Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES
P-ISSN 2581-1657
E-ISSN 2581-2203

An Exploration of Students' Understanding of Mathematical Concepts Based on the Information Processing System at MAN 1 Muaro Jambi

Randy Oktarino*, Jefri Marzal, Rohati
Magister of Mathematics Education, Universitas Jambi, Jambi, 36361, Indonesia

ARTICLE INFO

Article history:

Received: 09 June 2025
Revised: 13 June 2025
Accepted: 15 June 2025
Published online: 15 July 2025

Keywords:

Understanding of Mathematical Concepts, Information Processing System

* *Corresponding author:*

E-mail: randyoktarino@gmail.com

Article Doi:

https://doi.org/10.31258/jes.9.4.p.2864-2883

A B S T R A C T

Understanding mathematical concepts is one of the essential and fundamental aspects of mathematics learning in schools, with the aim of enabling students to develop the ability to understand mathematical concepts, explain the relationships between concepts, and apply concepts or algorithms flexibly, accurately, efficiently, and appropriately in problem-solving. This study aims to analyze and understand the extent to which students comprehend mathematical concepts, as well as to evaluate the effectiveness of the information processing system at MAN 1 Muaro Jambi in supporting students' understanding of mathematical concepts. This research is exploratory in nature and employs a descriptive qualitative approach. The research subjects consist of three tenth-grade students selected using purposive sampling. The instruments used in this study are a mathematical concept comprehension test on the topic of SPLTV and interviews. Data analysis was conducted by reducing data from written tests and interviews, and by using methodological and source triangulation. The results of the study show that the three subjects demonstrated different levels of conceptual understanding, which were based on the memory storage components involved in each subject. It is therefore concluded that students whose information processing reached the Long Term Memory stage demonstrated a better exploration of mathematical concept understanding compared to those whose processing only reached the Short Term Memory and Sensory Register stages.

1. Introduction

Understanding mathematical concepts is one of the essential and fundamental aspects of mathematics learning. Mathematics instruction in schools aims to equip students with the ability to understand mathematical concepts, explain the relationships between concepts, and apply concepts or algorithms flexibly, accurately, efficiently, and appropriately in problem solving (Mawaddah &

Maryanti, 2016). According to Sanjaya (2009), conceptual understanding is a student's ability not only to master a certain amount of subject matter, but also to express it in another form that is easier to understand, to interpret data, and to apply the concept in accordance with their cognitive structure (Sanjaya, 2009).

According to Romadon & Mahmudi (2019), the ability to understand mathematical concepts is a fundamental and essential skill that students must possess in order to develop higher-level mathematical abilities and to classify objects based on their definitions. Meanwhile, Sayekti (2019) defines the ability to understand mathematical concepts as the capacity to absorb and comprehend mathematical ideas by expressing them in the form of mathematical representations, creating problem-solving algorithms using one's own language, and applying concepts in accordance with the knowledge they possess. Therefore, it can be concluded that conceptual understanding is not merely about recalling a concept, but rather about students being able to construct and master the concept without relying on memorization (Romadon & Mahmudi, 2019; Sayekti, 2019).

According to Wahyuningsih et al. (2019), mathematics has recently become a subject that is disliked by some students. This is due to several factors, such as students' initial assumption that learning mathematics is difficult, the complexity of problem explanations, the difficulty of memorizing and understanding formulas, and so on, which have led some students to eventually dislike mathematics. However, according to Rosmawati & Sritresna (2021), in mathematics learning, students are often accustomed to memorizing concepts without understanding how those concepts are formed. As a result, when given problems that differ from the examples provided by the teacher, students struggle to solve them due to a lack of conceptual understanding (Wahyuningsih et al., 2019; Rosmawati & Sritresna, 2021).

Learning mathematics with conceptual understanding requires a high level of reasoning, as mathematical objects are abstract in nature. Therefore, mathematics learning should be directed toward understanding concepts that lead individuals to think mathematically in a clear and precise manner, based on logical and systematic rules. Conceptual understanding of each topic taught by the teacher is essential for every student, as it can support memory retention and make it easier to solve mathematical problems that involve numerous formulas (Aini et al., 2020).

The process of remembering material is related to how a person absorbs, organizes, and processes information or learning content. Information processing refers to the steps taken by students to acquire information, monitor it, and develop strategies related to the information through an approach that focuses on memory processes and ways of thinking (Suryana et al., 2022). The depiction or model of the brain's activity when processing information is known as the learning theory by Gagné (1988), called the "Information Processing Learning Theory." According to Gagné, learning involves a process of receiving information, which is then processed to produce output in the form of learning outcomes (Suryana et al., 2022; Rehalat, 2016).

According to Solso et al. (2008), information processing theory emphasizes memory and thinking processes. It comprises several parts, including information storage components and cognitive processing components. The information storage components consist of sensory memory/register, short term memory, and long term memory. The cognitive processing components include attention, perception, retrieval, rehearsal, and encoding (Solso et al., 2008; Nurhayati et al., 2020).

The information processing model was developed to aid in understanding the internal thinking processes that occur in the human brain or mind. Information processing begins with a stimulus or input received by the sensory memory/sensory register through the senses (Hitipiew, 2009). The information entering the sensory register is then filtered through selective attention, information that is not attended to is immediately forgotten, while information that receives attention is transferred to short term memory. The result of this selection process forms perception. When the information continues to receive attention and is frequently rehearsed (repeated), the perceived information is stored in long term memory. Once in long term memory, the information can be retrieved through specific strategies, or it may be forgotten (unable to be retrieved) due to deficiencies in the memory system or storage. Information processing theory not only explains observable behavior changes but also explores how individuals take in and utilize various types of information (Hitipew, 2009; Kusaeri, 2018).

