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COLLABORATIVE PROBLEM POSING USING GEOGEBRA: A STUDY ON HIGH MATH ABILITY JUNIOR HIGH SCHOOL STUDENTS

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ABSTRAK

Pengajuan masalah merupakan hal penting dalam belajar matematika karena meningkatkan kemampuan penalaran, berpikir kritis, dan berpikir kreatif. Namun, masih banyak siswa merasa kesulitan dalam pengajuan masalah. Melalui pengajuan masalah kolaboratif siswa dapat saling bertukar pemahaman. Penggunaan GeoGebra dalam pengajuan masalah dapat membantu siswa berperan aktif memunculkan ide-ide untuk mengkonstruksi masalah baru melalui fitur-fiturnya. Penelitian ini merupakan penelitian kualitatif yang bertujuan untuk mendeskripsikan pengajuan masalah semi terstruktur kolaboratif siswa SMP berbantuan GeoGebra pada kelompok tinggi. Penelitian ini dilakukan di salah satu SMP di Surabaya kelas IX semester ganjil tahun ajaran 2024/2025 pada rentang usia 14-15 tahun. Data penelitian dikumpulkan melalui Tes Pengajuan Masalah dan Focus Group Discussion. Subjek penelitian merupakan kelompok dengan kemampuan matematika tinggi yang terdiri atas dua siswa. Hasil penelitian menunjukkan kedua anggota dalam kelompok saling berkontribusi untuk masalah baru yang dibuat. Pada basis pengetahuan, mereka mengidentifikasi fakta, konsep, dan prosedur matematika. Pada heuristik dan skema, mereka mengeksplorasi GeoGebra untuk memunculkan ide-ide. Pada dinamika dan interaksi kelompok, mereka melakukan proses normalitas, konformitas, dan inovasi. Pada pertimbangan individu atas kesesuaian, kedua anggota saling berpendapat bahwa tiap individu terampil dalam mengajukan masalah dan masalah yang mereka buat dapat diterima anggota kelompok. Siswa tidak memiliki masalah selama berdiskusi dan mengungkapkan pendapat dikarenakan kesetaraan kemampuan matematika. Oleh karena itu, perlu penelitian lebih lanjut terkait apakah pengajuan masalah kolaboratif pada kelompok heterogen berbantuan GeoGebra juga berjalan demikian.
Kata Kunci: *Kolaboratif, GeoGebra, Pengajuan Masalah*

ABSTRACT

Problem posing is important in learning mathematics because it improves reasoning, critical thinking, and creative thinking skills. However, many students still find it difficult to pose problems. Through collaborative problem posing, students can exchange their understanding. The use of GeoGebra in problem posing can help students play an active role in generating ideas to construct new problems through its features. This research is a qualitative research that aims to describe the collaborative semi-structured problem posing of junior high school students assisted by GeoGebra in high groups. This research was conducted in one of the junior high schools in Surabaya class IX odd semester of the 2024/2025 school year in the age range of 14-15 years. The research data were collected through Problem Posing Test and Focus Group Discussion. The research subjects were a group with high mathematical ability consisting of two students. The results showed both members in the group contributed to each other for the new problem created. On knowledge base, they identified mathematical facts, concepts, and

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procedures. On heuristics and schema, they explored GeoGebra to come up with ideas. On group dynamics and interactions, they performed processes of normality, conformity, and innovation. In individual consideration of aptness, both members argued that each individual was skilled in proposing problems and the problems they created were acceptable to group members. Student had no problems during discussion and expressing their opinions due to their equal mathematical ability. Therefore, further research is needed on whether collaborative problem posing using GeoGebra heterogeneous groups also works.
Keywords: *Collaborative, GeoGebra, Problem Posing*

INTRODUCTION

The activity of *problem posing* is a fundamental task that plays a vital role in contemporary mathematics education. As emphasized by global mathematics education standards, the experience of recognizing, formulating, and creating self-generated problems is the core essence of doing mathematics itself. This *problem posing* activity is far more than just creating questions; it is a powerful tool for honing students' higher-order thinking skills. This is because, in the process, students are required to think critically about whether the problems they propose possess logical solutions or cannot be solved at all. Furthermore, students are trained to deeply analyze whether the issues raised have relevant connections to the existing material, whether the narrative of the question can be understood by others, and how the proposed solution procedures are structured. This complex cognitive process proves that *problem posing* can train students to understand mathematical concepts much more deeply than simply working on routine problems, fostering a more robust intellectual engagement with the subject matter (Burgos et al., 2024; Kwon & Capraro, 2021).

