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Research Article

A modified project-based learning model to promote students' creative thinking ability

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This study aims to promote students' creative thinking ability by modifying the Project-Based Learning model in Geometry courses. The research was conducted on 15 students in the Department of Mathematics Education. This descriptive quantitative research used an open test instrument about a project on designing Noah's Ark (ship) based on Islamic literature. Students solve the open problems by discovering the area and volume of the ship through a project in designing the possible geometric shape and size. These modified Project-Based learning activities are arranged according to creative thinking ability indicators. The data analyzed results show that there were various correct answers between students. The students' ship design results are cuboid (rectangular prism), trapezoidal prism, and frustum shapes. The average test score at 61 in the creative category. The achievement of each creative thinking indicator is fluency at 60%, flexibility at 61%, originality at 63%, and elaboration at 61%. It can be concluded that Geometry learning based on a modified Project-Based model can promote students' creative thinking ability.

Keywords: Modified project-based learning, creative thinking ability, geometry

1. Introduction

Higher education is an academic level higher than schools, therefore students are also faced with higher and more complex issues, especially in Mathematics majors, requiring higher-order thinking skills. One of the necessary thinking skills is the mathematical creative thinking ability (Handayani et al., 2020; Vidákovich, 2021; Yayuk, & As'ari, 2020). Mathematical creative thinking ability is the capability to create something new as well as the ability to generate new ideas that can be applied in problem-solving (Ayllón, 2016; Kartikasari & Usodo, 2020; Sriraman, 2008; Syahrın et al., 2019). Mathematical creative thinking ability is required in almost all courses, like Geometry (Aini et al., 2019; Jaenudin et al., 2021; Munakata et al., 2021). Geometry studies plane and spatial figures, focusing on measurement, shape, position, and others. Studying Geometry provides many fundamental skills and helps build skills in logical thinking, reasoning, problem-solving, and creativity. Thus, Geometry, being a fundamental discipline within Mathematics, plays a crucial role in fostering the creative thinking abilities of students in Mathematics learning (Fauzi et al., 2021). The Geometry course is taught to students starting from the second Semester in the Department of Mathematics Education at Institut Agama Islam Negeri [IAIN] Kerinci.

Mathematics Education is one of the departments at IAIN Kerinci, its purpose is to produce graduates who are professional and have an Islamic character, in line with the Vision and Mission of IAIN Kerinci, and based on the vision and mission of the Ministry of Religious Affairs of the Republic of Indonesia, which is to improve the quality of general education with religious character through the enhancement of religious teachings to realize a religiously Indonesian society. Mathematics students at IAIN Kerinci are expected to be not only competent in mathematics but also in Islamic Religious Education. Therefore, Mathematics Education Lecturers should be able to integrate Islamic Values into every Mathematics lecture.

As Mathematics Education lecturers, we have encountered several challenges in teaching, particularly in the Geometry course. Students often struggle to solve problems that require them to find solutions and new ideas from various geometric problems presented, resulting in a relatively low level of creative thinking skills among them. This aligns with research findings by Ramadhani et al. (2020) indicating students' limited ability to think creatively, both in smoothly solving problems and exploring different methods in Geometry problem-solving. Schoenfeld and Sloane (2016) stated that the instruction and acquisition of geometry entail a clash between the mathematical discipline that encompasses the characteristics and connections of shapes, and the difficulties associated with efficiently imparting and comprehending this content.

Additionally, we often face difficulties in integrating Islamic values in line with the Vision and Mission of IAIN Kerinci into Mathematics-specialized courses such as Geometry. Putri et al. (2020) also face the advantage, that the capacity of mathematics to impart both character and Islamic values is somewhat limited. The difficulties can be addressed by incorporating stories, narratives, and objects that cultivate Islamic spirit into Geometry lectures, such as the story of Prophet Noah. He received a revelation commanding him to build an ark (ship) to save himself and his followers from a flood disaster.

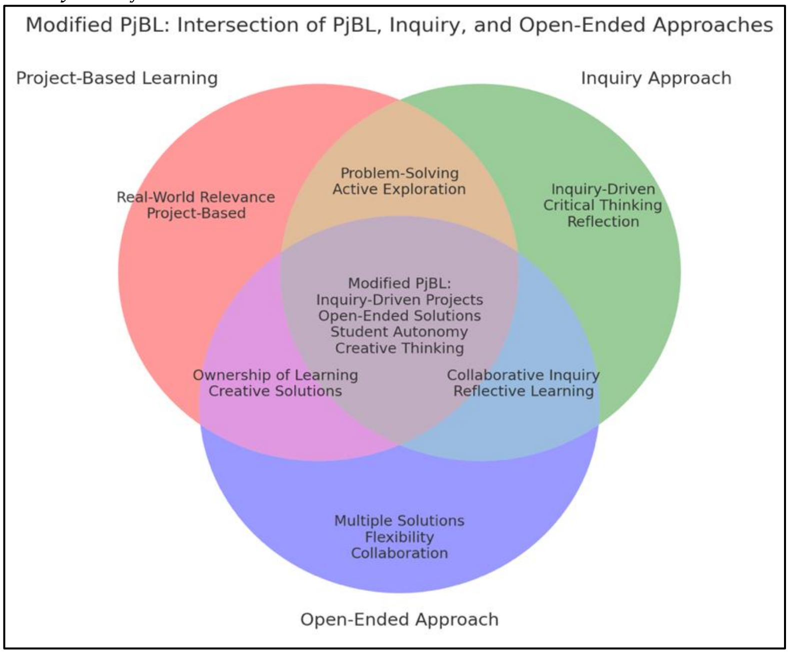
The process of describing the shape, size, and area of the ship is carried out using the Project Based Learning [PjBL] model. PjBL is employed to address complex problems through deep investigation and analysis of how to design the shape of the ship, which consists of various geometric structures. The implementation of the PjBL model involves an inquiry process where the lecturer presents a guiding question and guides students through a collaborative project in the process of describing the ship. PjBL is a learning approach focused on complex problems where students investigate and work on multidisciplinary, product-oriented tasks through long-term activities (Widyaningsoh & Yusuf, 2020).

The PjBL model is capable of promoting creative thinking ability as part of Higher-Order Thinking Skills [HOTS] (Billah et al., 2019; Prananda et al., 2020). Creativity is crucial in designing the shape of the ship based on its length, width, and height, as articulated by Islamic historians. There are differing opinions on the dimensions of the ship. Therefore, students must be able to creatively design various forms of the ship according to known dimensions. The creativity of students includes: 1) designing ships with different shapes but the same area; 2) designing ships with the same shape but different areas; 3) designing ships with different shapes and areas. These creations represent implementations of the Open-Ended approach, where a problem has multiple solutions. Moreover, the Open-Ended approach enhances students' creativity through the provision of open-ended situations (Suherman & Vidákovich, 2022).

The integration of the Open-Ended and Inquiry approach on PjBL generates a new learning model we call modified PjBL. Farhan and Ardimansyah (2022) said that modified project-based learning is a better approach because modified project-based learning is exciting, constructive, and integrated with intensive guidance by the teacher. In addition, the modified project-based learning gives students greater self-control, engagement, and capacity to cultivate their creativity. The Venn diagram that illustrates the intersection between the Project-Based Learning model, the Inquiry approach, and the Open-Ended approach that we call modified PjBL is present in Figure 1.

Several previous studies on Project Based Learning were done to develop the teaching material. Research and development conducted by Delyana et al. (2021) focused on developing a PjBL-based statistics module that was successfully validated. Additionally, research by Sari and Wulanda (2019) demonstrated that project-based worksheets effectively enhance students' creative thinking abilities in Physics courses. Another relevant study is the research conducted by Wulantina (2022) on the development of an E-Module for Linear Algebra using a Realistic Mathematics Education Approach based on Islamic values, which is not only valid but also practical. Furthermore, many previous types of research (Chin, 2014; Özdemir, 2006; Shchetynska, 2020; Ubuz & Aydınyer, 2019) found about PjBL in Geometry. No previous research was found regarding modified project-based learning in Geometry. Research by Farhan and Ardimansyah (2022) analyzes modified project-

Figure 1
Modified PjBL



based learning in Geography. They conclude that implementing Modified Project Based Learning can motivate students to be active in learning, student-centered, and have a good understanding of the content.

Based on various research findings in prior studies, we recognize several limitations. Therefore, we want to fulfill the gap research by conducting a study on Modifying the Project-Based learning model to promote the students' creative thinking ability at IAIN Kerinci. The project of describing the shape of a ship allows students to learn through various activities in the learning process, followed by applying their ideas. A modified PjBL model integrating Open-Ended and Inquiry approaches to design and describe the shape, area, and volume of the ship is expected to promote students' creative thinking abilities. Implicitly, it aims to integrate Islamic values into Geometry lectures.

2. Theoretical Framework

Geometry is a mathematical discipline that examines the characteristics and relationships of space and shapes. Geometry includes concepts such as points, lines, planes, and solid figures, as well as the rules that govern how these elements interact with each other. It also involves the measurement of lengths, areas, volumes, and angles, as well as the analysis of geometric shapes and structures. Historically, geometry originated from practical needs such as land measurement and building construction, but it has evolved into a more abstract discipline with applications in various fields of science and technology, including mathematics.

The Qur'an narrates the story of Prophet Noah building a very large and sturdy Ark because there would be a great flood. The construction, capacity, and size of Prophet Noah's Ark are mentioned in various Islamic literature. Hasan Al-Bashri stated that its length was 1200 cubits, width 600 cubits, and height 300 cubits. Meanwhile, another Islamic historian argued that the size of the Ark (ship) was 300 cubits in length, 50 cubits in width, and 30 cubits in height. Others interpret the size of the ship as 80 dziro' in length and 50 dziro' in width. Others argue that its size is 300 dziro' in length and 50 dziro' in width. If we convert 1 dziro' to 0.5 meters, then we can calculate the area of the ship. However, historians agree that the height of the ship is 30 dziro'. We summarize these four pieces in Table 1.

