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Translation Failure from Verbal to Symbolic Representations in Solving Contextual Problems: Female vs Male

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ABSTRACT

Representation translation is the ability to change one form of representation to another. This study aimed to describe the failure of the translation of verbal to symbolic representations in solving contextual problems experienced by male and female students. The research participants were eight students of class VII an Islamic public school at Gresik. Data were collected through task-based interviews and were analyzed in terms of the translation of verbal to symbolic representations by unpacking the source, preliminary coordinator, constructing the target, and determining equivalence. The results showed that at the stage of unpacking the source, both male and female students experienced the same failure, namely not understanding more complex contextual problems. In the preliminary coordinator stage, the male students failed to understand the requested symbolic representation, understand the meaning of mathematical symbols, and determine keywords. Whereas, female students only failed due to their mistakes in the previous stage. In the stage of constructing the target, the male students failed to construct a symbolic representation of the plans made and translate it into mathematical symbols, while the female students failed to translate verbal words into mathematical symbols and mathematical operations. At the determining equivalence stage, both the male and the female students failed to undertake this stage successfully.

Keywords**:** *Representation Translation, Verbal to Symbolic, Contextual Problems, Male and Female*

Kegagalan Translasi Representasi Verbal ke Simbolik dalam Menyelesaikan Masalah Kontekstual: Perempuan vs Laki-Laki

ABSTRAK

Translasi representasi adalah kemampuan mengubah suatu bentuk representasi ke bentuk representasi lain. Penelitian ini bertujuan untuk mendeskripsikan kegagalan translasi representasi verbal ke simbolik dalam menyelesaikan masalah kontekstual pada siswa laki-laki dan perempuan. Subjek penelitian adalah delapan siswa kelas VII MTs di Gresik. Teknik pengumpulan datanya melalui wawancara berbasis tugas. Data translasi representasi dianalisis dengan tahapan unpacking the source,

preliminary coordinator, constructing the target dan determining equivalence. Hasil penelitian menunjukkan pada tahap unpacking the source, baik siswa laki-laki maupun perempuan mengalami kegagalan yang sama yaitu belum mampu memahami masalah kontekstual yang lebih kompleks. Pada tahap *preliminary coordinator*, siswa laki-laki gagal memahami representasi simbolik yang diminta, memahami makna simbol matematika, dan menentukan kata kunci, sedangkan siswa perempuan hanya gagal akibat kesalahannya pada tahap sebelumnya. Pada tahap *constructing the target*, siswa laki-laki gagal menyusun representasi simbolik dari rencana yang dibuat dan mentranslasikan kata verbal ke simbol matematika, sedangkan siswa perempuan gagal mentranslasikan kata verbal ke simbol matematika dan operasi matematika. Pada tahap *determining equivalence*, siswa laki-laki dan perempuan belum mampu melakukannya.

Kata Kunci**:** *Translasi Representasi, Verbal ke Simbolik, Masalah Kontekstual, Laki-laki dan Perempuan.*

1. Introduction

Mathematical representation is one of the objectives of learning mathematics [1]. National Council of Teachers of Mathematics (NCTM) also states representation is one of the five standards of the mathematics learning process [2]. Representation is essential in learning mathematics, especially in problem-solving because it can help improve conceptual understanding, express mathematical ideas, and understand the interrelationships between concepts [3]. With the existence of a mathematical representation, the solution to solve the problems is rather focused and appropriate [4]. Mathematical representation is the ability to express mathematical ideas or concepts. Representation is a method used to communicate mathematical ideas or concepts from a given problem [3, 5-6]. NCTM also explains that the representations that students showcase are expressions of ideas and concepts that students display as substitute models to find solutions to the problems encountered as well as the result of the interpretation of their thoughts [2]. Mathematical representation can also be defined as the ability to think in processing information so that a concept or expression of mathematical ideas is found in the results of thoughts whether communicated verbal, visual, or symbolic [6-10]. So, mathematical representation is a form of interpretation of students' thoughts on a mathematical problem, which is used to find solutions to these problems.

In general, representation is divided into several forms, namely verbal, image, and symbol representations [11]. Hutagoal [12] states that mathematical representations are usually presented in graphs, symbols, and tables. Marliyanti and Amin [13] reveal that verbal representation is constructing stories based on the representations presented, visual representations make tables or graphs, and symbolic representations make mathematical models. In this study, the representation used was limited to only symbolic and verbal representations. Verbal representation is a representation in the form of a written text or story in the form of a conclusion about the meaning of the representation presented, while symbolic representation is a representation in the form of symbols or mathematical models. The existence of various forms of representation, on many occasions, requires the ability to change one form of representation to another, which is called translation.

The translation is the ability to translate or understand ideas expressed in another form from the original form given previously. In representation, Janvier defines translation as a process that involves changing from one form of representation to another [3]. Meanwhile, Bossé, Adu-Gyamfi, and Chandler [14] state that translation is a cognitive

process in changing information from one form of representation to another. Therefore, the translation of representation can be interpreted as changing one form of representation to another form of representation. Ahmad, Rahmawati, and Anwar [15] state that translation can also indicate students' understanding of mathematical concepts needed in problem-solving.

According to Bossé, Adu-Gyamfi, and Chandler [14], translation activities include (1) unpacking the source is disclosing the information contained in the source representation, (2) the preliminary coordinator determining the initial steps/strategies for forming the target representation, (3) constructing the target is forming or producing a target representation, and (4) determining equivalence evaluates the suitability between the source representation and the target representation obtained. In line with that, Rahmawati et al. [16] also found the stages of translation of representations carried out by students, including unpacking the source, preliminary coordinator, constructing the target, and determining equivalence. Research on translation processes undertaken by Nizaruddin et al. [17] and Zulianto and Budiarto [10] also refer to research results of Bossé, Adu-Gyamfi, and Chandler [14].

Based on the results of research undertaken by Wijaya et al. [18], students have difficulty solving contextual problems. Furthermore, the errors experienced by the students included understanding errors (e.g., misunderstood instructions, keywords, and selecting information), transformation (e.g., wrong operations or concepts), mathematical processing (e.g., algebraic errors, measurements, and answers before completion) and coding (wrong operations) in the interpretation of the appropriate mathematical answers. As a result, these difficulties affect their learning outcomes. 21st-century learning requires students to have the ability to solve real problems creatively [15]. One of them is in learning mathematics wherein meeting these demands each student material is given an absolute or contextual problem to be solved.

Contextual problems are difficulties that are closely related to situations experienced by students in real life [19]. Contextual mathematics problems are mathematical problems that involve various contexts, giving rise to situations that students have experienced in real or directly [20]. So, contextual problems are those taken or adopted from contexts that occur in real life where students have experienced. The use of contextual problems allows students to use various forms of representation. Similarly, Tandiseru [21] states that contextual problems could improve students' representation translation skills. The representation is very influential in dealing with contextual problems because it can help interpret a problem obtained to determine the right and appropriate solution [4].