Based on the results of observations conducted by the researcher in November 2024 during the first semester in Grade X at MAN 1 Muaro Jambi, it was found that most students had a limited understanding of the mathematical concepts delivered by the teacher. Although students were expected to meet all indicators of mathematical conceptual understanding, many were unable to formulate problem-solving strategies, apply basic calculations, use symbols to represent a mathematical concept, or convert one numerical form to another accurately when solving problems related to systems of linear equations in three variables (SPLTV). As a result, students experienced difficulties in connecting the concepts or information contained in the problems being solved.

Based on the above identification, this study aims to explore students' understanding of mathematical concepts based on the information processing system at MAN 1 Muaro Jambi. The objectives of this study are: (1) to analyze and understand the extent to which students at MAN 1 Muaro Jambi comprehend mathematical concepts, and (2) to evaluate the effectiveness of the current information processing system at MAN 1 Muaro Jambi in supporting students' understanding of mathematical concepts.

2. Methodology

This research is exploratory in nature, using a descriptive qualitative approach. Qualitative research aims to develop an in-depth exploration of a phenomenon, rather than to generalize findings to a population (Creswell, 2012). According to Arikunto (2014), descriptive research is a method that seeks to describe the object

or subject being studied as it is, with the goal of systematically portraying the facts and characteristics of the subject accurately in the form of sentences or words. The approach used in this study is a descriptive qualitative approach based on a case study (Creswell, 2012; Arikunto, 2014).

The subjects of this study were three tenth-grade students from MAN 1 Muaro Jambi. The research subjects were selected using purposive sampling, a technique in which subjects are chosen based on specific criteria. The criteria used for selecting the subjects were: (1) students who had previously studied the topic of systems of linear equations in three variables, and (2) students who demonstrated adequate ability to communicate their ideas, particularly mathematical ideas. This was intended to obtain as much information as possible regarding the students' knowledge of mathematical concepts they had learned, based on the information processing system they experienced.

The data in this study consisted of descriptive data on students' understanding of mathematical concepts related to the topic of systems of linear equations in three variables (SPLTV). The researcher administered a conceptual understanding test consisting of one question to the subjects. The students answered the question, and their responses were further explored through interviews. The researcher conducted interviews based on the students' worksheets to obtain a deeper insight into their understanding of mathematical concepts in the SPLTV topic.

The test of mathematical conceptual understanding in this study refers to the indicators of mathematical understanding ability proposed by Pollatsek, which have been modified as shown in Table 1 (Yanti et al., 2019).

Table 1. Indicators of Mathematical Conceptual Understanding Ability

Understanding of Mathematical Concepts	Indicators
Computational Understanding	Applying formulas or methods to solve problems. . Solving problems using a structured/ sequential approach. . Performing calculations algorithmically.
Functional Understanding	Relating the problem to variable form. Proving the validity of a formula or method.

The research instrument is one of the most essential elements in a study, as it serves as a tool or means for data collection. Therefore, the instrument must be relevant to the aspects being investigated in order to obtain accurate data. There are two types of instruments used in this study: the main instrument and supporting instruments. The main instrument in this study is the researcher themselves, who acts as the planner, data collector, data analyst, data interpreter, and ultimately the reporter of the research findings. The supporting instruments used in this study are tests and interviews.

The research procedure is divided into three stages: 1. Preparation stage, at this stage, all aspects related to the implementation of the research are prepared, starting with determining the research class, designing the research instruments, developing

the mathematical conceptual understanding test on the topic of systems of linear equations in three variables (SPLTV) along with the answer key, and scheduling data collection. 2. Implementation stage, the steps taken in this stage involve administering the mathematical conceptual understanding test on SPLTV to Grade X students at MAN 1 Muaro Jambi. In this stage, the researcher asks the research subjects to solve the SPLTV problems based on their conceptual understanding. The researcher documents the subjects' activities while working on the test and conducts in-depth interviews to clarify their responses, aiming to gain further insight into the reasoning behind their answers. 3. Final stage, in the final stage, the researcher processes and analyzes the data collected from the written test responses, interviews, and documentation using qualitative descriptive analysis. Before analyzing the data, the researcher first compiles the data collected from the field and transcribes it. Transcription is the process of converting audio recordings, videos, or notes into textual data. In this study, the researcher describes both the verbal expressions and nonverbal expressions of the subjects from video recordings and interviews into written words (Creswell, 2012).

The data analysis stage in this study consists of the following steps: 1. Exploring the data, the initial analysis involves exploring the data. At this stage, the researcher gathers all the necessary data. 2. Coding the data in the data coding process, the researcher selects the data that will be used and disregards any irrelevant data. The steps involved in coding include: (1) carefully reading all data transcriptions, (2) selecting one document and reflecting on its meaning, (3) assigning codes to the data, (4) creating a list of all code words, and (5) grouping the codes into categories (Creswell, 2012).

The coding method for students' responses on the mathematical conceptual understanding test in the SPLTV topic and the interview results has been prepared by the researcher, as shown in Table 2.

Table 2. Code Generation

Code	Meaning of Code
S-1	The first subject who completed the mathematical conceptual understanding test on the SPLTV topic
S-2	The second subject who completed the mathematical conceptual understanding test on the SPLTV topic
S-3	The third subject who completed the mathematical conceptual understanding test on the SPLTV topic

Data analysis in this study involved reducing the data obtained from written tests and interviews. This was done to focus on data deemed important. At this stage, the data were simplified and selected according to the research needs to determine students' conceptual understanding based on the information processing system. In addition, the data were presented in the form of written tests that had been coded and analyzed through students' narrative work. After the analysis, the researcher drew conclusions in the form of answers to the research questions posed earlier.