Table 1
Summary of Possible Ship Measurement

Possibility	*Length*	*Width*	*Height*
I	80 dziro’	30 dziro’	50 dziro’
II	300 dziro’	30 dziro	50 dziro’
III	1200 cubits	300 cubits	600 cubits
IV	300 cubits	30 cubits	50 cubits

Note. 1 dziro’ = 0,5 meters; 1 cubits = 0,45 meters.

Students can calculate the size, area, and volume of the ship based on the provided information. Various Islamic literature about the ship's construction, capacity, and size, is an open problem that is often used in an open-ended approach. Open-ended is an approach to teaching that directs students to think broadly about the issues presented, thereby generating various solutions. The Open-Ended approach not only involves open aspects in the questions or problems provided but also encompasses open aspects in the student's activities. In this approach, mathematical activities are seen as diverse forms of thinking, and students' activities and mathematical activities should be integrated into a unified whole.

The process of describing the shape, size, and area of the ship is undertaken using the modified Project Based Learning model. PjBL is one of the efforts to organize the Higher Education Curriculum in Indonesia. PjBL is a teaching method that uses project tasks as a tool to achieve the main goals of a course. Students are required to develop and apply various types of information acquired during their studies. The PjBL model consists of several steps, namely: generating questions, preparing investigations, collaborating, using supportive technology, and drawing conclusions (Kokotsaki et al., 2016). Furthermore, the PjBL model comprises 6 stages, which include: 1) defining the problem statement; 2) planning; 3) implementing the plan; 4) monitoring; 5) analyzing results; and 6) evaluating (Hasani et al., 2017). The PjBL model is also expected to train students to develop problem-solving skills so that they can address broader issues effectively such as describing the shape, size, and area of the Prophet Noah's ark. These activities can promote the students' creative thinking ability.

Mathematical creative thinking is the ability to create something new, providing fresh ideas that can be applied to problem-solving (Sriraman, 2008). This capability is essential for students to develop innovative solutions to problems. It encourages them to think outside the box and consider different perspectives, which is essential in both academic and real-world situations (Shively et al., 2018). It demands the ability to generate new ideas that have not been previously articulated. The geometry course explores various aspects of space. It is the ability to produce solutions that have not been previously considered and to discover connections among various new ideas (Dietrich, 2018). This ability encompasses several indicators including fluency, flexibility, originality, and elaboration. Fluency, defined as the capability to generate ideas and images effortlessly, flexibility, which involves organizing ideas into diverse categories, originality, Encoding the unique characteristics and atypicality of concepts to others, and elaboration, which embellishes ideas with detailed points, are all considered key characteristics of creative minds (López et al., 2024).

3. Methodology

This research was a descriptive quantitative study to promote students' creative thinking ability by modifying the PjBL model in the Geometry course. The research was conducted at the State Islamic of Kerinci (IAIN Kerinci), Indonesia. The subjects were 15 students of the 2A class in the Department of Mathematics Education who were taking the Geometry course during the 2023/2024 academic year. This sample selection technique was purposive sampling. The purposive sampling technique is a method of selecting samples based on specific considerations. In the current semester, two lecturers are teaching Geometry. Therefore, the researcher selects the research sample as class 2A of the Geometry course, which is not taught by the researcher.

This research used an open test instrument about a project on designing Noah's Ark based on various Islamic literatures. The test used was a mathematical creative thinking test consisting of 3 essay questions with indicators of fluency, flexibility, originality, and elaboration. The mathematical creative thinking test consists of 3 essay questions with indicators of fluency, flexibility, originality, and elaboration. Before administering the test, an analysis of the test items is conducted to evaluate the validity, reliability, difficulty level, and discrimination power. This test is administered to 13 students from Class 2B. The assessment of the test results completed by the students is done using a rubric for scoring creative thinking skills. This item test analysis is performed using the Anates application. Then, the test is administered to 15 students from Class 2A, and the results are analyzed using a rubric for scoring creative thinking ability. The recapitulation of the analysis of the test item is presented in Table 2.

Table 2
Recapitulation of Analysis on Mathematical Creative Thinking Test Item

Item	*Cor*	*Significancy*	*Reliability*	*DP*	*Exp.*	*DL (%)*	*Exp.*	*Exp.*
1	0.803	Very Sig.	0.83 (High)	0.28	Enough	71.88	Easy	Used
2	0.874	Very Sig.		0.45	Good	53.13	Moderate	Used
3	0.845	Very Sig.		0.95	Very Good	50.00	Moderate	Used

Note. Cor: Correlation; Sig: Significant; DP: Discrimination Power; EXP: Explanation; DL: Difficulty Level

The data analysis involves descriptive statistical techniques such as frequencies, means, medians, and distribution analysis. After that, we interpret the results of data analysis about students' creative thinking ability, then we describe the characteristics and patterns found in the data. The analysis of students' creative thinking abilities is conducted by comparing the results of their creative thinking ability tests with the criteria for students' creative thinking abilities according to Table 3.

Table 3
Category of Creative Thinking Abilities

Category	*Achievement*
Very Creative	81 – 100%
Creative	61 – 80%
Enough Creative	41 – 60%
Less Creative	21 – 40%
Not Creative	≤ 20%

4. Results and Discussion

The test instrument used to assess the students' creative thinking in Geometry teaching materials is based on the modified PjBL (Project-Based Learning) model "Noah's Ark". The test of mathematical creative thinking ability consists of 3 essay questions with indicators of fluency, flexibility, originality, and elaboration. This research instrument, including the grid and scoring rubric, has been officially registered as Intellectual Property Rights [IPRs]. The student's creative thinking abilities achievement is presented in Table 4.

Table 4 shows that the average attainment of students' creative thinking abilities is 61%, categorized as creative, with achievement indicators as follows: fluency at 60%, flexibility at 61%, originality at 63%, and elaboration at 61%. Both flexibility and fluency averaged scores of 7, corresponding to a 61% and 60% achievement rate, respectively. These findings suggest that most participants are capable of generating ideas and categorizing them into various categories, albeit not at an exceptionally high level. While this is an indicator of creativity, the scores reflect that there is capacity for enhancing the generation of a broader variety of thoughts and then adapting them to different contexts. Originality, with an average score of 8 and a 63% achievement rate, was the highest-scoring dimension. This suggests that the participants were relatively strong in

Table 4
The Students' Creative Thinking Abilities Achievement

Subject	*Flexibility*	*Fluency*	*Originality*	*Elaboration*	*Total*	*Score (%)*	*Category*
1	1	1	1	0	3	6	Not Creative
2	1	1	1	1	4	8	Not Creative
3	1	1	1	2	5	10	Not Creative
4	5	5	5	5	20	42	Enough Creative
5	6	6	8	4	24	50	Enough Creative
6	6	6	6	6	24	50	Enough Creative
7	6	6	7	6	25	52	Enough Creative
8	7	7	8	7	29	60	Enough Creative
9	9	9	9	9	36	75	Creative
10	9	9	9	9	36	75	Creative
11	10	9	10	12	41	85	Very Creative
12	12	12	12	12	48	100	Very Creative
13	12	12	12	12	48	100	Very Creative
14	12	12	12	12	48	100	Very Creative
15	12	12	12	12	48	100	Very Creative
Average	7	7	8	7	29	61	Creative
Achievement	61%	60%	63%	61%			

producing unique and unusual ideas compared to their peers. The slightly higher score in this dimension indicates that participants are more inclined to think outside the box, which is a positive sign of creative potential. Elaboration also averaged a score of 7, with a 61% achievement rate, indicating that while participants were able to provide details that enhance their ideas, this aspect was not particularly pronounced. The results suggest that participants may benefit from focusing more on elaboration to fully flesh out their ideas, adding depth and richness that could further distinguish their creative output.

The categorization of participants into different levels of creativity ranging from "Not Creative" to "Very Creative" shows a broad spectrum of creative ability. A significant proportion of participants fell into the "Enough Creative" category, indicating moderate creative abilities across all four dimensions. Notably, a small group achieved the "Very Creative" category, with perfect scores in all dimensions, emphasizing the variability in creative potential within the sample. Therefore, it can be concluded that the Modified PjBL Model can enhance the creative thinking abilities of Mathematics Education students at IAIN Kerinci. The summary of the student's creative thinking test scores across creativity categories are presented in Figure 2.

