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Metaphorical Thinking CoRelEx Spatial Students on Trigonometry Word Problem Solving Ability

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ABSTRACT

Problems in the reality of our lives require mathematics to be solved often using analogies in their solutions or also called metaphors. The condition of these problems requires students to develop abilities that emphasize the development of relationships between mathematical concepts and real phenomena in the surrounding environment. The method used in this study is descriptive qualitative with purposive sampling. The study was conducted at a public senior high school in Central Kalimantan during the 2024–2025 academic year, with 3 spatial students as subjects with Visual, Auditory and Kinesthetic learning styles in class X room H. This study aims to determine the metaphorical thinking process of students when solving trigonometry word problems. By using metaphorical thinking skills, students' mathematical understanding process becomes more meaningful because they can see, form, and map mathematical concepts to real concepts according to experience.

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INTRODUCTION

Mathematics is a science that has a major role in the development of the world of education which is related to abstract ideas and concepts that can contribute to the development of human thought (Faiziyah & Priyambodho, 2022). Mathematics is a science that has a major role in the development of the world of education which is related to abstract ideas and concepts that can contribute to the development of human thought (Faiziyah & Priyambodho, 2022). Students learn mathematics not only to count, but also to use trigonometry to build a framework for thinking, for the application of mathematical expressions to everyday problems. In reality, students' mathematical abilities in Indonesia are still low. Based on the survey results of the *Indonesia Mathematics and Science Teacher Education Project* (IMSTEP) and the *Japan International Cooperation Agency* (JICA), one of the causes of the low quality of students' understanding of mathematics is because they focus on procedural matters, such as using formulas without knowing the origin of the formula. Metaphorical thinking skills in the mathematics learning process can help students solve deeper trigonometry problems (Putri et al., 2022). Problems in the reality of our lives require mathematics to be solved, often using analogies in the solution or also called metaphors (Muttaqien, 2019).

National Council of Teachers of Mathematics (NCTM) establish five standard points of mathematical ability such as problem solving and representation that students should be able to have, especially at this time in mathematical thinking (NCTM, 2000). In this problem situation, students need to think about finding solutions, understanding concepts that emphasize students in developing

relationships between mathematical concepts and real phenomena in the surrounding environment (Pantaleon et al., 2024).

One of the mathematical thinking processes applied by students to develop relationships between mathematical concepts and phenomena in the surrounding environment is Metaphorical Thinking. Metaphorical Thinking is a thinking concept that emphasizes the relationship between mathematics and real phenomena. Metaphorical Thinking in mathematics is used to clarify how thoughts are related to mathematical activities, starting with mathematical modeling of a situation (Muthmainnah et al., 2021). Students will find it easier to understand a mathematical concept because the existing phenomena are in accordance with mathematical concepts and are often found in everyday life. Students can explain that the analogy process is a way of thinking that uses metaphors, which connect students' mathematical knowledge with real world phenomena around them (Relawati & Lukito, 2020).

This thinking process is called metaphorical thinking, which can be interpreted as a mental activity using metaphors that are appropriate to the situation being faced to understand a concept. This confirms that metaphors connect abstract ideas with concrete images, thus evoking experiential relationships (Gradini et al., 2022). Metaphorical thinking is a thinking process to understand abstract concepts into concrete things by analogizing something abstract with something concrete (Fianingrum et al., 2023a).

Metaphorical Thinking CoRelEx is very relevant to the spatial style of students because it is seen as a strategy in helping students understand mathematical material, especially trigonometry (Ernaningsih, 2020). Metaphorical thinking supports embodied knowledge and is not just a means of communication or visualization. Thus, in metaphorical thinking, abstract concepts will be transformed into real objects in everyday life. To determine success in learning mathematics, students can use metaphorical thinking that is closely related to metaphors that can conceptualize abstract concepts into more concrete and more familiar concepts (Makrufah & Fiangga, 2021).

According to the NCTM standards, the curriculum should emphasize active student involvement in constructing and applying mathematical ideas, problem solving as both a means and an end of instruction, and using effective questioning techniques that encourage student interaction. However, many parents are concerned that these changes will reduce the amount of time teachers can spend teaching basic Trigonometry skills (Reed, 1999). In metaphorical thinking, not all individuals can think metaphorically to the maximum. This is influenced by one of the factors, one of which is spatial intelligence with visual and auditory styles, which is related to students' learning styles.

