The Problem Posing Ability of Student in Class IX on Cylinder Using Oil Context

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Article Information
Received November 24th, 2025
Revised December 19th, 2025
Accepted December 31st, 2025

Diterima 24 November 2025
Direvisi 19 Desember 2025
Disetujui 31 Desember 2025

Keywords:
Problem Posing, Cylinder, Context Of Oil

Kata Kunci:
Kemampuan Mengajukan Masalah, Tabung, Konteks Minyak

ABSTRACT
This study aims to describe the problem-posing abilities of ninth-grade students on the topic of cylinders using an oil context. A descriptive qualitative approach was conducted at SMP Negeri 10 Prabumulih with three students representing high, medium, and low academic levels. Data were collected through a problem-posing test and interviews, analyzed using data collection, reduction, presentation, and conclusion drawing techniques. The results showed that students' problem-posing abilities varied across ability levels. High-ability students demonstrated flexibility in generating problems, used logical strategies, and drew conclusions relevant to the context. Medium-ability students were able to create new problems but still relied on familiar examples, while low-ability students experienced difficulties in formulating problems and performing calculations accurately. Indicators such as flexibility, originality, strategy use, argument analysis, and conclusion drawing were found to be interconnected. The use of the oil context increased students' motivation because it was close to their daily experiences. However, real-life contexts alone did not ensure originality without teacher guidance. This study recommends integrating local contexts into problem-posing instruction to enhance students' creativity, numeracy skills, and higher-order thinking abilities.

ABSTRAK
Penelitian ini bertujuan untuk mendeskripsikan kemampuan problem posing peserta didik kelas IX pada materi tabung dengan menggunakan konteks minyak. Penelitian ini menggunakan pendekatan deskriptif kualitatif yang dilaksanakan di SMP Negeri 10 Prabumulih dengan tiga subjek yang mewakili kemampuan akademik tinggi, sedang, dan rendah. Data dikumpulkan melalui tes kemampuan problem posing dan wawancara, kemudian dianalisis melalui tahap pengumpulan, reduksi, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa kemampuan problem posing peserta didik bervariasi. Peserta didik berkemampuan tinggi mampu membuat soal dengan fleksibilitas, menggunakan strategi penyelesaian yang logis, serta menarik kesimpulan sesuai konteks. Peserta didik berkemampuan sedang dapat membuat soal baru namun masih bergantung pada contoh yang familiar, sementara peserta didik berkemampuan rendah mengalami kesulitan merumuskan soal dan melakukan perhitungan secara tepat. Indikator kemampuan seperti fleksibilitas, orisinalitas, strategi penyelesaian, analisis argumen, dan penarikan kesimpulan saling berkaitan. Penggunaan konteks minyak meningkatkan motivasi belajar karena dekat dengan kehidupan sehari-hari peserta didik. Namun, konteks nyata saja tidak menjamin munculnya orisinalitas tanpa bimbingan guru. Penelitian ini

merekomendasikan integrasi konteks lokal dalam pembelajaran problem posing untuk meningkatkan kreativitas, literasi numerasi, dan kemampuan berpikir tingkat tinggi peserta didik.

INTRODUCTION

21st century skills, which include creativity, critical thinking, problem solving, communication, and collaboration, are fundamental abilities for learning and innovation (Turhan & Demirci, 2021). These skills serve as a guideline for students to not only succeed in the classroom but also to adapt to continuous changes and lifelong learning (Mangiduyos & Subia, 2021). In modern mathematics education, one approach that can develop these skills is problem posing (Trouche et al., 2020). The ability to pose problems not only trains students to solve given problems but also encourages them to create new problems based on certain situations or contexts, making the thinking process more active, creative, and reflective (Zhang et al., 2024).

According to Einstein & Infeld, "the posing of a problem is more important than actually solving it," meaning that formulating a problem is far more essential than merely solving it, as the process of asking questions lies at the heart of scientific thinking and meaningful learning. Similarly, Kilpatrick stated that "the experience of discovering and creating one's own mathematics problems ought to be part of every student's education," emphasizing that education should help students learn to think creatively, engage in mathematical exploration, and prepare for the future (NCTM, 2000; Toheri et al., 2020). Thus, problem posing based learning allows students to engage deeply in understanding concepts, connecting them with real situations, and developing creativity in mathematical thinking.

However, the reality of education in Indonesia shows that students' creative thinking and problem-solving skills are still low. The 2022 Minimum Competency Assessment and the 2022 Programme for International Student Assessment (PISA) reports revealed that Indonesian students' numeracy skills, particularly in solving geometric and contextual problems, remain below the OECD average (OECD, 2023). Many students tend to memorize formulas without understanding their meaning or relating mathematical concepts to real-life phenomena. This indicates the need for learning strategies that can develop creative and critical thinking skills through active student engagement in the learning process.

One effective way to address this issue is through a problem posing approach based on real-life contexts. Context-based learning enables students to perceive mathematics as a subject closely related to their daily lives. Zulkardi (2005) explained that real contexts can reduce the abstract nature of mathematics and motivate students to think actively. Previous studies also showed that using local contexts can enhance participation, creativity, and the quality of questions posed by students during problem-posing activities (Fitrisyah et al., 2023; Tesfaw et al., 2024; Widjaja et al., 2010).

