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Research Article

Scaffolding through cognitive mapping based on diagnosing students difficulties in solving problem

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Abstract

This study shows the diagnosis of difficulties faced by students when solving problems with a system of linear equations with three variables and efforts to overcome them by providing scaffolding interventions. The approach used in this study is qualitative. The sample selection using a purposive sampling technique was made by giving three math problems, the topic of a system of linear equations with two variables, then three students were selected to be the research subjects. The selection of students is determined based on the category of communication skills and low, medium, or high mathematical abilities. The research data were obtained from 3 sources: test sheets, semi-structured interviews, and the results of student work after scaffolding was given. Several research results show students' difficulties in solving three-variable linear equation systems problems based on Polya-based cognitive mapping: first, the difficulty in understanding the problem. This difficulty arises because of mental holes that students should not have at grade levels, such as knowledge of fractions, algebra, basic concepts of triangles, and others. Second: Difficulty compiling a solution. This can be seen when students cannot correctly model contextual problems into mathematical models. Third, the implementation of the complete plan can be identified through students' mistakes when performing arithmetical algebraic operations and applying appropriate mathematical rules/principles, the leading cause of which can occur due to inaccuracy and misconceptions about mathematical concepts. The researchers tried to overcome these problems by providing Level 2 scaffolding with the techniques proposed by Angirelli, including (explaining, reviewing, and restructuring).

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Introduction

Education is one of the basic foundations in starting and building the civilization of every human being. Through education, every human being is expected to become a superior human resource who has the attitudes, knowledge, and skills to adapt and contribute to their lives (Parno et al. 2020; Widana, 2018). Mathematics is one of the disciplines of knowledge that must exist in curriculum subjects at every level of education in schools (Blinder, 2013). Every student's fundamental basic science in living their daily lives (Prayitno, 2018). The importance of competence in mathematical knowledge makes it often dubbed the "Queen of Science," which means how significant the role of mathematics is as the root of knowledge from various scientific disciplines. The essential part of mathematics learning in schools is the learning process itself. The method of learning mathematics can train one's thinking logically, critically, and creatively to become the basis for someone to face the challenges of the times (Surya & Syahputra, 2017; Thinking, 2015).

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However, learning mathematics is a common scourge that scares most students; students sometimes think mathematics is a boring subject and complicated, even scary (Boote & Boote, 2018; Parno et al. 2021). The leading cause can occur because of students' difficulty digesting or understanding the subject matter. The problems experienced by students in understanding the lesson can be seen when students are asked to solve related math problems. Related math problems are similar, usually presented in various forms such as puzzles, story problems, or specific event phenomena (Blinder, 2013; Lutfianto et al. 2013). It can describe students' cognitive knowledge in solving mathematical problems in questions.

Based on an interview with Mrs. T as a mathematics teacher in one of the high schools in Parepare, South Sulawesi, Indonesia, stated that the daily exam on the material of a three-variable linear equation system showed low results, where only <50% of students managed to meet the minimum passing criteria with a score of >70, according to him most students fail to solve problems because they are not able to develop good problem-solving strategies even though most of the students are judged to have technically understood mathematically solving systems of linear equations of three variables. This shows that there are still students' difficulties in solving the problems of a three-variable system of linear equations. Therefore, it is necessary to search for / diagnose students' issues and overcome these difficulties.

In carrying out the diagnosis of difficulty, cognitive mapping is used. Explains that cognitive mapping can be used in various ways, including solving problems individually and in groups (Ramirez et al. 2016; Zahara et al. 2020). This technique makes it easy to identify the issues and creates a problem structure. In addition, the most important thing is that cognitive mapping will help formulate the difficulties experienced by students and determine the appropriate assistance intervention procedures (Gordon & Ramani, 2021; Martins et al. 2019).

Cognitive mapping in problem-solving requires a design that describes the flow of thinking or steps for solving coherent and clear problems. A description of the flow of thought or steps for solving readable and clear difficulties can be viewed from the strategy used because it is an essential part of solving problems (Buchori & Cintang, 2018; Cho & Kim, 2020). In her book entitled How to Solve, Polya states that the crucial thing in solving issues lies in strategy. The strategy in question is a heuristic strategy (Prayitno, 2018). Heuristic strategies are general steps to guide problem-solving in finding solutions to problems. According there are four general steps, namely, understanding the trouble (understanding the problem), planning a settlement (devising a plan), implementing the payment (carrying out the program), and examining back (looking back) (Rosydiana, 2017; Yuwono et al. 2018). Therefore, through Polya-based cognitive mapping, it will be more helpful for researchers to formulate the difficulties experienced by students coherently and transparently.

Suggested that one of the solutions that can be applied to overcome student difficulties is to build scaffolding. Scaffolding is an assistance intervention effort that can be in the form of questions, instructions, reminders, directions, or encouragement to students when these students experience errors or difficulties in solving problems. According to Slavin, Learning support is for someone in the early stages of learning (Awadelkarim, 2021; Thomas et al. 2021). The support is slowly removed, leading to more independent learning (Błazik-Borowa et al. 2020; Milara et al. 2020).

Based on the description above, this article describes the results of a study entitled Diagnosing Students' Difficulties in Solving the linear equation system of three variables (LESTV) problem through Polya-Based Cognitive Mapping and Efforts to Overcome with Scaffolding. This study aimed to describe the diagnosis of students' difficulties in solving LESTV problems revealed through Polya-based cognitive mapping and efforts to overcome them with scaffolding actions.

Problem of Study

Based on the background and research objectives above, the essential issues to be uncovered through this research are: What types of difficulties do students experience when solving problems on a two-variable system of linear equations? What are the causes of the problems encountered by students when solving problems, and how are the efforts to overcome students' difficulties in solving the problem of a two-variable wild equation system through Polya-based cognitive mapping with scaffolding?.

Method

Research Model

The approach in this research is a qualitative approach with a descriptive type of research. The subjects in this study were students in one of the high schools. The issues in this study were students who had studied the material for solving a system of three-variable linear equations. Researchers took three samples as research subjects based on the level of students' abilities (good, moderate, and less than one person each) and students' communication skills so that the disclosure of the completion process can be carried out correctly. Determination of a subject like this is expected

to represent the actual conditions in the field. Students who were selected as research subjects were then interviewed. Clarify, explore, or clarify the subject's work results when Solving LESTV problems. Therefore, the interviews conducted were semi-structured.

