(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING
Volume 6, No. 4, December 2023
P-ISSN 2621-4733
E-ISSN 2621-4741
https://dx.doi.org/10.22460/jiml.v6i4.p21623

HOW DO TEACHERS SOLVE PROBLEM WITH CONTRADICTION INFORMATION? STUDY OF PROSPECTIVE TEACHERS - PROFESSIONAL TEACHERS IN SOLVING PROBLEM USING THE IDEAL MODEL

Anas Ma'ruf Annizar[1], Sunardi[2], Susanto[3], Abi Suwito[4]

[1]Universitas Jember, Jl. Kalimantan Tegal Boto No. 37, Jember, Indonesia.
anasannizar28@gmail.com
[2]Universitas Jember, Jl. Kalimantan Tegal Boto No. 37, Jember, Indonesia.
sunardifkipunej@yahoo.com
[3]Universitas Jember, Jl. Kalimantan Tegal Boto No. 37, Jember, Indonesia.
susantouj.fkip@unej.ac.id
[4]Universitas Jember, Jl. Kalimantan Tegal Boto No. 37, Jember, Indonesia.
abi.fkip@unej.ac.id

ARTICLE INFO

Article history:

Received Dec 05, 2023
Revised Dec 08, 2023
Accepted Dec 10, 2023

Keywords:

Problem Solving Ability
Problem with Contradiction Information
IDEAL Model
Prospective Teachers

ABSTRACT

This research is a qualitative descriptive study which aims to describe the problem solving process of a professional teacher in finding solutions to problems of the Problem With Contradiction Information type. This research involved 1 mathematics teacher who had a professional teacher education certificate and had taught for at least 5 years (S1) and 1 mathematics teacher who had taught for at least 5 years but did not yet have a professional teacher education certificate (S2) and 1 prospective teacher who was still carrying out studies. S1 and does not yet have a professional teacher education certificate (S3). Data collection was carried out by tests and interviews. The research results showed that only S3 carried out all the IDEAL problem solving indicators and was the only research subject who realized the existence of contradictions in the given problem. Meanwhile, S1 and S2 do not look back and learn. All subjects started solving the problem by reading and making propositions from the problem given. S3 stated that he read twice, namely reading in depth and reading quickly to review the known data. S1 experienced Pythagorean priming when implementing the Making a Drawing and Backwards strategy. Meanwhile, S2 in implementing the Backwards strategy often has to do some work in his working memory so there are several steps that are not written down. S2 is aware that there is unnecessary data but considers it an open ended question. Meanwhile, S3 succeeded in stating that the question contained elements of contradiction and could not be done in the anticipating outcome and looking back steps. If you want to become a good problem solver then spend most of your time identifying and understanding problems and then determining how to work. Good problem solvers are not in a hurry but are still effective in solving problems. You even need to consider whether the problem can be solved or not.

Corresponding Author:

Anas Ma'ruf Annizar,
Fakultas Keguruan dan Ilmu Pendidikan,
Universitas Jember,
Jl. Kalimantan Tegal Boto No. 37, Jember, Indonesia
Email: anasannizar28@gmail.com

How to Cite:

Annizar, A.M., Sunardi., Susanto., & Suwito, A. (2023). How Do Teachers Solve Problem With Contradiction Information? Study of Prospective Teachers - Professional Teachers in Solving Problem Using

The IDEAL Model. *JIML*, 6(4), 294-307.

INTRODUCTION

One of the fields of study that influences the development of science and technology in this era of globalization is mathematics, therefore mathematics has become something that is of great concern in the world of education. However, from the results of the study conducted by PISA, it was found that the problem solving abilities of students in Indonesia are still relatively low. Polya (1973) defines problem solving as an effort to find a way out of a difficulty, to achieve a goal that is not immediately obtainable. Olivares et al., (2021) states that problem solving is a thought that is directed directly to finding a solution or solution to a specific problem. From this definition, it can be concluded that problem solving is a business process that uses all the knowledge, skills and understanding it has to find solutions to the problems it is given or faced. The importance of problem solving is emphasized by The National Council of Teachers of Mathematics (2000) that there are several reasons why problem solving is very important in learning today, namely: (1) Problem solving is part of mathematics; (2) Mathematics has applications and applications; (3) There is intrinsic motivation inherent in mathematical problems; (4) Problem solving can be fun; (5) Teach students to develop problem solving techniques.

Therefore, the problem-solving abilities of subjects in Indonesia need to be improved, one way is by providing problem-solving exercises for non-routine problems. Furthermore, problem solving can also act as a means to develop mathematical thinking as a tool for everyday life (Cockcroft, 1982; Dawkins & Epperson, 2014).

However, from the results of the study conducted by PISA, it was found that the problem solving abilities of students in Indonesia are still relatively low. This means there is homework for youteachers can monitor the development of students' problem-solving abilities to find out the level of their problem-solving abilities and which areas need to be improved (Annizar et al., 2021; Subakri & Annizar, 2021). Even though there has been a lot of research that examines student problem solving in Indonesia, it is still not known with certainty the root of the problem of students' relatively low problem solving skills. For this reason, researchers feel it is important to know the problem solving skills of educators or teachers. A very basic and theoretical assumption is that it is impossible for a teacher to be able to make his students have competent problem solving skills if an educator does not have them first (Sidenvall et al., 2022).