Definitionally, a problem in mathematics is understood as a situation that demands a resolution, yet the method or strategy to solve it cannot be immediately found or known. In this context, *problem posing* emerges as an academic task that requires students to design, compile, or develop new problems based on specific prompts. This activity can be carried out in various phases of the learning process, whether before, during, or after students complete standard problems provided by the teacher. Other definitions also describe *problem posing* as the activity of identifying, creating, and proposing various types of mathematical problems while simultaneously knowing how to solve them. Therefore, within the framework of this study, *problem posing* is specifically defined as a cognitive task asking students to creatively construct new problems based on given initial situations or information. This shifts the students' position from mere consumers of pre-made questions to active producers of knowledge who construct their own mathematical understanding through creative inquiry (Cai & Rott, 2023; Moore-Russo et al., 2020; Papadopoulos et al., 2021).

The initial situations or conditions provided in *problem posing* activities are usually classified into three main categories: free situations, *semi-structured* situations, and structured situations. Among these three types, *semi-structured* situations often present a particular challenge for students. Field realities show that many students still experience significant difficulties when asked to pose problems in these *semi-structured* situations. The difficulties faced by students usually include an inability to formulate questions that have viable solutions—meaning the proposed questions are often unsolvable. Additionally, students often perceive the information provided in such situations as insufficient or ambiguous, and they struggle to propose problems with an adequate level of creativity or complexity. This gap between the expectation that students can think creatively and the reality that they struggle in

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open-ended situations is the focus of attention; thus, this research specifically uses *semi-structured* situations to delve deeper into student potential and identify the specific cognitive barriers they encounter (Li et al., 2025; Saroyan, 2022; Supandi et al., 2021).

Various individual difficulties experienced by students in posing problems can be overcome through cooperative learning strategies, specifically through *collaborative problem posing*. This approach is based on the belief that the results of problem-posing conducted collaboratively will be much more substantial, both in terms of information completeness and solvability, compared to problems posed individually. This occurs due to the process of intensive discussion, negotiation of meaning, and diverse thought contributions from each group member. Within the dynamics of *collaborative problem posing*, several crucial aspects interact with each other, including the shared knowledge base possessed by the group, the thinking schemes or heuristics used, the dynamics and interactions between group members, and individual considerations regarding problem suitability. Through collaboration, students can correct and complement each other's ideas, so that cognitive barriers that might arise when working alone can be dismantled together to produce more valid and high-quality mathematical problem constructions that reflect a collective intelligence (Ceballos et al., 2025; Hansen, 2021).

In today's digital era, the integration of technology has become an inevitable supporting element in mathematics learning. Technology-assisted *problem posing*, such as the use of *GeoGebra* software, is proven to increase students' active roles in constructing the proposed problems and their solutions. The use of these tools aims to simultaneously develop students' problem-solving skills and creativity. Advanced features found in *GeoGebra*, such as points, lines, polygons, and arcs, are very helpful for students in constructing precise and accurate geometric objects. Additionally, the presence of sliders in *GeoGebra* also helps students build a dynamic understanding of changes in the properties of a given mathematical object (Rabi et al., 2021; Yerizon et al., 2021, 2022). With the help of this dynamic visualization, students do not just imagine abstract shapes in their minds but can experiment directly by manipulating objects, which ultimately triggers new ideas for posing more varied and challenging problems. This technological affordance allows for a more exploratory and experimental approach to learning that was previously difficult to achieve manually.

A review of several previous studies reinforces the argument regarding the importance of collaboration and technology. Existing studies show that group collaboration has a positive effect on students' interest in posing problems, making students more open and courageous in trying new things to find innovative solutions. Meanwhile, other research indicates that the use of geometry tools, animations, and graphic calculator features in *GeoGebra* for problem-solving can improve students' skills in posing problems, especially regarding the aspect of solvability and finding the right solutions. However, most of these studies tend to run independently; some focus purely on the social collaboration aspect, while others focus on the technical aspects of technology use. It is still rare to find research that comprehensively combines these two pillars of strength to see their impact on groups of students with specific ability characteristics. This research gap suggests a need for a more integrated approach to understanding how social interaction and digital tools function together in the classroom.