This research approach is a qualitative approach with a descriptive type of research. The subjects of this study were students of one of the high schools. The issues of this research are students who study the material for solving a system of linear equations with three variables. To ensure proper disclosure of the settlement process.

Participant

The researcher studied three subjects selected through the purposive sampling technique, taking into account the students' mathematical skills (one each for the good, medium, and bad categories) based on the students' completion results and good communication skills. Thus, it is hoped to reflect the actual situation on the ground.

Data Collection Tools

Furthermore, disclosure is made through interviews with the three selected subjects. Interviews were conducted to clarify, investigate, or clarify the results of the subject's work in solving LESTV problems. Therefore, the interviews conducted were semi-structured.

Table 1

Instruments of Questions LESTV

No	Questions
1	The perimeter of ABC is 70 cm. The length of AC is 2 cm longer than the length of AB, and the size of BC is 6 cm shorter than the length of AC. Find the side lengths of triangle ABC.
2	Triangle ABC's minimum angle is 1/3 of the middle grade, and the maximum angle is twice the sum of the other two angles. What is the measure of each angle of triangle ABC?
3	The cuboid's length, width, and height are A cm, B cm, and C cm, respectively. The perimeter of the base of the block is 76 cm, the circumference of the front pillar is 80 cm, and the rim of the right side is 68 cm. What is the volume of the block!

During the interview process, the subject was asked to verbally display the steps for solving the written questions revealed based on the Polya completion steps. The data obtained are coded and used as the basis for mapping with coherent and clear cognitive information. After knowing the location of the student's difficulties, the researcher carried out scaffolding so that the subject was expected to overcome the challenges and solve problems appropriately. The structure is in direct interaction between the teacher and the students involved. The form of interaction in question is scaffolding level 2, including explaining (explaining), namely conveying the concepts learned, reviewing (reviewing), which is refocusing students' attention, and restructuring (rebuilding understanding), which is simplifying something abstract so that it can be understood. Students (Fatahillah et al. 2017). Table 1 contains 3 LESTV questions. While Figure 1 is a Polya-based cognitive mapping design that is expected to solve the problems of a three-variable system of linear equations given to students.

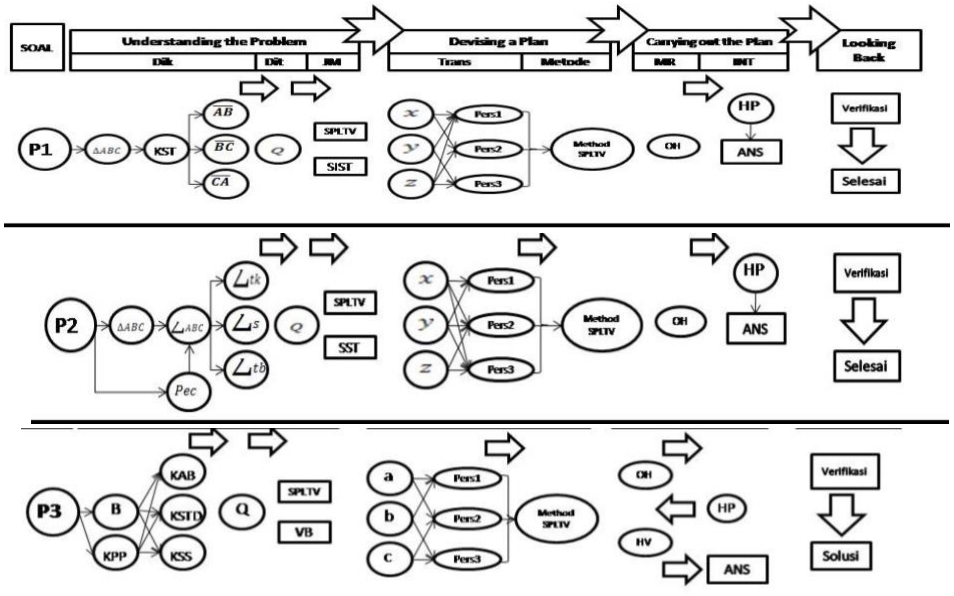
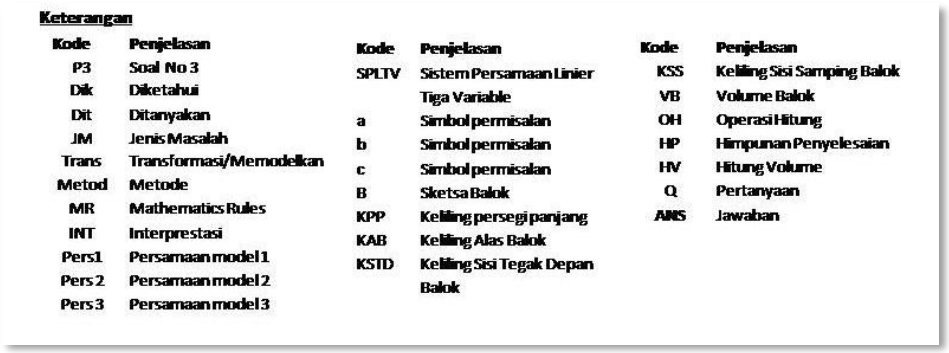


Figure 1

Polya-based Cognitive Mapping on Questions



Keterangan

Kode	Penjelasan
P3	Soal No 3
Dik	Diketahui
Dit	Ditanyakan
JM	Jenis Masalah
Trans	Transformasi/Memodelkan
Metod	Metode
MR	Mathematics Rules
INT	Interprestasi
Pers1	Persamaan model 1
Pers 2	Persamaan model 2
Pers 3	Persamaan model 3

Kode	Penjelasan
SPLTV	Sistem Persamaan Linier Tiga Variable
a	Simbol permisalan
b	Simbol permisalan
c	Simbol permisalan
B	Sketsa Balok
KPP	Keliling persegi panjang
KAB	Keliling Alas Balok
KSTD	Keliling Sisi Tegak Depan Balok

Kode	Penjelasan
KSS	Keliling Sisi Samping Balok
VB	Volume Balok
OH	Operasi Hitung
HP	Himpunan Penyelesaian
HV	Hitung Volume
Q	Pertanyaan
ANS	Jawaban

Results

The results and discussion can be separated into different sub or combined into one hero. The summary of the results can be presented in graphs and figures. The results and discussion sections must be free from multiple interpretations. The discussion must answer research problems, support and defend answers with results, compare relevant research results, state the study's limitations, and find novelty.