Based on the data presented, the researcher was able to reveal findings from the process of exploring students' understanding of mathematical concepts based on the information processing system at MAN 1 Muaro Jambi. To ensure the credibility of the data in this study, the researcher employed triangulation.

In this study, the researcher used both methodological and source triangulation. Methodological triangulation was conducted by comparing the results of the students' worksheets on the SPLTV topic with the interview responses. Source triangulation involved cross-checking data from different subjects using the same instruments, namely the critical thinking test and the interview guide.

3. Results and Discussion

a. Results

The results of the written test from all research subjects are described based on the indicators of mathematical conceptual understanding ability. The written test results are then compared with the interview results to strengthen the validity of the research data and support the process of drawing conclusions.

I. Exploration of Students' Mathematical Conceptual Understanding with the Sensory Register Storage Component

1. Subject 1

1.1. Solving problems using a structured/ sequential approach

The concept of a system of linear equations in three variables can be solved in a structured manner and described in terms that facilitate students' understanding. The results of Subject 1's responses indicate that for the indicator solving problems using a structured/ sequential approach, Subject 1 who corresponds to the Sensory Register stage of the information-processing system immediately asked or sought to determine what the question was asking when confronting the problem. The subject did not restate the information already provided in the question, as shown in Figure 1.

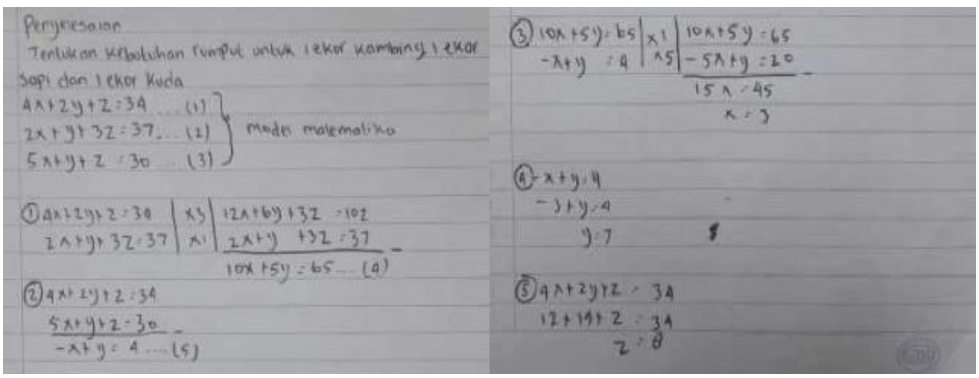

Figure 1. Subject 1's Response

Below is an interview excerpt with Subject 1 concerning the indicator solving problems using a structured/ sequential approach within computational understanding.

P : What was the first step you took in solving that SPLTV problem ?
S-1 : In the SPLTV problem earlier, I looked for what the question was asking.
P : Now explain, in proper sequence, the very first step that should be taken to solve the problem ?
S-1 : First, write down what is given in the problem, then identify what is being asked.
P : Why did you, in your work, only write down the question without noting what was given ?
S-1 : Because I forgot the steps the teacher explained, I wasn't very focused. So when I worked on the problem, I went straight to its core.

The interview results indicate that Subject 1, when solving the problem, immediately focused on identifying what the question was asking. The subject forgot the proper sequence of steps because the information entering the Sensory Register was not selected (selective attention) and, as it received no further attention, was immediately forgotten. Consequently, the subject did not first record the given information in the problem as the correct procedure requires.

The test and interview results indicate that Subject 1, who is classified under the Sensory Register storage component, solved problems by immediately focusing on what was being asked, without first writing down the information given in the problem.

1.2. Relating the problem to variable form

One of the most prominent indicators of mathematical concept understanding is the ability to relate a problem to variable form. This indicator requires first grasping the underlying concept so that one can assign representations for variables x, y, and z. After that, one constructs a mathematical model from the given equations, as shown in Figure 2.

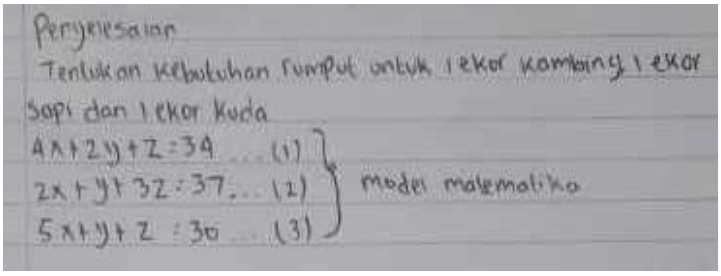

Figure 2. Subject 1's Response

The responses of Subject 1 in Figure 1.2 show that, for this indicator, the subject constructed the mathematical model effectively, even though they had not first defined representations for the two variables. When building the model, despite not using a structured approach in the previous indicator omitting to restate the

information given in the problem the subject nevertheless demonstrated a strong conceptual understanding in formulating the mathematical model.

Below is an excerpt from the interview with Subject 1 regarding the indicator relating the problem to variable form in functional understanding.

P : What step did you take to solve the equation ?
S-1 : I created the mathematical model.
P : Why didn't you define representations for the variables x, y, and z first ?
S-1 : I don't think it's necessary to set up representations. What matters is being able to construct the mathematical model.
P : Could you explain how you constructed the mathematical model ?
S-1 : I grouped x, y, and z, then determined the given value for each variable.