The representation translation ability of each student is different, one of which is influenced by gender [22]. Rosdiana, Budayasa and Lukito [23] state that gender differences affect problem-solving skills. The results of Erdem and Soylu's research showed that the reasoning of male students was significantly better than that of female students [24]. Jacklyn and Maccoby stated that, in general, females were superior in their verbal abilities while males were superior in their visual abilities [25]. Soenarjadi [26] also found that males were visually superior in solving problems, but females were superior in accuracy, precision, and thoroughness. So, the description illustrates that gender differences affect the translation process of student representation in solving contextual problems. This allows for differences in the form of the resulting representation.

Research on the translation of representations have been carried out by several researchers, including Swastika et al. [27], Duru and Koklu [28], Hidayati et al. [29], and Bosse, Gyamfi, and Cheetham [30]. From the results of research carried by Swastika et al. [27], there are still many students who do not fully understand the importance of

representation translation in solving mathematical problems, most of them only apply one form of representation as explained by the teacher. This causes the students' translation skills to be low. In line with that, Hidayati et al. [29] also found that the translation skills of junior high school students in solving linear equations of one variable are in a very poor category. Bosse, Gyamfi, and Cheetham [30] found that there are two most difficult representation translations where one of them is the translation from verbal representation to symbolic representation. This is reinforced by the results of research undertaken by Duru and Koklu [28] that students have difficulty in translating verbal representations into symbolic representations because of their incapacitation in understanding the problems given.

Some of the research above only focus on the representation translation process or activity and have not discussed in depth the representation translation failures experienced by students. As a result, the failures repeat yearly without any solutions to overcome them. Therefore, this study aimed to analyze further the failure of students' verbal to symbolic translations to solve contextual problems. The representation translation failures are the errors experienced by students during the representation translation process. The translation of verbal to symbolic representations in this study is limited to the initial stage of solving contextual problems, namely the stage of understanding the problem until finding a mathematical model that fits the contextual problem. It is expected that this study's results can later be used as a teacher as a reference in choosing the right strategy or method for the learning process to minimize student's failures or mistakes in answering questions related to representation translation and more optimal student learning outcomes.

2. Method

This qualitative study aimed to describe the failures occured in translating verbal representations to symbolic ones in solving contextual problems.

The research participants consisted of 8 students, four male students, and four female students in grade VII an Islamic public school at Gresik in the odd semester of the 2021/2022 academic year. They were chosen by using purposive sampling technique. Purposive sampling was a subject-taking technique based on specific criteria [31]. The selection of the research subject was carried out by considering that the student had not received the algebraic form material and was selected based on the test results where from the four variations or patterns of answers obtained, one male and one female student were taken to represent each variation of the answer with the mathematics teacher considerations or recommendations an Islamic public school at Gresik according to his communication skills to be interviewed.

The data collection technique used was the task of translating verbal representations into symbolic contextual problems and interviews. The data collection process began with the selected subjects completing all the mathematical representation translation tasks in order to obtain a pattern of failure experienced, then the subjects were interviewed on the results of the completion of the task to explore more information related to understanding or representational translation skills and the failure experienced by them.

The instrument used in this study consisted of the main instrument and the supporting instrument. The main instrument was the researcher himself, while the supporting instruments were the translation task of mathematical representations and semi-structured interview guidelines to reveal the translational skills of mathematical representations and to delve deeper into the failures experienced by the research subjects. The mathematical representation translation task instrument was used to measure the translation skills of

verbal to symbolic mathematical representations on contextual problems. This assignment was based on contextual questions on algebraic material to be converted into a mathematical form tailored to the research objectives. The questions made were then validated by experts, and then a test was conducted to determine the validity, reliability, difficulty index, and discriminating power. So, the obtained four questions were feasible and had the potential to be used in evaluating representations from verbal to symbolic as follows.

TABLE 1. The Tasks of Verbal to Symbolic Mathematical Representation Translation

Number	The Tasks of Translation	Topic
1	Ali is 5 years younger than Rosyid. Change the statement to mathematical form!	Linear Equation of Two Variables
2	The price of 9 packs of chocolate is IDR 63,000.00, and 3 packs of candy are IDR 15,000.00. Change the statement to mathematical form!	Linear Equation of One Variables
3	Adi bought 2 books and 1 pen at his school cooperative for IDR 7,500.00, Then Budi bought 3 books and 3 pens at the same place for IDR 13,500.00. Construct a mathematical model of the problem.	System of Two Variable Linear Equations
4	Ali has candy in the left pocket and right pocket of his pants. If one candy is moved to the right pocket, the number of candies in both pockets is the same. If one candy in the right pocket is moved to the left pocket, the number of candies in the left pocket becomes twice the number of candies in the right pocket. Construct a mathematical model of the problem above.	System of Two Variable Linear Equations (Complex Problem)

The obtained data were analyzed using the stages of the representation translation process adapted from Bossé, Adu-Gyamfi, and Chandler [13], namely unpacking the source, preliminary coordinator, constructing the target, and determining equivalence with refers to the representation translation indicators developed by researchers with expert validation in the table below.

TABLE 2. Indicators of Translation of Verbal to Symbolic Representations

Representation Translation Process	Indicator
Unpacking the source	1.1 Mention the information contained in the verbal representation 1.2 Identify what to look for and the adequacy of the information needed
Preliminary coordinator	2.1 Identify mathematical concepts and theorems related to constructing symbol representations 2.2 Identify previously solved problems that have the potential to help create symbolic representations 2.3 Drawing up a plan to make a symbolic representation
Constructing the target	3.1 Develop a symbolic representation of the problem based on the plan made
Determining equivalence	4.1 Evaluate the correctness of symbolic representations of verbal representations 4.2 Compose different symbol representations

Based on Table 2, in the unpacking of the source stage, there were two indicators related to students' skills in exploring the source representation. In the preliminary

coordinator stage, there were three indicators related to the ability to coordinate initial understanding and completion plans. In the constructing target stage, there was one indicator related to the ability of students in compiling symbol representations according to the plan made. In the determining equivalence stage, there were two indicators relating to the ability of students to evaluate the results and representation of different symbols.

The undertaken stages of data analysis were describing the data obtained according to the process and the indicators of the translation of the representation that was made and then presented in the form of a narrative that discussed the stages carried out and the form of failure experienced by the subject in completing the representation translation task, then interpreting the data by comparing it with previous research and conclude.

3 Results dan Discussion

The research participants were given contextual problems in verbal representations consisting of four questions. Participants were asked to convert them into the mathematical form of the problem. A given problem allowed students to solve it in several ways. Overall, from the 58 students' answers, students had translated from verbal to symbolic representations, but most still experienced failures or errors in the translation process. In other words, the symbol representations made were not in accordance with the verbal representations given.

Furthermore, from the students' answers, the researcher grouped into four patterns of answers based on the number of incorrect questions, then each pattern was selected by two students of a different gender who would be interviewed to dig deeper into their failures. Table 3 shows the selected participants.

TABLE 3. Research Participants

Wrong Answer Item (Pattern)	Number of participants meeting failure	Selected Participant's Initials	Gender	Code
1	10	DAS	Female	SP1
		FFDP	Male	SL1
2	40	ASA	Female	SP2
		SYP	Male	SL2
3	39	LS	Female	SP3
		MZA	Male	SL3
4	58	ZA	Female	SP4
		KD	Male	SL4

Based on the data above, it could be seen that for item 1 there were 10 failed students (17.24%), item 2 as many as 40 failed students (68.97%), item 3 as many as 39 failed students (67.24%), and item 4 all failed (100%). This showed that students' skills in translating from verbal to symbolic representations was still low.