This study describes the types of difficulties faced by students when completing LESTV with Polya-based cognitive mapping and efforts to overcome them with scaffolding. For this reason, three different groups of research subjects are described: a group of students with high math abilities in subjects 1(S1), a group of students with moderate math abilities in subject 2 (S2), and a group of students with low math abilities subject 3 (S3). Presented the results of each sample based on the student's character:

Table 2

The results of Examining Student Answers

Subject	Questions LESTV		
	Number One	Number Two	Number three
S1	√	-	√
S2	√	-	-
S3	-	-	-

Based on the examination results of students' written answers conducted by the researcher, as shown in Table 1, none of the three samples could solve the three questions correctly. This means that the three samples each have difficulties in solving problems. Diagnosis of S1 difficulty in question no two and efforts to overcome it with scaffolding.

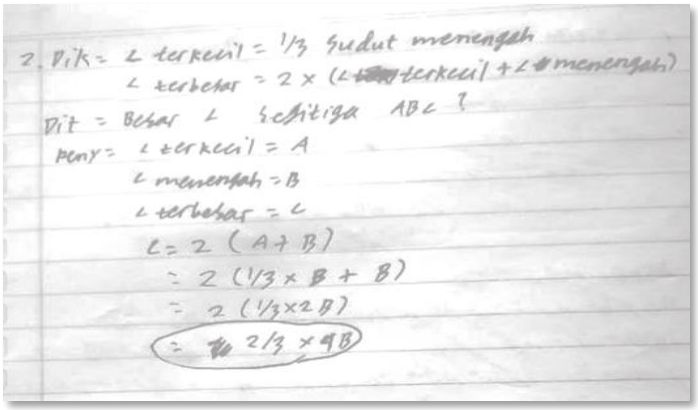


Figure 2

Completion of S1 for Question No. 2

Based on the results of S1 work and interviews, the researcher concluded that the difficulty experienced by S1 was the difficulty in understanding the problem completely (Understanding the problem). The following scaffolding interactions are given:

P: Try to read the question and explain what you understand! (Review)

S1: (reading the test questions and then the completion tests that have been made while explaining the purpose of the writing, when reading the completion section of S1, I realized that I had written equation two after being substituted with equation 1), gosh, I'm sorry, I misunderstood the equation.

P: Try to justify the deck! (Review)
S1: (Writes the equation, then looks confused and silent) I don't know how to continue the equation.

From the quote above, it can be seen that S1 can describe the information from the test statement but cannot reveal further information that the question wants. The following scaffolding is provided:

P: OK, deck, first I want to ask, will two linear equations with three variables be enough to find the solution for each equation? (Restructuring)
S1: Eee. I can't seem to do it, sis (looks doubtful)
P: Try the deck; use another solving method you have learned! (Restructuring)
S1: (trying to solve using the elimination method) Still can't, Sis. I need one more equation; the equation is constantly repeated.
P: yes, the solution will not be found because the resulting equation is constantly repeated/same. Now you can not find one more equation of the triangle? (Restructuring)
S1: Hm.., how do you do it? (looks confused as he stares and rereads the test questions)
Q: I want to ask, what do you know about a flat triangle? (Review)
S1: Has three sides, sis
P: Apart from that, try to focus on what is discussed. (Review)
S1: Eee, Has three angles total 180o
P: Well, that's right. Can you make it into a new equation? (Restructuring)
S1: (pause for a moment thinking, then surprised full of happy expression) Aaa, I already know, sis. the most extensive-angle + medium angle + most small angle = 1800. I can finish this bro, wait a minute, sis; I'll try it first.

S1 continues the solution by rewriting the three equations neatly and then looking for the solution set of the three-variable linear equation system using the elimination and substitution (mixed) methods. The solutions found are x, y, z = {15°,45°,120°}, respectively. Then at the end of the solution, S1 verifies the answer by matching the results of the hp substitution to the equation in the problem. The descriptions of cognitive mapping and scaffolding efforts for undergraduates in solving problem 1 are as follows.

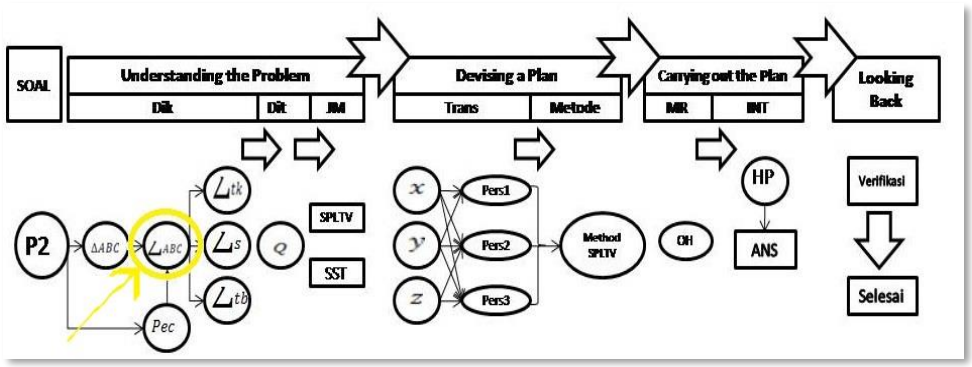


Figure 3
Mapping the Difficulty of S1 Question Number 2

Diagnosis of S2 difficulty in question number two and efforts to overcome it with scaffolding