The novelty or innovation of this research lies in the synthesis of these elements on a specific subject. It is known that *problem posing* can train problem-solving skills, critical thinking, and creative thinking. Groups of students with high mathematical abilities, often referred to as *high math groups*, generally have the ability to solve problems with appropriate

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procedures and possess a higher level of creative thinking compared to moderate or low groups. The use of technology and collaborative work is also known to enhance critical thinking across all levels. However, there has been no research that specifically links *collaborative problem posing* with a focus on technology utilization in groups of high-ability students within *semi-structured* situations. Therefore, this research exists to fill that gap by describing the profile of *collaborative semi-structured problem posing* in junior high school students using the help of *GeoGebra*, focusing on high-ability students to see the maximum potential that can be generated when these advanced learners are provided with sophisticated tools and a collaborative environment.

METHODS

This research uses a qualitative approach with a case study method. The case study method is a type of research that examines a specific phenomenon or case with the aim of collecting detailed and in-depth information within a certain period of time. The subjects of this study were a high group consisting of two students in grade IX of junior high school in the age range of 14-15 years. This study began by giving the Problem Posing Test to the subjects with a duration of 40 minutes which took place simultaneously with the Focus Group Discussion. Then the researcher analyzed the indicators of collaborative problem posing using GeoGebra based on the indicator rubric presented in Table 1.

Table 1. Indicator Codes of Collaborative Problem Posing using GeoGebra of Junior High School Students

Collaborative Problem Posing Indicator	Collaborative Problem Posing using GeoGebra Sub Indicators	Code
Knowledge Base	Write/state the known information from the given situation	BP1
	Identify mathematical facts, concepts, and procedures to structure the problem to be posed	BP2
.	Determine math content topics that can be turned into new problems	BP3
Heuristics and Schema	Choosing a specific strategy to pose a problem	HS1
	Discuss to develop possible problem-solving strategies that can be applied	HS2
	Discuss to develop possible outcomes of the problem to be posed	HS3
	Construct the proposed problem involving GeoGebra exploration	HS4
Group Dynamics and Interaction	Conduct discussions to form a common framework of thinking related to the problem posed (normality)	DI1
	Evaluate deviant members to return to the group reference (conformity)	DI2
	Negotiate to resolve conflicts when responses between members in the group differ (innovation)	DI3

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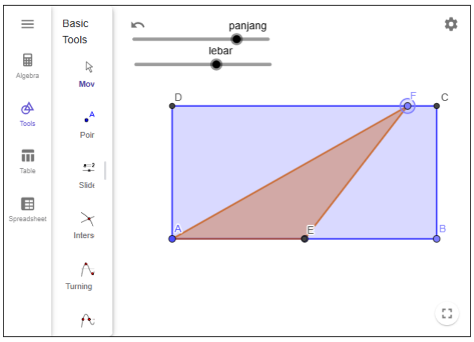
Individual Consideration of Aptness	Assess whether or not the problem has been addressed as expected.	PI1
	Making assumptions about how individuals' problem posing skills work	PI2
	Making conjectures related to the problem that has been proposed can be solved by others or not.	PI3
	Making conjectures related to the problems proposed by each individual can be accepted by group members or not.	PI4

In this study, the research instruments used consisted of Problem Posing Tests and Focus Group Discussion Guidelines that had been consulted with the research team together with teachers from the schools, Problem Posing Test using GeoGebra is shown in Figure 1 below.

INFORMATION
ABCD is a rectangle with point E as the midpoint of AB and point F located on CD.

EXPLORATION GUIDE
Try moving the length, width and point F sliders!
Then carefully observe what changes happen to the applet!

Please explore the GeoGebra applet below!



QUESTIONS
1. With your group, please discuss and choose the best 3 questions! (The questions can be derived from previous questions or you can come up with new questions from a combination of existing ideas!)
2. Write down the answer to each problem here!
3. Please upload the solution method you used to find the answer!

