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Yulyanti Harisman[1*]
Muchamad Subali Noto[2]
Wahyu Hidayat[3]
Mhmd. Habibi[4]
Anny Sovia[5]

Pedagogies and Didactic of Junior High School Teachers on Learning Process on Mathematical Problem Solving

Abstract

This study aims to see how the three junior high school teachers are in the learning process of problem-solving. Each teacher has documented their learning process that has been conducted during three meetings. The topic observation materials were Geometry; the materials chosen were because the topic would enable the process of learning about mathematical problem-solving. Videos of the learning process would be analyzed to see how the depth and breadth of pedagogical and didactic aspects of each teacher. The type of this research is descriptive research by using the study cases method. Based on the finding of the research, it was obtained a theory that suggested three categories of the depth of didactic and pedagogical aspects of teachers in the process of solving mathematical problems. These three categories are named in this paper with good, very good, and excellent categories. These three categories will be explained detail in this paper.

Keywords: Pedagogies, Didactic, Problem Solving.

Introduction

Aspects relating to the professionalism of teachers in the learning process is the depth and breadth of pedagogy and didactic. One of the studies that examined that was Negassa (2014) described the impact of the pedagogical ability of university teachers on the learning process. Participants of this study were 111 teachers with a random sampling technique. The teachers came from six different schools. The instruments used were questionnaires and checklists. The conclusion of this research was pedagogical skill affected teachers' professionalism in the learning process. Furthermore, Suryadi's (2010) analysis in the course of mathematics lectures on combinatorics courses based on an indirect approach. This study showed that didactic and pedagogical relationships could not be viewed partially. Still, it needs to be fully understood because, in reality, both relationships can coincide with seeing whether a teacher is professional or not in their teaching.

The next research is Zoest's study (1994) looked at how teachers performed the learning process presented in Table 1 below.

Yulyanti Harisman[1]*, Universitas Negeri Padang, Indonesia. Email: yulyanti_h@fmipa.unp.ac.id
Muchamad Subali Noto[2], Universitas Swadaya Gunung Jati, Indonesia.
Wahyu Hidayat[3], Institut Keguruan Dan Ilmu Pendidikan Siliwangi, Indonesia.
Mhmd. Habibi[4], Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia.
Anny Sovia[5], Universitas Pendidikan Indonesia, Bandung, Indonesia.

Table 1.

Category of the learning process based on the analysis of teachers action on the research Zoest (1994)

Content Performance	***Content Understanding***	***Learner Interaction***
1. Problem statement & Clarification		
Teachers Action		
Guiding toward a defined method to find solutions.	Early model stage of one or more methods to find solutions.	Giving enough information in determining purposes and activities (Cobb, Wood, &Yackel in Zoest, 1994).
Students Actions		
Start to model the solutions towards predefined methods.	Start to model and extend the ways to find the solutions.	Begin to interpret, clarify, and strive to build one or more methods to find solutions.
2. Exploration Solutions		
Teachers Action		
Checking progress and prevent deviations from methods to find expected solutions.	Allowing students to work individually on the choice of methods to find solutions than asking them to compare the solutions.	Encourage students about mathematical dialogue and consensus or consensus that share strategies and solutions Yackel, Cobb, Wood, Wheatley& Merkel in Zoest, 1994).
Students Action		
Running the methods to find the solutions that have been determined with clarification from the teachers.	Continue to develop an outline method provided by the teacher and then discuss the solution with group members.	Explain and negotiate solution strategies and solution efforts with other group members.
3. Helping the Impasse		
Teachers action		
The teacher makes the immediate approach by redirecting to a method to find a predetermined solution.	Quickly approach and advise students to try.	Facilitate the continuation of dialogue without providing substantive mathematical suggestions. Encourage the students to stay and know their problems. (Wood, Cobb, & Yackel in Zoest, 1994).
Students action		
Review the methods to find the solutions through teachers review.	Endeavor (effort) to follow up on the advice of teacher solutions given.	Reinterpret the problems, generate new strategies, or build on previous approaches with new insights.
4. Presentation of Solutions		
Teachers Action		
Evaluate students' answers, either wrong or correct, if one repeats the method for finding a predetermined solution. Rejecting student solution methods.	Accepting non-evaluative correct answers while refraining from addressing unsuccessful solution methods.	Accepting non-evaluative correct and false answers investigating solution methods regardless of their success. It helps to verbalize the entire solution effort (Cobb, Wood, & Yackel in Zoest, 1994).
Student Action		
Passive accepts the teacher's assessment of the solutions that were received.	Present the solutions and listen to the explanations of seemingly solution methods.	Present the answers and do a dialogue on solution strategies with teachers and other students. Able to improve their processes of solution based on this discussion.