The following explains the answers to the results of contextual problem solving, descriptions of selected participant interviews, and analysis of translation failures from verbal representations to symbolic representations with each pattern consisting of female and male participants.

3.1 Analysis and Discussion of Students' Representation Translation Failure Pattern 1

3.1.1 Participant SP1

After knowing the problem given, the participant solveed the problem as follows.

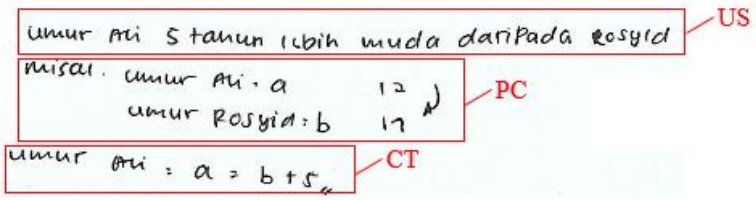


Figure 1. Answer of SP1 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SP101 : *Yes, I understand. I was asked to look for algebraic or mathematical forms*
P : *The algebraic form of what?*
SP102 : *From the statement that Ali's age is 5 years younger than Rosyid.*
P : *Is there sufficient information to solve the problem?*
SP103 : *Already*

Based on SP1's answer, SP1 rewrote the information from the statement given at the US stage, namely *Ali's age is 5 years younger than Rosyid*. Based on SP101 to SP103, the participant could understand the meaning of the question and identify what was sought and the adequacy of the information provided.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SP104 : *Let us say Ali's age is a and Rosyid's age is b, then make an illustration.*
P : *Have you ever received questions/materials like this before?*
SP105 : *Never*

At the PC stage, SP1 made a plan by assuming Ali's age was a and Rosyid's age was b, then tried to make an illustration by assuming that Ali's age was 12 years, so Rosyid's age was 17 years, and based on SP105 the participant had never encountered the same problem before. This meant that the participant could determine the initial idea in completing the given task.

Constructing the Target (CT) Stage

P : *Why use this symbol?*
SP106 : *Because it is just an example so you can use symbols in the form of any letters.*
P : *Why doesn't Rosyid's Age also use a?*
SP107 : *Because they are different, so the examples are also different.*
P : *Why is the operation used addition?*
SP108 : *Because it is "More" Sir.*

At the CT stage, SP1 wrote the model obtained was a=b+5. Based on SP106 and SP107, it was known that the participant was able to use and understand symbolic representations well but failed in translating the verbal word "Younger" into the form of mathematical operations, SP1 used the addition operation because the keyword taken was "More," where should use the operation was subtraction. Although the actual use of the addition operation could be justified if the model obtained was b=a+5. Based on this answer, SP1 failed to compose the requested symbolic representation, so it failed at this stage.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SP109 : *Sure*
P : *What makes you sure? How do you make sure it is correct?*
SP110 : *I don't know, Sir.*
P : *Are there other forms?*
SP111 : *None*

At the DE stage, SP1 was confident with the results obtained but did not know how to check them, and this could be seen from the results of interviews with SP110 and SP111. The participant also did not know that there were other forms. This made the participant not know that the answer was wrong. So, based on the interview results, SP1 had not been able to evaluate the truth and arrange other symbolic representations so that it failed at this stage.

Based on the results obtained, Figure 2 shows a process flow diagram and the failures experienced by the participant of SP1.

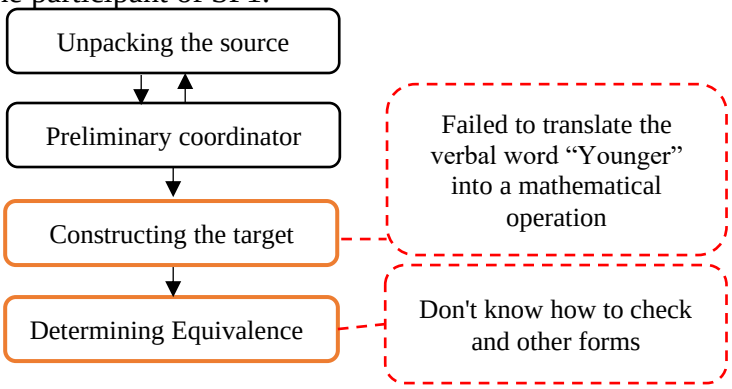
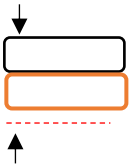


Figure 2. Process and Failure of SP1 Participant

Information:



: Process direction
: The process is done right
: The process failed
: Explanation
: Repeat to the previous process

3.1.2 Participant SL1

After knowing the problem given, the participant solveed the problem as follows.

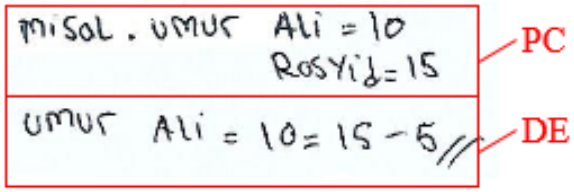


Figure 3. Answer of SL1 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SL101 : *Yes, I understand a little, sir, I was told to change it to mathematical form.*

P : *Is there sufficient information to solve the problem?*
SL102 : *Already*
P : *What information is provided?*
SL103 : *Ali is 5 years younger than Rosyid.*

SL1 did not rewrite the information provided at the US stage but disclosed it during the SL103 interview. Based on SL101 and SL102, the participant also did not understand the meaning of the question, but the participant knew that what he was looking for was a form of mathematics and felt that the information provided was sufficient.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SL104 : *Determine Ali's age, then determine Rosyid's age*.
P : *Have you ever received questions/materials like this before?*
SL105 : *Never*

At the PC stage, SL1 assumed Ali's age was 10 and Rosyid's age was 15, this was by the results of the SL104 interview that the settlement plan was to determine Ali's age and then determine Rosyid's age and SL1 had never received the same question before. Based on this answer, SL1 did not understand the requested symbolic representation, so it failed at this stage.

Constucting the Target (CT) Stage

P : *Why use Ali's age to be 10?*
SL106 : *because it was changed to mathematical form, so I took 10, sir*.
P : *Why is Rosyid not 10 too?*
SL107 : *Because Ali is 5 years younger, so Rosyid is 15 years old*.
P : *What do you think is a mathematical symbol?*
SL108 : *Math numbers*

Based on the answers given, SL1 did not do the CT stage because SL1 did not bring up variables in the previous stage. Based on the SL108 interview, there was a failure experienced by the participant, namely in understanding mathematical forms, where the participant considered the mathematical form to be a math number, so the participant assumed Ali's age was 10 and Rosyid's age was 15. So, SL1 had not composed the requested symbolic representation, so it failed at this stage.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SL109 : *Yes, I'm sure*.
P : *What makes you sure? How do you make sure it's correct?*
SL110 : *The result is the same as the question*.
P : *Are there other forms?*
SL111 : *Yes, 10+5=15*

At the DE stage, proven that Ali's age = 10 = 15-5 and was confident with the results obtained from the SL110 and SL111 interviews, the correction method was carried out by equating the results with questions. SL1 also explained the existence of another form, namely 10+5=15. However, due to the failure experienced at the PC stage, the final answer was also wrong.