The interview results show that Subject 1 identified the next step as creating the mathematical model. The subject also mentioned that the proper procedure before modeling would be to define representations for the variables. However, the subject believed that variable definitions were unnecessary, as long as they understood the concept for building the model.

The test and interview results demonstrate that Subject 1 was able to construct the mathematical model correctly, despite not defining variable representations beforehand.

1.3. Applying formulas or methods to solve problems

Applying formulas or methods to a three-variable linear equation system is highly efficient for solving mathematical problems. Elimination is one of the methods used to address issues in three-variable linear equations.

Subject 1's responses show that they did not specify the name of the method used in their solution; instead, they focused on the computational steps of the elimination method, as shown in Figure 3.

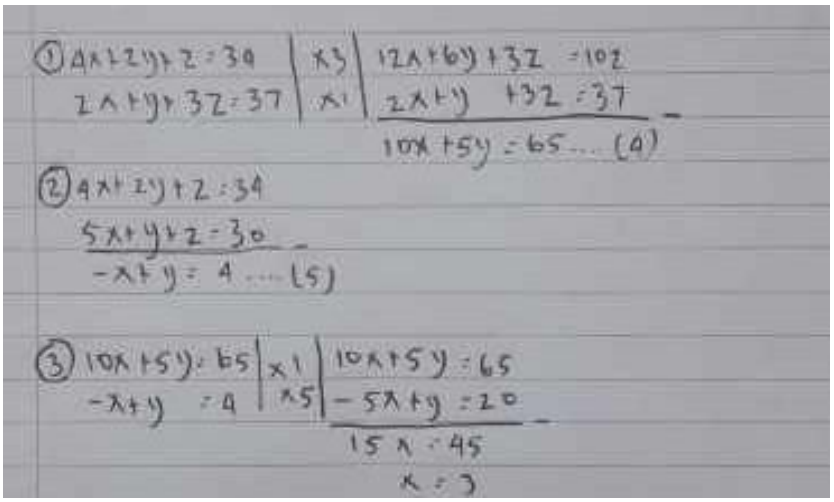

Figure 3. Subject 1's Response

Below is an excerpt from the interview with Subject 1 regarding the indicator applying formulas or methods to solve problems.
P : Which method did you use to solve that system of three-variable linear equations ?
S-1 : Elimination.
P : How did you apply the elimination method ?
S-1 : I eliminated one variable by adding or subtracting equations to obtain a new equation, then repeated the elimination process on the two resulting equations to determine the value of the target variable.

The interview results indicate that Subject 1 identified the method he used to solve the three-variable linear equation system problem as the elimination method. In applying this method, he performed the solution effectively. He also provided a clear explanation of the elimination method's purpose and usage: it's used to find the value of one variable in the problem, after which the substitution method is applied to determine the remaining variables.

The test and interview results reveal that, for this indicator, Subject 1 focused on carrying out the computational steps of the elimination method. However, he did not explicitly name the method in his write-up because he went straight into the elimination calculations.

1.4. Performing calculations algorithmically

One indicator of mathematical conceptual understanding specifically in computational comprehension is performing calculations algorithmically. This means accurately solving a problem's computations by using the method appropriate to each problem and following the prescribed steps of that method.

In Subject 1's case, after obtaining the value of one variable using the elimination method, the subject then used the substitution method to find the other variables. In the response, the subject substituted the previously determined value of x into one of the equations and performed the necessary calculations to determine the values of the remaining two variables. However, when applying the substitution method to solve for the other variables in the given equations, the subject was unable to carry out the calculations algorithmically and did not specify the name of the method used, as shown in Figure 4.

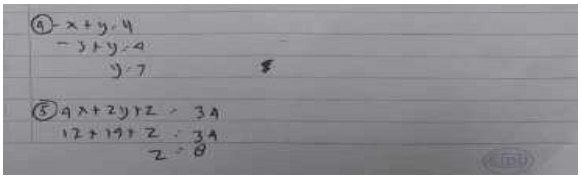

Figure 4. Subject 1's Response

Below is an excerpt from the interview with Subject 1 regarding the indicator performing calculations algorithmically.
P : What method did you use next ?

S-1 : Substitution.
P : Could you explain that method ?
S-1 : I substituted the results of the previous calculation into the given equation.

Subject 1 named substitution as the method used after elimination. The subject also described how substitution works, but the explanation lacked detail.

The test and interview results show that when applying substitution, Subject 1's calculations remained poorly structured.

1.5. Proving the validity of a formula or method

One indicator of conceptual understanding is the ability to prove the validity of a formula or method. Such proof confirms that the obtained results align with the problem's requirements.

In Subject 1's solution, the student did not draw a conclusion or restate the computed values of x, y, and z. The student also failed to demonstrate the correctness of their answers.

Below is an excerpt from an interview with Subject 1 on proving a formula's or method's validity.
P : What do you do after obtaining the values of x, y, and z ?
S-1 : I conclude by writing down the values of x, y, and z again.
P : Why didn't you write a conclusion in your answer ?
S-1 : I forgot that I needed to make a conclusion, so I didn't write one.

Subject 1 stated they know how to draw a conclusion, but they forgot the necessary steps because they could not recall the process they learned. During the interview, the subject made no mention of proving a formula's or method's validity because the conceptual information from the three-variable linear equations lesson was not attended to and was immediately forgotten when solving the problem.