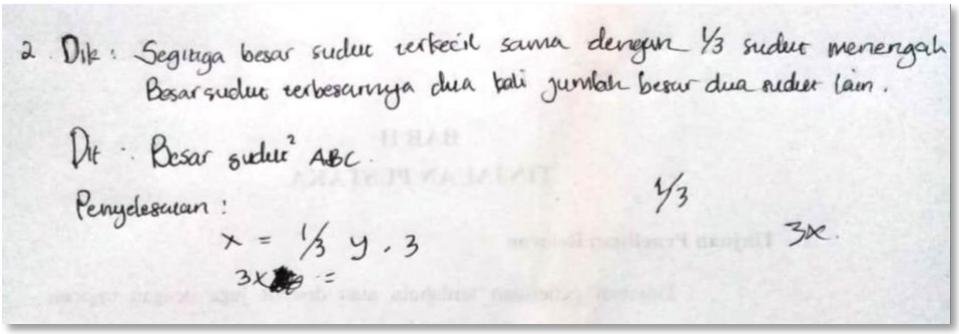


Figure 4
Completion of S2 for Question No. 2

Based on the master's work and interviews, the researcher concludes that understanding the problem (Understanding the problem) is also experienced by masters. The following scaffolding interactions are given:

P: OK, for question Number Two, why don't you proceed to the completion stage? Are you having trouble? (Review)
S1: Yes, Sis, I don't know how to make it into an equation, Sis, hehe…
P: can you tell me what you understand from the question! (Review)
S1: (S1 rereads the question, and it seems that he doesn't understand its meaning).
P: Can you describe roughly what the triangle shape looks like! (Review)
S1: Hm..,(Looks confused)

From the quotation above, it can be seen that S2 has difficulty modeling cases into equations, but S2 also seems to have trouble describing the triangular shape of the problem. Here is the scaffolding provided:

P: Try to draw the triangular shapes that you know. (Restructuring)
S1: Here, Sis, (Draw the shapes of triangles in a row: right triangle, equilateral triangle, isosceles triangle, any triangle).
Q: I want to ask, what is the difference between these triangular shapes. (Restructuring)
S1: The lengths of the sides are different, and the angles are also different.
P: That's right, each has a different side length, angle, and shape from the other. Try to focus on the rise in the problem; describe the shape of the triangle in the issue! (Review)
S1: (Looks back at the question while reading silently) Oh well, an isosceles triangle only has two different large angles. Roughly any triangular shape.
P: Yes, that's right, there are three different large angles in the triangular form (the largest, medium, and most minor tips). Now, you can not write the equations. (Restructuring)
S1: Oh yes, sis, wait a minute, I'll try, sis.

S2 tries to write by assuming x, y, and z as minor, medium, and numerous triangle angles. Equation 1 looks correct by writing $x = 1/3\ y$ or $3x - y = 0$, but when writing the second equation, S2 looks less precise, so it requires parentheses that flank the addition of x and y. As a result, the equation written becomes $z = 2\ x + y$ or $2x + y - z = 0$. When P tries to ask the truth of equation 2, it appears that S2 is silent for a moment thinking and then suddenly realizes that there is a dangerous parenthesis operation. At the completion stage, S2 seemed confused in finding the third equation of the problem, realizing the difficulty, along with the scaffolding provided:

P: OK, in discussing the angle of a triangle, how many triangle angles do you know so far? (Restructuring)
S1:180° no more and no more petite sis (quick answer)
P: OK, can any of you make an equation? (Restructuring)
S2: Ready, I understand, sis, $x + y + z = 180°$ like this, sis?.
P: Yeah, right. please solve it. (Restructuring)

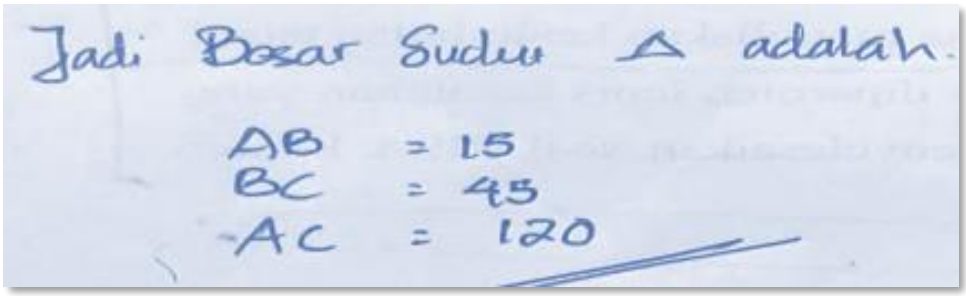


Figure 3
Conclusion of S2 Answers to Question Number Two

From Figure 3, it can be seen that S2 made a mistake when writing triangular angle notation, which resembles side notation. So P asks S2 to correct the error by finding the right note independently, then S2 rewrites the correction. The descriptions of cognitive mapping and scaffolding efforts for Masters in Solving Problem 1 are as follows:

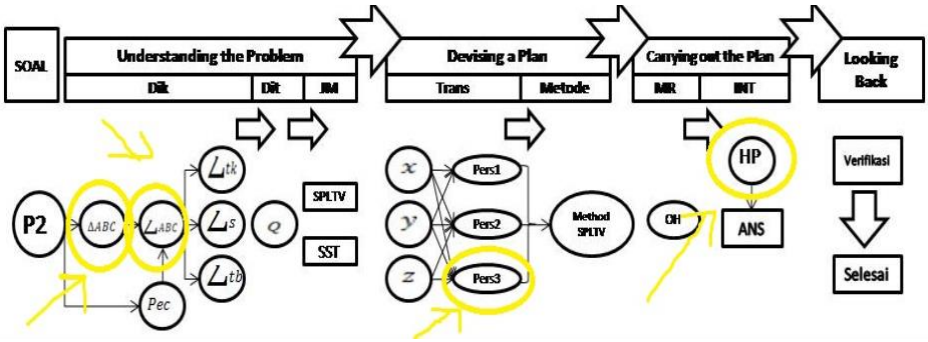


Figure 5

Mapping the Difficulty of S2 Question Number Two

Diagnosis of S1 difficulty in question number three and efforts to overcome it with scaffolding

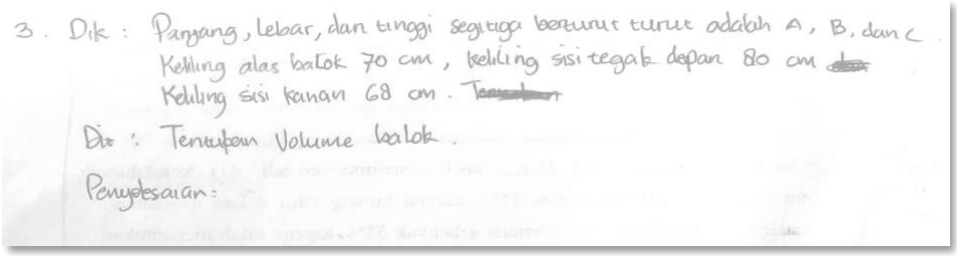


Figure 6.