Based on the results obtained, Figure 4 shows a process flow diagram and the failures experienced by the participant of SL1.

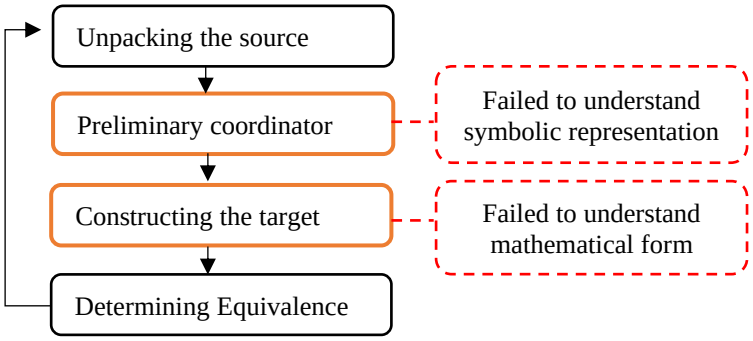


Figure 4. Process and Failure of SL1 Participant

3.2 Analysis and Discussion of Students Representation of Translation Failure Pattern 2

3.2.1 Participant SP2

After knowing the problem given, the participant solved the problem as follows.

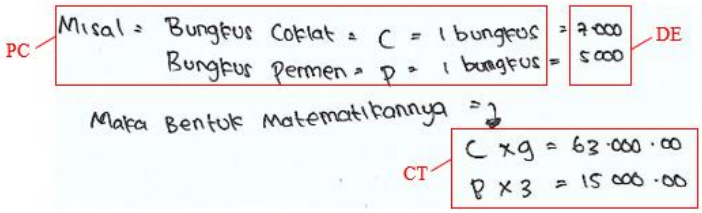


Figure 5. Answer of SP2 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*

SP201 : *Yes, sir, I was told to change it to mathematical form.*

P : *Is there sufficient information to solve the problem? Explain!*

SP202 : *Already, sir, 9 packs of chocolate for 63,000, and 3 packs of candy for 15,000.*

At the US stage, SP2 did not rewrite the information provided, but revealed in interviews SP201 to SP202, the participant was also able to identify what they were looking for and the sufficiency of the information provided.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*

SP203 : *Read the problem, make an example that I take from the first letter of the object, then make a model according to the problem given and check the results.*

P : *Have you ever received questions/materials like this before?*

SP204 : *I think there was a time when I was in elementary school, but I forgot*.

At the PC stage, SP2 assumed 1 pack of chocolate was the same as C, and 1 pack of candy equaled P. In the interview, SP203 explained the plan carried out, namely reading the problem, making an example that I took from the first letter of the object, and then making a model according to the problem given and checking the result. The participant further explained that he had encountered the same problem before but forgot. Based on the answers presented, the participant could determine the initial idea in completing the

given task but fails to identify concepts, mathematical theorems, and related problems in compiling symbolic representations, so he failed at this stage.

Constructing the Target (CT) Stage

P : *Does that mean C is 1 pack of chocolate or the price of chocolate?*
SP205 : *1 pack of chocolate*
P : *Not the price?*
SP206 : *No*
P : *Then why is there C=7000?*
SP207 : *That's because the price of 9 chocolates is 63,000, so the price for 1 pack is 7,000.*
P : *Why not use the same symbol for candy, namely C?*
SP208 : *The objects are different, so the examples are also different*.

At the CT stage, SP2 wrote down 2 equations that were models of the given problem, namely C×9=63,000 and 3×P=15,000. In the interview, SP205 confirmed that C meant 1 pack, not the price, and explained that the symbols used were different because the objects were different. Based on this answer, SP2 failed, which he did not realize, namely in translating the quantity of chocolate (verbal) into a variable (symbolic) which should be the price of chocolate each pack. So based on this answer, SP2 had not been able to compose the requested symbolic representation, so he failed at this stage.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SP209 : *Yes, I'm sure sir.*
P : *What makes you sure? How do you make sure it's correct?*
SP210 : *From the model, if 9 is moved, section C = 7,000 is the same as the meaning of the question.*

At the DE stage, SP2 wrote down the price of each pack of chocolate = 7,000 and each pack of candy = 3,000. The participant believed in the results obtained, according to the interview results, SP209 and SP2 explained how the correction was made from the model, if 9 was moved, then C = 7,000 was the same as the question's meaning.

Based on the results obtained, Figure 6 shows a process flow diagram and the failures experienced by the participant of SP2.

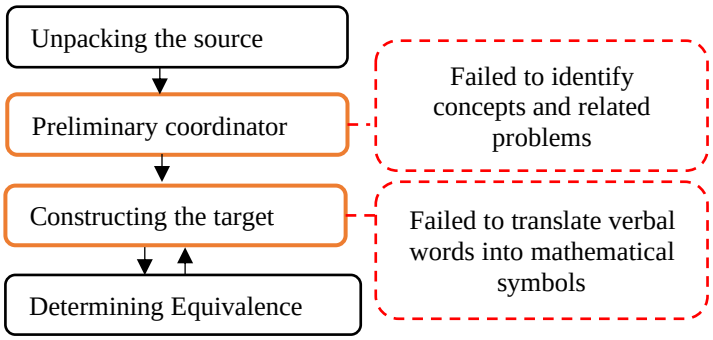


Figure 6. Process and Failure of SP2 Participant

3.2.2 Participant SL2

After knowing the problem given, the participant solved the problem as follows.

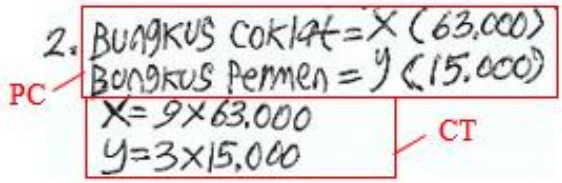


Figure 7. Answer of SL2 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SL201 : *God willing, understand*
P : *Can you explain what you understand from the question?*
SL202 : *Given a statement then asked to change it to mathematical form.*
P : *Is there sufficient information to solve the problem? Explain!*
SL203 : *Yes, the price of 9 packs of chocolate is 63,000, and the price of 3 packs of candy is 15,000.*

SL2 did not rewrite the information provided at the US stage but revealed it in the SL203 interview. Based on the answers to the SL201 interview, the participant also understood the meaning of the question and felt that the information provided was sufficient, namely the price of 9 packs of chocolate was 63,000, and the price of 3 packs of candy was 15,000.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SL204 : *The first step is to make an example first, then make a model according to the given problem.*
P : *Have you ever received questions/materials like this before?*
SL205 : *If the question is not yet, but the material seems to have been, sir.*
P : *What is the material about?*
SL206 : *Forgot, sir*

At the PC stage, SL2 assumed that the chocolate pack equaled x (63,000) and the candy wrapper equaled y (15,000). Based on the interview, SL204 explained the plan that was carried out, namely the first step was to make an example first and make a model according to the problem given. SL205 also explained that he had never encountered the same problem before but forgot. Based on these answers, the participant could determine the initial idea in completing the given task but fails to identify concepts, mathematical theorems, and related problems in compiling symbolic representations namely, the participant had been unable in the example process carried out, which should only be in the form of symbols not the other information needs to be entered. As a result, the participant failed at this stage.