Kurniati et al.(2021) states that a person's thinking process is influenced by the characteristics possessed by each individual. Based on this, the researcher suspects that metaphorical thinking is influenced by spatial intelligence and also learning style. Spatial intelligence is the ability to produce, store, retrieve and represent problems in the form of well-structured illustrations or images that are very relevant to the surrounding life (Polya, 1973).

Learning style is a student's daily habit in processing the absorption of information, experience, and treating the experience they have so that it can be used as a basis that is inherent in the student. In general, learning styles are divided into three large groups, namely visual learning styles, auditory learning styles, and kinesthetic learning styles. Visual learning style is a learning style that emphasizes more on how to see, observe, look, and the like. The strength of this learning style lies in the sense of sight (eyes).

The characteristics of the mathematics learning style of visual people include: being orderly in studying mathematics, being thorough, being able to remember visual associations well in learning mathematics, through writing on the board, graphs, and pictures, preferring to read.

The characteristics of the mathematics learning style of auditory people include: being easily distracted by noise, auditory people learn by listening, therefore they usually need an atmosphere away from noise to learn mathematics well, being able to repeat what the mathematics teacher explained verbally, and liking to discuss.

The characteristics of the kinesthetic type of mathematics learning style include: learning through manipulation and practice or practice questions. Therefore, this study also aims to explore the metaphorical thinking process of Phase E students in solving mathematics problems based on learning styles (Jagom et al., 2021).

The main target of learning mathematics is to solve problems or problem solving. Without this skill, the benefits of mathematical ideas, knowledge and skills will be very limited (Latumeten et al.,

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2021). Kemdikbud(2023) states that there are five standards of mathematical abilities that students must have in order to realize the goals of learning mathematics in Indonesia, namely critical thinking and problem solving skills, creative thinking skills, communication and collaboration.

Metaphorical Thinking is a mental activity and thinking process that uses metaphors to understand a concept and solve problems in the learning process. This approach is relevant in the mathematics learning process because the concept of thinking emphasizes the relationship between mathematics and real phenomena around it (Sundary et al., 2020). Its application is by connecting mathematical concepts with concepts known to students, expressing the form of mathematical concepts in easy-to-understand language to indicate students' understanding of the concepts applied (Hibatullah et al., 2020). According Pantaleon et al., (2024) and Gradini et al., (2022) the following is a further explanation of the Metaphorical Thinking CoRelEx process:

Table 1. *Metaphorical Thinking CoRelEx Process*

Process	Indicator
Connect	Connecting by comparing two or more things/ideas to be learned with everyday experiences that has the aim of understanding something.
Relate	Connecting different ideas with knowledge that is more familiar to students. Students can connect different ideas to things they already know. This can start by observing the similarities between the ideas. For example, Does the idea also have a solution or discovery?
Explore	Making Models and describe what two ideas have in common. Students create something and create new understanding based on the connection and discovery stages. such as creating their own questions according to their understanding and based on the previous stage. In this case, abstract concepts are connected and understood through the metaphor process. The findings found through metaphors are redefined according to the material being studied.
Experience	Apply the results obtained on problems faced and applying products or results to other problems or contexts. So, it can be said that in metaphorical thinking, abstract mathematical material or ideas are transferred and connected to concrete material or ideas (contextual problems), then a relationship is built between the two by selecting and organizing the characteristics of contextual problems that are appropriate to explain abstract mathematical concepts.

Metaphorical Thinking CoRelEx is the basis for understanding mathematical ideas. Students are asked to understand a real contextual problem and prepare a solution plan (Hidayah & Prayitno, 2023). Students will find it easier to understand a mathematical concept because the phenomenon is a mathematical concept and is often found in everyday life and can illustrate it in the form of images, more precisely, their spatial abilities (Andayani et al., 2024). Then they can explain that the CoRelEx process is a way of thinking that uses metaphors, namely connecting students' mathematical knowledge with real-world phenomena around them. To find out success in learning mathematics, students can use metaphorical thinking which is closely related to metaphors, namely being able to conceptualize abstract concepts into concrete and more familiar concepts (Sihaloho & Saragih, 2024).