Figure 1. Problem Posing Test

The data analysis technique used is the Miles-Huberman model. The initial stage of data analysis began with data collection using problem posing test and FGD. Then the FGD data was reduced to sort out discussions that were relevant to collaborative problem posing using GeoGebra. Presentation of data from the problem posing test results is presented in the form of screen shots of GeoGebra pages and FGD results are presented in the form of FGD transcripts.

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The high group in this study consisted of two students with the same gender and ability (males with high mathematics ability) coded with KTA and KTB. The researcher as the main instrument of qualitative research was also involved during the FGD process which was coded (P). In order to avoid errors or subjectivity of researchers in assessing student work and to ensure the validity of qualitative research data, the validity of data in this study was assessed using member check techniques. The purpose of the member check technique is to find out how far the data obtained by the researcher is in accordance with what is given by the data giver (Wirdania et al., 2024). Furthermore, the conclusion was drawn by describing the collaborative semi-structured problem posing of junior high school students assisted by GeoGebra in the high group.

RESULT AND DISCUSSION

Result

The results of high math ability group's collaborative semi-structured problem posing can be seen in Figure 2. below.

Answer

1. Diketahui AFE adalah segitiga sama kaki, tentukan rumus untuk mencari luas 1/2 dari AFE !

2. Bagaimana rumus untuk mencari luas daerah yang tidak diarsir?

3. Panjang dari persegi panjang ABCD adalah 30 cm dan lebar 20 cm. Cari lah keliling dari setengah persegi panjang !

Translate :

1. Suppose AFE is an isosceles triangle. Find the formula to find the area of 1/2 of AFE!
2. What is the formula to find the area of the unshaded area?
3. The length of square ABCD is 30 cm and the width is 20 cm. Find the perimeter of half of the rectangle.

Figure 2. Problem Posing Result

The three problems posed were categorized as solvable and related with the flat shapes in the semi-structured situation given. Two of them are math problems without size and one math problem with size. The following is an explanation of each indicator of collaborative problem posing using GeoGebra by the high group.

A. Knowledge Base

https://doi.org/10.51878/science.v6i1.8928

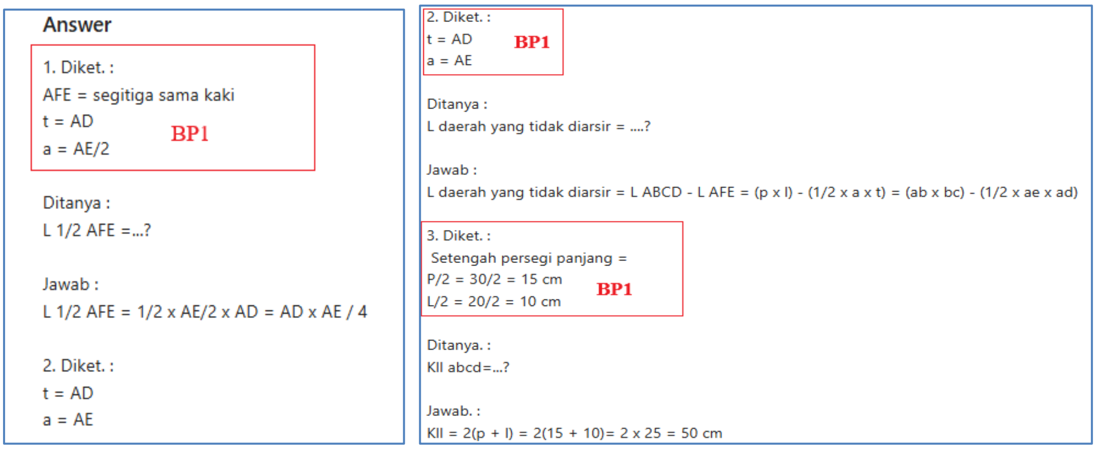

Figure 3. Answers and Solutions in GeoGebra

(1) KTA : *"These are all of unknown size so we are generalizing."*
(2) KTB : *"The problem is that it's not a full triangle like point E to the end so it's a little difficult. I want to find the area of the rectangle minus the area of the triangle but I'm still confused."*
(3) KTA : *"Yes, we already know the length and width, so we just need to find it. The length of D to F with the length of D to A can be made phytagoras to find AF, right they are triangles. Later the DF can be generalized."*
(4) KTB : *"This is the phytagorean slope, right? Does it mean subtraction or addition?"*
(5) KTA : *"If the slope is added, like . So later to find the c is rooted first."*
(6) KTB : *"But we are an isosceles triangle not a right-angled triangle."*