Figure 2
Summary of the student's scores across creativity categories

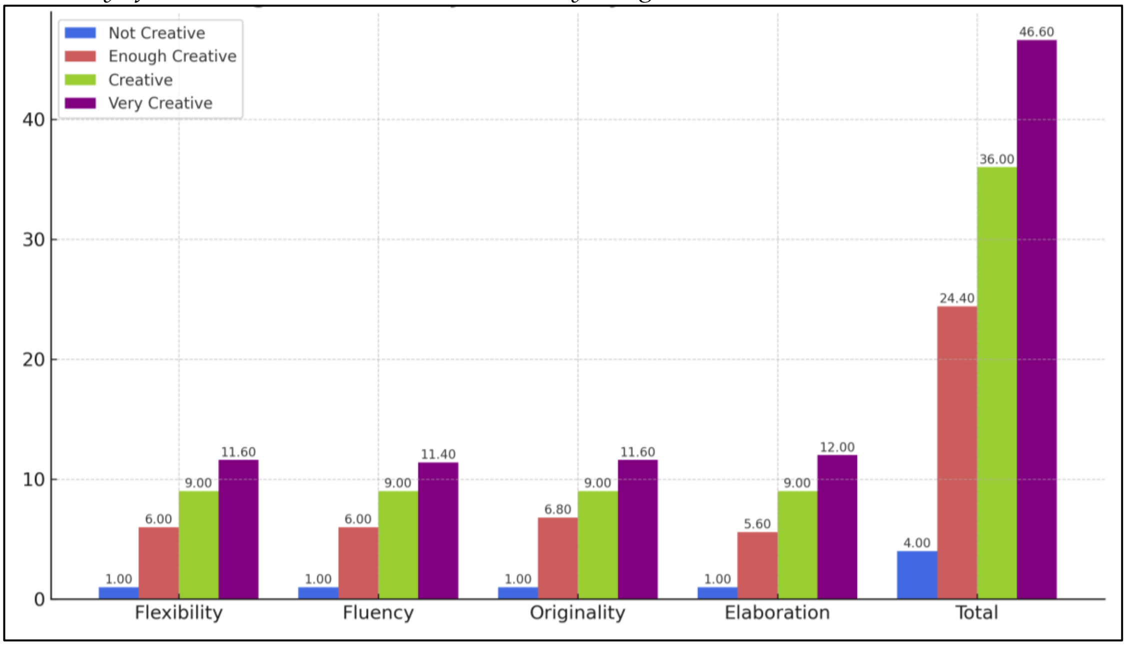


Figure 2 shows that the very clear gradation from "Not Creative" to "Very Creative" across all categories suggests a well-defined spectrum of creativity. The data imply that creativity is a multi-dimensional construct where different aspects (flexibility, fluency, originality, elaboration) contribute to overall creativity. The steep rise in scores as we move from "Not Creative" to "Very Creative" could reflect the impact of either inherent abilities or external factors (like training, education, or environment) that enhance creativity. the total score aggregates all the dimensions (flexibility, fluency, originality, elaboration). The wide margin between "Very Creative" and the other groups underscores that "Very Creative" individuals consistently outperform across all creativity dimensions. The very clear gradation from "Not Creative" to "Very Creative" across all categories suggests a well-defined spectrum of creativity within the population. The data may imply that creativity is a multi-dimensional construct where different aspects (flexibility, fluency, originality, elaboration) contribute to overall creativity. The steep rise in scores as we move from "Not Creative" to "Very Creative" could reflect the impact of either inherent abilities or external factors that enhance creativity. The cumulative total for "Not Creative" is notably low, indicating that individuals in this category lack proficiency across all measured dimensions of creativity.

The first question of the creative thinking skills test is a project to design a possible ship shape using geometric shapes according to the possible lengths, widths, and heights of the ship provided. Students can design the shape of a ship by integrating geometric plane figures with the lengths, widths, and heights of the ship according to the possible dimensions provided. The ship designs produced by the students are in the form of a cuboid, trapezoidal prism, and frustum. Students could synchronize between the ship's image, the geometric plane figures forming the ship, and the known possible dimensions. Students are also able to calculate the Area and Volume.

Students successfully integrated ship drawings with geometric plane figures corresponding to known possible dimensions. Students demonstrated the ability to calculate both the area and the volume of the designed shapes. Out of a total of 12 possible correct variations, students produced 6 correct variations. The specific dimensions and geometric configurations of the 6 correct variations are presented in Table 5.

Table 5
Recapitulation of Student Answer Variations

	Possibility			
Shape	*I (students)*	*II (students)*	*III (students)*	*IV (students)*
Cuboid (Rectangular Prism)	1	1	3	2
Trapezoidal Prism	7	0	0	0
Frustum	1	0	0	0

Based on Table 5 above, the cuboid design was the most varied, with students producing it in four different variations. The cuboid was identified by students across all four categories (I-IV). Specifically, one student each in Possibility I and II, three students in Possibility III, and two students in Possibility IV identified this shape. This suggests that the cuboid, being a more commonly recognized and perhaps simpler geometric shape, was more frequently identified by students across varying levels of understanding. The trapezoidal prism design was produced by the majority of students in one variation. The trapezoidal prism was identified by seven students, all in possibility I. Interestingly, no students from possibility II, III, or IV identified this shape. This might indicate that those who did recognize the trapezoidal prism were at a basic or initial level of understanding, perhaps due to specific exposure to this shape in prior lessons. The absence of identification in the other categories could suggest either a lack of familiarity or difficulty in recognizing this less common shape. The frustum design was produced by one student in one variation. The frustum was identified by only one student in possibility I. This low identification rate might reflect the complexity of the frustum compared to the other shapes, suggesting that students generally found this shape more challenging to recognize or recall.

The distribution of students across different possibilities for each shape suggests varying levels of geometric creativities. The cuboid, being a more straightforward and familiar shape, was recognized across all levels, indicating that most students have a basic creativity of this shape. In contrast, the trapezoidal prism and frustum were less commonly identified, suggesting a potential gap in students' familiarity or comfort with these shapes. The data implies that while students may be confident in recognizing basic geometric shapes, there is a need for more focused instruction on less familiar and more complex shapes like the trapezoidal prism and frustum. Incorporating more diverse geometric shapes into the curriculum and using varied teaching methods could help improve students' spatial reasoning and overall geometric comprehension.

Recognizing and understanding different geometric shapes requires spatial reasoning, mental flexibility, and the ability to visualize objects from various perspectives, all of which are integral components of creativity. Flexibility in creativity is about categorizing ideas into different groups and thinking from various angles. The ability to recognize different shapes, such as the cuboid, trapezoidal prism, and frustum, reflects a student's mental flexibility in visualizing and categorizing three-dimensional objects. The fact that the cuboid was identified across all categories, while more complex shapes like the frustum were rarely recognized, suggests that students might have varying levels of cognitive flexibility. Those who can easily switch between different shapes and identify them might also be more adept at generating diverse ideas in creative tasks.

Fluency involves the spontaneous flow of ideas, which can be paralleled by the ease with which students identify and recall geometric shapes. Students who identified the cuboid across categories might demonstrate a baseline fluency in recognizing common shapes. However, the limited recognition of the trapezoidal prism and frustum suggests that fluency might be constrained when it comes to less familiar or more complex forms, indicating that these students might struggle with generating a broad range of ideas in creative contexts.

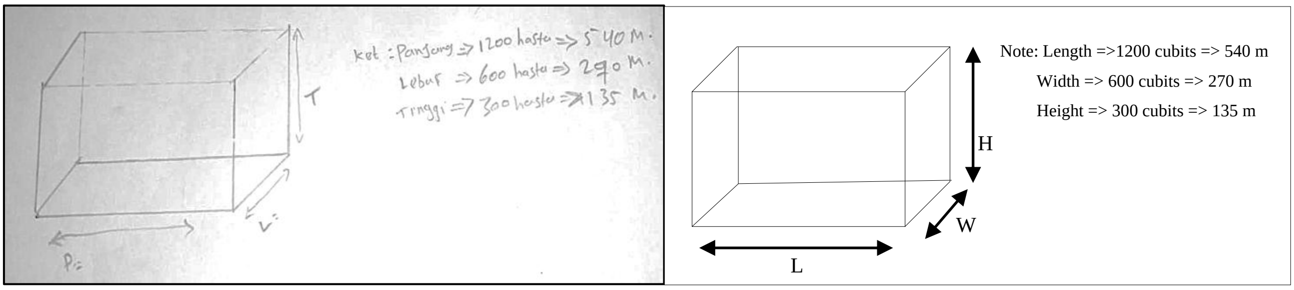
Originality, the uniqueness of ideas, can be linked to how students perceive and identify geometric shapes that are less commonly discussed, such as the trapezoidal prism and frustum. The one student who identified the frustum, for example, could be considered to have demonstrated a higher level of originality, as this recognition indicates an ability to think beyond the obvious and consider less conventional forms.

Elaboration is about adding details to ideas, which in geometric terms could mean recognizing and describing the unique characteristics of different shapes. Students who identified shapes like the trapezoidal prism might have a greater capacity for elaboration, as this involves distinguishing it from more common shapes like the cuboid. However, the low number of students who identified these shapes suggests that most might still be developing this aspect of their creativity.

4.1.1. Cuboid (Rectangular Prism)

A total of 7 students designed the ship in the form of a cuboid (rectangular prism) at all possible measurements. This choice was based on the ease of both drawing and calculation. Students found it easier to calculate the area and volume of the ship by using only the formulas for the area and volume of a cuboid. Figure 3 shows a picture of a student's answer regarding the shape of a ship in the form of a cuboid.