From this explanation, good problem solving skills are very important for a teacher to have so that they can pass them on to their students. Based on this, this article was created to provide a better understanding of the meaning of the problem solving process and how to evaluate problem solving, so that educators can find out how their own problem solving abilities are, improve them and can specifically apply them to learning in the classroom. Broadly speaking, this research is important to carry out as a starting point in policy making by stakeholders regarding whether training is necessary, as well as curriculum policies and the like related to problem solving.

To evaluate problem solving abilities, an indicator is needed, in this article an indicator created by Bransford & Stein (1993), namely Identify problems and opportunities, define goals, explore possible strategies, anticipate outcomes and act, and look back and learn which is defined as identifying problems and opportunities, determining goals, exploring possible strategies, anticipating results and implementing them, as well as looking back and studying them. Besides that, the purpose of this article is to find out how teachers solve problems in solving PWCI problems based on the IDEAL indicators created by Bransford & Stein.

There are reasons for choosing the IDEAL problem solving indicators and PWCI problems in this research. The reason for choosing IDEAL is that this problem solving process was developed as a follow-up to Polya's heuristic problem solving so that it complements Polya's existing sub-indicators such as "Determining the opportunity for solving the problem" and "anticipating the results of the strategy to be chosen" (Brookhart, 2010; Nabila & Mohaffyza, 2020). Meanwhile, the reason for choosing PWCI problems, which are problems with certain contradictions, is given to teachers to encourage more accuracy, critical and creative thinking in looking at the problems given. This is considered important to instill in the thinking of teachers and students so that it is more contextual and can be applied in solving everyday problems, both mathematical and non-mathematical, so that there are times when a problem is given before looking for a solution, it is necessary to consider the feasibility or adequacy of the existing information (Annizar et al., 2020; Dewey, 1933).

METHOD

This research was carried out in Jember Regency with the research subjects namely 3 teachers with details of 1 mathematics teacher who has a professional teacher education certificate and has taught for a minimum of 5 years (hereinafter referred to as S1), 1 mathematics teacher who has taught for a minimum of 5 years but does not yet have an education certificate teacher profession (hereinafter referred to as S2), as well as 1 prospective mathematics teacher who is still completing his 1st degree studies, so he does not yet have a teacher professional certificate (hereinafter referred to as S3). The selection of subject categories based on professionalism was carried out to provide a brief overview of whether a teacher's problem solving is also influenced by their teaching experience and level of professionalism as measured by whether or not they have a professional teacher certificate. Based on this, it is known that subject selection was carried out using a purposive method.

The data collection technique in this research is the PWCI problem solving test which consists of 1 essay type question which has been previously validated and an interview whose interview guide has also been validated by experts. Triangulation techniques are used in this research to compare and/or complement test results with interviews.

The analytical technique used in this descriptive qualitative research is analytical techniques Miles et al., (2014) which includes data condensation, data presentation, and drawing conclusions. The indicators used were adopted from the IDEAL problem solving indicators created by Bransford & Stein (1993) (in table 1), namely as follows:

Table 1. Indicators of Problem Solving Ability

Indicator	Description
Identify Problems and Opportunities	• Identification of problems • Determine whether the problem can be solved or not
Define Goals	• Determine alternative goals • Choose one goal that has the greatest chance of finding a solution
Explore Possible Strategies	• Determine alternative strategies to solve problems • Reanalyze the objectives taking into account the strategies implemented
Anticipate Outcomes and Act	• Anticipate possible outcomes • Implementing the strategy
Looking Back and Learn	• Looking back at the actual impact of the strategies implemented • Learn from experience

The PWCI problem solving test instrument used in this research has been validated by experts. The following are the questions used in this research.

The lamp is a combination of a cone and a half ball with a lamp length of 28 cm, a radius of 7 cm and a cone line of 25 cm. What is the volume of the lamp?

RESULTS AND DISCUSSION

Results

Subject S1 (Teacher with more than 3 years teaching experience and professional certificate)

- Identify Problems and Opportunities

In this indicator there are 2 sub-indicators, namely identifying problems and seeing opportunities. At the problem identification stage based on interviews, the subject stated that he read each sentence to understand the essence of the sentence so that he knew the meaning of the problem given in its entirety. Based on the theory of Language Psychology from Sternberg & Sternberg (2012) It is known that S1 at the initial stage of solving the problem made a proposition by reading each sentence of the problem given. Making prepositions is important as the subject's first step in understanding the problem given, propositions are also important as a representation of the problem (in its entirety) to be brought into the subject's working memory and implicated in long-term memory in the form of understanding the meaning of the problem, visual representations related to phenomena. in questions, and so on. In this step, S1 makes a proposition for at least 2 things, namely, providing in-depth meaning regarding the problem given, along with sketching a visual picture in his cognitive. S1 identified the problem as finding the volume of a combination of a hemisphere and a cone.