Based on the results of previous expert research results, this problem as the following research:

Problem of Study

Research experts have focused on seeing how the depth and breadth of pedagogic and didactic of teachers in the process of learning mathematics in general. There has not been much research focusing on didactic and pedagogical teachers in the learning process of mathematical problem-solving. This study aims to see how the depth and breadth of pedagogical and didactic aspects of teachers in the process of learning about solving mathematical problems.

Methods

Research Desing

This research uses a case study approach. This study was chosen because this study examines and analyzes how the depth of pedagogic and didactic teachers on problem-solving teaching at various levels of junior high school. Creswell (2015) said the case study approach was used to study events, programs, or more than one individual.

Participants

Three junior high schools in different cities of Bandung (one of a city in Indonesian) *cluster* (level) were chosen as places of the research. One volunteer teacher in the eighth grade from each school would serve as a subject of observation in the learning process of mathematical problem-solving. A bunch is a school group that is determined based on the school's rank. According to information from Bandung education office, there are three junior high schools clusters in Bandung. *The groups* are A, B, and C. The purpose of selecting a school with varying levels is to avoid the reliability and validity issues that may be present in Patton's (1990) small sample size.

Data Collections Tools

In this study, the researcher is the main instrument as a data collection tool. The research will provide a perception of various sources of data collection, namely: teacher learning videos, interviews, documents, and field notes.

Issues discussed as well as data collection tools are discussed in Table 2 below.

Table 2.

Research Instruments and Observed Aspects

The thing that was studied	Research instrument
The depth and breadth of the didactic and pedagogical aspects in learning about mathematical problem-solving which include: 1) the use of various problem-solving strategies, 2) learning mathematical problem-solving heuristically, and 3) creation of interactions between students, teaching materials, and teachers in the learning process about solving mathematical problems.	• Video learning mathematical problem-solving. • Interview guidelines. • Questionnaire.

Data from the three aspects of the observational review were collected from various instruments such as learning videos, observation sheets, and interviews through the stages of validity and reliability as follows:

1. Credibility Testing

In this study, an extension of observation has been carried out on the learning process about problem-solving by three teachers. Initially only carried out on one observation meeting, because the data needed is not yet specific its validity, the observation is repeated three times. Each teacher's video is watched repeatedly to ensure the teacher's classification in the learning process about problem-solving. Data collection for each aspect was also triangulated by interviewing the teacher by asking several open questions. Documentation of student work is also used as triangulation of other data.

2. Transferability Testing

The results of the study had been used to look at different samples in the population group, namely other teachers in the same school. Grouping in research can be used and able to reduce the example.

3. Dependability Testing

This research has already passed the replication stage carried out by peers.

4. Conformability Testing

The results of research on the grouping of teachers based on the theoretical study in this study have been carried out and confirmed with experts and peers through small group discussion forums.

Data Analysis

Data were analyzed using coding and classification. Teacher videos are transcribed and classified based on differences that arise. Creswell (2015) said the purpose of data analysis in case study research was to describe cases/various cases and their context based on problem development and problem classification.

Procedure

One volunteer teacher in the eighth grade from Three Junior high school would serve as a subject of observation in the learning process of mathematical problem-solving. Each teacher would be observed and recorded in videos of

their learning process for three meetings. The material chosen was Geometry. It was chosen because the content might enable the process of solving mathematical problems. The results of video analysis would be given codes and presented in several categories if there were different learning processes for each of them.

Results

Based on the analysis of learning video from each teacher, the categories obtained depth and breadth of pedagogical and didactic aspects of the teacher in the learning process about mathematical problem solving are shown in Table 3 below.

Table 3.

Categories of depth and breadth of pedagogy and didactic aspects of the teacher in the learning process of mathematical problem solving

Aspect	**Description of Aspect**	**Categories**		
		Good	***Very Good***	***Excellent***
Depth and Extent Aspect of Didactic and Pedagogic in learning about mathematical problem solving	Using various problem-solving strategies	Directing students to problem-solving process with an approach that has been set	Leading students to the problem-solving process with a variety of strategies	Teachers ask the students to display their troubleshooting process by providing help needed instructions
	Heuristic mathematical problem-solving learning	Students with teachers try to understand the process of solving mathematical problems following a predetermined strategy	Students with teachers try to understand the problem-solving process toward pre-defined strategy choices	Students recognize the process of understanding the mathematical problem solving of the stratum Self-constructed strategy
	Creating interactions among students, teaching materials, and teachers in the learning process on mathematical problem solving	One-way communication from teachers to students in the accurate problem-solving process	Two-way interaction but not involving other students in the precise problem-solving process	Two-way interaction by participating other students collaboratively in the process of solving mathematical problems

The following explanation will describe how one of the aspects of the depth of didactic and pedagogical.

Citation of the learning process of teacher S-1 in the video one for material finding cube nets.