Figure 3
Student's Answer in the Form of a Cuboid (Rectangular Prism)

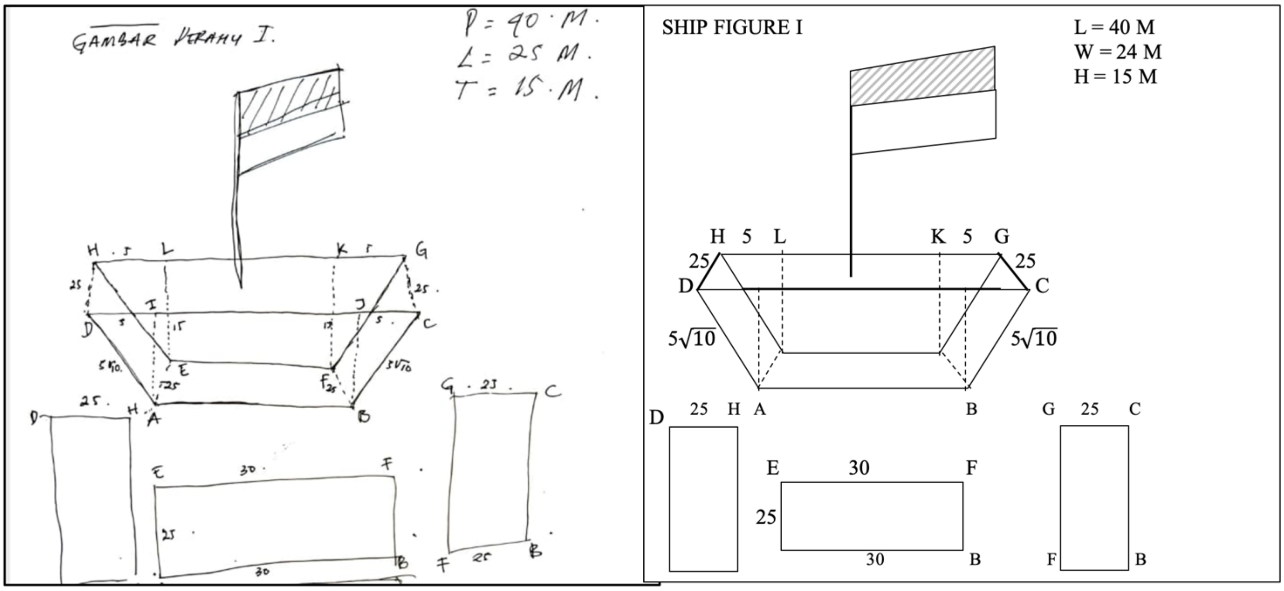


The student sketch of a rectangular prism (a three-dimensional box) with dimensions labeled Length (P) = 1200 cubits has been converted to 540 meters, Width (L) = 600 cubits has been converted to 270 meters, and Height (T) = 300 cubits has been converted to 135 meters. The sketch resembles a simple rectangular prism, which is a basic geometric shape often used to represent the dimensions of a three-dimensional object. However, this sketch by itself lacks the specific details and features that would typically characterize a ship, such as a hull shape, deck layout, or any indication of maritime design elements like a bow, stern, or superstructure. This simplified representation, a rectangular prism could be a starting point or a base model for a more creative design for a ship. Creativity would come into play when transforming this basic shape into a functional and aesthetically pleasing vessel. Designers often start with basic geometric shapes and then apply creative thinking to refine and adapt these shapes into something more complex and suited to specific needs. The simple rectangular prism shape is very boxy and not hydrodynamic. A boxy shape is more typical of a barge or cargo container rather than a ship meant for sailing efficiently.

4.1.2. Trapezoidal Prism

A total of 7 students designed the ship in the form of a cuboid at the first possible measurement. The student mentioned a trapezoidal prism in their answer regarding the shape of a ship because they might be describing a hull design where the cross-section of the ship's hull resembles a trapezoid when viewed from the side. This shape can be a common design in certain types of ships or boats, especially those with a broader base and narrower top section. The trapezoidal shape helps in providing stability and efficient displacement of water, especially in vessels designed for specific purposes like cargo ships or some types of naval vessels. Figure 4 presents a student's answer sheet regarding the shape of a ship in the form of a trapezoidal prism.

Figure 4
Student's Answer in the Form of a Trapezoidal Prism

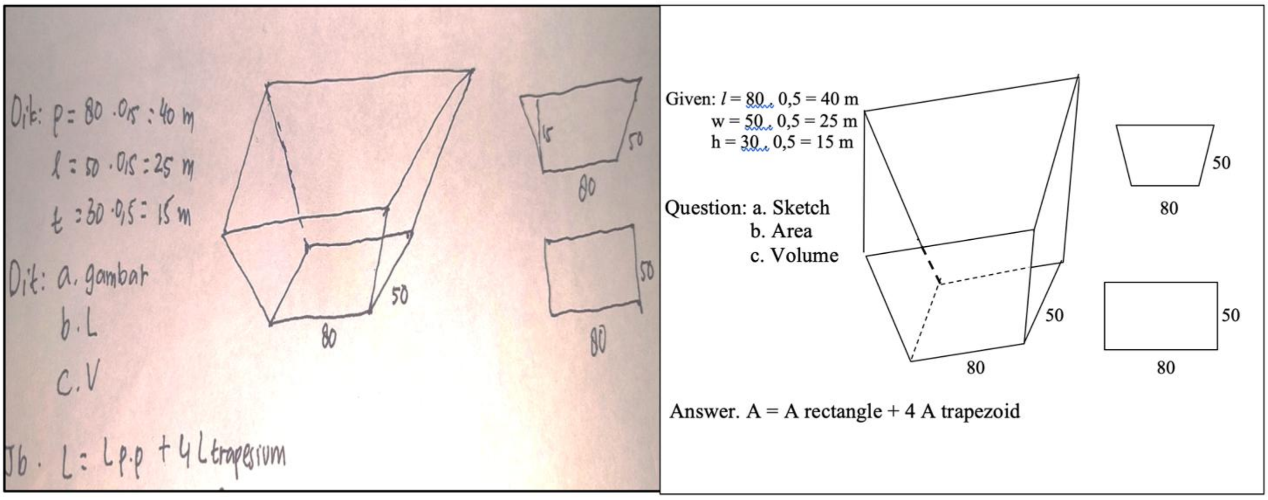


The ship in Figure 4 is designed as a trapezoidal prism with the specified dimensions. The ship comprises two trapezoids for the front and back sides, two rectangles for the left and right sides, and one rectangle as the base. The trapezoid **vertices**: A, B, C, D (for the front trapezoid), E,F,G,H (for the back trapezoid). This visual representation highlights the geometric shapes that form the ship's structure. The trapezoidal faces are at the front and back of the ship, while the rectangular faces are on the left, right, and bottom sides. Each of these shapes comes together to form the overall structure of the ship. The base rectangle runs along the bottom, while the trapezoidal faces form the front and back, creating the characteristic shape of a trapezoidal prism. The trapezoidal prism design offers a balanced space distribution, with a wide deck for operations and a narrower base for improved stability. This indicates that the student is applying a creative mindset to represent an answer that can be seen as a creative approach, showcasing their originality, flexibility, and capacity for elaboration. The student quickly and easily generates multiple geometric shapes or ideas and selects the trapezoidal prism among many options, which indicates fluency indicators of creative thinking.

4.1.3. Frustum

A student designed the ship in the form of a frustum at the first possible measurement. He mentioned a frustum in his answer regarding the shape of a ship because he prefers a specific design feature or component of the ship's structure. A frustum is a geometric shape that resembles a truncated cone or pyramid, where the top and bottom sections are parallel but have different sizes. In the context of a ship, a frustum shape might be used to describe parts of the ship's superstructure, such as a tapered or truncated section of a mast, funnel, or even certain sections of the hull, depending on the ship's design. It could also refer to the shape of certain components used in shipbuilding or marine engineering, where such geometric forms are employed for various functional or structural reasons. Figure 5 shows a student's worksheet regarding the shape of a ship in the form of a frustum.

Figure 5
Student's Answer in the Form of a Frustum



A frustum can represent the ship, especially when considering the form of the triangular prisms on top of the cuboid base. The triangular prisms described in the ship's structure could be visualized as frustums. Instead of being simple triangular prisms with flat sides, the prisms could taper, resembling a frustum with a large triangular base and a smaller triangular top. The lower part of the ship remains a rectangular cuboid, providing stability and volume for cargo or passengers. The upper part, initially described as triangular prisms, can be reinterpreted as frustums, where the triangular shape narrows as it rises. This shape is beneficial for reducing wind resistance and potentially enhancing the aesthetic and functional design of the ship. This combination gives the ship a solid, stable lower structure with a more aerodynamic upper structure, helping it glide through the water more efficiently.

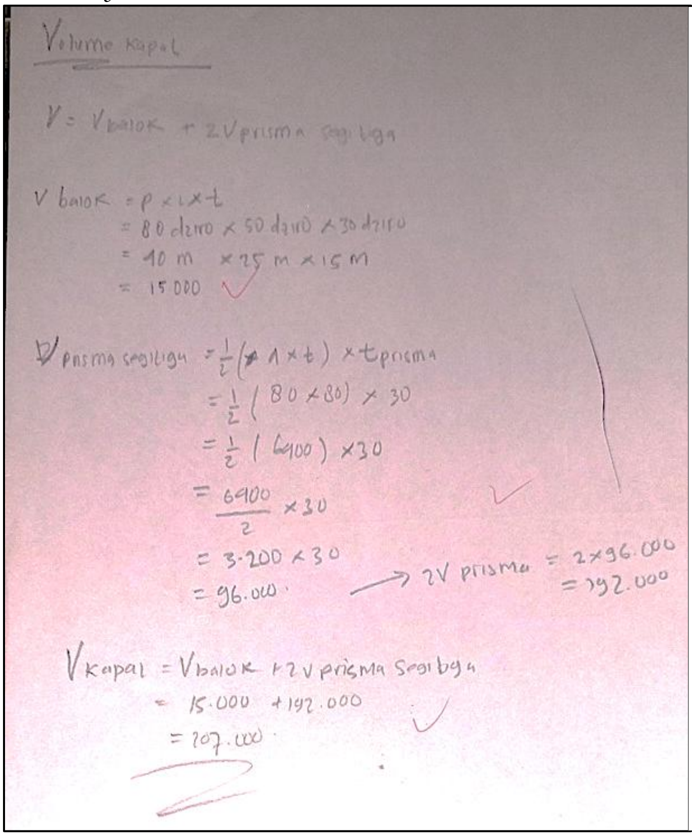
Using a frustum to represent the ship's design is creative. Innovative design, functional benefits, visual appeal, and conceptual flexibility demonstrate creativity in the use of frustums in the ship's design. A frustum shape can enhance the ship’s hydrodynamic efficiency by reducing water and air resistance. This is particularly useful for modern ships aiming for higher speeds and better fuel efficiency. The frustum shape offers a sleek and modern look. It deviates from traditional blocky designs, giving the ship a distinctive and futuristic appearance. The combination of a cuboid base with frustum-shaped upper structures provides a visually interesting contrast. It moves away from the conventional uniform shapes, making the ship stand out. Frustum shapes are often associated with cutting-edge technology and modern aesthetics, which can be appealing for new designs.