The test and interview results show that Subject 1 did not prove the validity of any formula or method. Additionally, the subject did not draw a conclusion from the values obtained for x, y, and z due to inattention to the conceptual information and decreased focus during mathematical problem solving

II. Exploration of Students' Mathematical Conceptual Understanding with the Short Term Memory Storage Component

2. Subject 2

2.1. Solving problems using a structured/ sequential approach

Subject 2's response shows that they effectively restated the information provided in the problem. They began by writing down what was known from the problem, what was being asked, and what the answer would be, as shown in Figure 5.

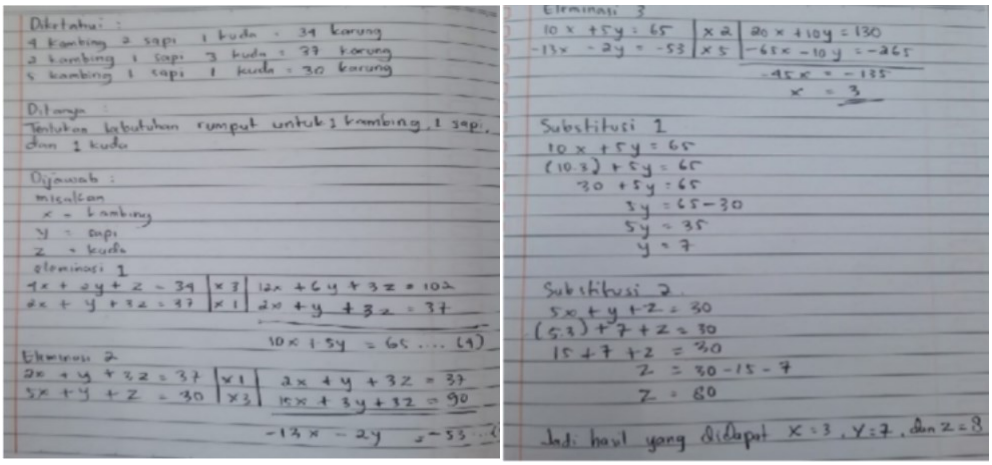

Figure 5. Subject 2's Response

Below is an excerpt from an interview with Subject 2 regarding the indicator solving problems with a structured/ sequential approach.

P : What is the first step you take when you encounter a three-variable linear equation problem like this ?

S-2 : I first write down what is given in the problem and what is being asked.

P : Can you explain the actual steps in order ?

S-2 : First I note everything that is given, then I identify what is being asked, and only after that do I solve the problem.

The interview results show that Subject 2 explained that the first step when encountering a mathematical problem like this is to restate the information given in the problem and then identify what is being asked. The subject clearly understands the steps needed to solve the problem.

The test and interview results show that Subject 2 adopted a structured approach in the initial phase of solving the three-variable linear equation system by first writing down the information obtained and then identifying what was being asked. This occurred because the information entering Subject 2's Sensory Register received focused attention and was transferred into Short Term Memory, allowing the subject to form a clear perception and accurately retrieve and restate that information when solving the problem.

2.2. Relating the problem to variable form

Subject 2's response indicates that they only wrote or defined the variable representations without constructing a mathematical model, as shown in Figure 6.

Figure 6. Subject 2's Response

Below is an excerpt from the interview with Subject 2 regarding the indicator relating the problem to variable form.
P : What step did you take next to solve the problem ?
S-2 : I defined the representations for the two variables.
P : Why didn't you construct a mathematical model ?
S-2 : I was a bit confused because I had forgotten something in the solution process, so I only set up the variable representations before moving on to the next step.

The interview results show that Subject 2 only defined the representations for the two designated variables. The subject did not construct a mathematical model because, midway through solving the problem, they felt they had forgotten certain solution steps.

The test and interview findings indicate that the information stored in Subject 2's Short Term Memory was not rehearsed, causing some steps to be forgotten. Consequently, when it came time to form a mathematical model, the subject only set up the variable representations.

2.3. Applying formulas or methods to solve problems

Subject 2 effectively solved the system using the elimination method, even though they were initially unsure how to construct the mathematical model. They applied elimination to derive additional equations and then solved for one of the variables using the fourth and fifth equations obtained, resulting in an accurate final calculation, as shown in Figure 7.

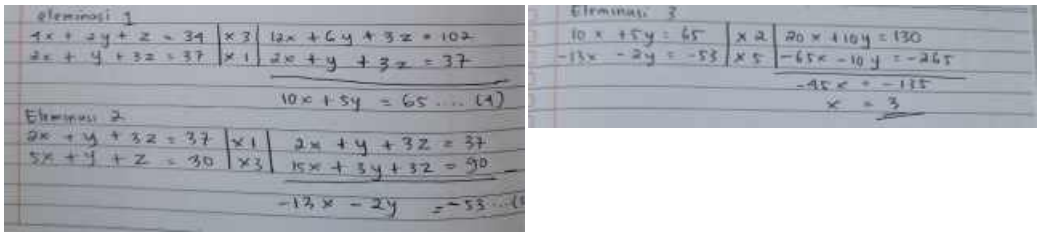

Figure 7. Subject 2's Response

Below is an excerpt from the interview with Subject 2 regarding the indicator applying formulas or methods to solve problems.
P : What method did you use to solve the system of equations ?
S-2 : The elimination method.
P : How did you apply the elimination method ?
S-2 : I eliminated one of the variables on my answer sheet, I eliminated variable z first.

The interview results show that Subject 2 clearly explained the method they used and how they applied it to solve the three-variable linear equation system.