1. S-1 Teacher (Depth of Didactic and Pedagogical Aspect) in Learning about Mathematical Problem Solving

Preliminary Activity	:	S-1 teacher formed eleven groups of students. Each group obtained six squares of marble papers with different colors. Then the teacher of S-1directed each group to assemble six squares and fold them to form a cube. The teacher also said that the eleven groups were expected to find a different set of circuits because the number of cube nets was eleven pieces
Core Activity	:	Each group assembled six squares that if they were folded, they would form cubes according to the teacher's previous directions
Closing Activity		The process of sifting through (verify) whether the square form the group draws was a complete cube web, the teacher confirmed the truth by matching eleven correct types of ns with webs the teacher prepared before. This was done by gluing the webs that the teacher made on nets that match the group. The process of it can be seen from the following Figure 1.  ***Figure 1.*** *Verifying Process by Matching with Teachers Provided*

Related to the above video analysis, S-1 teachers. It can be categorized into categories *good* where teachers directed the students to problem-solving processes by establishing strategies. Teachers did not lead the students to problem-solving methods with varying approaches. Teachers also did not ask students to display the problem-solving process in their way, where the teacher only provided the necessary help. The following lesson will be presented in the teacher's lesson samples on the second observation.

The citation learning process of teacher S-1 in the second video for the review materials related to the circle.

Preliminary Activity	:	At the beginning of the learning process, the teacher gave some problems on the board. The teacher asked the students to count the straps on the triangle with the radius of the circle known
Core Activity		1. The teacher allowed the students to finish the problems presented. 2. The students solved the problems in their ways; some of the strategies used by the students can be seen in Figure 2 and Figure 3.
	:	

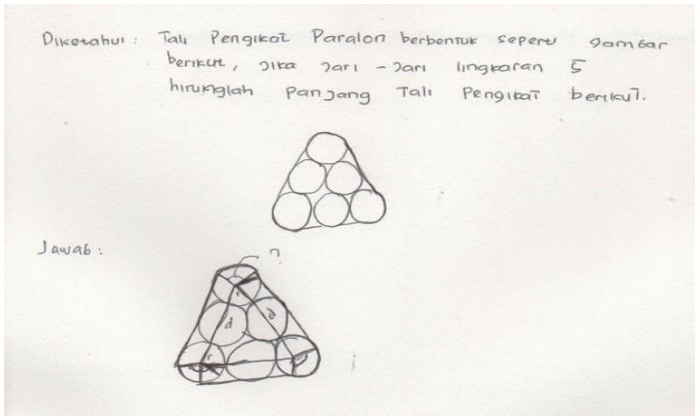
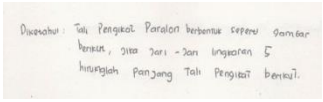


Figure 2.

Representation of students in Mathematical problem Solving

Translation of Images	
	Paralon strap is shaped like the following picture, if the radius of the circle is 5, calculate the length of the paralon strap!

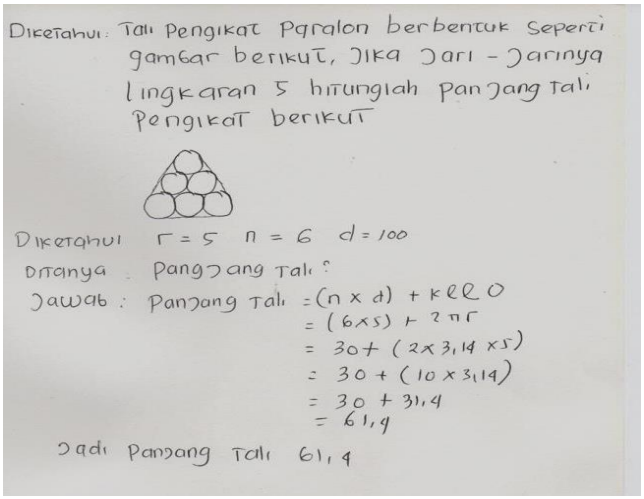
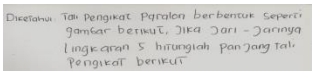
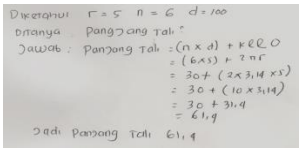


Figure 3.