The next sub indicator is seeing opportunities. This means that problem solvers are encouraged to look at opportunities first to see whether the problem has the potential to be resolved (find a solution) or not (Ernest, 2004; Krulik & Rudnick, 1988). Likewise with S1, based on the results of interviews and tests, as well as as a continuation of the sub-indicator "problem identification" S1 sees the problem given as an opportunity that can be resolved considering the many known variables including overall height and radius. The S1 results in the first indicator are reflected in Figure 1 below.

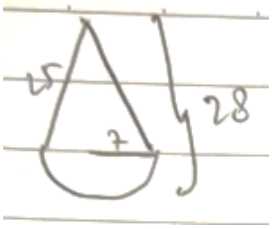

Figure 1. Identify Problems and Opportunities S1

S1 wrote the picture in stages, in the first stage S1 described the combined shape of a cone and a half sphere without any other data immediately after he finished reading the problem given. Or in other words, the proposition he makes in the sub-indicator identifies the problem of producing an image in the first stage and is displayed using visual representation. This is in line with research Keles & Yazgan, (2022) which states that geometric problems will be easier if they are represented visually, because with the large amount of data in working memory it will be too difficult to process all the data without forgetting one of them. For this reason, visual representations (pictures) are made to simplify or help written representations (questions). Although it is not clearly written whether S1 knows what the problem is, based on interview data S1 stated that the problem is determining the volume of the lamp.

Furthermore, to support the sub-indicator "seeing opportunities", S1 continues the problem solving process in stage 2, namely writing down known data into the visual representation created, including information that is not in accordance with the strategy that will be chosen.

- Define Goals

This indicator consists of 2 sub-indicators, namely "determining alternative goals" and "choosing a goal that has a high chance of finding a solution". In this indicator, S1 has steadily chosen the goal, namely calculating the volume of a half-sphere and cone combined as a result of his understanding of the first indicator, identify problems and opportunities. Even though this was not written on the worksheet, based on the results of the interview the subject stated it explicitly. The subject is quite confident in his understanding of the problem, which has an impact on his belief in his goals. As a result, S1 felt there was no need to determine other alternative goals. Basically problems and goals are 2 different things. Jäder et al., (2020) believes that problems are gaps between expectations and reality, while goals are bridges built to bridge expectations and reality that experience gaps. However, in this problem, S1 sees the problem given as something routine, so the problem in the questions used is the goal to be achieved.

- Explore Possible Strategies

In this indicator there are 2 sub-indicators, namely "determining alternative strategies to solve problems" and "reanalyzing objectives by considering the strategies implemented". In this indicator, it can be seen that the subject is using the Making a Drawing strategy by finding height using the Pythagorean theorem. Subjects also used a Backward strategy to analyze the volume of the lamp as a combination of the volume of a half sphere and a cone (Posamentier & Krulik, 2008). The following is the subject work on the Explore Possible Strategy indicator:

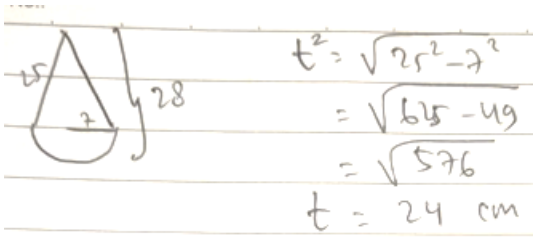

Figure 2. S1 when using the Making a Drawing Strategy

Figure 3. S1 when using the Backward Strategy

Re-analysis of objectives by considering these 2 strategies was not carried out by the research subject on the grounds that the problem given had been encountered before, so he was quite confident in using the chosen strategy. In fact, this question is a PWCI question which is different from what the subject thinks. In this case, S1 experiences what is called priming in the Pythagorean theorem (Sternberg & Sternberg, 2012). This means that subjects tend to use the Pythagorean theorem every time they are presented with a problem related to triangles without considering simpler strategies such as subtracting the total height from the radius of a circle. This is also in accordance with opinion Hacatrjana, (2022) which states that usually priming will be felt more by people with longer experience grappling with the material being discussed.

- Anticipate Outcomes and Act

In this indicator S1 only "implements strategy" as one of the 2 sub-indicators. S1 was careless by not anticipating other results that might emerge (if using other data provided by the question). In the sub-indicator "implementing the strategy" the subject carried out the strategy chosen at the beginning well and thoroughly as seen from the absence of mistakes he made. Likewise, when implementing the backward strategy, S1 also looked very prepared and wrote as if he was using forward steps even though the forward steps were only written on paper, and based on the results of the interview, S1 explained the reasons for each reason why calculating the volume of a half sphere and calculating the volume of a cone was in order to calculate lamp volume. This explanation is what is called the Backward strategy. This is in line with theory Posamentier & Krulik (2008)which explains that the Backward strategy is a strategy where the problem solver walks backwards from what is being asked and then breaks it down into smaller components. This was clearly done by S1 who knew that what he was looking for was the volume of the lamp and then worked backwards by thinking about the volume of the shapes that make up the lamp. The steps to implement the strategy carried out by S1 are as follows:

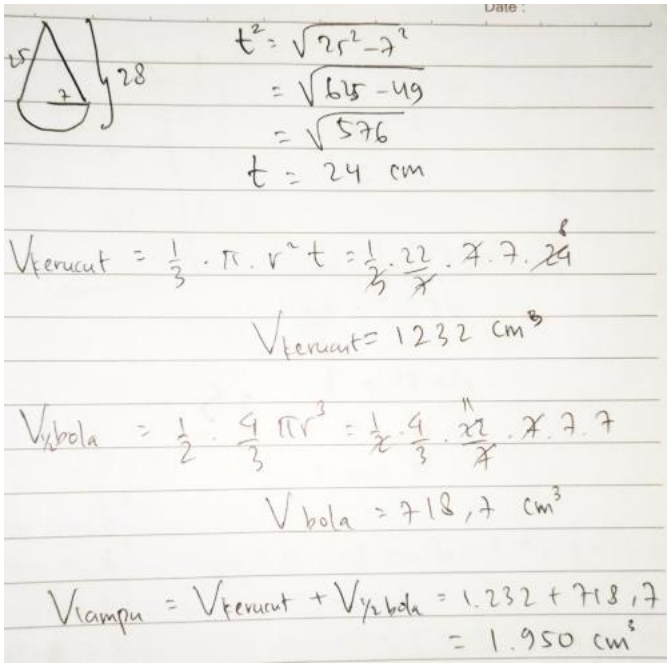

Figure 4. S1 when implementing the Strategy

Based on S1's experience, the subject carried out the strategy he chose well, the choice of the pi value was also chosen taking into account the length of the given radius. Even the formula for the volume of a half sphere is written well. The only inaccuracy made by the subject was the addition of 1,232+718.7 which was written as 1,950. During the interview, S1 explained that he forgot to add the decimal numbers. Although this is a small mistake, in other areas, small differences can make a huge difference. What S1 did was in accordance with what was explained by Toh et al., (2014)that there are times when problem solvers who have adequate knowledge in the field of mathematics fail to find the right solution because of careless actions carried out during the problem solving steps, whether reading, looking, or even operating (adding or subtracting).

- Looking Back and Learn

In this indicator, subject S1 no longer felt the need to "look back at the actual impact of the strategy implemented". He felt that he was confident with the results obtained because he

thought this was a routine problem with only the addition of unimportant variables (distractors). The result is that the subject is not aware of the addition errors made.

Likewise, with the sub-indicator "learning from experience", the subject admitted that to solve the problem given, he really depended on knowledge, especially his experience because he had encountered and solved a similar problem. So when the subject was asked what he had learned from this problem, the subject answered "there are many things that can be learned, but it looks like I have done it before." This statement indicates that S1 actually felt that he did not learn much from this problem because he had encountered a similar problem before. This occurs due to failure to see the problem as a whole, failure to determine the possibility that the problem can be resolved, and failure to explore possible strategies. This is in accordance with the statement Krulik & Rudnick (1988) that it is important for problem solvers to consider the existence of additional information, hidden information and ignore distracting information in the problem.

Subject S2 (Teachers with more than 5 years of teaching experience but do not yet have a professional certificate)

- Identify Problems and Opportunities

In this indicator there are 2 sub-indicators, namely identifying problems and seeing opportunities. At the problem identification stage based on interviews, the subject stated that he read the problem given to understand the context of the problem and find out what the problem was. This was confirmed during an interview by S2 who stated that he started solving the problem by reading the question and determining what was being asked. Just like S1, S2 also formulates propositions to be implanted into his working memory Sternberg & Sternberg (2012). The propositions stored by S2 into his working memory include the general problem context and visual images related to the problem (a combination of a cone and a half sphere). In this section the subject imagines a visual image of the problem given but does not represent it in his work paper. This is done by the subject for the reason that the problem given is not too difficult so it can still be remembered. However, in accordance with the theory of memory in problem solving proposed by Ernest (2004) states that a person's working memory is generally limited so that visual, symbolic and written representations are needed on work papers that help problem solvers remember better. At this stage S2 does not write down the known data in the problem, and this has an impact on solving the problem which requires looking at the problem every time you want to substitute the value of a variable (and this is less efficient). This happens because the working memory is no longer able to retain a lot of information at once. Because retaining visual memories takes up a lot of working memory space. So that known data can no longer be remembered.

In the sub-indicator of seeing opportunities, based on the interview the subject stated that he was confident that the problem was ready and able to be solved because all the data needed was known, namely the height of the lamp and the radius of the half ball. In fact, S2 is so convinced of this that he stated in his interview quote that only the concept of volume is needed for this problem.