In this study, the oil context was chosen because it is relevant to students' everyday lives in Prabumulih City, South Sumatra. The city hosts the largest Oil Gathering Center (PPP) in the region, managed by PT Pertamina EP Prabumulih Field. The cylindrical structure of oil storage tanks presents a geometric phenomenon that can be explored in mathematics learning. Through this context, students can study the concepts of volume, surface area, and the real-life application of geometry. By connecting mathematical concepts to their surroundings, students are expected to better understand concepts, become motivated to think critically, and be encouraged to pose meaningful problems.

By connecting mathematical concepts to their surroundings, students are expected to better understand concepts, become motivated to think critically, and be encouraged to pose meaningful problems. However, empirical evidence remains limited regarding how a local industrial context supports students' problem-posing processes in three-dimensional geometry, particularly on cylinders at the junior high school level. Existing studies on contextual problem posing often emphasize engagement or overall outcomes, while in-depth qualitative profiles of students' performance across key problem-posing indicators (flexibility, originality, problem-solving strategy, argument analysis, and conclusion drawing) and how these profiles differ by ability level are still underexplored. Therefore, this study focuses on describing Grade IX students' problem-posing ability on cylinders using an oil context. The study focuses on five indicators of problem-posing ability: flexibility, originality, problem-solving strategy, argument analysis, and conclusion drawing. This research is expected to provide a comprehensive overview of students' thinking abilities and the factors that influence them. Therefore, the main research question is: How are the problem-posing abilities of ninth-grade students on the topic of cylinders using the oil context? In line with this, the purpose of this study is to identify and describe those abilities in depth.

METHOD

This study employed a descriptive qualitative approach aimed at describing the problem-posing abilities of ninth-grade students on the topic of cylinders using an oil context. The research was conducted at SMP Negeri 10 Prabumulih during the first semester of the 2025/2026 academic year. A descriptive qualitative design was chosen because it allows researchers to provide a rich, detailed description of a phenomenon as it naturally occurs, without manipulating any variables (Creswell, 2017). This approach focuses on understanding participants' experiences and perspectives, making it appropriate for exploring students' thought processes in problem formulation and reasoning within real-life mathematical contexts. According to Moleong (2014), qualitative research seeks to uncover meaning, structure, and process, while the descriptive type emphasizes factual and systematic depiction of findings.

The research subjects were selected using a purposive sampling technique based on recommendations from mathematics teachers and the school principal, as well as the characteristics of students' written responses. Three students were chosen as the main subjects of the study. Learning activities were conducted face-to-face using a problem-posing approach on the topic of cylinders. A problem-posing ability test consisting of contextual mathematical problems was used, focusing on five indicators: flexibility, originality, problem-solving strategy, argument analysis, and conclusion drawing. Semi-structured interviews were conducted to gain deeper insights into students' thinking processes.

The research procedure consisted of three main stages: preparation, implementation, and data analysis. The preparation stage involved developing research instruments, including a teaching module, student worksheets, problem-posing ability test items, and an interview guide. The instruments were designed based on problem posing indicators and learning objectives for the topic of cylinders. Instrument validation was conducted through expert judgment by two mathematics education lecturers and one mathematics teacher, focusing on content relevance, clarity of language, and suitability for junior high school students. Revisions were made according to the validators' suggestions before implementation.

The implementation stage consisted of three classroom learning sessions using the problem-posing approach, followed by a problem-posing ability test. During this stage, students completed learning activities using the developed worksheets, followed by administration of the problem-posing ability test. Interviews were then conducted with selected students to further explore their problem-posing processes and reasoning.

The data analysis stage involved data collection, data reduction, data display, and conclusion drawing, following the interactive analysis model of Miles & Huberman (1992). The analysis was conducted manually by examining students' written test responses and interview transcripts to identify the appearance of problem posing indicators. The results were analyzed descriptively to describe each student's problem-posing ability profile.

RESULTS AND DISCUSSION

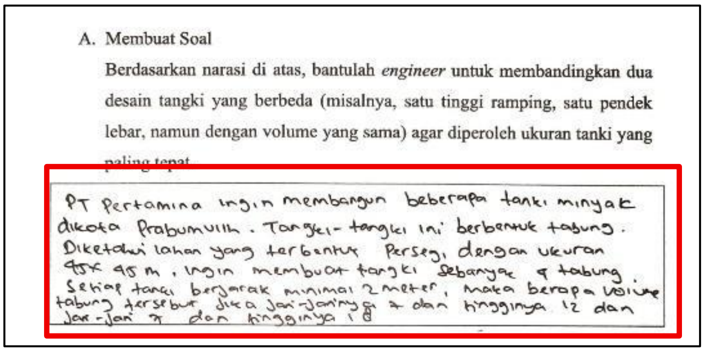
This research was conducted over four class meetings in Grade IX.4, consisting of three instructional sessions using a problem-posing approach and one session devoted to a problem-posing ability test. During the first meeting, the learning process focused on the topic of cylinders using a problem-posing learning approach with an oil storage context. Although the oil context increased student engagement, the findings indicate that context alone was insufficient to foster originality in problem posing. This finding is consistent with previous studies showing that problem-posing activities can enhance students' engagement and higher-order thinking skills, but their effectiveness strongly depends on instructional design and teacher support (Zhang et al., 2024). Students' ability to transform real-life situations into mathematical problems depended largely on instructional guidance and scaffolding provided by the teacher. In the second meeting, students participated in problem-posing activities by creating new mathematical problems based on the given context. To avoid mere imitation of textbook problems, the teacher guided students through structured prompts, such as modifying constraints, changing quantities, and posing questions from different perspectives. The structure of problem-posing tasks and the type of prompts provided have been shown to significantly influence students' creative performance and confidence in problem posing (Baumanns & Rott, 2024). The third meeting was devoted to group discussions and presentations, where each group shared and refined their constructed problems using contextual examples. During this stage, students were encouraged to explain the reasoning behind their problem construction and justify the uniqueness of the problems they created. In the fourth meeting, a problem-posing ability test was administered to assess students' skills in generating and solving mathematical problems. The test lasted 60 minutes and aimed to provide an overview of each student's problem-posing competence after the series of learning activities. The table below presents the components of problem-posing abilities assessed in the test.