Representation of students in Mathematical problem Solving

		Translation of Images
		 Known: Paralon strap is shaped like the following picture, if the radius of the circle is 5, calculate the length of the paralon strap!
		 Known: $r = 5, n = 6, d = 100$ asked: rope length Answer: rope length $= (n \times d) + circumference$ $= (6 \times 5) + 2\pi r$ $= 30 + (2 \times 3{,}14 \times 5)$ $= 30 + (10 \times 3{,}14)$ $= 30 + 31{,}4$ $= 61{,}4$ So, the rope length is 61,4
		3. The teacher continued to monitor the student's work to go around the room and provided help to students who asked for things that were not yet understood; the teacher gives the help was in the form of clues that lead to a solution
Closing activity	:	The teacher asked several students to present their work in front of the class and discussed the result with all class members

Based on the above video analysis, S-1 teachers can be categorized into *excellent*, where S-1 teachers asked students to perform the problem-solving process in their way, and the teacher only provided the necessary assistance/guidance. S-1 teachers did not lead students to problem-solving methods with varying strategies, and S-1 teachers also did not lead students to problem-solving processes with established procedures.

Preliminary Activity	:	1. The teacher explained the purpose of learning, namely finding the surface area of a triangular cube 2. The teacher told what the surface area cube means by saying that it is the vast amount throughout the side or field in the robust figure. 3. Students were asked to sit down in groups in pre-defined groups to find the formula of the surface area of the cube. 4. The teacher asked the students to remove the box that has been requested beforehand for the students to take. The size of the cube was freed on the students. Students might make their own and also look for a cube-shaped box 5. The teacher asked the students to find the surface area of the cube
Core activity	:	1. Students discussed with a group of friends to discover the surface area of the cube 2. The students did various methods to find the surface area of the cube, one of them which was by cutting the sides of the cube until it tore off and formed squares and counted the entire square area, then summed it up as shown by the Figure 4.  ***Figure 4.*** *Students Cut All Cube Sides until the sides were taken off*

		3. Another student's strategy was to simply cut the hands of the cube to form a net and calculate the area of the square that forms the cube nets. 4. The other groups also performed different strategies such as not cutting the cube, but only measuring the sides of the cube so that it got one square area, then counting with six. It can be seen in Figure 5.  ***Figure 5.*** *Students Measured Solid Figure of Cube* 5. The teacher monitored the students to get around and gave some help
Closing Activity		1. Students presented their findings in front of the class 2. Other students were asked to respond to the findings

Based on the above video analysis, the S-1 teacher can be categorized into the teacher category *excellent*. The S-1 teacher asked the students to present the problem-solving process in their way. The teacher only provided the necessary assistance/guidance. The S-1 teacher only gave an understanding of what the surface area of the cube means and asked the students to provide a cube-shaped box, then let the students free to be creative on the cube to obtain the surface area formula. S-1 teachers did not lead students to problem-solving processes with varying strategies, and S-1 teachers also did not lead students to problem-solving methods with established procedures.

Based on the analysis of the video above, it can be concluded that the S-1 teacher has a tendency as an *excellent* teacher where the S-1 teacher asked the students to present the problem-solving process in their way, and the teacher only provided the necessary guidance.

2. S-2 Teacher (Teacher Who came from School Two) Depth of Didactic and Pedagogical Aspect in Learning about Mathematical Problem Solving

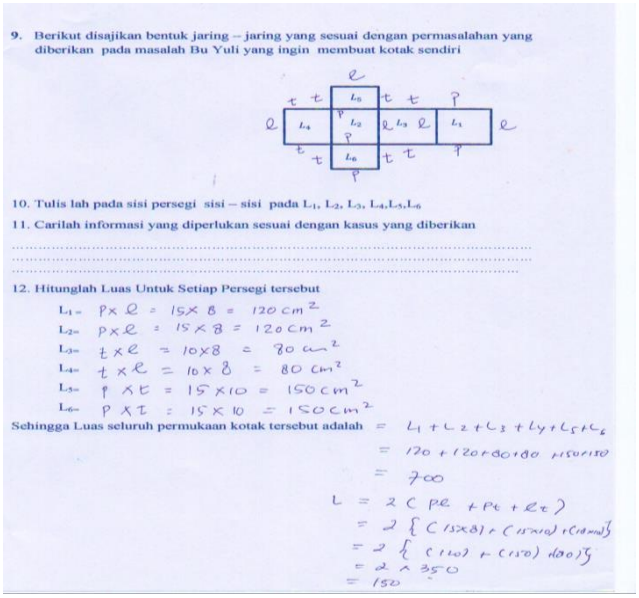
Coverage of the S-2 teacher's learning process on video one for the problem of finding cube nets.