The test and interview findings indicate that Subject 2 successfully executed the elimination method on the given equations, even though they initially felt they had forgotten how to present the mathematical model.

2.4. Performing calculations algorithmically

After applying the elimination method, Subject 2 then used the substitution method to find the remaining unknown variable values. The subject worked with exceptional care and in a clear, step-by-step manner, yielding a correct final result, as shown in Figure 8.

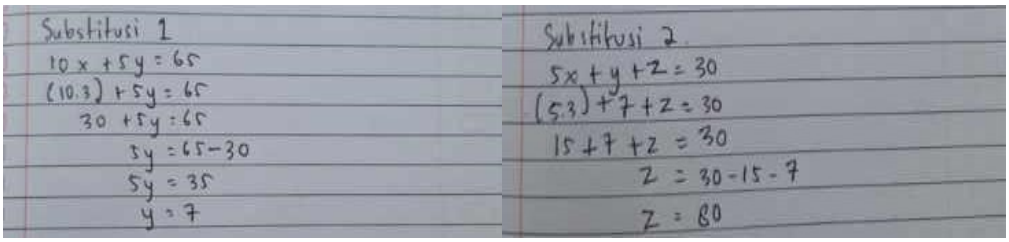

Figure 8. Subject 2's Response

Below is an excerpt from the interview with Subject 2 regarding the indicator performing calculations algorithmically.
P : Which method did you use next ?
S-2 : Substitution, which means plugging the x value obtained from the elimination step into the equation to determine y and z.

The interview results show that Subject 2 clearly explained the method they used and laid out the procedure in a logical sequence. Specifically, the subject substituted the x-value from the elimination step into one of the equations to derive the remaining variables.

The test and interview findings indicate that Subject 2 approached solving a three-variable linear system with meticulous attention throughout the process. Although the subject initially felt they had forgotten some concepts, they ultimately completed every step of the method successfully.

2.5. Proving the validity of a formula or method

Here, Subject 2 only drew a conclusion based on the final results obtained through the elimination and substitution processes. The subject did not verify that these results satisfy the two original equations. Instead, the subject wrote a very brief conclusion, as shown in Figure 9.

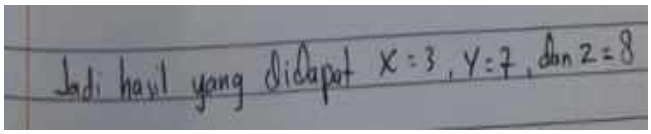

Figure 9. Subject 2's Response

Below is an excerpt from the interview with Subject 2 regarding the indicator proving the validity of a formula or method.
P : Can you explain how you proved the validity of the formula or method you used ?
S-2 : I'm still confused about how to align my answer with the problem and what the underlying concept is.

The interview results show that Subject 2 felt confused about how to verify that their solution matched the problem using the chosen method, because they believed some concepts had been forgotten and were hard to recall.

The test and interview findings indicate that, at this stage, Subject 2 experienced uncertainty in completing the task. However, the subject was still able to correctly determine the values of the three designated variables, despite having been confused when formulating the mathematical model.

III. Exploration of Students' Mathematical Conceptual Understanding with the Long Term Memory Storage Component

3. Subject 3

3.1. Solving problems using a structured/ sequential approach

Subject 3 was able to solve the problem in question number 1 related to the indicator of solving problems using a structured/ sequential approach very well. During the interview process, the subject explained that the first step when encountering a problem like the one above is to first try to understand the question, then write down the components of the problem such as the known information, what is being asked, and the answer, as shown in Figure 10.

The following is an excerpt from the interview conducted with Subject 3 related to the indicator of solving problems using a structured/ sequential approach.
P : What is the first step you take when you encounter a three-variable linear equation system like this ?
S-3 : First, I try to understand the problem and recall the steps and concepts for solving these systems that we were taught. Then I write down what is already known and identify the core of the problem, what is being asked.
P : Can you explain your process step by step ?
S-3 : As I mentioned, first I understand the problem, then I list the known points, next I note what is being sought or asked, and only after that do I work on the solution. I can do this because I frequently review how to solve these kinds of systems.

The interview results show that the information obtained by Subject 3 received sustained attention and frequent rehearsal, allowing it to enter long-term memory. Once stored, the information could be retrieved, enabling Subject 3 to explain in detail the steps taken to solve the problem.