Table 1. Components of Problem Posing Ability on The Test

Components of Problem Posing Ability	A	B	C	D
Flexibility	Yes	No	No	No
Originality	Yes	No	No	No
Problem solving strategy	Yes	Yes	Yes	No
Argument analysis	No	Yes	Yes	No
Conclusion drawing	No	No	No	Yes

Based on **Table 1**, columns A - D represent the four sections of the problem-posing ability test. Column A (Section A) refers to the problem construction task, where students were asked to generate a contextual problem related to the oil–cylinder situation. Column B (Section B) captures students' planning of a solution strategy, indicating how they intended to approach the problem. Column C (Section C) reflects problem solving and argument justification, where students showed their calculations and provided reasoning to support their chosen steps. Finally, column D (Section D) represents conclusion drawing, in which students stated a final decision or conclusion and linked it back to the given context.

During the learning process, S1 appeared active and enthusiastic in participating in discussions, and the written test results met several indicators of *problem-posing* skills. In the problem construction section, S1 demonstrated the ability to create a word problem with two different considerations by using the given information and ensuring relevance to the oil context. However, S1 was not yet able to expand the problem or connect it with other related mathematical knowledge.


A. Membuat Soal
Berdasarkan narasi di atas, bantulah *engineer* untuk membandingkan dua desain tangki yang berbeda (misalnya, satu tinggi ramping, satu pendek lebar, namun dengan volume yang sama) agar diperoleh ukuran tanki yang paling tepat.

PT Pertamina ingin membangun beberapa tanki minyak dikota Prabumulih. Tangki-tangki ini berbentuk tabung. Diketahui lahan yang terbentuk Persegi dengan ukuran 45x 45 m, ingin membuat tangki sebanyak 4 tabung. Setiap tangki berjarak minimal 2 meter, maka berapa volume tabung tersebut jika jari-jarinya 7 dan tingginya 12 dan jari-jari 7 dan tingginya 18

English Version

PT Pertamina plans to build several oil tanks in the city of Prabumulih. These tanks are cylindrical in shape. It is known that the land has a square shape with a size of 45 × 45 meters, and the company wants to build four cylindrical tanks. Each tank must be at least 2 meters apart. What is the volume of the tanks if the radius and height are respectively 7 meters and 12 meters, then 7 meters and 18 meters?

Figure 1. S1's Response in Section A

P	:	*Apart from the question you created, did you ever think of another type of problem based on the given narrative?*
S1	:	*I did think about using the height and the radius.*
P	:	*How did you plan to use the height and the radius?*
S1	:	*I wasn't sure, that's why I didn't include it in the question*
P	:	*Have you ever seen a similar problem before?*
S1	:	*Yes, I have.*
P	:	*When was that?*
S1	:	*During the Mathematics Olympiad (OSN).*
P	:	*Was the question similar to this one?*
S1	:	*Yes, quite similar, but a bit different*
P	:	*What was different?*
S1	:	*In this one, the radius is asked for, but in the OSN question, the volume was given and the height was the one being asked.*

Based on the **Figure 1** and the interview, S1 had previously encountered a question with a similar concept and then modified it by changing the question so that it asked for the volume of the cylinder.