Frustum is the part of a pyramid or cone that remains after the top is cut off by a plane parallel to its base. Therefore, a frustum can originate from a pyramid (pyramid frustum) or a cone (conical frustum). According to Figure 5, the students draw the ship in the form of a pyramid frustum. A frustum is created by cutting one side of the pyramid with two parallel planes (Wang & Jia, 2019). The pyramid is chopped off, a plane parallel to the base is created and it becomes a Truncated Pyramid, usually referred to as a Frustum (Olu, 2020). The student struggled to determine the area of the frustum but made an incorrect calculation for its volume. The volume should be obtained from the sum of the volume of the square prism, rectangular prism, and square pyramid (Butuner, 2015).

4.1.4. Students' works based on their abilities

In high-ability students, the process of solving problems in designing the shape, area, and volume of the ship has already shown creative thinking ability in the very creative category. The development of student's creative thinking abilities through Geometry learning based on the modification of the PjBL model can be seen from one of the students' worksheet in Figure 6.

Figure 6
The Very Creative Student's Worksheet



Ship Volume

V = V cuboid + 2V triangular prism

V cuboid = l x w x h
= 80 dziro x 50 dziro x 30 dziro
= 40 m x 25 m x 15 m
= 15.000

V triangular prism = $\frac{1}{2}$ $(base\ x\ h)$ x h prism
= $\frac{1}{2}$ (80 x 80) x 30
= $\frac{1}{2}$ (6400) x 30
= $\frac{6400}{2}$ x 30
= 3200 x 30
= 96.000

2 V prism = 2 x 9600
= 192000

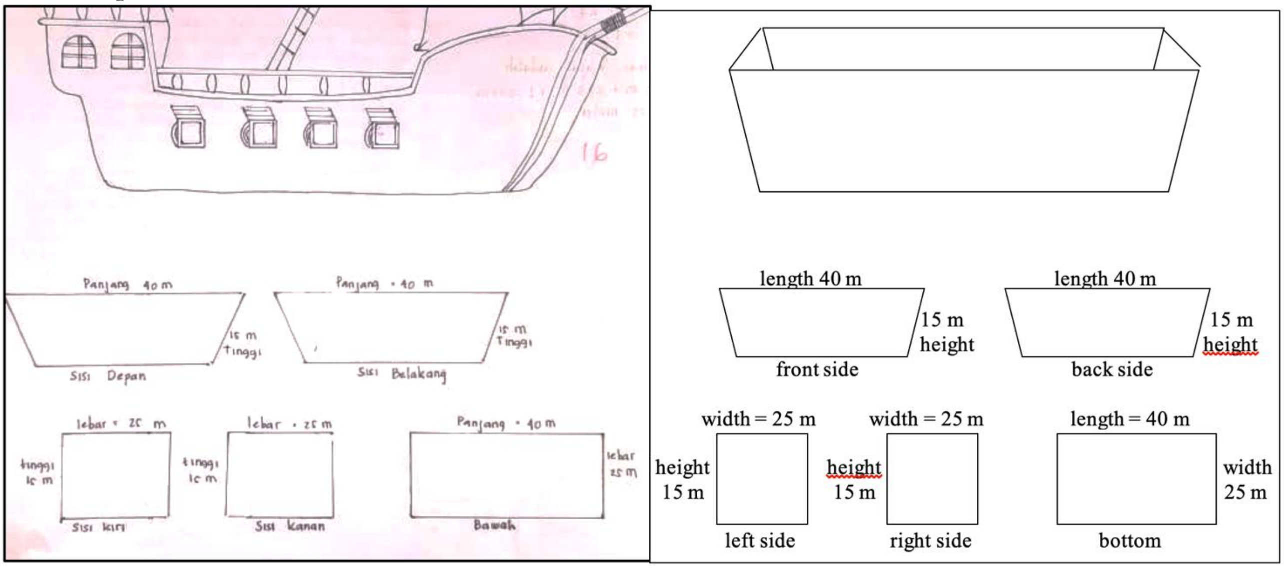
V Ship = V cuboid + 2V triangular prism
= 15.000 + 192.000
= 207.000

Based on the very creative student's calculations in Figure 6, they visualized the ship as a combination of a rectangular (cuboid) base and two identical triangular prisms on top, forming a streamlined shape. The cuboid forms the main hull or body of the ship. It's a rectangular box-like structure that serves as the primary section of the ship with length (l) = 40 meters, width (w) = 25 meters, and height (h) = 15 meters. The volume of this part is 15,000 m3. This section is likely the main storage or cargo area, providing the bulk of the ship's capacity. The ship has two identical triangular prisms attached on top of the cuboid base, likely forming the upper structure or deck of the ship. These prisms give the ship a pointed or streamlined shape, helping it move efficiently through water. The base of the triangle = 80 meters, this represents the width of the ship at its widest point. Height of the triangle (h_base) = 80 meters, representing the height of the ship's side profile, making the deck or upper structure taller and more spacious. Height of the prism (h_prism) = 30 meters, this represents the length of the ship covered by the triangular structure, stretching along the deck. The volume of each prism = 96,000 m^3, since there are two, the total volume of these prisms is 192,000 m^3. The ship's overall form combines the cuboid base with the two triangular prisms. The total volume of 207,000 m^3 provides insight into the ship's potential size and usage.

From Figure 6, it is shown that the student can solve problems fluently (fluency) with correct answers. The student was able to compute the volume of the ship using the correct and appropriate solid geometry volume formula. The student also demonstrates open and flexible thinking (flexibility) by selecting the appropriate ship size based on known possibilities and then synchronizing and aligning it with the ship's drawing and the types of geometric shapes used. The student's very creative work is unique, original, and different from other students' work (originality). The student can develop (elaborate) the problem of the shape, size, area, and volume of the ship in the Geometry lesson being discussed. The Geometry teaching materials containing the area and volume of geometric shapes with the modified PjBL Model can open students' minds, enabling them to think outside the box, that is, to think differently and develop creative thinking skills (Khafah et al., 2023).

Enough creative students can design the shape of the ship creatively but have yet to accurately calculate the area and volume of the ship. These students struggle to integrate geometric shapes depicted in diagrams with the length, width, and height measurements of the ship according to the given possibilities. Figure 7 shows an example of the work from enough creative students.

Figure 7
The Enough Creative Student's Worksheet



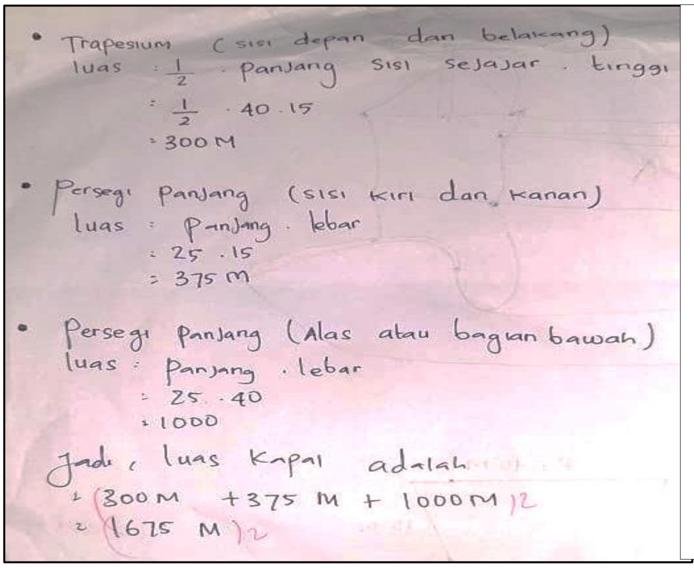
From Figure 7, it appears that the students are having difficulty synchronizing the ship sketch with the geometric shapes used to form the ship, along with their respective measurements. In Figure 7, the student has indicated that the length of the trapezoid's leg is 15 meters, which was obtained from 30 dziro' x 0.5 meters. While this calculation is correct, 15 meters should represent the height of the ship, which is also the height of the trapezoid. Therefore, there is an inconsistency between the ship sketch and the measurements provided by the student. This misunderstanding is caused by student's difficulty in applying formulas to real-world objects. Applying abstract geometric formulas to real-world objects, like a ship, can be challenging because it requires abstract thinking and a strong grasp of geometry. To overcome these challenges, the lecturer can provide guided practice to students on applying formulas to simplified versions of real-world objects. The lecturer may start with simpler objects (e.g., rectangular prisms, pyramids) and gradually introduce more complex shapes like trapezoidal prisms. Contextualizing each part of the ship with a corresponding geometric shape can bridge the gap between theory and application.

The cause of the student's difficulty in synchronizing the ship sketch with the geometric shapes and their respective measurements could stem from a misunderstanding of Geometric terminology. Students might not fully understand terms like "height," "base," "length," and "width," and how these apply to different geometric shapes. This misunderstanding can lead to incorrect application of dimensions in formulas, such as confusing the height of the trapezoid with the length of the prism. The students should clarify terminology to ensure that they understand geometric terms and their applications through definitions, examples, and practice problems (Chiphambo, 2019). They should use clear, labeled sketches, and lecturers may guide students through identifying dimensions and corresponding geometric shapes (Kulamikhina et al., 2022).

The student with moderate ability is making errors in calculating the area and volume of the ship. This type of error is typically due to a lack of precision in the student's mathematical calculations (2 students), although they are still considered creative in designing the shape, area, and volume of the ship quantitatively. They achieve between 60% to 80%, while there are also five students categorized as enough creative, achieving between 40% to 60%. The errors in calculating the area and volume of the ship can be seen in Figure 8.