Word Problems play an important role especially since most life situations are described in words. Word Problems are one of the few domains of school mathematics that require situations described in words and the transformation of mathematical solutions back into the problem context (Radiusman & Simanjuntak, 2020). Word Problems provide an appropriate means to develop general competencies and attitudes with students; enable students to draw their own conclusions from the information presented independently, to recognize, understand, analyze and access representative examples of real-world mathematical use; develop the ability of solvers to activate mathematics to extra-mathematical situations; build with students a rich and comprehensive picture of mathematics in all its aspects, as a science, as a field of activity in society and culture and motivate students and help them in acquiring, learning and maintaining mathematical concepts, ideas, methods and results (Novotna, 2006). Word Problems in mathematics, especially Trigonometry, are problematic questions or those that present problems that students commonly experience and encounter in everyday life, so that they can provide meaning in the process of solving them (Farida Tunnajach, 2021).

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Problem solvers try to translate keywords in the problem statement directly into a series of calculations that will produce answers and do not build a qualitative representation of the situation described in the problem (Agusta, 2020). In a meaningful approach, known as the problem model approach, the problem solver translates the problem statement into a mental model, namely Metaphorical Thinking, of the situation described in the problem. This mental model then becomes the basis for building a solution plan in mathematics, especially Trigonometry (Hegarty et al., 1995).

METHOD

This study uses a qualitative approach, namely describing complex illustrations of the problems studied. Purposive sampling is a non-random sampling method where researchers ensure illustration citations through a method of determining a specific identity that is in accordance with the objectives of the study so that it is expected to be able to respond to research cases (Lenaini, 2021). The research subjects were not selected randomly, but were taken by considering their spatial abilities so that the disclosure of the thinking process could be carried out properly. This study presents 3 spatial student subjects based on their learning styles to explore the Metaphorical Thinking CoRelEx process.

Figure 1. Spatial students are working on word problems to find out how to solve Trigonometry problems

This process is reflected in the students' approach to solving trigonometry word problems. The participants in this study were students from Class E (Grade 10, Room H) at a public senior high school in Central Kalimantan, Indonesia, during the even semester of the 2024–2025 academic year.

Figure 2. The process of interviewing spatial students after working on Trigonometry word problem

Several research instruments used are: (a) Student Activity Sheets for Solving Trigonometric Comparison Story Problems, (b) Interview Guidelines and (c) Field Notes, and (d) Documentation. The exam questions are in the form of two descriptive questions developed from the Metaphorical Thinking CoRelEx indicators in Table 1.

Data analysis according to Miles and Huberman in (Saleh et al.,2017) This interactive model has four components, namely (1) data collection, (2) data reduction, (3) data presentation and (4) drawing conclusions/verification. The relationship between the four must continue to be compared to determine the direction of the contents of the conclusion as the final result of the research. The interactive analysis pattern proposed by Miles and Huberman can be seen in the following illustration.

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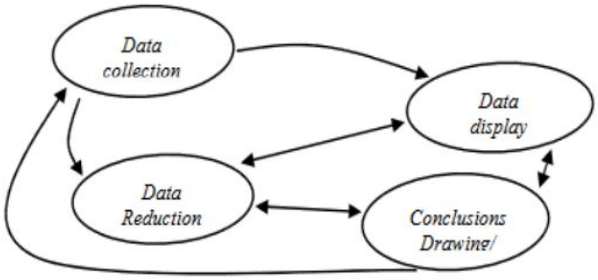

Figure 3. Interactive data analysis diagram according to Miles and Huberman

The explanation of the data analysis illustration above is as follows:

1. Data collection is the collection of information that allows researchers to draw conclusions and take action. Data presentation is an explanation of information in the form of complete descriptions and narratives, which are arranged based on the main findings contained in data reduction, and presented using the researcher's language logically and systematically, so that it is much easier to understand. So that all data that has been obtained in the field, both in the form of interviews, observations, and analysis, can produce a picture of the CoRelEx Metaphorical Thinking process of students in solving Trigonometry story problems at the partner school.
2. Data reduction is the process of selecting, focusing, and simplifying all types of information that support research data obtained and recorded during the data research process in the field. Basically, the data reduction process is a qualitative data analysis step that aims to sharpen, classify, direct, clarify, and create focus by simplifying things that are less important. So that the narrative presentation can be understood well, and leads to conclusions that can be accounted for.
3. Data presentation is the process of compiling information that provides possible conclusions in qualitative research. This data presentation can be done in the form of brief descriptions, charts, and the like.
4. Drawing conclusions and verification constitutes the final stage of the previously described process. Conclusions are derived from analyzed data and verified based on evidence collected at the research site. In this stage, the researcher formulates conclusions regarding the Metaphorical Thinking CoRelEx process in solving trigonometry word problems, as demonstrated by students at a public senior high school in Central Kalimantan.