- Define Goals

This indicator consists of 2 sub-indicators, namely "determining alternative goals" and "choosing a goal that has a high chance of finding a solution". Just like S1, in this indicator S2 has steadily chosen its goal, namely calculating the volume of a lamp consisting of a combination of half a sphere and a cone as a result of its understanding of the first indicator, identify problems and opportunities. The subject is quite confident in his understanding of the

problem, which has an impact on his belief in his goals. As a result, S2 felt there was no need to determine other alternative goals.

- Explore Possible Strategies

In this indicator there are 2 sub-indicators, namely "determining alternative strategies to solve problems" and "reanalyzing objectives by considering the strategies implemented". In this indicator, it can be seen that the subject uses a Backward strategy to analyze the volume of the light as a combination of the volume of a half ball and a cone. The following is the subject work on the Explore Possible Strategy indicator:

Figure 5. S2 when using the Backward Strategy

Re-analysis of objectives by considering this strategy was not carried out by the research subjects because the strategy used was a strategy that was very simple and very clear so the chance of making a mistake was almost non-existent. This would be true if the question were not a PWCI question. S2 didn't even try to look for other strategies, for example Logical Reasoning, to approach the problem because he was too sure that what he was doing was the most effective and most efficient strategy. The result was that S2 did not re-analyze the objectives to consider the strategy to be chosen. Usually the subject does not "re-analyze the goal by considering the strategy they have" because the subject only has 1 alternative strategy so that when determining 1 strategy they have carried out the goal analysis for the first time and feel confident about the 1 strategy they have.(Keleş & Yazgan, 2022; Toh et al., 2014)

- Anticipate Outcomes and Act

Like S1, in this indicator S2 only "implements strategy" as one of the 2 sub-indicators. S2 was careless by not anticipating other results that might arise (if using other data provided by the question). Based on the interview, S2 actually knows about another approach that can be used to implement his strategy, namely the Pythagorean theorem by utilizing the length of the curved side of the cone. However, S2 stated that he did not use this approach to implement the strategy because the approach he chose, namely reducing the height of the lamp minus the radius, was the most efficient approach. Below, the Anticipate Outcome and Act stage can be seen in Figure 6.

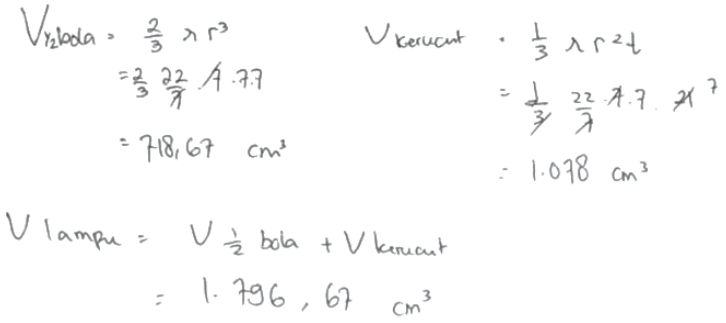

Figure 6. S2 when implementing the strategy

At the stage of implementing the strategy, S2 implemented the strategy well, in fact S2 was consistent in his "style" by carrying out several algebraic operations in his working memory without writing them down on his working paper. One of them is that when writing the formula for the volume of a half sphere, the subject immediately writes 2/3. From the results of the interview, the subject was able to explain that actually 2/3 came from ½ multiplied by 4/3. The same as S1, S2 implements a backward strategy by calculating the volume of the half

sphere and cone as part of the lamp volume. This is in line with the theory of Posamentier & Krulik, (2008)which states that generally the backward strategy is used to find variables from an existing formula and is used for problems with a less complex approach. This is in accordance with S2 which uses a "subtraction operation" approach to find the height of the cone and uses the volume formula of a half sphere and cone to determine the volume of the lamp.

- Looking Back and Learn

In this indicator, the same as S1, subject S2 no longer feels the need to "look back at the actual impact of the strategy implemented". He felt confident with the results obtained because he thought this was a routine problem which was open ended in terms of "how to solve it". He knew there was another way to solve it, namely using the Pythagorean Theorem, but considered it to be one of many variations on the open ended problem given. S2 mistook the type of questions that were PWCI as open ended questions with one answer (various ways). The result was that S2 (even after the interview) still did not realize that the Pythagorean theorem that he knew would produce a different answer, resulting in a contradiction.

Subject S3 (Prospective Mathematics Teachers who are still completing their Bachelor's Degree 1 studies and do not yet have a professional certificate)

- Identify Problems and Opportunities

In this indicator there are 2 sub-indicators, namely identifying problems and seeing opportunities. At the problem identification stage based on interviews, the subject stated that first he read each sentence to understand the essence of the sentence so that he knew the meaning of the problem given in its entirety. The subject stated that he read the questions twice, namely using a fast reading technique and a deep reading technique. At first he used deep reading techniques to find out the meaning of the problem given. And sure enough, through the interview, S3 was able to explain the questions using his own language. This own language is what is called by Sternberg & Sternberg (2012) as a proposition, the result of reading sentence by sentence semantically. Next, the subject uses a fast reading technique, namely a reading technique that prioritizes speed over understanding. This is also in accordance with opinion Sternberg & Sternberg (2012) which states that if someone reads at high speed, the snapshots (images produced from a glance at the reading text) become shorter but with greater frequency, resulting in a shorter time, and this will tend to reduce the reader's understanding. Subject S3 used this technique to re-record known data in a given problem through a visual representation in the form of an image of a light (a combination of a half sphere and a cone). The following is Figure 7 about how S3 subjects identify the given problem.