Completion of S2 for Question Number Three

Based on the results of the master's work and interviews, the researcher concluded that the difficulties experienced by the undergraduate were the difficulty of understanding the problem completely (Understanding the problem) and making plans by modeling it mathematically (Devising a Plan). The following scaffolding interactions are given:

P: Try to read the questions slowly so that they are easy to understand, then convey the meaning or information about the questions one by one! (Review)

S2: (reads the questions slowly and then asks) Yes, bro, but sis, that's part A cm, B cm, and C cm. It's a bit confusing, sis?

From the quote above, it can be seen that S2 has difficulty understanding the sentence 1 question. S2 does not think that A cm, B cm, and C cm are the lengths of the ribs on the beam, which are described in succession with the shaft's length, width, and height.

P: Oh yes, deck, try sketching the shape of the space first! (Restructuring)

S2: This is a block, right, (while sketching the block)

Q: Yes, do you know the beam's length, width, and height? (Review)

S2: this is long, wide, then this is your height (while pointing to the sketch you made)

Q: So what's confusing about A, B, C? (Review)

S2: Ohh, A, B, and C are the same as x, y, z, sis. (It looks like the students have pseudo)

P: Not the same, but that's just an example. What kind of example? (explanation)

S2: A is the length of the block, B is the width of the league, then C cm is the height of the block.

P: Well, that's just an example of the unknown size (Explaining)

S2: yes, sis. How do you make the equation?

From the quote above, S2 has been able to change his mindset toward the LESTV solution. However, the final selection shows that S2 still has difficulty modeling the information into mathematical equations. When asked to show each circumference which was informed about S2, he was able to show it but did not realize the equations that could be formed in it. The following scaffolding is provided:

P: Take a look at the length of the ribs on each circumference that you have shown. In the beginning, you have labeled the size of the ribs with, for example, A cm, B cm, and C cm. Now, can you not make it into an equation? (Restructuring)

S2: What do you mean, brother? (looks confused, understanding PP sentence)

P: Take a look at the circumference of the base of the beam. Can you not make it into an equation with the size given earlier? (Restructuring)
S2: Ooh, understand, the circumference of the base of the block A + B + A + B = 78
Q: Can you not simplify it? (Restructuring)
S2 : So, bro, 2A + 2B = 78
P: Now, you can do the same thing on any circumference! (Restructuring)
S2: Oh yes, you can.

S2's difficulty in solving problem number three can be overcome through the provision of scaffolding above; this can be seen when S2 can write three equations through information about the circumference of the side of the beam. After being compiled into a three-variable linear equation system, S2 seems to solve correctly using the determinant matrix/crammer's rule solving method. And then don't forget to verify the answer by showing the result of substituting the value of the solution set into the existing equation. The descriptions of cognitive mapping and scaffolding efforts for undergraduates in solving problem 1 are as follows:

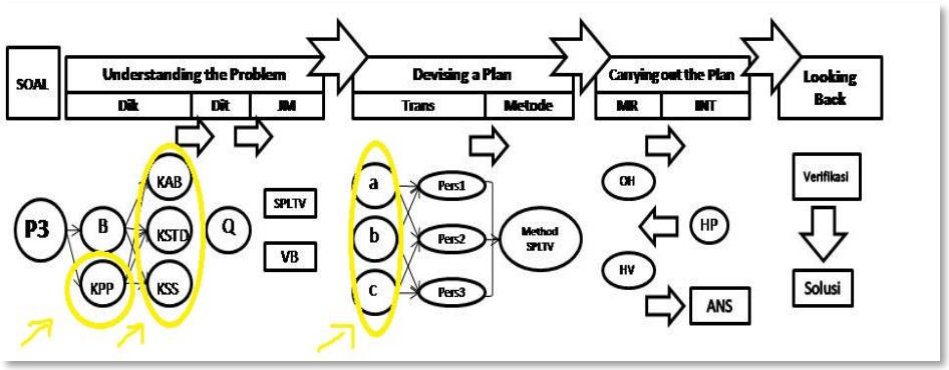


Chart 7
Mapping the Difficulty of S2 for Question Number Three

Diagnosing S3 difficulties on question number one and efforts to overcome it with scaffolding

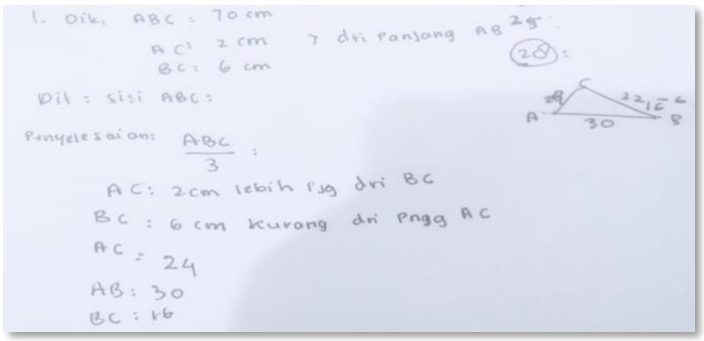


Figure 8
Results of S3 Work for Question Number One

Based on the results of doctoral work and interviews. S3 did not seem to have difficulty understanding the meaning of this question, as seen through the interview results where S2 could explain the importance of the question well. In addition, the solution that S3 tries to make shows an exciting diagnosis where S3 tries to guess the length of each side, which starts by dividing by three the perimeter of the triangle to produce an estimate of the size of the three sides, and tries to guess while matching it with the information known from the problem. However, it can be seen that the final answer given is still wrong because there are still questions that contradict the last response provided. So P concluded that S3 had difficulty developing a settlement plan (Devising a Plan). The following scaffolding interactions are shared:

P: You have understood the meaning of the question; what do you think we can do here to model the statement into a mathematical equation? (Reviewing)
S3: What are you? (still confused by the question P sentence)
P: Usually, we start by making an example first. What can we try to make an equation first? (Restructuring)
S3: the length of the shortest, medium, and longest sides. Can you make x, y, and z, bro?