Constucting the Target (CT) Stage

P : *Why in the first step of chocolate pack = x (63,000)?*
SL207 : *I take the example of x for a chocolate pack.*
P : *Then why is there (63,000)?*
SL208 : *That's because the question is given the chocolate for 63,000.*
P : *x represents how many packs?*
SL209 : *1 pack sir*
P : *So, what's the model? Try to explain?*
SL210 : *Like this, sir, because there are 9 chocolates, the model is $x=9\times63{,}000$.*
P : *Why not use the same symbol for candy, namely x?*
SL211 : *Because they are two different types.*

At the CT stage, SL2 wrote down the model of the given problem, namely x=9×63,000 and y=3×15,000. In the SL209 interview, it was explained that x represented 1 pack, and there were (63,000) because gave it in the problem. SL2 also explained in SL211 that it did not use the same symbol because the two types were different. Based on that answer, SL2 failed in translating the quantity of chocolate (verbal) into a variable (symbolic), supposedly the price of chocolate each pack and the symbolic representation obtained was wrong, where SL2 equated the variable with the product of multiplying the number of objects with the price, for this occurred due to a failure at the PC stage.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SL212 : *God willing, sir.*
P : *What makes you sure? How do you make sure it's correct?*
SL213 : *If I read it again, it is the same as the problem given.*

In the DE stage, SL2 believed in the results obtained, and SL213 explained how the correction was made by reading the solution and equating it with the given problem.

Based on the results obtained, Figure 8 shows a process flow diagram and the failures experienced by the participant of SL2.

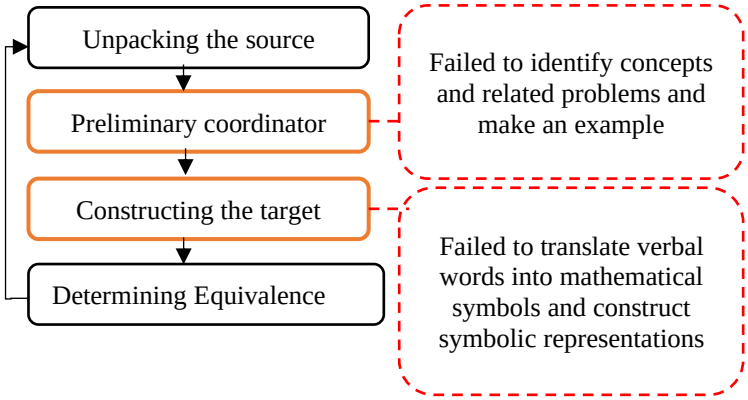


Figure 8. Process and Failure of SL2 Participant

3.3 Analysis and Discussion of Students Representation Translation Failure Pattern 3

3.3.1 Participant SP3

After knowing the problem given, the participant solved the problem as follows.

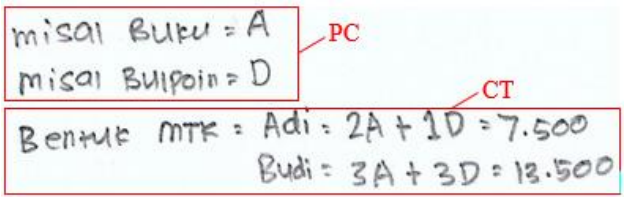


Figure 9. Answer of SP3 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SP301 : *Yes, sir, I was asked to change the statement to its mathematical form.*
P : *Is there sufficient information to solve the problem? Mention any information!*

SP302 : *Yes, Adi bought 2 books and 1 pen for 7,500, and Budi bought 3 books and 3 pens for 13,500.*

At the US stage, SP3 did not rewrite the information provided but revealed in the interview SP302 that the information provided by Adi bought 2 books and 1 pen for 7,500, and Budi bought 3 books and 3 pens for 13,500 and felt that was enough. Based on the interview SP301, the participant understood the problem given.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SP303 : *Read the questions first, determine what is for example, make a model.*
P : *Have you ever received questions/materials like this before?*
SP304 : *Have you ever seen questions like this.*
P : *About what material?*
SP305 : *Hmmm… algebra if I'm not mistaken.*

At the PC stage, SP3 gave example of a book with A and a ballpoint pen with D. In the interview, SP3 explained that the plan was to read the questions first, determine the examples, and make a model. Furthermore, SP3 also explained that he had encountered the same problem before and often mentioned that the related material was algebra, although he was still unsure. Based on these answers, SP3 could determine the initial idea in completing the given task and identify related concepts and problems solved before.

Constructing the Target (CT) Stage

P : *If the example is not A and D, is it okay?*
SP306 : *Yes, what matters is a letter symbol.*
P : *Why did you take the example of books and pens?*
SP307 : *Because of the similarity of the things that Adi and Budi bought, and as far as I know, the separation is usually for objects.*
P : *So, A is for example a book or 1 book or the price of 1 book?*
SP308 : *Just book*
P : *If 2A means 2 books?*
SP309 : *Yes*
P : *Why are books and ballpoint pens made of different distinctions?*
SP310 : *Because they are two different things*
P : *There are Adi and Budi, why are they using the same example?*
SP311 : *Because I bought it at the same shop.*

At the CT stage, SP3 wrote down the model of the given problem, namely Adi=2A+1D=7,500 and Budi=3A+3D=13,500. Based on the SP308 interview conducted, it was explained that A represented the book and explained the reason for taking the example of books and ballpoint pens because of the similarity of Adi and Budi's objects. They agreed that the separation was usually for things. Based on the answers at the interview, the participant understood symbolic representation quite well. Still, there was a failure that he did not realize, namely in translating a book (verbal) into a variable (symbolic) instead of the price of a book. So, at this stage, SP3 failed.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SP312 : *Sure, sir*
P : *What makes you sure? How do you make sure it's correct?*
SP313 : *Same as the question given, how to read it again, sir*

At the DE stage, SP3 believed in the results obtained from the SP312 interview and explained how to correct the answer by rereading the questions and solving them.

Based on the results obtained, Figure 10 shows a process flow diagram and the failures experienced by the participant of SP3.

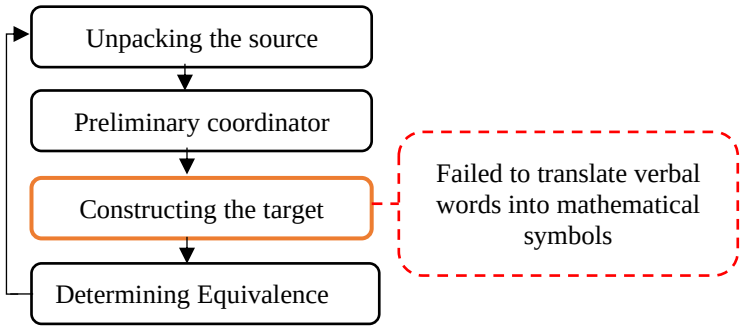


Figure 10. Process and Failure of SP3 Participant

3.3.2 Participant SL3

After knowing the problem given, the participant solved the problem as follows.