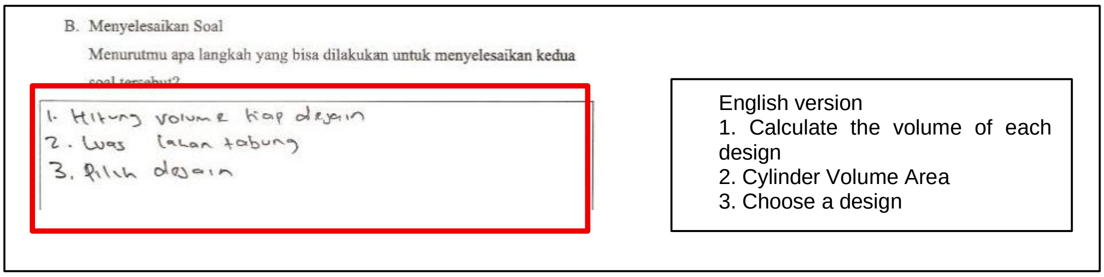


Figure 2. S1's Response in Section B

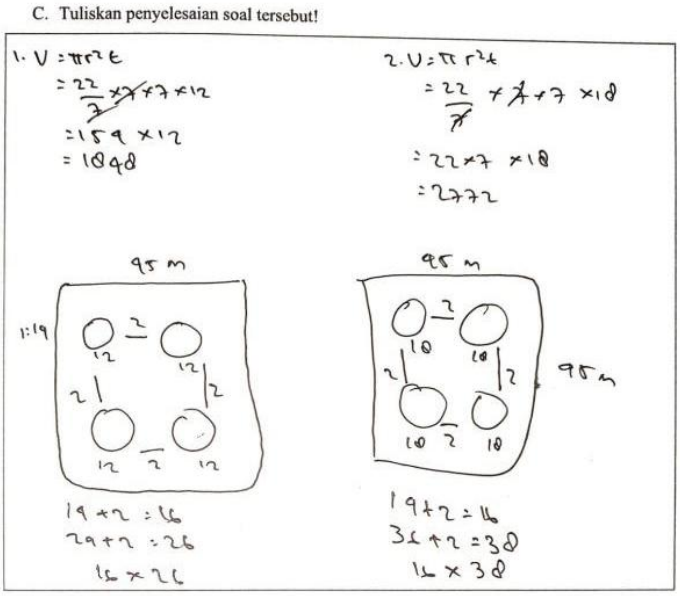


Figure 3. S1's Response in Section C

Based on **Figure 2**, S1 showed an initial solution strategy in section B by listing steps such as calculating the volume of each design and choosing an appropriate design. This response indicates that S1 was able to identify the main procedures needed to solve the problem. Based on **Figure 3** S1's written solution, the student demonstrated a clear, systematic, and logical problem-solving strategy. S1 completed the answer accompanied by an illustration showing the placement of the cylinder within the available land area. However, a minor calculation error was identified. Therefore, an interview was conducted to confirm S1's reasoning.

P : *How did you arrive at this answer?*

S1 : *I used this formula, and I know some people use 3.14 while others use 22/7. I chose 22/7. Then the radius is multiplied by the height, so it's 154 times 12, which equals 1848. The radius is 7, so the diameter is 14, the distance is 2, and the cylinder's height is 12. So, the land area used is 16 by 26.*

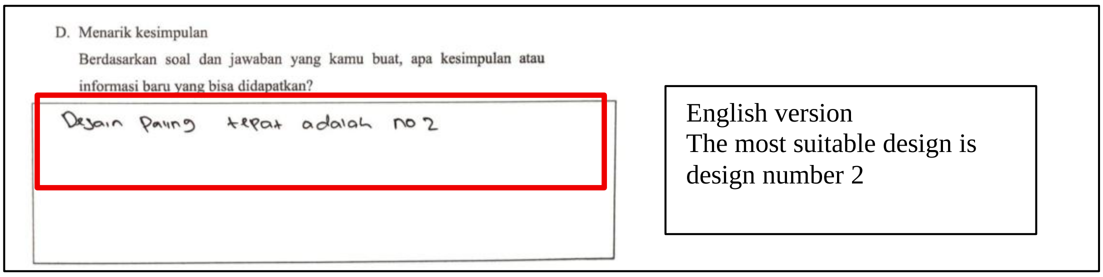
P : *So, it's less than 45 by 45, meaning it meets the requirement?*

S1 : *Yes.*

P : *What about the second one?*

S1	:	*For the second one, I also used 22/7. The radius is 7 and the height is 18, so the result is 2772. This one is the same as before: 7 + 7 = 14, but the height is 18, so the total is 16 by 38, which still fits the available area.*
P	:	*The radius is 7, so the diameter should be 14, right?*
S1	:	*Oh yes, I made a mistake. But after recalculating, it's still less than 45 × 45.*
P	:	*So, what conclusion can you draw?*
S1	:	*The best design for the cylinder is number 2.*
P	:	*Why?*
S1	:	*Because it has a larger capacity.*

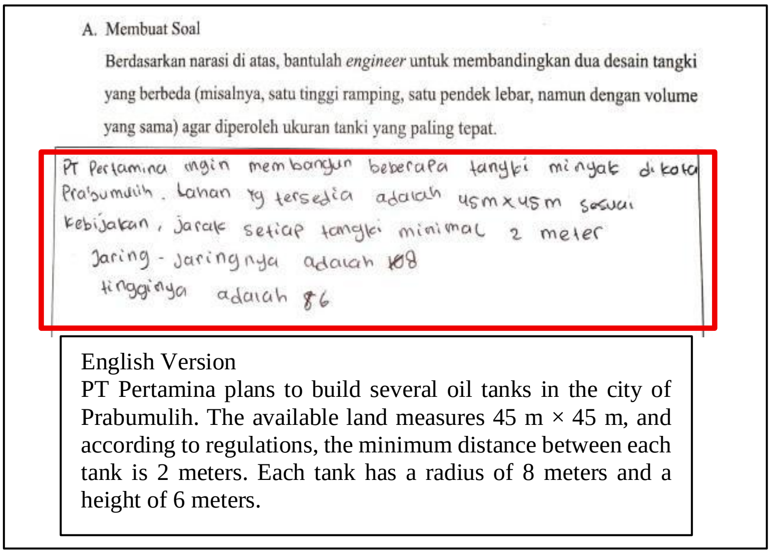
From the interview results, S1 solved the problem in a structured and complete manner. The student also provided logical arguments despite the minor calculation error. S1's reasoning was supported by complete data, including visual representation and numerical computation. This thinking process indicates that S1 was able to explain conclusions clearly and connect mathematical results with the real-world context of the problem created. Based on **Figure 4** and interview results, it can be concluded that S1 possesses a high level of problem-posing ability.