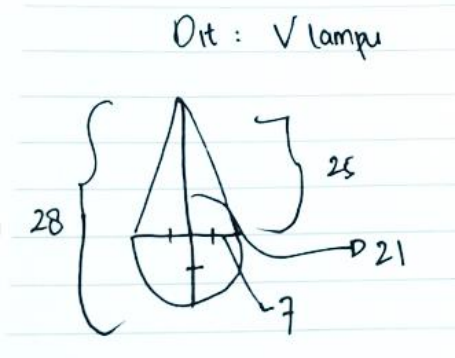

Figure 7. S3 when identifying the problem

Based on Figure 7, the subject writes down what is asked and what is known directly using visual representation (pictures of lights).

Next, for the sub-indicator looking at opportunities, initially S3 felt that the problem given had the opportunity to be solved because it contained many known variables or data. So S3 feels that the data is sufficient to find a solution to the problem given.

- Define Goals

This indicator consists of 2 sub-indicators, namely "determining alternative goals" and "choosing a goal that has a high chance of finding a solution". In this indicator, S3 confidently chose the goal, namely calculating the volume of a half-sphere and cone combined as a result of his understanding of the first indicator, identify problems and opportunities. This can be seen in writing in the work of subject S3 in figure 7 above.

- Explore Possible Strategies

In this indicator there are 2 sub-indicators, namely "determining alternative strategies to solve problems" and "reanalyzing objectives by considering the strategies implemented". In this indicator, the subject can be seen using the Making a Drawing strategy by depicting 2 models, namely the Lamp model (Figure 7) and the Triangle Model (Figure 8). However, the drawings were not made sequentially but rather the lamp model (figure 7) was depicted first.

And the subject continues with the problem solving stage directly at the Anticipate Outcome and Act stage. The subject did not re-analyze the goal he chose by considering the strategy applied because he felt that the only goal was to find the combined volume and the strategy was to create an image which was then carried out with a procedural approach.

- Anticipate Outcomes and Act

On this indicator, S3 begins to implement the strategy by finding the height of the cone using the subtraction operation technique as in Figure 7. The result obtained is 28 (the height of the lamp) minus 7 (the radius of the half ball), namely 21. After S3 finds the height of the cone , S3 does not directly determine the volume of light which is stated as the objective of the problem given, instead here S3 anticipates the outcome by drawing Figure 8 about Right Triangles and the Pythagorean Theorem.

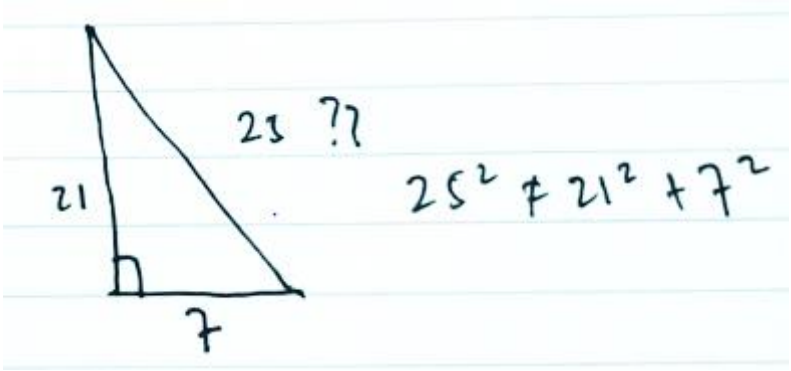

Figure 8. S3 when using the Pythagorean theorem approach

Based on Figure 8, S3 found that the results for the height of the cone were different between using the "height reduction" approach and the "Pythagorean theorem". Finally, the subject returns to the opportunities step to determine whether the problem is really possible to solve or not. The result was that the subject stated that the problem could not be solved because there was data that was not appropriate or consistent. The following is the complete S3 job.

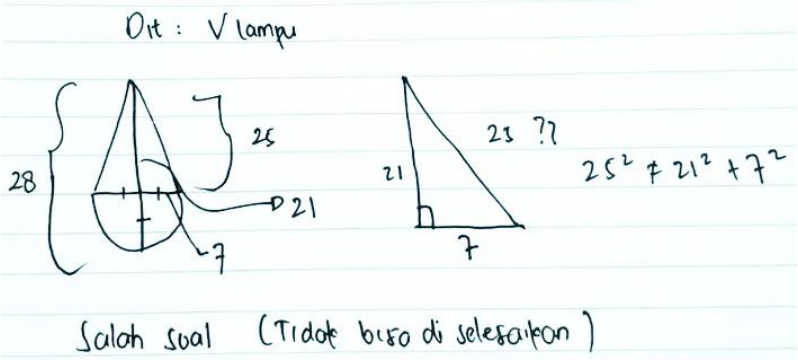

Figure 9. S3's work

- Looking Back and Learn

In this indicator, subject S3 has carried out the indicator "looking back at the actual impact of the strategy implemented", the evidence of which is shown by a change in perspective based on the approach used to find a solution to the problem given. Not only that, the subject also checked the results of the calculations that had been carried out considering that there was a difference between the height of the cone obtained from the Pythagorean Theorem and the usual subtraction operation.