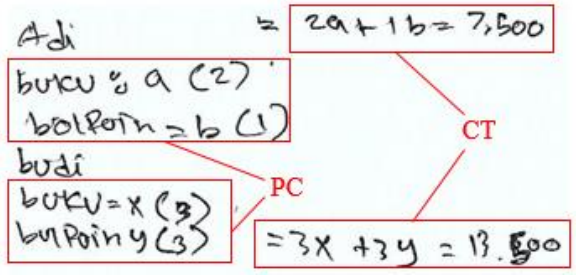


Figure 11. Answer of SL3 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*

SL301 : *Yes, I understand. Looking for the mathematical form.*

P : *Is there sufficient information to solve the problem? Mention any information!*

SL302 : *In my opinion, Adi bought 2 books and 1 pen for 7,500 and Budi bought 3 books and 3 pens for 13,500.*

At the US stage, SL3 did not rewrite the information provided but revealed in the SL301 interview that understanding the problem given and mentioning the information provided was sufficient, namely Adi bought 2 books and 1 pen for 7,500 and Budi bought 3 books and 3 pens at a price 13,500 in SL302.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*

SL303 : *Make an example, then make a mathematical form.*

P : *Have you ever received questions/materials like this before?*

SL304 : *Never, but you know, sir.*

P : *About what material?*

SL305 : *I don't know, sir.*

At the PC stage, SL3 assumed that what Adi bought, books = a(2) and pens = b(1), while what Budi bought, books = x(3) and pens = y(3). SL3 in the interview, explained that the plan was to make an example, then make a mathematical form. Furthermore, SL3 also explained that they had never encountered the same problem before and did not know the related material. Based on these answers, the participant determined the initial idea in solving the given problem. Still, the participant did not understand symbolic

representation, so he failed to translate the same object with 2 different symbols, where one symbol should represent two different objects. Same because bought it at the same place. In addition, based on the interview results, SL3 also failed to identify concepts, mathematical theorems, and related questions, so SL3 failed at this stage.

Constructing the Target (CT) Stage

P : *Why did you take the example of books and pens?*
SL306 : *Because the object in question is a book and a pen.*
P : *Why not Adi and Budi?*
SL307 : *Because that's someone's name, sir.*
P : *In the example of a does it mean books or many books or the price of books?*
SL308 : *Book*
P : *So how many books is a?*
SL309 : *2 sir, because I bought 2 books.*
P : *Why are books and pens made for each child differently?*
SL310 : *Because the person who bought it was different*
P : *If it's made the same, can it be done?*
SL311 : *No*
P : *For example, if you buy a book = a and a pen = a, is that okay?*
SL312 : *No, because it's a different thing.*

At the CT stage, SL3 wrote down the given model with Adi=2a+1b=7,500 and Budi=3x+3y=13,500. Based on SL306 and SL307 interviews, the participant understood keywords that could be for example objects but based on SL308, the participant failed to translate the quantity of books (verbal) becomes a variable (symbolic) which should be the price of a book, for the other variables are also the same. As a result of the failure experienced, the final result of the symbolic representation obtained was also wrong. So, at this stage, SL3 failed.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SL313 : *Sure*
P : *What makes you sure? How do you make sure it's correct?*
SL314 : *I don't know, sir. Waiting to be corrected.*
P : *Are there other forms of the obtained model?*
SL315 : *No, sir*

At the DE stage, SL3 believed in the results obtained from the results of the SL313 interview but based on SL314, the participant did not know how to correct it. The participant also did not know the existence of other forms. As a result, the participant was not aware of the failure he had experienced. So, based on the results of the interview, SL3 had not been able to evaluate the truth and arrange other symbolic representations so that the participant failed at this stage.

Based on the results obtained, Figure 12 shows a process flow diagram and the failures experienced by the participant of SL3.

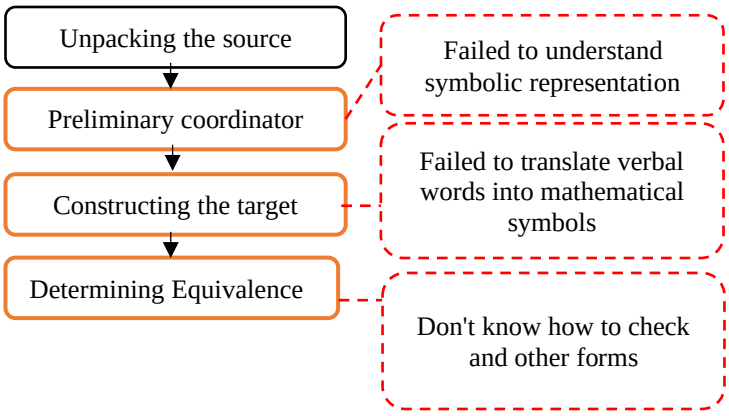


Figure 12. Process and Failure of SL3 Participant

3.4 Analysis and Discussion of Student's Representation Translation Failure Pattern 4

3.4.1 Participant SP4

After knowing the problem given, the participant solved the problem as follows.

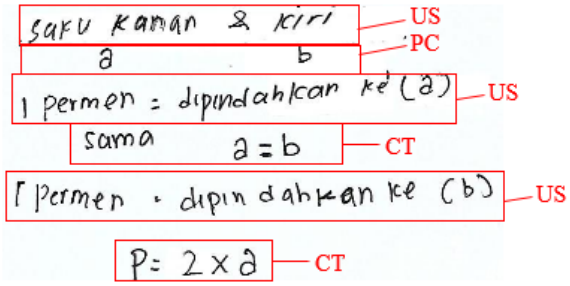


Figure 13. Answer of SP4 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SP401 : *Honestly, no, sir. I'm just trying it.*
P : *Can you explain what the question means?*
SP402 : *Make a mathematical model of the problem given, sir.*
P : *Is there sufficient information to solve the problem? Mention any information!*
SP403 : *Maybe already, 1 candy in the left pocket if moved to the right pocket, the amount is the same, if 1 candy in the right pocket is moved to the left then the number on the right is 2 more.*

At the US stage, SP4 rewrote the information provided and confirmed in the SP401 interview that the participant did not understand the question's meaning. Based on SP403, according to him, the information provided may be sufficient, namely 1 candy in the left pocket if moved to the right pocket, the amount was the same. If 1 candy in the right pocket was moved to the left, then the number on the right was 2 more. Based on these answers, the participant could state the information contained. However, the participant failed to identify the adequacy of the information available because he did not fully understand the problem given. However, the participant still tried to solve it according to what he understood.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SP404 : *Understand the problem, make an example, write the appropriate model.*
P : *Have you ever received questions/materials like this before?*
SP405 : *Never*

At the PC stage, SP4 wrote the example for the right pocket is a, while the left pocket was b. Based on SP404, the problem-solving plan was to understand the problem, make an example, and write the appropriate model. The participant felt that he had never encountered the same problem. Based on these answers, the participant could determine the initial idea in solving the given problem but failed to identify concepts, mathematical theorems, and related questions. As a result, the participant failed in choosing keywords to model, where a should represent many candies in the right pocket, and b many candies in the left pocket. So, at this stage, SP4 failed.