Figure 8

The Errors in Calculation Made by the Students



- Trapezoid (front and back side)
  A = $\frac{1}{2}$. the sum of parallel sides . height
  = $\frac{1}{2}$. 40 . 15
  = 300 M
- Rectagle (left and right side)
  A = *length* . width
  = 25 . 15
  = 375 M
- Rectangle (base or bottom side)
  A = *length* . width
  = 25 . 40
  = 1000

So, the Area of the ship is
= 300 M + 375 M + 1000 M
= 1675 M

The main reason for the student's mistake is that they don't comprehend the trapezoid area formula and how to use it effectively. The student calculation shown in Figure 8 was incorrect. The main error made by the student in the calculation of the trapezoid's area resulted in a large miscalculation of the ship's overall surface area. When calculating the area of the trapezoid (front and back sides), the student appears to have made a mistake. He treated one base as zero or omitted the second base, resulting in a miscalculation. The correct area for the trapezoid is based on both bases and the height should be A= $\frac{1}{2} \times (40 + 30) \times 15 = 525$ m^2. The student's calculation of 300 m^2 is significantly lower than the correct area of 687,5 m^2. The student made this mistake by adding only one base to the trapezoid rather than using both.

With two trapezoids representing the ship's front and back, two rectangles called "a" representing the ship's left and right sides, and a rectangle labeled "b" representing the ship's bottom, Figure 8 demonstrates the students' inventiveness in constructing the shape of the ship. Nevertheless, student calculations of the ship's area were incorrect. They did not include the flat rectangle structure at the top of the ship (rectangle b) in their area calculations. Furthermore, during the area computation, they just added up the areas of the three different geometric form types trapezoids, rectangle a, and rectangle b. But each kind of shape is made up of two similar sections (the ship's bottom and top, left and right sides, and front and back). While displaying a moderate level of mathematical competence and imprecise formulation in the area of the trapezoid, these fairly proficient students also exhibit creative potential (see Figure 7). The student's total of the ship area 1675 m^2 is incorrect because the trapezoid area was miscalculated. The correct total surface area should be Total Surface Area = 2 (525 m^2 + 375 m^2) + 1000 m^2 = 2800 m^2.

The modified PjBL (Project-based Learning) model is less effective when applied to students with low initial mathematical abilities. PjBL often involves complex, open-ended projects that require a strong foundation in basic mathematical concepts. Students with lower initial abilities struggle to understand and apply these concepts within the context of the project, leading to frustration and reduced learning outcomes (Alqudah et al., 2013). The cognitive demands of managing a project, integrating multiple skills, and applying them to real-world problems can be overwhelming for students with low initial abilities. They might face difficulties in keeping up with the project's pace, leading to gaps in understanding (Komara et al., 2023). Students with lower mathematical abilities often require more scaffolding and step-by-step guidance (Supriadi et al., 2019). PjBL's emphasis on exploration and discovery may not provide the structured support they need to build their skills gradually. This is evident in Table 4, where three students categorized as not creative struggled to solve the test questions effectively, as shown in Figure 9.

Figure 9
The Non-Creative Student Worksheet

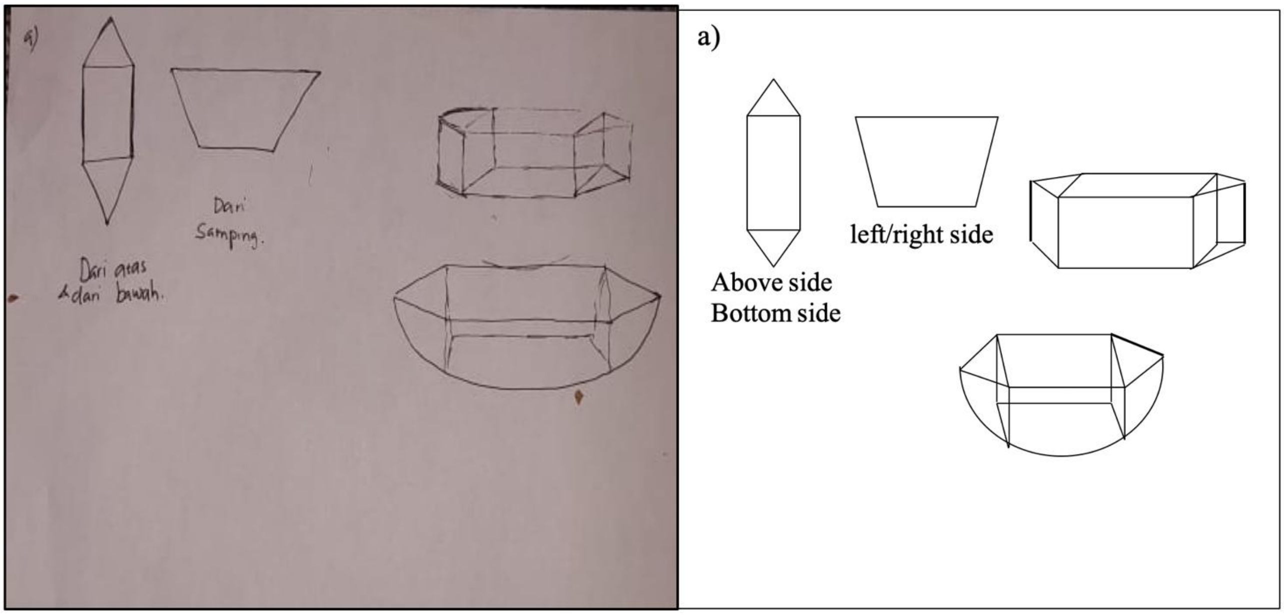


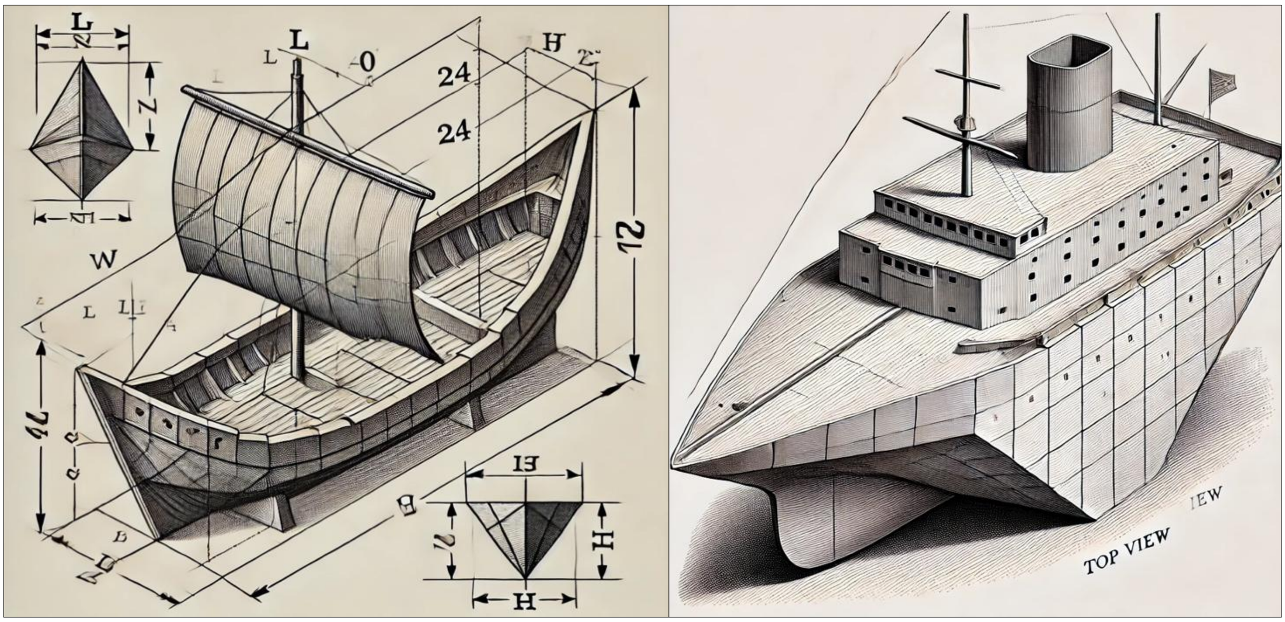
Figure 9 above shows that students are facing difficulties sketching the ship. Students might need help visualizing and translating a 3D item into a 2D sketch because they may need help with spatial thinking. This may result in incomplete or inaccurate drawings that do not appropriately represent the form and structure of the ship. The students were having difficulty determining which 2-dimensional (2D) geometric objects make up the 3-dimensional (3D) geometric shape of the boat, this likely points to challenges in spatial reasoning, visualization, and geometric understanding. These difficulties indicate challenges in certain aspects of creative thinking, particularly those related to visualization, spatial reasoning, and problem-solving (İbili et al., 2020). Creative thinking involves strong visualization skills and the ability to imagine and mentally manipulate shapes and objects.

Non-creative students in this study exhibit low initial mathematical abilities, which lead to confusion when designing the shape of the ship using geometric shapes according to given possibilities of length, width, and height. This could be attributed to their low spatial abilities. Soraya et al. (2021) found in their research that individuals with low prior mathematical abilities also tend to have low spatial abilities. This suggests that students with low mathematical abilities also lack spatial imagination in designing ship shapes. Therefore, this study suggests further research on developing spatial abilities among students with low initial mathematical abilities as a strategy to enhance their creative thinking skills.

We recommend educators implement many strategies to anticipate the difficulties faced by non-creative students. Regularly discuss the importance of persistence and experimentation in creative thinking. Provide positive reinforcement for students who attempt different approaches, even if they make mistakes, and encourage peer collaboration to share ideas and strategies. Educators should identify students who may need more focused support and provide them with additional resources, such as simplified exercises, personalized guidance, or access to peer tutoring. Consider differentiated instruction to meet the diverse needs of the class. Students can improve their ability to understand and work with geometric concepts, while also enhancing their creative thinking skills. Providing a supportive, engaging, and exploratory learning environment will help students anticipate their challenges and develop confidence in both their geometric and creative abilities.