RESULT AND DISCUSSION

The following section presents the Metaphorical Thinking process demonstrated by Phase E students in solving trigonometry word problems, as observed and analyzed in this study. This description highlights the cognitive strategies and spatial reasoning patterns employed by the students throughout various stages of problem-solving. The findings are organized according to key components of the CoRelEx spatial framework used in the research.

1. One day, Kania played on the edge of a lake around her place of residence and she wanted to measure the width of the river by observing a tree that was right in front of her which was right on the edge of the river. Then Kania walked 160 meters and looked back at the tree she saw first. She measured the size of her viewing angle towards the tree which turned out to be 60°.

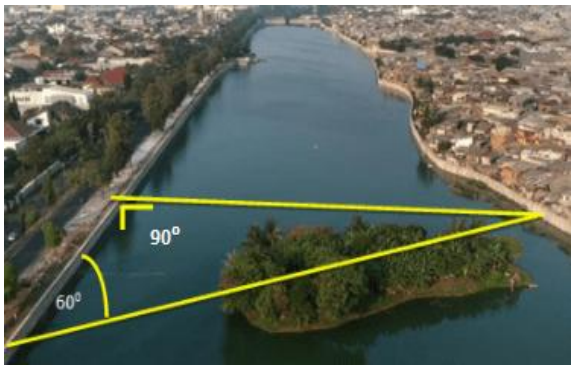

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Figure 4. Metaphorize real life objects (a river) into trigonometry

a. Based on this information, determine whether the following statements are true or false and provide concrete reasons according to your ideas!

Statement	True/False
The width between Kania and the opposite river bank can be calculated using **Cos 60°**	.....
The size of the angle of the opposite bank of the river between where Kania started playing and where Kania is standing now is **30°**.	.....
The sum of the angles between the starting place where Kania played and the place where Kania is standing now is **180°**	.....

b. If Kania is going to the edge of the lake right across, then how wide is the river that Kania must cross? According to your respective ideas, include pictures and Trigonometric modeling!

The following is a series of Metaphorical Thinking CoRelEx processes for each spatial subject based on auditory, visual, and kinesthetic learning styles:

1) Auditory Spatial Subject 1(ASS 1)

Initially, ASS 1 thought that there was a river that was very wide. ASS 1 immediately connected the river with a right triangle. ASS 1 connected the word problem with the river. In this connect process, ASS 1 connected the idea of an angle with the word problem. ASS 1 stated that there was a special angle of 90° while pointing to the starting point where Kania was standing near the river. ASS 1 told the story that it could be used as a starting point before Kania moved to another corner. Then after telling the story, he made a picture of a different right triangle connected by a ratio. ASS 1 imagined that every place Kania stood could be said to be the points that make up a right triangle that was 90°.

The results of the ASS 1 interview are as follows:

R : *What was on your mind when you first read the question?*

ASS 1 : *This question discusses the relationship between the width of the river and the distance Kania moved, so it is very connected to a right triangle. because there is a right angle, namely* 90°. *I imagine that at Kania's starting point until her movement in another direction, I can think of it as the points that make up the right triangle, sis.*