Constructing the Target (CT) Stage

P : *Why do you take the right pocket and left pocket?*
SP406 : *Because in my opinion, the main focus is on the problem, sir.*
P : *So, a is the same as the left pocket? Or something else?*
SP407 : *Yes, sir*
P : *1 candy is moved to (a), can you explain what it means?*
SP408 : *If 1 candy is moved to the right pocket, then the candy in the right pocket is the same as in the left pocket.*
P : *Where did the candy come from?*
SP409 : *From left pocket*
P : *So, the number of candy equals a? is that so?*
SP410 : *Yes, sir*
P : *What is the symbol for P?*
SP411 : *Ohw.. sorry sir, it should be b, not P.*

SP4 wrote that the model obtained was a=b when 1 candy was moved to the right pocket and b=2a when 1 candy was moved to the left pocket in the CT stage. Based on the interview, SP406 explained taking the example because the main focus was on the right and left pockets. The participant also confirmed that a was a pocket object and much candy corresponds to a. The participant initially wrote the symbol P, but in the interview, SP4011 confirmed that it should be b. Based on the answer, SP4 also failed to use the correct operation corresponding to the problem given. It was seen that SP4 could not understand the operation that represented the word "moved," which the model should be b-1=a+1 and a-1=2(b+1). So, based on this answer, SP4 had not been able to compose the requested symbolic representation, so the participant failed at this stage.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SP412 : *Not sure*
P : *Why are you not sure?*
SP413 : *Because I've never encountered such a problem.*
P : *Do you know how to correct it?*
SP414 : *No, sir*
P : *Are there other forms?*
SP415 : *No, sir*

In the DE stage, based on SP412 to SP414, the participant was unsure of the answer because they had never received a similar question before so the participant did not know how to correct it. So, based on the interview results, SP4 had not been able to evaluate the truth and arrange different symbolic representations so that the participant failed at this stage.

Based on the results obtained, Figure 14 shows a process flow diagram and the failures experienced by the participant of SP4.

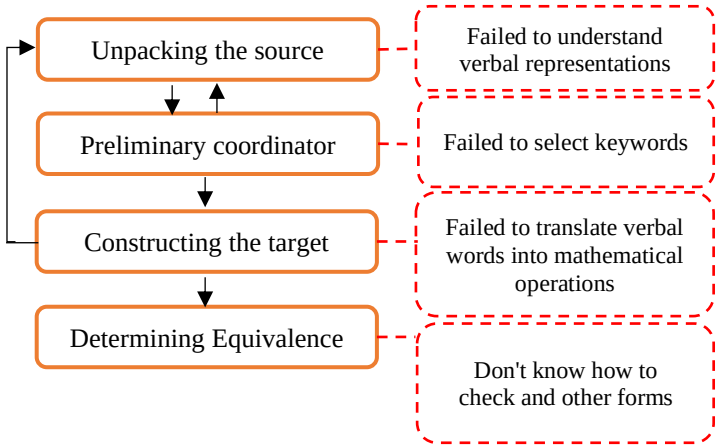


Figure 14. Process and Failure of SP4 Participant

3.4.2 Participant SL4

After knowing the problem given, the participant solved the problem as follows.

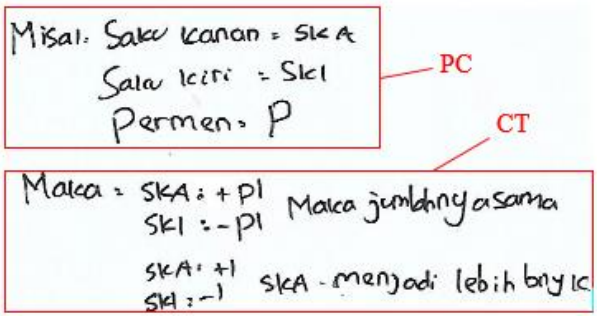


Figure 15. Answer of SL4 Participant

While the results of interviews with the participant are as follows:

Unpacking the Source (US) Stage

P : *Do you understand the problem given? Explain!*
SL401 : *Yes, I understand. Looking for the mathematical form*
P : *Is there sufficient information to solve the problem?*
SL402 : *In my opinion, not enough*
P : *Can you explain what is missing?*
SL403 : *I don't know, sir*
P : *If so, try to mention the important information in the question?*
SL404 : *Candy in the right and left pockets, if you move 1 to the right the amount is the same, if you move 1 to the left, the right one is twice as much.*

At the US stage, SL4 did not rewrite the information given. Still, it was conveyed in the SL401 interview that the participant understood the meaning of the question, and according to him, the information provided was still lacking. Still, the participant did not know what the lack of information was. The participant in SL404 explained essential information from the question, namely the candy in the right and left pockets. If you moved 1 to the right, the number was the same, if you move 1 to the left, the right one was twice as much. Based on the answers given, SL4 mentioned the information

contained. However, the participant still did not understand the problem given, namely not identifying the adequacy of the required information, so he failed at this stage.

Preliminery Coordinator (PC) Stage

P : *Can you explain your plan for the solution?*
SL405 : *Making an example of the right and left pocket, making the model.*
P : *Have you ever received questions/materials like this before?*
SL406 : *Never*

At the PC stage, SL4 assumed the right pocket with SKA, the left pocket with SKI, and candy P, then SL405 explaind the problem-solving plan was to make an example of the right and left pocket, make a model, and based on SL406, the participant conceived that he had never encountered a problem the same one. Based on these answers, the participant could determine the initial idea in solving the given problem but failed to identify concepts, mathematical theorems, and related questions. As a result, SL4 failed in selecting the keywords to be used, translating the pocket object (verbal) into a variable (symbolic) which should be a lot of candy in the pocket. So, at this stage, he failed.

Constructing the Target (CT) Stage

P : *Why did you take right, left, and candy pockets?*
SL407 : *Because I think that's the example.*
P : *Can you explain the model you got?*
SL408 : *If SKA is added by 1 candy and SKI is reduced by 1 candy, the amount of each pocket is the same. If SKA is added by 1 candy and SKI is reduced by 1 candy, the SKA is more.*
P : *Why for example, with SKA, SKI and P?*
SL409 : *Taken from the first letter, sir.*
P : *If left pocket = a and right pocket with b, is it okay?*
SL410 : *Yes, you can*
P : *There is the same number of candies in each pocket, can it be modeled?*
SL411 : *No*

In the CT stage, SL4 wrote down the obtained model: If SKA was added by 1 candy and SKI was reduced by 1 candy, the number of each pocket was the same. If 1 candy added SKA and 1 candy reduced SKI, the SKA was more, this was also stated in SL408. Furthermore, based on SL411, according to SL4 the verbal sentence *the number of candies per pocket is the same* could not be modeled. Based on this answer, the participant had not been able to compose a symbolic representation of the problem based on the plan made, as a result the participant failed.

Determining Equivalence (DE) Stage

P : *Are you sure about the answer?*
SL412 : *Bismillah sure*
P : *What makes you sure? How do you make sure it's correct?*
SL413 : *I don't know, sir.*
P : *Are there other forms of mathematics?*
SL413 : *I don't know, sir.*

In the DE Stage, based on SL412 and SL413, the participant was sure of the answer even though he did not know how to correct it. As a result, the participant was not aware of the failure he had experienced. So, based on the results of the interview, SL4 had not been able to evaluate the truth and arrange other symbolic representations so that the participant failed at this stage.