P: Well, that's right, that's what I mean. The shortest side can be represented by x, the medium side by y, and the longest side by z; now, you can not write down each equation? (Restructuring)

S3: Wait, let me try, sis

S3 writes down the three equations and solves the LESTV using the elimination method.

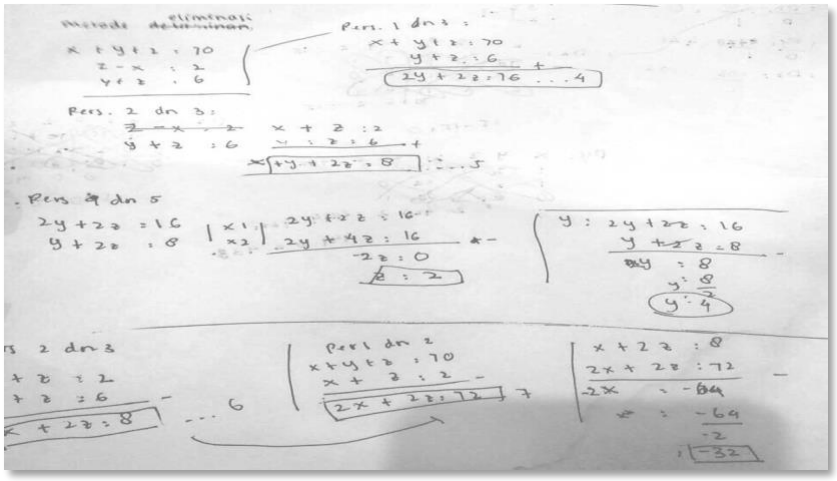


Figure 9

Completion of S3 for Question No One After Scaffolding 1

From Figure 7, S3 made a mistake at the beginning when writing y+z = 6 in the third equation, even though it should have been written y –z = 6, so the solution in the next step should have been written has continued errors. In this condition, P asks S3 to verify the value of hp obtained in the initial equation to make S3 aware of the mistakes in the solution. Realizing that there was an error in the answer, S3 tried to re-examine the solution made but could not learn where the mistake in the solution was made. Finally, P asked S3 to review the written equation three. After re-dissecting the equation simply, S3 was able to see the operating error used in the third equation, as shown in Figure 7. After improving the third equation, S3 solved the problem with the correct answer accompanied by proof of verification of the correctness of the solution set. The descriptions of cognitive mapping and scaffolding efforts for undergraduates in solving problem 1 are as follows:

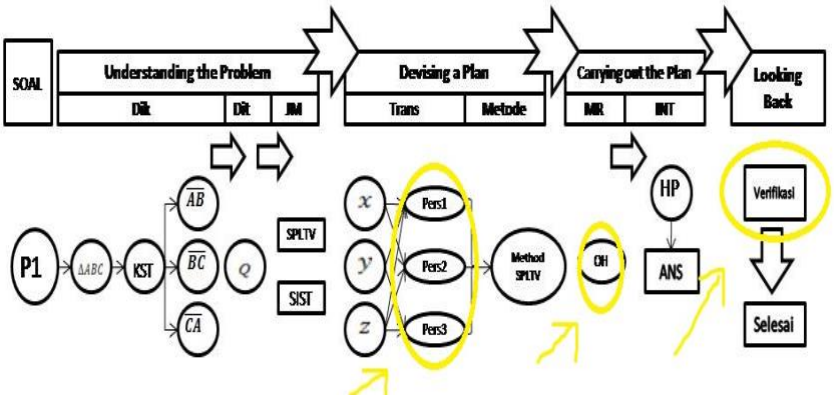


Figure 9

Mapping the Difficulty of S3 Question Number One

Diagnosis of S3 difficulties on question number two and efforts to overcome it with scaffolding

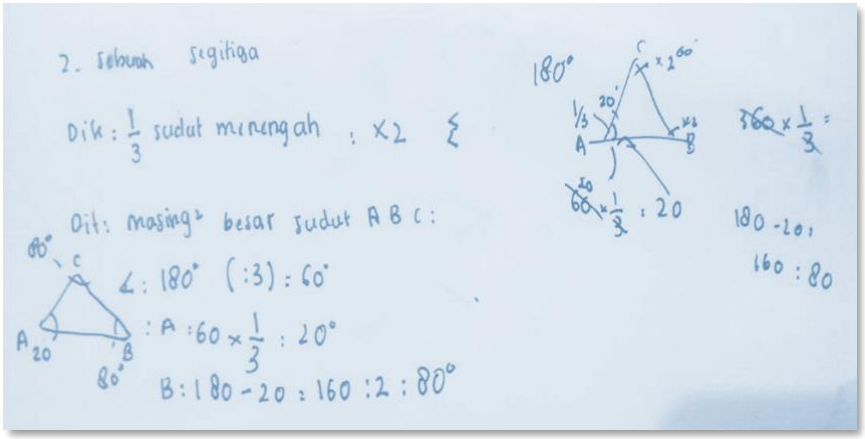


Figure 10
Results of S3 Completion for Question No. 2

Based on the results of the master's work and interviews, the researcher concludes that the difficulties experienced by the doctoral doctor are the difficulty of understanding the problem completely (Understanding the problem) and developing a good settlement plan (Devising a program). The following scaffolding interactions are given.

P: OK, number three, try to explain what is understood from the problem and how to get the solution!? (Review)
S3: OK, sis, here what I understand is a triangle with 1/3 middle angle, then multiply by two the other two angles are more extensive, my solution is bro, right triangle angle is 180° with 3 points, so I divide it by three first, so the result is 60 °, then I divide 60 ° by three so that we know the size of one of the angles of the triangle, which is 20 °, the remaining 160, I divide by 2 = the result is 80 ° sis (Explains in a stammering tone, slightly embarrassed to describe his thoughts which is pessimistic about the answer).