In the sub-indicator "Learning from experience", S3 admitted based on the results of the interview that this was the first time the subject had encountered a question like this, and it seemed like there was a typo in the question, but it is very possible that this was intentional because the data provided in the question was excessive.

Discussions

Based on the results above, it can be seen that only S3, which is a prospective teacher subject, is aware that a solution cannot be found for the problem given. When compared with S1, the researcher believes that S3 is less influenced by certain priming because S3 has less experience grappling with questions than S1 who has taught and discussed questions with students for more than 5 years. This result is in accordance with opinion Hacatrjana (2022) that usually priming will be felt more by people with longer experience grappling with the material being discussed. It is also very possible that S3's as prospective teachers who are currently pursuing their studies have motivation and a level of critical and exploratory thinking that is still sharp compared to teachers who have all kinds of interests so that in solving problems they prioritize their level of speed. Even though this assumption still needs to be tested for truth through further research (which is used as a suggestion in this article). The results for the PWCI problem were subjects S1 and S2 were not aware of the importance of checking again and anticipating the results that would be obtained. Slightly different from S1, S2 actually realizes that there are other variables that are not needed to find a solution, or are even needed, but are not efficient. However, S2 did not explore this further and viewed the question as an open ended question. So even if using different approaches S2 estimates it will produce the same answer.

In applying the problem solving method, S2 was slightly better than S1 (although both failed to see the problem as containing contradictory information) because S1 made calculation errors and took a longer approach influenced by Pythagorean priming. S2 is better able to see more efficient approaches. Although this research is not intended to draw general conclusions, based on the results of the 3 research subjects, a rough picture can be seen that there is no influence whether or not having a professional certificate has on teachers' problem solving abilities. It is also necessary to carry out further research related to teachers' problem solving

in terms of their age, because it is very possible that it is not experience that influences their problem solving process but age. As mentioned by Sternberg & Sternberg (2012) that related to information processing and memory, age has a very important factor because the older a person gets, the more cognitive processing will decline.

CONCLUSION

Based on the research findings and discussion, several conclusions can be drawn that (S1) teachers who have more than 5 years of teaching experience and have a professional certificate begin the problem solving process by reading each sentence to make a proposition from the problem given, then understand what is being asked. as a goal to be achieved and continue it by representing the problem in the form of an image. After the image is presented, S1 writes down the known variables or data in the image he has created, including information that is not in accordance with the strategy he has chosen. Next, S1 approaches the problem by applying the Making a Drawing strategy by finding height with Pythagoras (There is Pythagorean Priming in solving the problem). S1 was satisfied with finding 1 strategy and 1 solution without proof or verification of the answer. S1 did not look back and learn so he did not realize that he had made an error in the addition operation.

Meanwhile, S2 begins the problem solving process by reading first and determining what is asked first as the goal of the problem being achieved. Even though S2 did not make a pictorial representation of the problem given, S2 understood well what the expected goal of the problem was and immediately took 1 strategy to approach the problem with a Backward strategy. S2 tends not to write down everything that he can still remember and imagine, so based on interviews the subject imagines image representations in his cognitive. Even though it is not written in sequence, based on interviews the subject explains the reasons for choosing step by step to find what is being asked. After determining the Backward strategy, the subject returned to recording the information provided to be substituted for the strategy he chose. The subject did not use the look back and learn indicator in solving the problem.

Lastly, S3 in solving PWCI problems starts by reading the problem 2 times using in-depth reading and fast reading techniques. Deep reading is used to identify problems and determine goals, while fast reading is used to identify the value of data when implementing a strategy. The subject carries out all the indicators in IDEAL so that the subject understands that there will be contradictions in the problems given at the anticipating outcome and looking back and learn stages.

Some suggestions that researchers can give, especially to future researchers, are the need for further research regarding motivation, critical thinking skills and problem solving of teachers in terms of their age. It is also necessary to carry out similar research with more research subjects.

ACKNOWLEDGMENTS

In this section the authors would like to thank the partners who have jointly supported and helped so that this research can go well. In addition, researchers also thankful to all subjects who have taken their time to fill out the test. The cost of the research conducted is credite to the research team's personal funds.

REFERENCES

Annizar, A. M., Lestari, A. C., Sofiah, Khairunnisa, G. F., & Maulyda, M. A. (2020). Proses Berpikir Inkuiri dalam Menyelesaikan Masalah Higher Order Thinking Skills (HOTS) ditinjau Dari Tingkat Kognitif. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(4), 1192–1204.