FGD Transcript of Knowledge Base

In Figure 3, they wrote that the height of triangle AFE is equal to the width of square ABCD. After moving the length and width sliders on GeoGebra, they stated that flat shapes have no size so that the rectangle was initialized with length 30 cm and width 20 cm (1). After moving the slider point F to the middle of side AE, they identified the triangle on GeoGebra as an isosceles triangle (Figure 2.). There was a time when they thought of the phytagoras theorem but they canceled it because they recalled that the triangle was labeled as an isosceles triangle, not a right triangle on line (6).

B. Heuristics and Schema

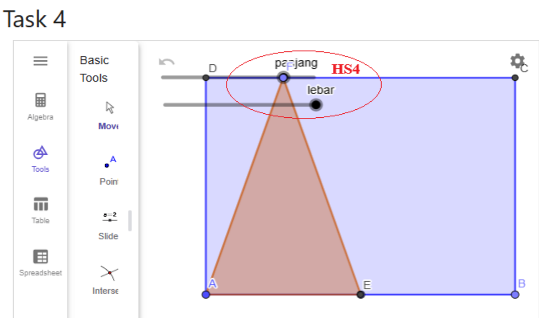

Figure 4. GeoGebra Exploration Result

(7) KTB : *"I tried the length of ABCD 30 cm. Is the perimeter or area better?"*

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(8) KTA : *"You can, it's up to you."*
(9) KTB : *"The triangle is three times the side, so find the side first."*
(10) KTA : *"It's hard to find, at least you have to know the size of the other side, it's the same side. I can only find the perimeter of the rectangle if the triangle is difficult."*
(11) KTB : *"What if we try to find the area? The area of half a triangle."*
(12) KTA : *"The length is this one and the width is this one, right? (explores GeoGebra by sliding the length and width sliders)."*

FGD Transcript of Heuristics and Schema

The problem that initially sought the area of the whole triangle became the area of half a triangle (11). Both members discussed to develop possible problem-solving strategies that could be applied (9 & 10). Exploration of GeoGebra by shifting the length and width sliders helped show that the shape was a rectangle and shifting the slider of point F in triangle AFE helped in finding the height of triangle AFE which is equal to the width of the ABCD rectangle and memorizing it as an isosceles triangle (12 & Figure 4.).

C. Group Dynamics and Interaction

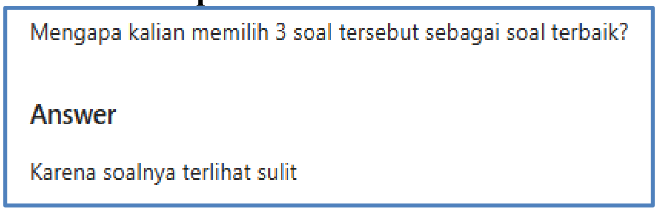
(13) KTB : *"I have an idea. I'll find half the length of this rectangle. From rectangle to square, just divide it by two. (After doing the experiment/calculation) It turns out that this doesn't work. The perimeter of the square is four times the side but this is a different side."*
(14) KTA : *"Yes, rectangle and square are different. Rectangles have different sides."*
(15) KTB : *"How about turning it into a half rectangle? It's more unique, isn't it? Find the perimeter of half a rectangle, is that okay?"*
(16) KTA : *"We can, as long as we know the sides."*
(17) KTB : *"At first I wanted to find the length of the side of the equilateral triangle but it turned out to be phytagoras. What if I add it to find the perimeter and area of the equilateral triangle? (After doing the calculations he found it difficult). Not so, just go back to the original problem."*