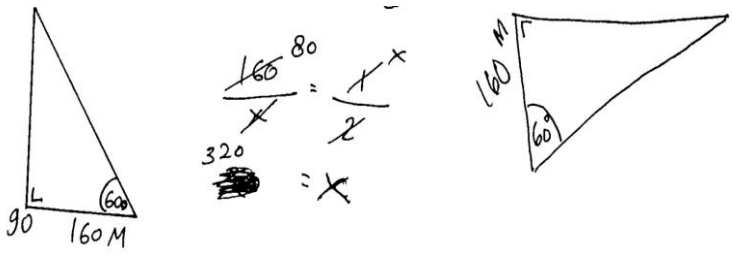

Figure 5. Results of solving word problems in the *connect* stage by ASS 1

After ASS 1 read the given question repeatedly, then ASS 1 stated that there were other ideas that had similarities to solve this problem. When asked what the similarities were between the other ideas, ASS 1 answered that this question could be solved using the exact trigonometric ratio to find the width of the river he had imagined. Furthermore, ASS 1 thought that from the picture there was a Special angle of 60° after he said there was a right angle. At this relate stage, ASS 1 immediately wrote down the things that were known in the question such as the distance from Kania to the starting point where she was standing right across from the tree by writing down what was known and what was asked.

The results of the ASS 1 interview are as follows:

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ASS 1 : *Oh yes, sis, I used to learn about measuring the width of this river in first semester. It turns out that this right triangle is similar to another idea, namely using trigonometric ratios other than Pythagoras. Then there are several things that are asked, namely the angles and the distance from Kania to the place next to it which has an angle of* 60°. *Then the distance from Kania to the next path is* 160 *m.*

R : *Okay, why can this problem use trigonometric ratios?*

ASS 1 : *Because in the picture there is a Special angle of* 60°, *there is even a perfect right angle. So this story problem is immediately solved using trigonometric ratios, it can be* $\cos\alpha$, $\sin\alpha$, *or* $\tan\alpha$ *sis.*

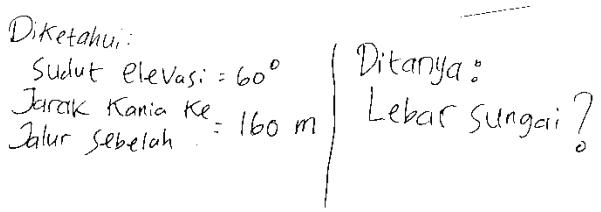

Figure 6. Results of solving word problems in the *relate* stage by ASS 1

Then, ASS 1 looked for a solution to this word problem starting with the Pythagorean formula first, because he thought that in this problem he had to find and find an unknown side so that when solving the next problem ASS 1 would be more efficient in finding a solution. At this explore stage, ASS 1 began solving the problem based on the connect and relate stages. ASS 1 started this with the Pythagorean formula first, then he continued by finding the value or size of the corresponding angles.

The results of the ASS 1 interview are as follows:

R : *Why did you use the Pythagorean formula to determine the problem and how was your problem-solving process for the next problem?*

ASS 1 : *Because I wanted to prove the problem that had a true or false statement, and I got the correct answer, the reason is because what is sought is the comparison of the side and the hypotenuse at the distance between Kania and the river across. Then for the second statement it is also true, because the angle of the flank in the river across between the initial place where Kania played and the place where Kania is standing now is* $180° - (90° + 60°) = 30°$.
Then for the third statement it is wrong, the reason is The sum of the angles between the initial place where Kania played and the place where Kania is standing now is 150° *not* 180°.

R : *Thank you, the process is very good, what about question s1(b)?*

ASS 1 : *For question 1(b), I initially used Pythagoras because if I were to find the width of a river, if illustrated it would form a right angle and a special angle, with* $a^2 + b^2 = c^2$.

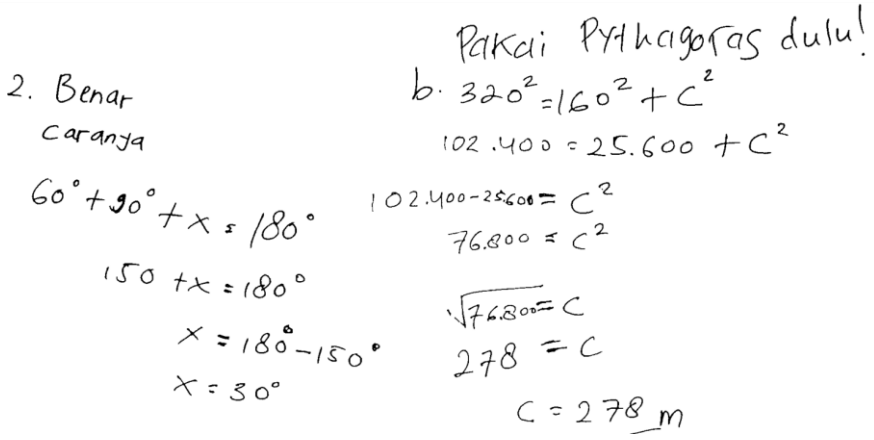

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Figure 7. Results of solving word problems in the *explore* stage by ASS 1