From the quote above, it can be seen that S3 misunderstood the information about the question. S3 tried to estimate by guessing the angle in the narrated question. Still, the data was incomplete, resulting in an incorrect answer because another statement did not adequately verify it. The following scaffolding is provided.

P: Interesting, the explanation seems to be misinformation (laughs jokingly). OK, deck, let's look again at the problem. How many angles are there that you want to look for? try to mention. (Reviewing)
S3: ee.. angle of triangle ABC bro.
P: Yes, please read the question carefully. How many different angles are there from the triangle in question? (Restructuring)
S3: Oh, there are three, sis. The first is the smallest angle, the second is the middle angle, and the third is the most significant, bro.
P: Yes, that's right, each question has a different angle. Look at your answer. Do you meet the criteria for the question? (Review)
S3: Hehe, no, Sis.

After realizing the error in the solution, scaffolding was directed to construct an understanding of S3 to solve the problems independently. The following structure is given:

P: So, can you solve it by using the LESTV solution? (Review)
S3: Huh..?
Q: Do you remember the first step to take in LESTV? (Review)
S3: For example, Sis.
P: OK, what can be, for example, in the problem? (Restructuring)
S3: Hmm..(long time thinking), maybe the smallest angle = x, the middle angle = y, and the most extensive angle = z
P: Well, that's right. Now, can't you slowly arrange the equations with the example you made? (Restructuring)
S3: Hm, I'll try it first, sis

S3 slowly reads carefully and tries to understand the meaning of the problem, and then it is modeled into a three-variable linear equation. At this stage, S3 compiles the equation including the third equation, namely $x + y + z = 180°$.

Still, when writing the first equation, it is x = 1/3 y. S3 must need basic guidance assistance with fraction multiplication operations from P to convert the equation to 3x –y = 0 to make it look identical to the other equations. After all the equations were compiled, S3 tried to solve the LESTV using the elimination method but realized that the resulting solution was still wrong by verifying the substitution of hp into the equation. The interview results concluded that S3 only experienced inaccuracy in seeing the calculation operations in its completion.

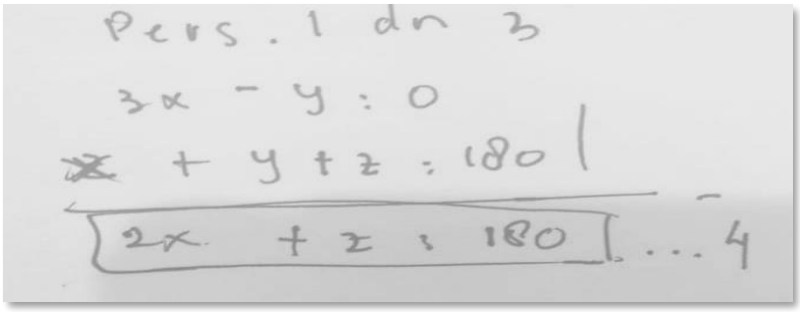


Figure 11.

Errors in the S3 Calculation Operation in Question No. 2

From Figure 9, it can be seen that S3 had a mistake, namely writing –y – y = 0 and 0 -180 = 180. After realizing this error, S3 immediately corrected and found an answer by solving the problem. The descriptions of Polya-based cognitive mapping and scaffolding efforts for Doctoral Degree in Solving Problem 2 are as follows:

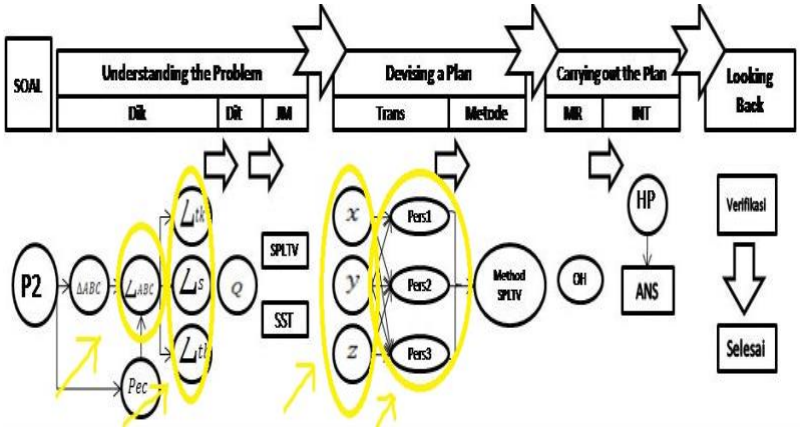


Figure 12

Mapping the Difficulty of S3 Question Number Two

Diagnosis of S3 difficulties in question number three and efforts to overcome it with scaffolding. In collecting the completion answer sheets, it was found that the S3 completion sheets were still empty. Disclosure of difficulties can only be known through interviews. The interview results concluded that S3 really could not understand the meaning of the question statement (Understanding the problem). Besides that, S3 also had difficulty modeling the statement into the form of a mathematical equation. The following scaffolding interactions are given:

Q: How come Number three is empty? (Review)
S3: Hehe, I don't understand what you mean.
P: Same as the previous question, try to read slowly and convey what you understand. (Review)
S3: (reading the question) Eh, here is what I understand, Sis. There is a block with a circumference of 76 cm from the base of the beam, 80 cm to the rim of the front upright, and 68 cm to the right side. Asked to find the volume kak.
P: OK, so what should we do if we want to find the volume of the block?
S3: Using the formula length x width x height bro.
Q: That's right, so we need information about the beam's length, width, and height. Is there any information on the problem? (Review)
S3: Here, you will explain, Sis, the length, width, and height of the blocks, respectively, A cm, B cm, and C cm.
P: Well. Now try to sketch the shape of the beam, then label each side of the shaft with that information. (Restructuring)
S3: What do you mean?

P: Try drawing first what the shape of the block looks like if the length, width, and height are different. (Explaining)
S3 : (Draw the blocks)
Q: Which part of the rib tells the length, width, then height? (Review)
S3: Ee, this is the length, this is the width, then this is the height (while pointing to the picture)
P: OK, try the other ribs also labeled. Those are parallel sides of the same length, right? (Review)
S3: Yes, sis. (write one by one) oh.. this is the equation that will be made later, sis, from the information about the circumference (starting to understand the meaning of constructive scaffolding), the front and right sides, right, sis (pointing one by one to the part of the sketch that is intended.
P: That's right. Try to make your equation for each circumference. (Restructuring)
S3: Oh yes, sis.