FGD Transcript of Group Dynamics and Interaction

When proposing problem number 3, KTB had the idea to make a problem related to the perimeter of half a square and KTA agreed (13&15). KTB suggested a problem related to a square. However, after careful calculation, KTA confirmed that the ABCD rectangle with a length of 30 cm and a width of 20 cm if divided into two parts would not be a square (14). There was a discussion to create a problem related to right triangles as a result of moving the point F slider in GeoGebra to combine with the half-square problem. However, due to difficulties, the two decided to return to the original idea of the area of half a square without involving right triangles (17).

https://doi.org/10.51878/science.v6i1.8928

D. Individual Consederation of Aptness



Translate: why did you choose these 3 questions as the best questions?
Answer: because the questions look difficult

Figure 5. Opinions related to the questions asked in GeoGebra

(18) KTB : "My question is still easy about the area of a right triangle. What if you change it to half a rectangle? It will be more unique. Find the perimeter of half a rectangle, is that okay?"
(19) KTA : "We can, as long as we know the sides. Our problem is unique."
(20) P : "Have you ever been in a group together in math class before?"
(21) KTB : "Already brother, often in the same group with him in math, science, and other lessons. He's smart, I like being in a group with him."
(22) KTA : "Yes, he's smart too."
(23) P : "Didn't you want to do a problem about rectangles and triangles?"
(24) KTB : "No. it's too difficult."

FGD Transcript of Individual Consideration of Aptness

KTB thought that the problems they created were as expected and unique because they were different from the problems they usually encountered. Each individual was satisfied with their abilities and praised each other's abilities (18&19). When asked by the researcher, both of them had often been in a math group or other subjects so their discussions were smooth (21&22). They agreed that problems related to triangles and rectangles combined would be difficult to solve so they focused on one particular shape in each problem they had submitted (24 & Figure 5.).

Discussion

Analysis of the research data indicates that high-ability mathematics students are able to respond to *semi-structured* situations very effectively through high-quality *problem posing*. This finding confirms that students in this category possess the cognitive capacity required to transfer previously learned conceptual understandings into new contexts. Based on the group's work, the students successfully formulated three *solvable* mathematical problems, two of which were problems without specific dimensions and one that involved numerical measurements. This capability aligns with previous literature stating that high-ability student groups tend to utilize their existing knowledge structures to identify information gaps and formulate questions relevant to the topic. Their success in solving all the problems they posed themselves is also a strong indicator that their understanding is not merely at the surface level but encompasses deep procedural and conceptual mastery, allowing them to predict solutions even before the problems are fully formulated (Toifur et al., 2025; Zhang et al., 2023).

In the aspect of the *knowledge base*, this group demonstrated superior ability in translating visual situations into precise mathematical language. They were able to identify geometric properties from images presented in the software, such as distinguishing between

https://doi.org/10.51878/science.v6i1.8928

isosceles and right-angled triangles, and understanding the implications of the absence of measurement labels on those shapes. The ability to state visual ideas into verbal and symbolic representations is a hallmark of students with high mathematical ability, enabling them to process abstract information into more concrete problem components. Furthermore, the collaborative process of identifying facts and concepts showed that they were able to break down complex information into smaller, more manageable parts. This allowed them to construct several variations of problems simultaneously from a single given situation, proving that a strong knowledge base serves as the primary foundation for flexibility in thinking when facing open-ended *problem posing* tasks (Bobrowicz & Thibaut, 2023; Scheibling-Sève et al., 2022; Zhang et al., 2023).

Exploration using *GeoGebra* technology proved to play a crucial role in shaping students' heuristics and thinking schemes before they proposed their final problems. The activity of moving sliders in the application provided instant visual feedback that helped students understand the dynamic nature of geometric shapes, such as changes in area or form resulting from the manipulation of certain variables. This finding supports the view that the digital manipulation of mathematical objects can stimulate the emergence of new ideas that might not occur in a conventional paper-and-pencil environment. Through this exploration, students' understanding evolved from a simple concept of rectangle area to more complex connections involving the Pythagorean theorem, even though they eventually adjusted their strategy based on the level of difficulty (Lehmann, 2022; Singleton & Ellis, 2020; Yunianto et al., 2024). The use of this technological tool functions not only as a visualization medium but also as a cognitive tool that helps students connect disparate mathematical concepts, facilitating the construction of richer and more integrated mental schemes before they determine which problem is most feasible to propose (Johnson et al., 2020; Tiwari et al., 2021; Yerushalmy et al., 2022; Yurniwati & Soleh, 2020).