Annizar, A. M., Sofiah, S., Lestari, A. C., Dalimarta, S., & Wulandari, Y. N. (2021). The process of student analytical thinking in understanding and applying lattice method to solve mathematical problem The process of student analytical thinking in understanding and applying lattice method to solve mathematical problem. *Journal of Physics: Conference Series*, *1836*(012047), 1–10. https://doi.org/10.1088/1742-6596/1836/1/012047

Bransford, J. D., & Stein, B. S. (1993). *The IDEAL Problem Solver: A Guide for Improving Thinking, Learning, and Creativity* (Second Edi). W.H. Freeman and Company.

Brookhart, S. M. (2010). *In Your Classroom*.

Cockcroft, W. . (1982). Mathematics Counts. *Report of the Committee of Inquiry into the Teaching of Mathematics in Schools in England and Wales*, ix–311. https://doi.org/10.1093/teamat/8.4.150

Dawkins, P. C., & Epperson, J. A. M. (2014). The development and nature of problem-solving among first-semester calculus students. *International Journal of Mathematical Education in Science and Technology*, *45*(6), 839–862. https://doi.org/10.1080/0020739X.2014.884645

Dewey, J. (1933). How we think: A restatement of relation of reflective thinking and education process. In *D.C. Heath and Co. Publishers*.

Ernest, P. (2004). *The Philosophy of Mathematics Education: Studies in Matehematics Eduacation* (This editi). Routledge Falmer: Taylor & Francis Group.

Hacatrjana, L. (2022). Flexibility to Change the Solution: An Indicator of Problem Solving That Predicted 9th Grade Students' Academic Achievement during Distance Learning, in Parallel to Reasoning Abilities and Parental Education. *Journal of Intelligence*, *10*(7), 1–17. https://doi.org/10.3390/jintelligence10010007

Jäder, J., Lithner, J., & Sidenvall, J. (2020). Mathematical problem solving in textbooks from twelve countries. *International Journal of Mathematical Education in Science and Technology*, *51*(7), 1120–1136. https://doi.org/10.1080/0020739X.2019.1656826

Keleş, T., & Yazgan, Y. (2022). Indicators of gifted students' strategic flexibility in non-routine problem solving. *International Journal of Mathematical Education in Science and Technology*, *53*(10), 2797–2818. https://doi.org/10.1080/0020739X.2022.2105760

Krulik, S., & Rudnick, J. A. (1988). Problem Solving: A Handbook for Elementary School Teachers. In *Allyn and Bacon Inc.* Allyn and Bacon Inc.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook* (H. Salmon (ed.); Edition 3). SAGE Publications, Inc.

Nabila, M. B. G., & Mohaffyza, M. M. (2020). Problem Solving Skills based on IDEAL Model in Implementing Undergraduate Final Year Project. *Journal of Technology and …*, *1*(1), 26–33. http://ejournal.jthkkss.com/index.php/jthkkss/article/view/18%0Ahttps://ejournal.jthkkss.com/index.php/jthkkss/article/download/18/26

Olivares, D., Lupiáñez, J. L., & Segovia, I. (2021). Roles and characteristics of problem solving in the mathematics curriculum: a review. *International Journal of Mathematical Education in Science and Technology*, *52*(7), 1079–1096. https://doi.org/10.1080/0020739X.2020.1738579

Polya, G. (1973). How to Solve It: A New Aspect of Mathematical Method. In *Princenton*

Universitu Press. Princenton University Press. http://www.jstor.org/stable/3609122?origin=crossref

Posamentier, A. S., & Krulik, S. (2008). *Problem-Solving Strategies for Efficient and Elegant Solutions Grades 6-12: A Resource for the Mathematics Teacher*. Corwin Press.

Sidenvall, J., Granberg, C., Lithner, J., & Palmberg, B. (2022). Supporting teachers in supporting students' mathematical problem solving. *International Journal of Mathematical Education in Science and Technology*, 1–21. https://doi.org/10.1080/0020739X.2022.2151067

Sternberg, R. J., & Sternberg, K. (2012). Cognitive Psychology. In *Cognitive Psychology: Sixth Edition* (Sixth Edit). Wadsworth Cengage Learning. https://doi.org/10.4324/9781003312727-25

Subakri, & Annizar, A. M. (2021). The effects of covid-19 in learning : effective and efficient online learning models of mathematical statistics and real analysis from the students ' perspective The effects of covid-19 in learning : effective and efficient online learning models of mathe. *Journal of Physics: Conference Series*, *1836*(012048), 1742–6596. https://doi.org/10.1088/1742-6596/1836/1/012048

The National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics, Inc.

Toh, P. C., Leong, Y. H., Toh, T. L., Dindyal, J., Quek, K. S., Tay, E. G., & Ho, F. H. (2014). The problem-solving approach in the teaching of number theory. *International Journal of Mathematical Education in Science and Technology*, *45*(2), 241–255. https://doi.org/10.1080/0020739X.2013.822580