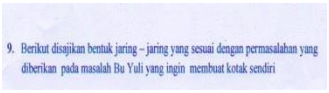
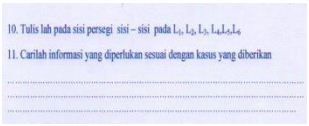
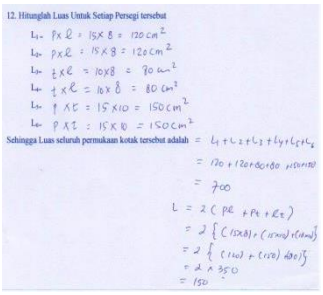
Preliminary activity	:	1. The teacher asked students to sit down in groups. 2. Teachers performed the process of giving an understanding of finding of the shape of the cube webs by drawing a series of squares on the board and explained when the squares are folded and forming a cube, it is a cube web, and vice versa.
Core activity	:	While applying the chosen strategy, the teacher asked the students to describe a series of squares on a printed paper with a different set among intermediate members with other members in one group. Then cut them out and pasted them on the cardboard
Close activity		The teacher showed all the cube webs that were created by the groups and confirmed the truth of the sequence to students from other groups.

Based on the above video analysis, S-2 teachers can be categorized into categories *good* where teachers directed students to the problem-solving process with established strategies. Teachers did not lead the students to problem-solving methods with varying approaches. Teachers also did not ask students to display the problem-solving process in their way, where the teacher only provided the necessary help. Below is presented a snapshot

of the learning process conducted by teacher S-2 in second observation.

Here is the learning process of teachers S-2 video two where the material was the formula surface cubes and cuboids.

Preliminary activity	:	1. The teacher expressed the purpose of learning how to find the formula of the surface area of the cube and the formula for the surface area of the cuboids 2. The teacher distributed Worksheets to each group to give problems at the worksheet it was "Ms Yuli is a cake maker. She gets cake orders as much as 80 boxes. Usually, she buys the box where the cake is, but this time she wants to make it herself so as not to cost too much. The box size that she wants to make is 25 cm x 20 cm x 15 cm x 20 cm x 20 cm x 20 cm. Ms Yuli starts to calculate the size of which box to use. If she wants to create a box with the same material but with a small cost, which box will Ms Yuli choose? 3. The teacher explained the problem in Worksheets. Then The teacher-guided the students what each group would do by drawing a square and rectangular papers. According to the size of the problem given to Worksheets.
Core Activity	:	4. Students created squares and rectangles according to the teacher's directions, and then attached them to cardboard to form a web of cubes and cuboids. This can be seen in Figure 6.  ***Figure 6.*** *Students Make Square and Rectangle then Stick it on Carton Paper* 5. Each group calculated the area of each square and rectangle and filled it in Worksheet 6. Students fell in answer to worksheets by counting all the rectangular regions, and the square. That is formed and obtained the form of the formula, as seen in Figure 7.  ***Figure 7.*** *One of the Worksheet Students Answer Sheet*

<table>
<tr><td></td><td></td><td>
<table>
<tr><td colspan="2">Translation of Images</td></tr>
<tr><td> 
</td><td>9. The following is a picture of the beam netting to solve the problem of Mrs Yuli who wants to make her box</td></tr>
<tr><td> 
</td><td>10. Write on the square side of the sides on L1, L2, L3, L4, L5, L6
11. Look for the information needed following the case given</td></tr>
<tr><td> 
</td><td>12. Calculate the Area for Each Square
$L_1 = p \times l = 15 \times 8 = 120cm^2$
$L_2 = p \times l = 15 \times 8 = 120cm^2$
$L_3 = t \times l = 10 \times 8 = 80cm^2$
$L_4 = t \times l = 10 \times 8 = 80cm^2$
$L_5 = p \times t = 15 \times 10 = 150cm^2$
$L_6 = p \times t = 15 \times 10 = 150cm^2$
So that the entire surface of the box is
$= L_1 + L_2 + L_3 + L_4 + L_{51} + L_6$
$= 120 + 120 + 80 + 80 + 150 + 150$
$= 700$
$= 2(pl + pt + lt) = 2\{(15 \times 8) + (15 \times 10) + (8 \times 10)\} = 2 \times 350 = 700$</td></tr>
</table>
7. The teacher asked the group to compare the final number of the two surfaces, which the surface smaller is the box selected by Ms Yuli to make the cake</td></tr>
<tr><td>Closing activity</td><td>:</td><td>The work of the group is presented in front of the class</td></tr>
</table>

Following the above video analysis, the S-2 teacher can be categorized into a category *good* where the teacher directed the students to the problem-solving process with a predetermined strategy. Teachers did not lead students to problem-solving methods with varying approaches. Teachers also did not ask students to display the problem-solving process in their way, where the teacher only provided the necessary help. Furthermore, the following material will be presented as a snippet of the teacher learning process on the second observation. Below is presented a snapshot of the learning process conducted by teacher S-2 on the third observation.

It is the learning process teachers S-2 on video three to material Prism.

Preliminary activity	:	The teacher expressed the purpose of learning which was to know the definition, the elements, formula volume, and the formula for the surface area of the prism
Core activity	:	1. The teacher explained the meaning of prism by using media, and then the teacher explained the types and elements of the prism on the board. It can be seen in Figure 8.