Trapezoidal prisms and frustums might not be as familiar to students because they were less commonly encountered in everyday situations than more basic shapes like cubes, cuboids (rectangular prism), and cylinders. To add clarity to the visualization aspects of the sketch, we tried to illustrate the results of the students' work which requires further research as the recommendation of this research. The ship forming the trapezoidal prism and frustum into a 3-dimensional sketch is presented in Figure 10.

Figure 10
3-D Illustration of The Ship made from a Trapezoidal Prism and a Frustum



5. Conclusion

This research aimed to promote students' creative thinking ability. This research has been conducted to integrate Islamic values into the geometry lecture, in line with the vision and mission of the Department of Mathematics Education at the State Islamic Institute of Kerinci. This institute seeks to ensure that its graduates are not only professionals in mathematics education but also possess Islamic characteristics. We wish to emphasize that this study does not aim to promote any religious beliefs, endorse the truth of the story of Prophet Noah, or address any issues related to ethnicity, religion, race, and inter-group relations. The research is focused solely on the academic and geometric aspects of Noah's Ark design as a study to connect geometry concepts with Islamic values.

We also want to clarify that all sketches of the ark (ship) produced in this research are not representations of Noah's Ark as believed by certain societies. These images are purely illustrative and are intended solely for educational purposes. The calculated area and volume of the ship are mathematical approximations and may not reflect the actual historical dimensions.

Based on the research results, we conclude that the average creative thinking test score at 61 in the the creative category. The achievement of the fluency indicator at 60%, flexibility at 61%, originality at 63%, and elaboration at 61%. The students' ship design results are cuboid, trapezoidal prism, and frustum shapes. The students produced 6 correct variations answers from a total of 12 possible correct variations. The variety indicates the development of students' creative thinking skills. Therefore, the modified PjBL model can promote students' creative thinking abilities.

The research results suggest that the lectures aiming to boost creativity should focus on enhancing all four dimensions, particularly for those in the "not creative" and "enough creative" categories. Tailoring programs to target specific weaknesses by improving originality or elaboration skills might help individuals move up the creativity spectrum.

Future research should focus on analyzing the geometric and structural implications of ship designs modeled as frustums and trapezoidal prisms. It is recommended to develop advanced mathematical models with practical case studies and interdisciplinary approaches that may further enhance the understanding and application of the designs.

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Author contributions: EYPN was designed and is the chief researcher. All authors were part of the collection, analysis, and interpretation of data. All authors read and approved the final manuscript.

Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of interest: The authors declare that no conflicts of interest occur.

Ethics statement: All participants provided informed consent prior to their involvement in the study. They were informed about the study's purpose, procedures, and their right to withdraw at any time without consequence.

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References

Aini, A. N., Mukhlis, M., Annizar, A. M., Jakaria, M. H. D., & Septiadi, D. D. (2020). Creative thinking level of visual-spatial students on geometry HOTS problems. *Journal of Physics: Conference Series*, *1465*(1), 012054. http://doi.org/10.1088/1742-6596/1465/1/012054

Alqudah, Y., AlQaralleh, E., & Mace, M. (2013). Enhancing the teaching of digital signal processing through project-based learning. *International Journal of Online and Biomedical Engineering, 9*(2), 21. https://doi.org/10.3991/ijoe.v9i2.2489

Ayllón, M. F., Gómez, I. A., & Ballesta-Claver, J. (2016). Mathematical thinking and creativity through mathematical problem posing and solving. *Journal of Educational Psychology-Propósitos y Representaciones*, *4*(1), 195-218. http://doi.org/10.20511/pyr2016.v4n1.89

Billah, A., Khasanah, U., & Widoretno, S. (2019). Empowering higher-order thinking through project-based learning: A conceptual framework. *AIP Conference Proceedings, 2194*(1), 5139743. https://doi.org/10.1063/1.5139743

Butuner, S. O. (2015). Using history of mathematics to teach volume formula of frustum pyramids: dissection method. *Universal Journal of Educational Research*, *3*(12), 1034-1048. https://doi.org/10.13189/ujer.2015.031213

Chin, W. (2014). *The effects of project-based learning in high school geometry* (Publication No. 3648522) [Doctoral dissertation, University of Hawaii]. ProQuest Dissertations and Theses Global.

Chiphambo, S. (2019). Mathematics dictionary: enhancing students' geometrical vocabulary and terminology. In N. Feza (Ed.), *Metacognition in learning* (pp. 1-15). Intech Open. https://doi.org/10.5772/intechopen.86409

Delyana, H., Fauzan, A., Armiati, A., Gistituati, N., & Asmar, A. (2021). Pengembangan modul statistika berbasis project based learning [Development of a statistics module based on project based learning]. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *5*(3), 2313-2323. https://doi.org/10.31004/cendekia.v5i3.772

Dietrich, A. (2018). Types of creativity. *Psychonomic Bulletin & Review, 26*(1), 1-12. https://doi.org/10.3758/s13423-018-1517-7

Farhan, F. I., & Ardimansyah, A. (2022). Modified project-based learning in geography: a better approach. *Foundasia*, *13*(2), 70-75. https://doi.org/10.21831/foundasia.v13i2.57924

Fauzi, F., Vitoria, L., Darnius, S., & Israwati, I. (2021). Developing students' creative thinking skills through problem solving approaches to geometry materials in grade 5 of private elementary school Banda Aceh. *Proceedings of AICS-Social Sciences*, *11,* 375-381.

Handayani, U. F., Sa'dijah, C., Sisworo, S., Sa'diyah, M., & Anwar, L. (2020). Mathematical creative thinking skill of middle-ability students in solving contextual problems. *AIP Conference Proceedings*, *2215*(1), 645. https://doi.org/10.1063/5.0000645

Hasani, A., Hendrayana, A., & Senjaya, A. (2017). Using project-based learning in writing an educational article: an experience report. *Universal Journal of Educational Research, 5*(6), 960-964. https://doi.org/10.13189/ujer.2017.050608

İbili, E., Çat, M., Resnyansky, D., Şahin, S., & Billinghurst, M. (2020). An assessment of geometry teaching supported with augmented reality teaching materials to enhance students' 3D geometry thinking skills. *International Journal of Mathematical Education in Science and Technology*, *51*(2), 224-246. https://doi.org/10.1080/0020739X.2019.1583382

Jaenudin, A., Sukestiyarno, Y. L., & Mariani, S. (2021). Analysis of students creative thinking in solving transformation geometry problems. *Turkish Online Journal of Qualitative Inquiry, 12*(5), 244.

Kartikasari, I. A., & Usodo, B. (2020). Analysis of mathematical creative thinking abilities in primary schools. In A. G. Abdullah, I. Hamidah, A. A. Abdullah, & D. Darhim (Eds.), *Proceedings of the 3rd International Conference on Learning Innovation and Quality Education (ICLIQE 2019)* (pp. 742–748). Atlantis Press. https://doi.org/10.2991/assehr.k.200129.093

Khafah, F., Suprapto, P., & Nuryadin, E. (2023). The effect of project-based learning model on students' critical and creative thinking skills in the ecosystem concept. *Jurnal Pendidikan Biologi Indonesia, 9*(3), 244-255. https://doi.org/10.22219/jpbi.v9i3.27461

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, *19*(3), 267-277. https://doi.org/10.1177/1365480216659733

Komara, E., Berliana, B., Firman, M., & Gunawan, U. (2023). Implementation of project-based learning model to improve students' critical thinking skills. *Economic Education Analysis Journal, 12*(3), 192-198. https://doi.org/10.15294/eeaj.v12i3.75919

Kulamikhina, I., Abrosimova, E., Esmurzaeva, Z., Zakotnova, P., & Galkina, V. (2022). Technological aspect of terminological training of professional workers. *Journal of Higher Education Theory and Practice, 22*(7), 52-67. https://doi.org/10.33423/jhetp.v22i7.5267

López Martínez, O., Lorca Garrido, A. J., & de Vicente-Yagüe Jara, M. I. (2024). Indicators of verbal creative thinking: results of a Delphi panel. *Frontiers in Psychology*, *15,* 1397861. https://doi.org/10.3389/fpsyg.2024.1397861

Munakata, M., Vaidya, A., Monahan, C., & Krupa, E. (2021). Promoting creativity in general education mathematics courses. *Primus, 31*(1), 37-55. https://doi.org/10.1080/10511970.2019.1629515

Olu, O. S. (2020). The volume of a rectangular frustum: an alternative method. *Abacus (Mathematics Science Series)*, *47*(1), 61-68.

Özdemir, E. (2006). *An investigation on the effects of project-based learning on students' achievement in and attitude towards geometry* (Publication no. 181014) [Master's thesis, Middle East Technical University]. Council of Higher Education Thesis Center.