Based on the results obtained, Figure 16 shows a process flow diagram and the failures experienced by the participant of SL4.

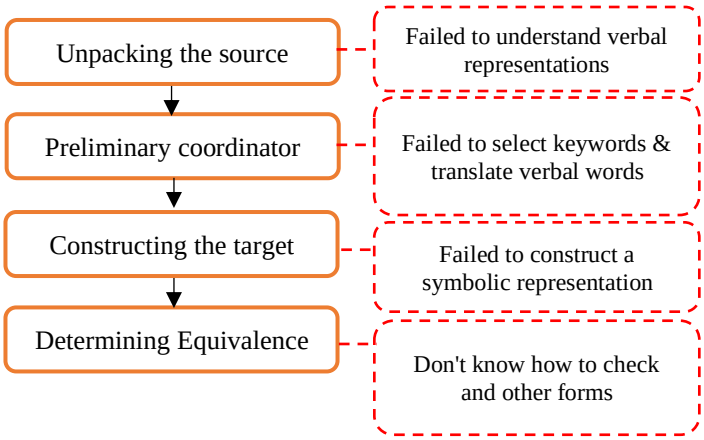


Figure 16. Process and Failure of SL4 Participant

Based on the explanation above, Table 4 summarizes the forms of translation failures from verbal representations to symbolic representations of research participants.

Table 4. Summary of the forms of failure to translate verbal representations to symbolic representations of research participants

Wrong Question Items	Participant	M/F	Location of Failure by Stage of Translation				Indicator not fulfilled
			US	PC	CT	DE	
1	DAS	F	×	×	√	√	3.1, 4.1 and 4.2
	FFDP	M	×	√	√	×	2.1, 2.2, 2.3 and 3.1
2	ASA	F	×	√	√	×	2.1, 2.2 and 3.1
	SYP	M	×	√	√	×	2.1, 2.2 and 3.1
3	LS	F	×	×	√	×	3.1
	MZA	M	×	√	√	√	2.1, 2.2, 3.1, 4.1 and 4.2
4	ZA	F	√	√	√	√	1.2, 2.1, 2.2, 3.1, 4.1 and 4.2
	KD	M	√	√	√	√	1.2, 2.1, 2.2, 3.1, 4.1 and 4.2

Information:
√ : The process failed
× : The process is done right

Based on Table 4, the failures experienced by students in each item and indicators that had not been met could be seen as a result of the failures experienced. Male students experienced different failures from female students. This was in line with the results of the Saputra's research [22] that showed that each student's representational translational skills were different, one of which was influenced by gender. Jacklyn and Maccoby's conveyed that female was superior in verbal while male was superior in visual [25].

At unpacking the source stage, both male and female students experienced the same failure, namely not understanding contextual problems given to complex problems, where students had not been able to identify the adequacy of the information provided. This was in line with the results of the Mangulabnan's research [32] that students could also experience failure when they could not understand words, phrases, or sentences in a given problem. This was a common failure that often occurred when the given problem was more complex. Rahmawati and Anwar [3] also stated that students were still lacking in understanding the events represented verbally. Gooding also found that most students had

difficulty understanding the problem [30]. Failure at this stage affected the next stage in solving the given problem

In the preliminary coordinator stage, most of the male students experienced failure. The failures they experienced did not understanding the requested symbolic representation, not understanding the meaning of symbols in mathematical models, and incorrectly determining keywords. This was in line with Duru and Koklu's research [28] that revealed that students had difficulty translating from verbal to symbolic representations in algebraic equations using symbols. Swastika et al. [27] showed that many students still failed to understand the meaning of variables in modeling. In contrast, the female students who failed at this stage were only a few students, where the failure they experienced resulted from failure at the unpacking the source stage.

At construction the target stage, students tended to experience failure. Male students tended to fail to construct symbolic representations of the plans made and fail to translate verbal words into mathematical symbols of the problems given. This was in line with the finding of Mangulabnan [32], that students experienced algebraic translation failures where the target representation had a different meaning from the source representation. In addition, there were also failures in translating verbal words into mathematical sentences. This showed that students did not know how to use variables correctly and could not distinguish one variable representation from another. The failure experienced by male students resulted from the failure at the preliminary coordinator stage.

Female students experienced failure to translate verbal words into mathematical symbols and failed to translate verbal words into mathematical operations. This was in line with the Ati's research [34] that one of the failures occurred when the operation used was not following the verbal statement in the question, which was called an operation failure. Mangulabnan [32] also found an operation failure defined as a failure in the use of basic mathematical operations such as addition, subtraction, division, and multiplication.

At the determining equivalence stage, some students evaluated the answers obtained even though they did not find the failure they experienced. While others still could not evaluate the truth of the symbol representation obtained and did not know of any other form of the mathematical model of the given contextual problem. As a result, students do not know the failure they have experienced. This was in line with the expression of Swastika et al. [27] that, on average, students were not aware of the mistakes made because of their lack of ability to evaluate. Ahmad, Rahmawati, and Anwar [15] also found that some students did not determine equivalence.

Therefore, based on the results and discussion above, it was generally found that the failure of representation translation was influenced by gender, although not significantly. The location of the difference in failure occurred at the preliminary coordinator stage, where male students failed more at this stage, while female students tended to fail at the constructing the target stage. Female students were better than male students. This followed Mhlanga's statement [35] that female students could solve problems correctly and thoroughly while male students could solve problems correctly, but not meticulously.

4 Conclusions

Based on the results of the analysis and discussion related to the failure of the translation of verbal to symbolic representations in solving contextual problems experienced by students, it can be concluded that at the stage of unpacking the source, both male and female experience the same failure, namely not being able to understand the contextual problems given. This will only happen for complex problems. Although

both fail at this stage, female is better at verbal skills. At the preliminary coordinator stage, male tends to experience failure, namely failing to understand the requested symbolic representation, not understanding the meaning of symbols in mathematical models, and incorrectly determining keywords, while female only experiences failure due to their mistakes in the previous stage. At the stage of constructing the target, both male and female tend to experience failure at this stage. Male experiences failure in constructing symbolic representations of the plans made and fail to translate verbal words into mathematical symbols, while female experiences failure in translating verbal words into mathematical symbols and fail to translate verbal words into mathematical operations. Although they both fail at this stage, female is better at composing the requested symbolic representation. At the determining equivalence stage, several male and female students fail because they still cannot evaluate the truth of the symbol representation obtained and do not know of other forms of mathematical models. This causes students not to realize the failure they have experienced.

Henceforth, the failures experienced generally occur due to failure to understand symbolic representations, so the researchers suggest to mathematics teachers to be able to design appropriate learning, one of which is by placing more emphasis on understanding the concept of symbolic representation, how to write symbols, and increasing practice solve contextual problems. In addition, the differences in abilities between female and male can be used as a reference in choosing the suitable learning model. This study is only limited to the failure of the translation of verbal to symbolic representations in solving contextual problems qualitatively and has not been able to provide an overview of other representational translation failures. Thus, it is suggested that this study can be continued with quantitative research with a large number of participants to generalize the location of translational failures that often occur.

5 References

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