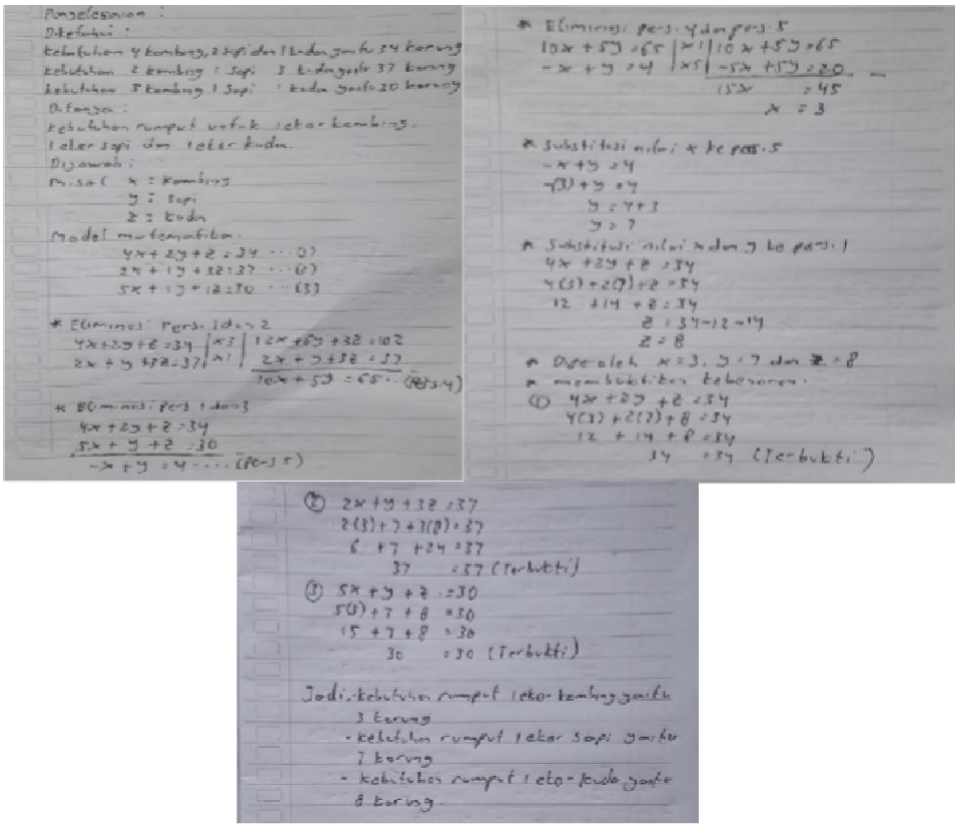

Figure 10. Subject 3's Response

The test and interview findings indicate that Subject 3 follows a structured approach in the initial phase of solving a three-variable linear equation system: first restating the information given in the problem and then identifying what is being asked.

3.2. Relating the problem to variable form

Subject 3's response shows that they set up representations for the variables x, y, and z. They then constructed a mathematical model of the given problem very effectively, as shown in Figure 11.

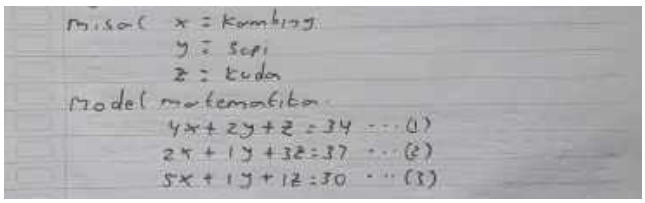

Figure 11. Subject 3's Response

Below is an excerpt from the interview with Subject 3 regarding the indicator relating the problem to variable form.

P : What will you do next to solve this three-variable linear equation system ?

S-3 : First, I define the variables x, y, and z. Then I translate the given problem into equations to form the mathematical model.

The interview results indicate that Subject 3, thanks to frequent rehearsal and the information stored in long term memory, was able to answer the questions posed and clearly explain that they first defined the variables and then constructed the mathematical model. The test and interview findings show that Subject 3 worked with meticulous care in setting up the variable representations and subsequently building the mathematical model from the equations provided in the problem.

3.3. Applying formulas or methods to solve problems

Subject 3's answer shows that they did an excellent job explaining the problem by outlining the method used and correctly applying it to solve the problem, as shown in Figure 12.

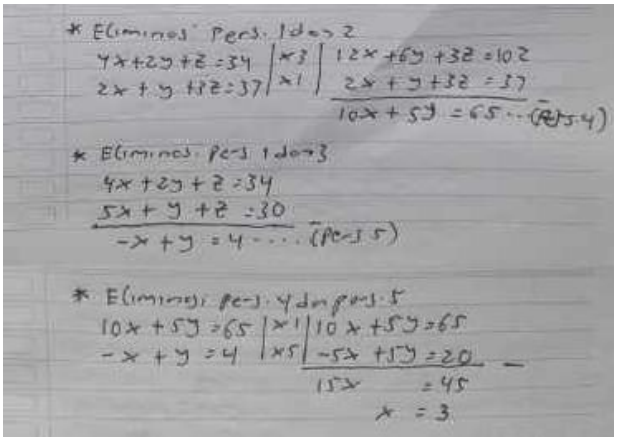

Figure 12. Subject 3's Response

Below is an excerpt from the interview with Subject 3 regarding the indicator applying a formula or method to solve a problem.

P : What method did you use to solve the System of Linear Equations in Three Variables (SPLTV) in this problem ?

S-3 : I used the elimination method. First, after we build the mathematical model, we check if we can directly eliminate one of the variables. If not, we multiply one of the equations so that the coefficients of that variable match, which allows us to eliminate it. After the first elimination, we obtain a new equation (let's call it Equation 4). We then perform a second elimination to get another new equation (Equation 5). Finally, we eliminate between equation 4 and equation 5 to isolate and solve for a single variable.

The interview results show that Subject 3 answered the question effectively and was able to explain the method they used to solve the three-variable system of linear equations, namely the elimination method. The test and interview findings indicate that Subject 3 applied the elimination method with meticulous care when solving the problem.

3.4. Performing calculations algorithmically

Subject 3's response shows that they performed the substitution method very well. It is clear that the subject used substitution in their calculations by substituting the

value of a previously determined variable into one of the equations to find the value of another variable, as shown in Figure 13.

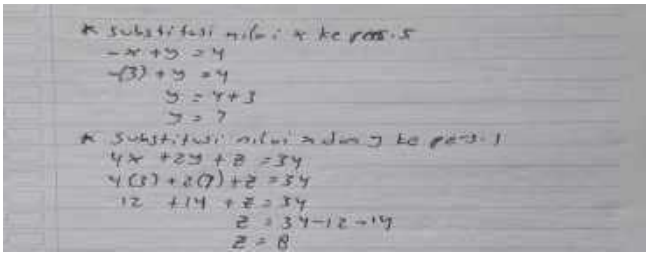

Figure 13. Subject 3's Response

Below is an excerpt from the interview with Subject 3 regarding the indicator performing calculations algorithmically.