D. Menarik kesimpulan
Berdasarkan soal dan jawaban yang kamu buat, apa kesimpulan atau informasi baru yang bisa didapatkan?
Desain Paling tepat adalah no 2

English version
The most suitable design is design number 2

Figure 4. S1's Response in Section D

Subject S2 demonstrated a moderate level of problem-posing ability. This was evident during the learning process, as S2 appeared fairly active in class discussions and was able to meet several indicators of problem-posing skills.


A. Membuat Soal
Berdasarkan narasi di atas, bantulah *engineer* untuk membandingkan dua desain tangki yang berbeda (misalnya, satu tinggi ramping, satu pendek lebar, namun dengan volume yang sama) agar diperoleh ukuran tanki yang paling tepat.
PT Pertamina ingin membangun beberapa tangki minyak di kota Prabumulih. Lahan yg tersedia adalah 45m x 45m sesuai kebijakan, jarak setiap tangki minimal 2 meter
Jaring - jaringnya adalah 8
tingginya adalah 6

English Version
PT Pertamina plans to build several oil tanks in the city of Prabumulih. The available land measures 45 m × 45 m, and according to regulations, the minimum distance between each tank is 2 meters. Each tank has a radius of 8 meters and a height of 6 meters.

Figure 5. S2's Response in Section A

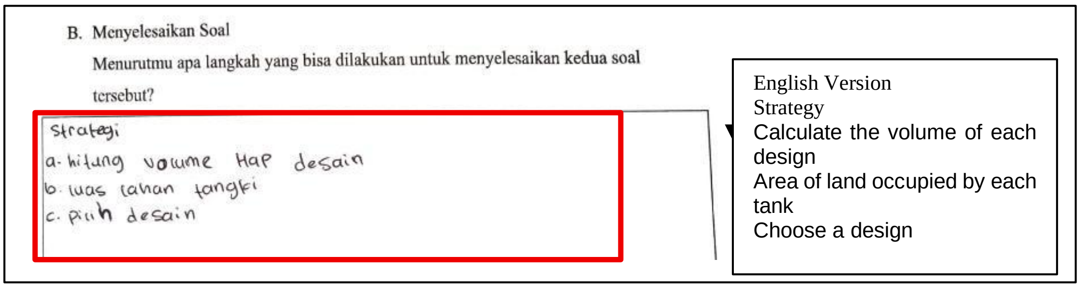


Figure 6. S2's Response in Section B

The following is an excerpt from the researcher's interview with S2 regarding the problem created:

P : *How did you come up with this problem? What was your initial idea?*
S2 : *The idea came from the example shown in class during the previous lesson.*
P : *Then?*
S2 : *I followed what was explained before, so I wrote it like this.*
P : *So, it was based on the example taught in class?*
S2 : *Yes.*
P : *Did you ever think about changing or modifying the problem?*
S2 : *No.*
P : *How did you solve this problem?*
S2 : *By finding the surface area of the tank and then choosing the design.*
P : *Have you ever seen a problem like this before?*
S2 : *No, I haven't.*
P : *So this is your first time?*
S2 : *Yes.*
P : *So, for your problem, you only made one consideration, right?*
S2 : *Yes.*

Based on **Figure 5** and the interview results, the problem created by S2 took the form of a contextual word problem with only one main consideration, namely comparing tank designs based on surface area and volume. S2 relied heavily on examples previously discussed in class and did not attempt to modify or extend the given situation, indicating limited originality and a strong dependence on familiar textbook structures. Moreover, the problem was not connected to other relevant mathematical concepts beyond the immediate context. However, as shown in **Figure 6**, S2 was able to identify a clear, systematic, and logical problem-solving strategy.

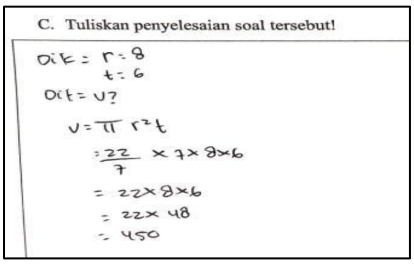
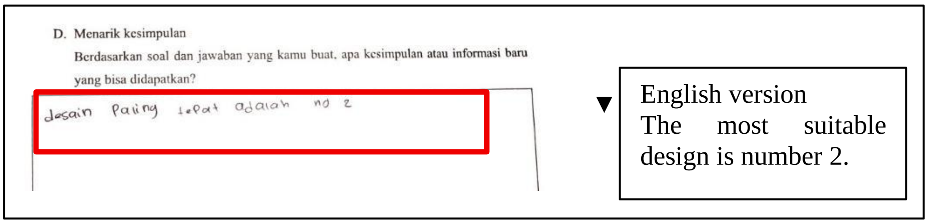


Figure 7. S2's Response in Section C


D. Menarik kesimpulan
Berdasarkan soal dan jawaban yang kamu buat, apa kesimpulan atau informasi baru yang bisa didapatkan?
desain paling tepat adalah no 2

English version
The most suitable design is number 2.