Prananda, M. R., Proboningrum, D. I., Pratama, E. R., & Laksono, P. (2020). Improving higher order thinking skills (HOTS) with Project Based Learning (PjBL) model assisted by Geogebra. *Journal of Physics:*

Conference Series, *1467*(1), 012027. http://doi.org/10.1088/1742-6596/1467/1/012027
Putri, R. I. I., & Aisyah, N. (2020). Learning integers with realistic mathematics education approach based on Islamic values. *Journal on Mathematics Education,* *11*(3), 363-384. http://doi.org/10.22342/jme.11.3.11721.363-384
Sari, D. S., & Wulanda, M. N. (2019). Pengembangan lembar kerja mahasiswa berbasis proyek dalam meningkatkan kemampuan berfikir kreatif mahasiswa [Development of project-based student worksheets to improve students' creative thinking abilities]. *Natural: Jurnal Ilmiah Pendidikan IPA*, *6*(1), 20-33. https://doi.org/10.30738/natural.v6i1.4073
Schoenfeld, A. H., & Sloane, A. H. (2016). *Mathematical thinking and problem solving*. Routledge. https://doi.org/10.4324/9781315044613
Shchetynska, A. (2020). *The Effectiveness of Project-Based Learning on Student Geometry Achievement and Creativity Within the Requirements of 21st-Century Learning* (Publication No. 28024595) [Doctoral dissertation, Gardner-Webb University]. ProQuest Dissertations and Theses Global.
Shively, K., Stith, K. M., & Rubenstein, L. D. (2018). Measuring what matters: Assessing creativity, critical thinking, and the design process. *Gifted Child Today*, *41*(3), 149-158. https://doi.org/10.1177/1076217518768361
Sriraman, B. (2008). The characteristics of mathematical creativity. *ZDM, 41*(1-2), 13-27. https://doi.org/10.1007/s11858-008-0114-z
Suherman, S., & Vidákovich, T. (2022). Assessment of mathematical creative thinking: A systematic review. *Thinking Skills and Creativity*, *44*, 101019. https://doi.org/10.1016/j.tsc.2022.101019
Supriadi, N., Syazali, M., Lestari, B., Dewi, E., Utami, L., Mardani, L., & Putra, F. (2019). The utilization of project based learning and guided discovery learning: effective methods to improve students' mathematics ability. *Al-Ta Lim Journal, 25*(3), 261-271. https://doi.org/10.15548/jt.v25i3.487
Syahrin, A., Suwignyo, H., & Priyatni, E. T. (2019). Creative thinking patterns in student's scientific works. *Eurasian Journal of Educational Research*, 19(81), 21-36. https://doi.org/10.14689/ejer.2019.81.2
Ubuz, B., & Aydınyer, Y. (2019). Project-based geometry learning: Knowledge and attitude of field-dependent/independent cognitive style students. *The Journal of Educational Research*, *112*(3), 285-300. https://doi.org/10.1080/00220671.2018.1502138
Vidákovich, T. (2021). STEM-E: Fostering mathematical creative thinking ability in the 21st Century. *Journal of Physics: Conference Series*, *1882*(1), 012164. https://doi.org/10.1088/1742-6596/1882/1/012164
Wang, Z., & Jia, K. (2019). Frustum convnet: Sliding frustums to aggregate local point-wise features for amodal 3d object detection. In X. Hu (Ed.), *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* (pp. 1742-1749). IEEE. https://doi.org/10.1109/IROS40897.2019.8968513
Widyaningsih, S. W., & Yusuf, I. (2020). Implementation of Project-Based Learning (PjBL) assisted by e-learning through lesson study activities to improve the quality of learning in physics learning planning courses. *International Journal of Higher Education*, *9*(1), 60-68. https://doi.org/10.5430/ijhe.v9n1p60
Yayuk, E., & As' ari, A. R. (2020). Primary school students' creative thinking skills in mathematics problem solving. *European Journal of Educational Research*, *9*(3), 1281-1295. https://doi.org/10.12973/eu-jer.9.3.1281

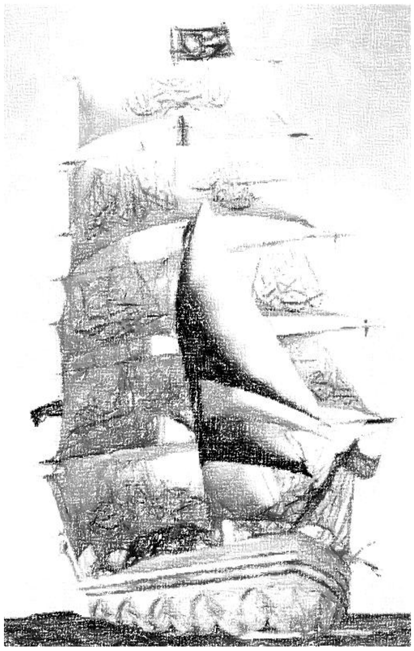
Appendix 1. Creative Thinking Ability Test Instrument based on Modified Project-Based Learning Model "Prophet Noah's Ship"

Course	: Basic Geometry	Semester	: 2(Even Semester)
Researchers	: 1. Eline Yanty Putri Nasution, M. Pd 2. Putri Yulia, M.Pd	Academic Year	: 2022/2023

Geometry is a branch of mathematics that deals with spatial components. In fact, geometry has existed since the time of the Prophet Noah (Nuh AS). The Qur'an mentions the story of the great flood and how Prophet Noah received a divine command from Allah SWT to build a ship to save himself and the believers from the disaster that would destroy the disbelievers.

There are various historical interpretations regarding the size of the ship. Some say it was 80 *dziro'* long and 50 *dziro'* wide. Others argue that it was 300 *dziro'* long and 50 *dziro'* wide. Assuming one *dziro'*t equals 0.5 meters, we can calculate the area and volume of the ship. Some historians agree that the height was 30 *dziro'*.

But, Hasan Al-Bashri suggested the ship was 1200 cubits long, 600 cubits wide, and 300 cubits high. Other historians believe it was 300 cubits long, 50 cubits wide, and 30 cubits high.



The image is for illustration purposes only.

Possibilities:

Option	Length	Width	Height
1	80 *dziro'*	30 *dziro'*	50 *dziro'*
2	300 *dziro'*	30 *dziro'*	50 *dziro'*
3	1200 cubits	300 cubits	600 cubits
4	300 cubits	30 cubits	50 cubits

Note: 1 dziro' = 0,5 meters
1 cubits = 0,45 meters

Questions:

a. Describe the shape of Prophet Noah's Ship geometrically
b. Calculate the surface area of the Ship
c. Calculate the volume of the Ship

Appendix 1 continued

Scoring Rubric for Students' Creative Thinking Ability

No	*Indicator*	*Score*
1	Fluency	
	Do not answer or use irrelevant ideas for solving the given problem	0
	Gives relevant ideas to solve the given problem but not fluently.	1
	Gives relevant ideas to solve the given problem fluently, but not completely	2
	Gives relevant ideas to solve the given problem fluently but incorrectly	3
	Gives relevant ideas to solve the given problem fluently and correctly	4
2	Flexibility	
	Does not answer or provide one or more answers, but all are incorrect.	0
	Provides only one method of solution, and a miscalculation in the process results in an incorrect answer.	1
	Provides only one solution method, and the calculation process leads to the correct result.	2
	Provides more than one method (varied), but some of the results are incorrect due to miscalculations in the process	3
	Provides more than one method (varied), and the calculation process leads to the correct result.	4
3	Originality	
	Not providing an answer or providing an incorrect answer	0
	Providing an answer in their own way but it cannot be understood	1
	Providing an answer in their own way and the calculation process is directed, but it is incomplete	2
	Providing an answer in their own way with a correct reason but not showing something unique	3
	Providing an answer in their own way with a correct reason and showing something unique	4
4	Elaboration	
	Not providing an answer or providing an incorrect answer	0
	There is an error in expanding the situation without providing details	1
	There is an error in expanding the situation without providing insufficient details	2
	Expanding the situation correctly but with insufficient details.	3
	Expanding the situation correctly and providing detailed elaboration	4

Appendix 1 continued

Creative Thinking Ability Grid

Learning Outcomes			*Creative Thinking Ability Indicators*	*Problem*
Learning Outcomes of the Study Program	S9	Demonstrating responsibility for work in their area of expertise independently.	Originality	Geometry is a branch of mathematics that deals with spatial components. In fact, geometry has existed since the time of the Prophet Noah (Nuh AS). The Qur'an mentions the story of the great flood and how Prophet Noah received a divine command from Allah SWT to build a ship to save himself and the believers from the disaster that would destroy the disbelievers. There are various historical interpretations regarding the size of the ship. Some say it was 80 *dziro'* long and 50 *dziro'* wide. Others argue that it was 300 *dziro'* long and 50 *dziro'* wide. Assuming one *dziro'* equals 0.5 meters, we can calculate the area and volume of the ship. Some historians agree that the height was 30 *dziro'*. But, Hasan Al-Bashri suggested the ship was 1200 cubits long, 600 cubits wide, and 300 cubits high. Other historians believe it was 300 cubits long, 50 cubits wide, and 30 cubits high. **Questions:** a. Describe the shape of Prophet Noah's Ship geometrically b. Calculate the surface area of the Ship c. Calculate the volume of the Ship
	P4	Mastering the knowledge and steps in developing critical, logical, creative, innovative, and systematic thinking, as well as having intellectual curiosity to solve problems at both individual and group levels in academic and non-academic communities.	Flexibility	
	KU1	Being able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology, while considering and applying humanitarian values relevant to their area of expertise.	Elaboration	
	KU2	Being able to demonstrate independent, high-quality, and measurable performance.	Originality	
	KK4	Being able to facilitate the development of mathematical knowledge potential to actualize mathematical abilities and skills in real-life situations in schools/madrasahs and society.	Elaboration	
Course Learning Outcomes		Able to analyze the concepts of plane figures and solid figures and use them to solve related problems. (S9, P4, KU1, KU2, KK3, KK4);	Fluency	
Sub-Course Learning Outcomes		Being able to analyze the properties and measurements of flat shapes and solid shapes [C4, P2, A5]	Fluency	
		Being able to solve related problems. [C4, P2, A5]	Flexibility	

Note: S = *Sikap* (Attitude); KU = *Keterampilan Umum* (General Skills); S, P, KU, and KK were taken from the Syllabus; P = *Pengetahuan* (Knowledge); KK = *Keterampilan Khusus* (Specific Skills)