P : What method did you use next ?

S- 3 : The substitution method. Once you've obtained the value of one variable using the previous method, you substitute that value into one of the equations to find the values of the other two variables.

The interview results show that Subject 3 answered in detail and clearly explained the proper steps for applying their chosen method.

The test and interview findings indicate that Subject 3 effectively used the substitution method after first applying the elimination method to solve the three-variable linear equation system.

3.5. Proving the validity of a formula or method

Subject 3 was able to demonstrate that the obtained answers matched the given problem by substituting the values of x, y, and z into equations 1, 2, and 3. After that, the subject drew a conclusion, as shown in Figure 14.

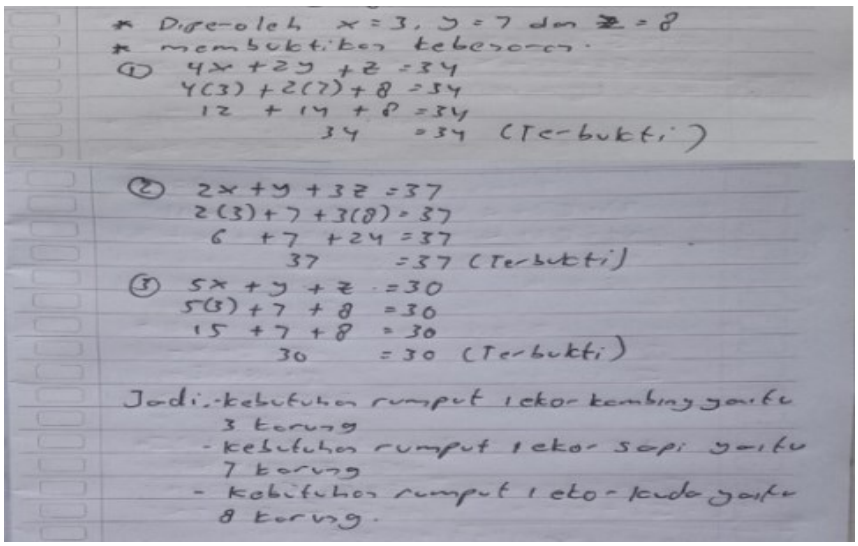

Figure 14. Subject 3's Response

Below is an excerpt from the interview with Subject 3 regarding the indicator proving the validity of a formula or method.
P : Can you explain how you prove the validity of a formula or method you used ?
S-3 : First, I try to understand the underlying concept. Once we know the values of x, y, and z from the elimination or substitution steps, we substitute those values into equations 1, 2, and 3 to verify consistency, checking whether the results match the original problem. After confirming they do, we draw our final conclusion.

The interview results show that Subject 3 was able to explain clearly and in detail the steps taken to validate the answers obtained by their chosen method. This level of detail stems from well-established long-term memory storage, which allowed the subject to fully retrieve and articulate the validation process, ensuring the solution aligns with the three-variable linear equation system concept.

The test and interview findings indicate that, in the final phase of solving the three-variable system, Subject 3 successfully demonstrated the method's correctness and then summarized the results derived from their calculations.

b. Discussion

Based on the research findings, students' understanding of mathematical concepts from the three subjects, according to the information processing theory, showed varying levels of conceptual understanding. These differences were based on the type of information storage component activated in each subject.

Subject 1 solved the SPLTV problem by directly focusing on what was being asked in the question. This occurred because, during the information processing stage, the information that entered the Sensory Register was not selected through selective attention and was not given proper focus, resulting in the information being immediately forgotten. As a result, the mathematical concepts required for solving the SPLTV problem could not be explained according to the appropriate concepts, and the subject proceeded directly to answer the question without applying the underlying conceptual understanding.

Subject 2 solved the SPLTV problem in a structured way, but some concepts were still forgotten. In this case, the information that entered the Sensory Register was selected (selective attention) and given focus, allowing it to be passed into Short-Term Memory. However, information stored in short-term memory is sometimes forgotten and does not last long, which caused the subject to be unable to fully apply all necessary concepts when solving the SPLTV problem.

Subject 3 demonstrated a complete understanding of the SPLTV concepts when solving the problem. This was because the information received by Subject 3 was fully processed and stored in Long Term Memory, allowing the required concepts to be effectively retrieved during problem solving.

4. Conclusion

Based on the analysis of the research findings, as explained in Information Processing Theory, students' understanding of mathematical concepts is highly influenced by the extent to which information is processed within their memory systems. Differences in the storage components, Sensory Register, Short Term Memory, and Long Term Memory, result in varying levels of conceptual understanding regarding Systems of Linear Equations in Three Variables (SPLTV). This study indicates that the mathematical conceptual understanding of Grade X students at MAN 1 Muaro Jambi varies according to the stages of the Information Processing System. It can be concluded that students who process information up to the Long-Term Memory stage demonstrate a deeper exploration and better understanding of SPLTV concepts compared to those whose processing only reaches the Short-Term Memory or remains at the Sensory Register stage.

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How to cite this article:

Oktarino, R., Marzal, J., & Rohati. (2025). An Exploration of Students' Understanding of Mathematical Concepts Based on the Information Processing System at MAN 1 Muaro Jambi. *Journal of Educational Sciences*, *9(4)*, 2864-2883.