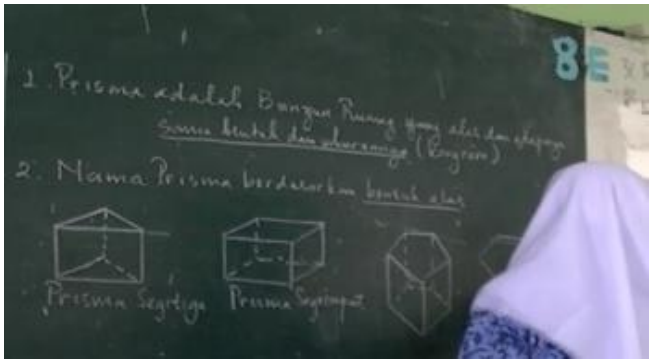
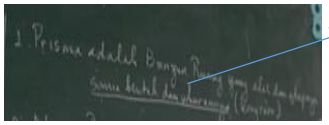
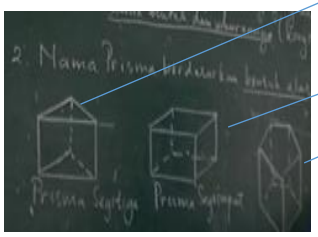


Figure 8.

Teacher Explained the Types of Prisms and Prism Elements

Translation of Images	
	1. A Prism is a geometry which base and roof are the same a shape and size (congruent)
	2. The name of Prism is based on its shape and base Triangular Prism Rectangular prism

2. The teacher explained how to get the prism volume formula. The first explaining that the cube and cuboids are prisms with square and rectangular pads so that the volume formula of the prism with a square-shaped base is the same with the cube and cuboids volume formula, i.e., V = base (rectangle) times the height. Thus for the triangular base formulas, the volume of the prism becomes V = base (triangle) x-height. And so on, the volume formula of the prism depends on the shape of the base of a prism, which shown by Figure 9.

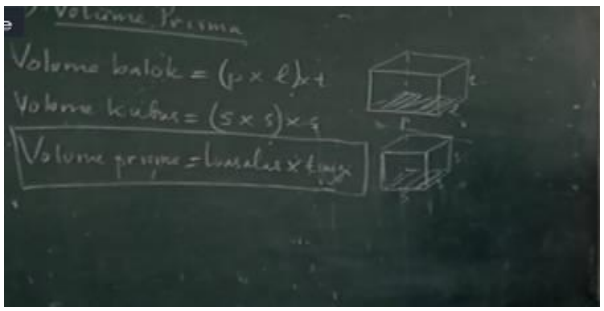
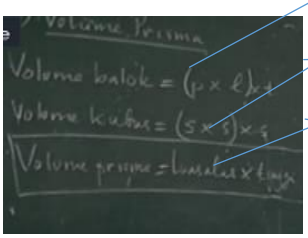
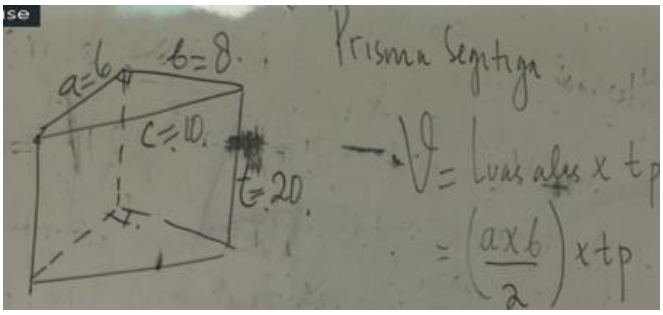
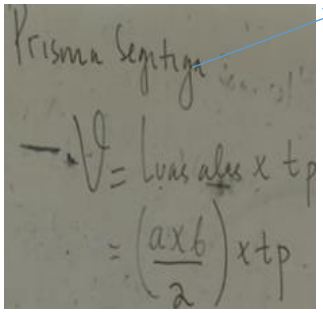


Figure 9.

Teacher Explained the Prism Volume Formulas Derived from the Volume Formulas of the cuboids and Cubes.

		Translation of Images  Beams Volume $= (p \times l) \times t$ Cubes Volume $= (s \times s) \times s$ Prisms Volume = Area of a pedestal × high 3. The teacher gave a question to be solved by the students, as in Figure 10.  ***Figure 10.*** *The teacher-directed the students in solving the problem* Translation of Images  Triangular Prism $v =$ area of pedestal $\times\ t_p$ $= \left(\frac{a \times b}{2}\right) \times\ t_p$ The teacher instructed the students to calculate the triangle prism volume with the ribs in the solid already known in length. Students could quickly solve the problem by merely substituting the values a, b, and t into the formula already written by the teacher on the board. Then, in the same way, the teacher instructed the students to calculate the volume of the prism with the base of the diamond and trapezium.
Closing activities	:	The teacher corrected the student's work.