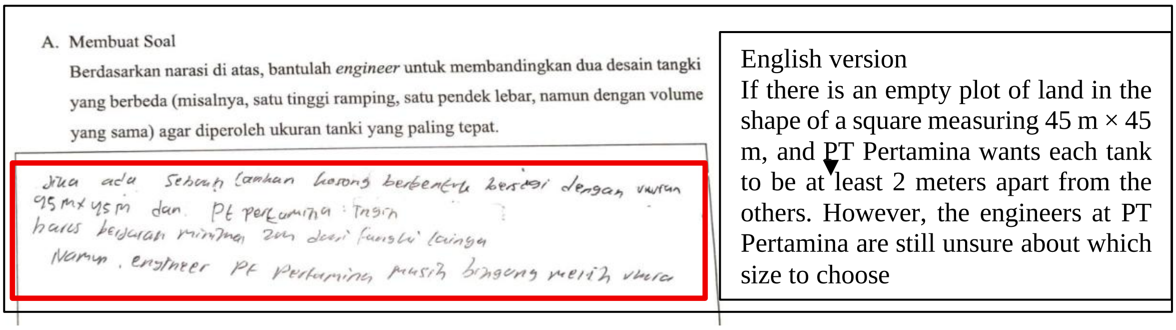
Figure 8. S2's Response in Section D

Based on **Figure 7** the written solution, S2 was able to solve the problem in a structured manner. However, several calculation errors and conceptual misunderstandings in determining the cylinder's volume were identified. Therefore, the researcher conducted an interview to confirm S2's responses, as follows.

P	:	*How did you solve the problem you created?*
S2	:	*I used the cylinder volume formula. I used 22/7, there's a seven so I canceled it, then multiplied by 8 and 6.*
P	:	*Where did the eight come from?*
S2	:	*I think it was divided somehow… I forgot. Then 22 times 8 times 6, the result is 450.*
P	:	*Why did you suddenly use the number seven?*
S2	:	*To make the calculation easier.*
P	:	*So, what was your conclusion?*
S2	:	*The best design is number 2.*
P	:	*But didn't you only make one design in your problem?*
S2	:	*I'm not sure anymore.*

Based on **Figure 8** and the interview, it can be concluded that S2 did not fully understand how to calculate the volume of a cylinder. This was indicated by the incorrect substitution of the radius value in the formula. S2 tended to focus on simplifying the arithmetic process rather than maintaining conceptual accuracy, even replacing one radius value with seven to make the calculation easier. Furthermore, the conclusion drawn by S2 did not align with the problem previously created.

Based on the test and interview results, it can be concluded that S2 possesses a moderate level of problem-posing ability. During the learning activities, subject S3 appeared less active in group discussions. The following are the results of the test and interview conducted with S3.


A. Membuat Soal
Berdasarkan narasi di atas, bantulah *engineer* untuk membandingkan dua desain tangki yang berbeda (misalnya, satu tinggi ramping, satu pendek lebar, namun dengan volume yang sama) agar diperoleh ukuran tanki yang paling tepat.

English version
If there is an empty plot of land in the shape of a square measuring 45 m × 45 m, and PT Pertamina wants each tank to be at least 2 meters apart from the others. However, the engineers at PT Pertamina are still unsure about which size to choose

Figure 9. S3's Response in Section A

P : *How did you come up with this problem? What was your initial idea?*
S3 : *At first, I was going to copy the narrative from this problem. I remembered an example from the previous lesson, so I changed my mind.*
P : *So, what did you decide to do?*
S3 : *I just tried to continue it, but the question wasn't finished yet.*
P : *Other than this problem, did you ever think about adding new information?*
S3 : *No.*
P : *Have you ever seen a similar problem before?*
S3 : *No, this is my first time.*

Based on **Figure 9** and interview results, it was observed that S3 was not yet able to formulate a complete problem. In addition, S3 required more time than the other students to determine additional information such as the radius and height of the cylinder. Consequently, S3 did not complete Section A and proceeded directly to the next part of the test.

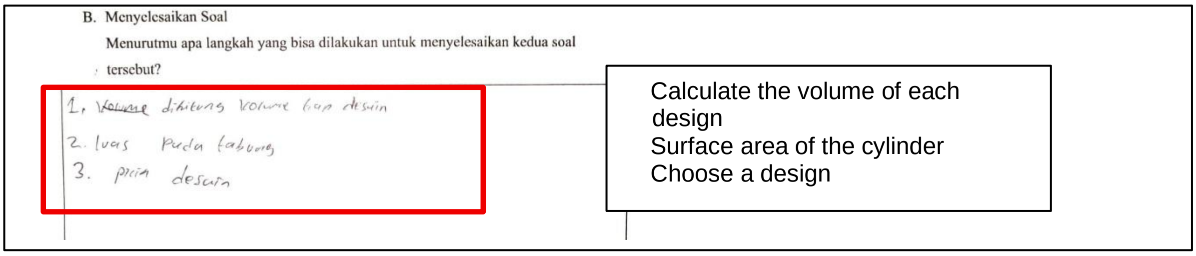


Figure 10. S3's Response in Section B

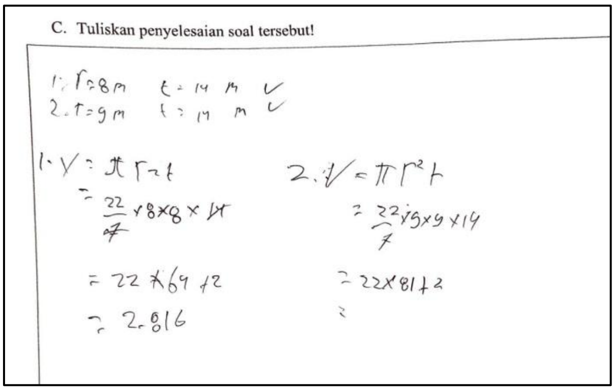


Figure 11. S3's Response in Section C

Based on the written answers in **Figure 10** and **Figure 11**, S3 was able to outline a problem-solving strategy that appeared clear, systematic, and logical. However, when compared with the problem created, the written strategy did not correspond to the question itself, since the problem statement did not provide sufficient information to calculate the volume or choose the appropriate design. Therefore, the researcher conducted an interview to confirm S3's reasoning, as follows:

P : *How did you solve the problem?*
S3 : *I used the volume formula, 22/7 times 8 times 8 times 14.*
P : *And then?*
S3 : *8 times 8 is 64, so 22 times 64 plus 2 equals 2816.*
P : *What about the second problem?*
S3 : *The radius is nine, but I didn't finish the calculation.*
P : *What conclusion did you draw?*
S3 : *I didn't make one.*

Based on the interview, it was found that S3 still made errors in performing arithmetic operations and was unable to solve the problem correctly. The arguments presented were unclear and incomplete. However, S3 showed some understanding of the nature of the problem being addressed, even though no conclusion was written in the problem-posing test sheet. Based on the test and interview results, it can be concluded that S3 possesses a low level of problem-posing ability.

This study aimed to describe the problem-posing abilities of three students with high, medium, and low performance levels after participating in learning activities using the problem-posing approach. The learning process was conducted over four classroom meetings, consisting of three instructional sessions using a problem-posing approach and one session devoted to a written test, followed by semi-structured interviews to explore students' thought processes in depth. The results showed that S1 was able to generate a variety of problems and apply systematic solution strategies, although minor calculation errors occurred. S2 was able to create a new problem, yet their thinking pattern remained dependent on previously taught examples. Meanwhile, S3 struggled to formulate a problem and often made conceptual and computational errors. The analysis showed differences among the three students in flexibility, originality, strategy formulation, argument analysis, and conclusion drawing. Furthermore, these findings support previous research by Cai & Hwang (2002), which stated that problem-posing ability is closely related to conceptual understanding and instructional support. Furthermore, the use of a local context such as oil was found to increase learning motivation, though further guidance is needed to ensure the creation of truly contextual problems (Tesfaw et al., 2024). The researcher also acknowledged limitations, including a small sample size and short research duration, making the results descriptive rather than generalizable.

In addition to the overall findings, an in-depth analysis of each indicator revealed that flexibility was reflected in students' abilities to generate varied problems and view situations from different perspectives. Previous research has shown that flexibility and originality in problem posing are closely related to students' creative mathematical thinking and problem-solving abilities (Sadak et al., 2022). This aspect was most evident in S1, who successfully produced more than one type of problem. Originality appeared in S1 and partly in S2, whereas S3 struggled to develop new problems beyond previously taught examples. This pattern suggests that students with limited conceptual understanding tended to imitate previously learned examples, even when working within a real-life context. Without explicit instructional guidance, these students experienced difficulty transforming contextual situations into mathematically meaningful and original problems. Studies indicate that structured scaffolding is essential in helping students move beyond imitation toward constructing meaningful and original mathematical problems, as students' problem-posing ability is closely related to their level of mathematical reasoning and cognitive development (Handayani et al., 2018; Romsih et al., 2019; Wang et al., 2025). Their study showed that students with limited conceptual understanding tended to rely on imitation rather than generating flexible and original problems, even when problem-posing activities were explicitly introduced. Regarding strategy formulation, all three students were able to outline their solution steps, but the level of systematic reasoning varied. S1 demonstrated logical and structured strategies, while S2 and S3 frequently substituted incorrect values. Zhang et al. (2024) emphasized that the ability to design coherent solution strategies is a key characteristic of students with strong problem-posing skills. Argument analysis was another distinguishing factor, as only S1 could provide a logical justification for selecting a specific tank design. The conclusion-drawing abilities also differed: only S1 could relate the mathematical results to real-life contexts, whereas S2 and S3 could not. This finding supports Divrik (2023) view that the success of problem posing depends on students' reflective thinking skills, as reflected in S1's ability to justify and conclude logically. Therefore, problem-posing learning not only nurtures creativity but also strengthens students' logical reasoning. A recent meta-analysis confirms that problem-posing interventions have a positive and measurable effect on students' mathematical learning outcomes across educational contexts (Ran et al., 2025).This finding is consistent with previous research showing that problem-posing activities contribute significantly to the development of students' mathematical reasoning, with stronger effects observed among students at higher cognitive development stages (Romsih et al., 2019).