From the scaffolding quote above, S3 can understand the purpose of the scaffolding action given, as evidenced by the completion of the S3, which can model the statement in question into a mathematical equation. Followed by solving the three-variable linear equation system using the elimination-substitution method. The following scaffolding is provided:

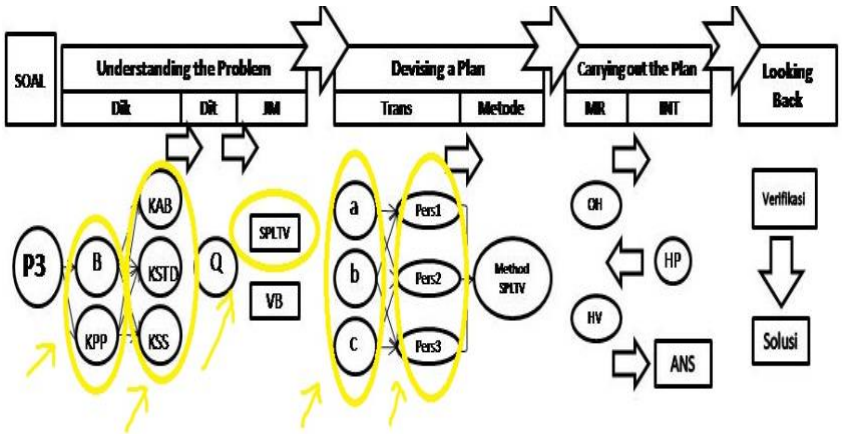


Chart 13
Mapping Errors S3 Question Number Three

Discussion

Based on the results of calculations and data analysis from this quasi-experimental study, it shows that the average effective learning behaviour learning outcomes of the experimental class that uses art-based learning (ABL) are higher than the control class that uses teaching-based practices. Learning in microteaching classes using art-based learning has a real effect on the development of effective teaching behavior of prospective teacher students. Teaching behavior with minimum standards to be based on the impact on student academic involvement (Maulana et al. 2017) initial understanding of how effective teaching can develop learning condition, classroom management, clear instruction, active learning, teaching adaptation, teaching and learning strategies. ABL has proven to be successful in developing learning outcomes in aspects of teaching behaviour.

Through art-based learning students can explore their imagination, creativity, skills and presentation of their masked works. This research supports the statement of Cathy Nutbrown (2013) that humans need art for holistic development; efforts to integrate art with other areas of learning; and stronger and clearer conceptualization of art-based learning is needed. The arts in education make learning experiences meaningful and authentic, this facilitates the development of creative problem solving, critical thinking skills, offers opportunities for students to explore, understand and appreciate themselves, and directly to their communities (Hulsbosch, 2010). ABL functions as an integrative, personal growth and development tool, documentation of experience, and for transfer of learning to work (Deaver, 2012). This research is an attempt to find a comprehensive explanation of the class given art-based learning in the practice of becoming prospective teachers.

Students' talents and interests can be directed by making something great but easy to do, easy to adapt, and using new simulations. The new simulation has been made through the visual form of the mask. Students' great interest in visual form images (Kurniawan et al. 2019) is in line with the dissertation from Brenner (2010) in the implementation of ABL, actually students who have very little artistic skills can also create great art. Student-centered learning makes it easier to adapt and reduce students' burden in understanding and learning the material presented by the teacher (Putranta & Jumadi, 2019). Art creation is a means of each individual to make new simulations (Springborg & Ladkin,

2018). Through ABL, prospective teacher students try to demonstrate creating art by creating masks with themes and stories from the material they want to teach, from preparing, making, presenting and reflecting.

Conclusion

From the results of this study, several conclusions can be drawn as follows: Difficulty in completing questions 1 in S1 and S2 because it cannot reveal complete information about the meaning of the statement of questions, besides that it occurs because the subject cannot relate to the problem given to the mathematical concepts that have been studied/mathematical models to make three linear equations variable from information about the circumference of the triangle and the length relationship between the sides of the triangle (shortest, medium and longest). The form of action given is level 2 scaffolding: explaining, reviewing, and restructuring.

It is challenging to solve question 2 in S1, S2, and S3 because it cannot reveal complete information about the meaning of the question statement sentence. At S2, there is a cognitive hole where S2 cannot simplify equations with fractional operations, so they have difficulty executing the equation using the LESTV solution method. In S2, the test occurs because of misinformation and conceptions about the problem, assuming the given triangle is the same as an equilateral triangle, even though the triangle described by the problem is an arbitrary triangle with three different angle sizes. In addition, S2 and S3 still experience errors in executing the completion plan. This happens because of the difficulty in determining the problem-solving strategy. The form of action given is level 2 scaffolding: explaining, reviewing, and restructuring.

Difficulty in completing question 3 occurred in S2 and S3 because they could not understand the meaning of the question statement sentence. In S2, a problem arose because there was a tendency for S2 to think pseudo, unable to reveal the examples stated in the questions in the form of notation A, B, and C. S2 considers that such an example is not as usual with the usual solutions so that it becomes one of S2's difficulties, besides that S2 also has a little difficulty determining a good solution strategy. In S3, he could not write down any solutions because he could not understand the intent of the questions. From the interview results, the researcher concluded that S3 was difficult to understand the information about the questions. Still, there were also difficulties in S3 when compiling a completion plan and executing the completion and the form of action given. Is scaffolding level 2, namely, explaining, reviewing?

Difficulty understanding the problem is the most common problem in every child. This difficulty occurs because the format of the questions presented is not as usual in class. The design of the questions consists of a story, and the questions are asked at the end of the story. The tendency of students to think pseudo in solving problems is one of the obstacles at this stage where students are no longer faced with similar questions but are modified to make the process of thinking and search visibility.

Some subjects experienced minor errors in solving due to a lack of accuracy in carrying out calculation operations. The answers to questions were not appropriately verified after finding the solutions.

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