Based on the above video analysis, S-2 teachers can be categorized into the *good* category where the teacher directed the students to problem-solving processes with established strategies. Teachers did not lead students to problem-solving methods with varying approaches. Teachers also did not ask students to display the problem-solving process in their way, where the teacher only provided the necessary help.

Based on the analysis of the video on the observation of one, two, and three teachers, S-2 Teachers is more oriented to teachers who are categorized *good*, i.e. teachers directed students to the problem-solving process with a predetermined strategy.

3. S-3 teacher (a teacher who comes from school three) the depth of didactic and pedagogical aspects in learning about mathematical problem solving

Teachers' teaching process on video one for cube web material.

Preliminary activity	:	The teacher provided an understanding of what the cube nets are through a medium, *PowerPoint*. When the media was shown their cubes whose sides were open one by one and the S-3 teacher gave an explanation when all the sides were opened and formed a flat build, then that's called the cube nets.
Core Activity	:	The strategy used by the S-3 teacher could find the cube webs are to ask each student to open the package book; the package book consists of a few square series. The teacher asked the students to imagine which square sequence would build up the cube space, then it is the cube webs, and vice versa.
Closing Activity	:	At the time of the verification process, the teacher confirmed the truth of the square series to the students by displaying the work of several students in front of the class.

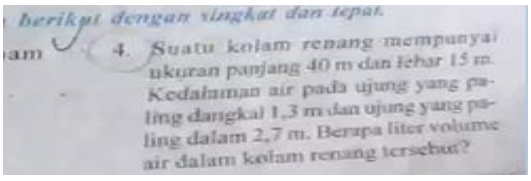
Based on the above video analysis, S-3 teachers can be categorized into a *good* category where teachers directed students to problem-solving processes with established strategies. Teachers did not lead the students to problem-solving processes with varying strategies. Teachers also did not ask the students to display the problem-solving process in their way, where the teacher only provides the necessary help. Furthermore, the following material will be presented a snippet of teacher poses on the second observation. Below is presented a snapshot of the learning process conducted by teacher S-3 on the second observation.

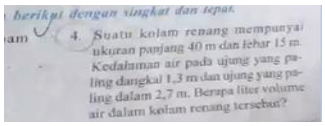
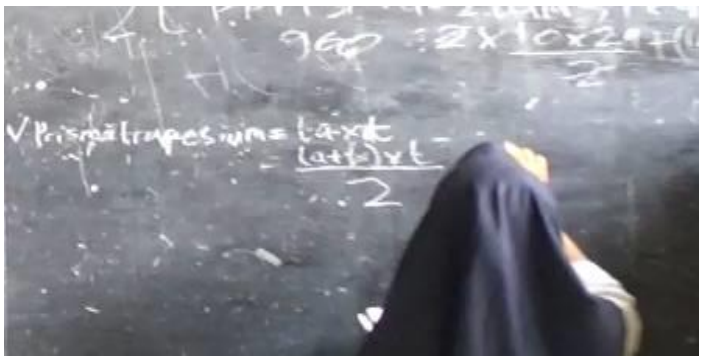
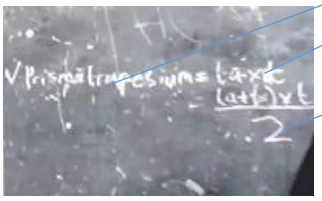
A snippet of the S-3 teacher's learning process on the two videos for the material finds the surface area and volume of the prism.

Preliminary Activity	:	The teacher explained what the surface area of the prism and pyramid through a *PowerPoint*.
The core activities	:	The teacher gave several examples of material related to the questions and made a detail solution on the board
The closing activities	:	The teacher conveyed the lesson objectives for the following week to discuss Issues related to the surface area and volume of a prism

Based on the above video analysis, the teacher S -3 can be categorized into a *good* category where the teacher directed the students to the problem-solving process with a predetermined strategy. Teachers did not lead the students to problem-solving processes with varying strategies. Teachers also did not ask students to display the problem-solving process in their own way, where the teacher only provided the necessary help. Furthermore, the following material will be presented as a snippet of the teacher process on the second observation. Below is presented a snapshot of the learning process conducted by teacher S-3 on the third observation.

A snapshot of the S-3 teacher's learning process on video three on the discussion of surface prism issues and prism volume.