Several factors may explain why some students did not fully meet all problem-posing indicators. A lack of concentration during lessons was observed, with some students being distracted by non-academic activities or missing key explanations due to classroom interruptions. In addition, several students tended to avoid carefully reading and analyzing problems, preferring to give up rather than attempt a solution. Another contributing factor was the limited opportunity for structured collaborative discussions during problem-posing activities. As a result, students with lower confidence had fewer chances to learn from peers who demonstrated stronger reasoning and problem-posing skills. Strengthening collaborative discussions may create a richer learning environment in which students can exchange ideas, clarify their reasoning, and develop a deeper understanding of how to construct mathematical problems. Furthermore, the problem-posing sessions were conducted only three times due to time constraints. This limited frequency may not have been sufficient for students to internalize problem-posing as a habitual cognitive process. Developing flexibility, originality, and strong reasoning in problem posing requires repeated and sustained practice over a longer period, allowing students to gradually move beyond imitating examples toward independently constructing meaningful mathematical problems. This result aligns with Anggraini & Pratiwi (2024), who found that students' mathematical thinking skills developed more effectively when creative mathematical activities were implemented consistently over multiple learning sessions. Their findings suggest that limited exposure to creative tasks, including problem posing, may restrict students' opportunities to develop flexibility and originality in mathematical thinking.

Another important finding concerns the role of context in learning. The use of the oil context had a positive effect on student engagement during learning activities. When students were presented with situations familiar to their daily lives, they became more enthusiastic and active in creating problems. However, the findings indicate that the use of context alone was not sufficient to ensure originality in students' problem-posing. While the oil context increased engagement, several students still relied on familiar problem patterns, suggesting that contextual familiarity does not automatically lead to original mathematical problem construction. This finding aligns with Tesfaw et al. (2024) who stated that real-life contexts enhance the relevance and interest of mathematics learning. However, although students were able to generate contextual mathematical problems, the level of flexibility and originality varied. Previous studies have shown that the development of creative thinking skills is essential for enhancing flexibility and originality in mathematical problem posing, particularly when supported by instructional strategies that explicitly foster creativity (Nusantara et al., 2025). This variation may be attributed not only to differences in students' initial abilities, but also to the limited number of problem-posing opportunities provided during the intervention. When problem posing is practiced only a few times, students tend to rely on familiar problem structures rather than experimenting with alternative representations or constraints. This condition may be influenced by the limited duration of problem-posing activities implemented in this study. Developing higher-order problem-posing abilities requires more frequent and sustained practice, which may help students move beyond imitating examples toward constructing original problems. This suggests that context alone does not guarantee originality if students merely imitate problem patterns without deeply understanding the given data. This tendency may be related to students' epistemological obstacles in mathematical thinking, which limit their ability to connect prior knowledge with new contexts when constructing original problems (Ruli et al., 2025).

Therefore, teachers play a crucial role in designing problem-posing activities that promote deeper contextual exploration, including guiding students to validate data and justify the mathematical structure of the problems they create. Research syntheses emphasize that effective problem-posing-based learning requires clear instructional structures, carefully designed tasks, and sustained teacher guidance (Cai, 2022). sc Teachers need to provide structured scaffolding, such as guiding students to modify given data, explore alternative constraints, and reflect on the mathematical structure underlying real-life situations. Such guidance helps students move beyond merely imitating textbook problems toward constructing well-structured and meaningful mathematical problems based on contextual information. Previous studies have consistently emphasized that instructional support plays a critical role in helping students move from imitative problem posing toward more original and meaningful problem construction (Romsih et al., 2019).Without adequate scaffolding, problem-posing activities may fail to fully develop students' higher-order thinking skills.

This pedagogical role is particularly important in the Indonesian context, where students' ability to connect mathematical concepts with real-world situations remains relatively weak, as reported in the PISA 2022 assessment (OECD, 2023). Consequently, integrating meaningful local contexts, such as oil storage scenarios, combined with effective teacher guidance, can support the development of students' numerical literacy and higher-order thinking skills. This study contributes to the literature by providing a detailed qualitative description of how students at different ability levels engage in problem-posing activities within a local contextual setting, highlighting that meaningful contexts must be accompanied by structured scaffolding to effectively support flexibility, originality, and reasoning in students' mathematical problem posing.

CONCLUSION

Based on the findings, students' problem-posing abilities varied according to their initial performance levels. High-achieving students (S1) demonstrated flexibility in generating problems, applied logical solution strategies, and drew conclusions relevant to the given context. Medium-achieving students (S2) were able to formulate new problems but remained dependent on familiar patterns, while low-achieving students (S3) experienced difficulties in constructing logically structured problems. These results indicate that problem-posing ability is influenced by students' conceptual understanding, learning experiences, and the level of instructional support provided by the teacher.

The use of an oil context played an important role in increasing students' motivation, as it was closely related to their daily lives. However, real-life context alone was not sufficient to foster higher levels of flexibility and originality without exploratory guidance during problem-posing activities. The five indicators of problem-posing ability, which include flexibility, originality, problem-solving strategy, argument analysis, and conclusion drawing, were found to be interconnected. Students who were able to generate a variety of problems also tended to demonstrate stronger reasoning and argumentation skills.

This study has limitations, particularly the small number of participants and the relatively short research duration. As a descriptive qualitative study conducted in a specific classroom context, the findings cannot be generalized. Future research involving a larger number of students may reveal greater variation in problem-posing abilities and provide deeper insights into the development of flexibility, originality, and reasoning through sustained problem-posing activities. In addition, future studies may explore the use of different contextual themes, such as environmental issues, cultural practices, industrial settings, or daily-life situations, to examine how various contexts support students' creativity and numerical literacy. Despite these limitations, the findings suggest that integrating meaningful local contexts into mathematics instruction, accompanied by appropriate teacher guidance, can support the development of students' higher-order thinking skills.

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