The problem-solving strategies implemented by this group were heavily characterized by collaboration, where they utilized a *goal manipulation* approach to modify problems. This process involved intensive discussion to merge individual ideas into a single, more comprehensive group problem. This synergy illustrates that combining ideas sourced from individual knowledge is highly beneficial in developing a mature solution plan and anticipating potential obstacles. When they encountered a dead end, such as difficulty in complexly combining triangle and rectangle concepts, they were able to negotiate a return to a more realistic strategy without reducing the quality of the problem. The discussion dynamics that took place prove that *collaborative problem posing* provides space for the exchange of perspectives, where each group member complements the others' shortcomings (Baumanns & Rott, 2021; Halttunen et al., 2023; Xu et al., 2023). This strategy allowed them to evaluate the feasibility of solutions from various angles before reaching a consensus, making the validity of their final product more robust than if it were completed independently (Nicholas & Oak, 2020; Viola & Gambini, 2022).

The group dynamics and social interactions occurring during the research process reflected a harmonious progression of normalization, conformity, and innovation. This high-ability group successfully established a uniform framework of thinking regarding the standards of the problems they wished to propose, thereby minimizing unproductive conflict. When one member deviated from the discussion path or proposed an overly complex idea, other members took an active role in evaluating and redirecting the group's focus toward the initial goal. This phenomenon indicates that collaboration within homogeneous groups tends to run smoothly

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due to role equality and fair contributions in task completion. Moreover, this collaborative atmosphere provided psychological safety and appreciation, which in turn increased their interest in mathematics and fostered an open attitude toward criticism. The ability to overcome previous failures through peer support became a key factor in maintaining their motivation and persistence throughout the *problem posing* process (Fairhurst et al., 2023; Savić et al., 2021; Zhao & Huang, 2025).

In the aspect of *individual consideration of aptness*, there was a high level of mutual trust among members regarding their respective competencies. The belief that their partners could produce "unique" and high-quality ideas became the main driver of group productivity. This mutual trust created a positive learning environment where students felt comfortable experimenting with new ideas without fear of judgment. They actively made conjectures regarding the difficulty level and feasibility of the proposed problems and valued each individual's contribution by accommodating those ideas into the combined problem construction. The feelings of happiness and security arising from this teamwork impacted not only affective but also cognitive aspects, as an effective cross-correction mechanism was in place. When one member made a conceptual or calculation error, other members promptly but politely provided corrections, ensuring that the group's final output was free from fundamental mistakes.

The validity of the analysis results was strengthened through a *member checking* process, where participants confirmed that the researcher's interpretations accurately reflected their experiences and thoughts during the learning process. This clarification is vital to ensure that research findings are unbiased and truly represent the students' perspectives. From the students' point of view, interactive features such as sliders in *GeoGebra* were acknowledged as being very helpful in exploring the relationships between abstract geometric elements and making them more tangible. The easy accessibility of the software, which can be operated via mobile phones, was also a significant added value in supporting learning flexibility. This indicates that the appropriate integration of technology, supported by solid collaboration strategies, can significantly enhance the quality of mathematics learning. The implications of these findings suggest that educators should more frequently facilitate problem-based learning with the help of dynamic technology to optimize the potential of high-ability students.

CONCLUSION

The results showed that three of the problems posed were categorized as solvable and appropriate to the semi-structured situation given. Two of the three problems, it appears that they are trying to maintain the initial condition of flat shapes without size. The role of GeoGebra is also very helpful for students to build concepts and come up with problem posing ideas. In the knowledge base, they identified mathematical facts, concepts, and procedures. In heuristics and schema, they explore GeoGebra to generate ideas. In group dynamics and interactions, they performed processes of normality, conformity, and innovation. In individual consideration of aptness, both members argued that each individual was skilled in proposing problems and the problems they created were acceptable to group members. This study used homogeneous math ability groups so that students felt comfortable discussing because they felt equal in terms of ability. However, facts in the field generally show that classroom learning uses heterogeneous groups. So for other researchers, they can try heterogeneous math groups so that students with high abilities can help in linking between concepts to students with low abilities.

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