Preliminary Activity	:	1. The teacher-reviewed the surface and prism volume formula given in the previous week 2. The teacher asked the students to work on some questions in the activity book.
Core activity	:	1. The teacher-guided the students in solving the problem in the activity book with the procedures that the teacher taught before. Here is an example of the problem in the activity book in Figure 11.  berikut dengan singkat dan tepat. 4. Suatu kolam renang mempunyai ukuran panjang 40 m dan lebar 15 m. Kedalaman air pada ujung yang paling dangkal 1,3 m dan ujung yang paling dalam 2,7 m. Berapa liter volume air dalam kolam renang tersebut? ***Figure 11.*** *Examples One of the Problems in the Activity Book*

		Translation of Images  4. Suatu kolam renang mempunyai ukuran panjang 40 m dan lebar 15 m. Kedalaman air pada ujung yang paling dangkal 1,3 m dan ujung yang paling dalam 2,7 m. Berapa liter volume air dalam kolam renang tersebut? 4. A swimming pool has a length of 40 m and a width of 15. The depth of the water at the shallower end is 1.3 m, and the deepest tip is 2, 7m. How many litres of water volume in the swimming pool? The teacher's referral for solving the problem was to use the width of the trapezium multiplied by the height of the prism. 2. The student was solving the problem in front of the class as directed by the teacher in Figure 12.  ***Figure 12.*** *The student was Solving the Problems Appropriate with the teacher's guidance* Translation of Images  Volume of the trapezoidal prism $= l_a \times$ t $= \frac{(a+b) \times t}{2}$
Closing Activity	:	The teacher gave some problems for homework

Based on the above video analysis, the S-3 teacher can be categorized into *a good* category where the teacher directed the students to the problem-solving process with a determined strategy. Teachers did not lead the students to problem-solving processes with varying strategies. Teachers also did not ask students to display the problem-solving process in their way, where the teacher only provides the necessary help. Furthermore, the following material will be presented as a snippet of the teacher process by the second observation. Below is shown a snapshot of the learning process conducted by teacher S-3 on the third observation. Two and three teachers S-3 is more oriented to teachers who are categorized *good,* i.e., teachers directed students to the problem-solving process with a predetermined strategy.

Discussion and Conclusions

In addition to the teacher category in the depth and breadth of the pedagogical and didactic aspects of learning about problem-solving presented in this paper, many other research studies have found that teachers do have different categories in the professional aspects of teaching. Research (Beswick, 2005; Beswick 2012, Mosvold, 2015, Köksal, 2018)) in their research found several types of teachers about their beliefs about mathematics, mathematics learning, and mathematical problem-solving. Further research (Harisman, 2019, Harisman 2018, Muir 2007 a) also found categories of teachers in reflecting their learning process.

Categories of teachers on the depth of pedagogical and didactic aspects on Problem-Solving can be upgraded (Novita, Putra, & Johar, 2019). That means is that if the teacher is in a good category, it can be changed to a very good or excellent category. Many things can be done to upgrade the teacher category. The way witch forward by experts is by changing the teacher beliefs, attitude, and teacher reflections in the learning process about problem-solving (Ertmer, 2005; Gates, 2006; Haney, Czerniak, & Lumpe, 1996; King, Shumow, & Lietz, 2001; Maggioni & Parkinson, 2008; Sakellariou & Rentzou, 2012; Harisman, 2019 a). For example, a teacher who starts to have beliefs about learning about problem solving is a process of transfer of knowledge from teacher to student, so his teaching practice will require lectures (good teachers). However, when these beliefs were changed by considering students already had the knowledge he had before, so the class will be taught by constructing student knowledge (excellent teachers). This is an internal aspect that affects the depth of the pedagogical and didactic elements of the teacher in the learning process about problem-solving.

In addition to internal aspects, external aspects can also affect the teacher in teaching. Including the external elements are the educational background, length of the lesson, and often doing activities or training (Muir, 2007 b). Harisman (2019 b) and Jung, Choi, & Jung, (2020) said that teachers who often did training would tend to be excellent teachers in their teaching practices. This is also supported by studies of other experts who conduct training of teachers so that teachers become better in teaching. Armiati (2020) Conduct training of junior high school teachers to improve the quality of the questions given to students in their education. Where in the beginning the research was only 41 per cent of teachers who were able to design items that honed the ability to think highly higher students after being given training 71 per cent of teachers created the questions correctly. Similar research was also carried out by Blömeke et al. (2008) were able to improve the pedagogical and didactic abilities of the teacher through studio lesson training. Furthermore, the teacher's educational background also enhances the teacher's pedagogical and didactic skills in teaching. This was stated by researchers Garbett (2011) who examined three teachers (Germany, South Korea, and Taiwan) by obtaining different instructions which also made them different in their abilities.

The categories of teachers in their learning will influence student achievement in their learning outcomes (Harisman, 2019b). Teachers who have professionalism in the excellent category will produce sophisticated students in their performance (Harisman, 2019c). However, the teacher is the main factor that determines the success of students the teaching material factor (Kariman, 2019; Hayran & Beydoğan, 2017)). The internal elements of the students themselves also influence student achievement (Harisman, 2017, Noto, 2017; Harun, 2017).

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