning to match the ability of mathematical semiotic representation of students.

CONCLUSION

The understanding of mathematical concepts depends largely on the representation and interpretation of signs. This mathematical semiotic representation students learn things related to signs on the basis of problems of everyday life. Therefore, it is very important to analyze the semiotic representation with symbolic subjects related to SPLSV, in order to know more about the representation of students on the symbolic that exist in SPLSV material in everyday life.

The semiotic representation of a symbolic subject has two indicators: using mathematical symbols to solve problems and interpreting mathematical symbols. The ability of students to use mathematical symbols to solve problems is appropriate so that the results of the analysis of the four students obtained a percentage of 100% and inversely proportional to the ability of students to interpret mathematical symbols are very low in accordance with the results of the analysis of researchers where the four students who were targeted could not answer the question correctly. So that a percentage of 0% is obtained in the 2nd problem.

Based on the results of the above analysis with the results that are inversely proportional between the 1st and 2nd indicators, the researcher hopes that there will be further research on more students and mentoring in order to be able to see the representation of each student on the SPLSV material.

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