Finally, at this Experience stage, ASS 1 solved a more complex word problem using trigonometric ratios based on ASS 1's experience after going through the previous three stages, namely Connect, Relate, and Explore, which initially ASS 1 used Pythagoras, then at this time he expressed the equation for finding the width of the river using the trigonometric ratio, namely $\tan 60°$, because ASS 1 thought that what had been obtained was the front side and the side of the river.
The results of the ASS 1 interview are as follows:

R : *After you solve this word problem, can you use it in your daily life on other trigonometry problems?*
ASS 1 : *Yes, in this problem I use the calculation that the width of the river is 278 m, if using trigonometry, you can use the ratio* $\tan 60°$ *to get* $160\sqrt{3}$ *m*
R : *Okay, thanks for the idea.*
ASS 1 : *You're welcome, sis, let me explain the reason for using* $\tan 60°$ *because if we want to cross the river, we will look for the ratio of the front and side sides in the right triangle image, sis.*

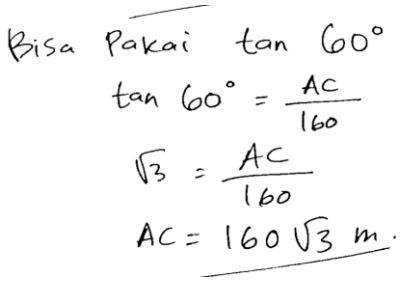

Figure 8. Results of solving word problems in the *experience* stage by ASS 1

Based on the four stages in the metaphorical thinking process of ASS 1, it can be concluded that ASS 1 has achieved the Metaphorical Thinking CoRelEx indicator.

2) Visual Spatial Subject 2 (VSS 2)
At the connect stage, VSS 2 carefully observed the given problem that there was a river that was very wide so that he directly related it to trigonometric ratios without going through Pythagoras. Then VSS 2 made the idea he had with the given word problem by making a different right triangle image while connecting it to the known angle in the problem, namely $\alpha = 60°$.
The results of the VSS 2 interview are as follows:

R : *What was on your mind when you first read the problem?*
VSS 2 : *If I really pay attention, this problem tells about the width of the river which is closely related to trigonometric ratios, because there is a special angle, namely* $60°$*, sis.*

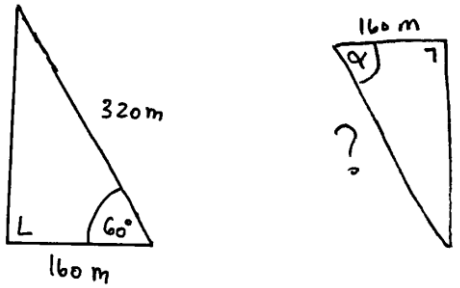

Figure 9. Results of solving *word problems* in the *connect* stage by VSS 2

After VSS 2 repeatedly observed the trigonometry word problem, then VSS 2 stated that there was another idea that had similarities to solve this problem. When asked what the similarities were between the other ideas, VSS 2 still read it repeatedly and answered that this problem could be

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solved using a right triangle or Pythagoras. At this Relate stage, VSS 2 read the entire question given again and then wrote down the things that were known in the question, such as a right angle measuring 90° along with the known distance in the picture and wrote down what was asked.
The results of the VSS 2 interview are as follows:

VSS 2 : *After I read this question repeatedly, this trigonometric ratio is similar to another idea, namely using the Pythagorean ratio.*
R : *Why can this problem use the Pythagorean right triangle ratio?*
VSS 2 : *Because in the picture there is a special angle of* 90°. *So we can solve this story problem using Pythagoras to find the hypotenuse first and then continue by applying the rules of trigonometric ratios.*

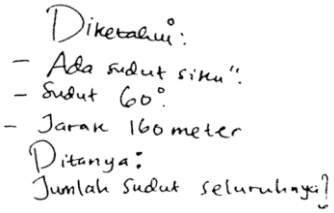

Figure 10. Results of solving *word problems* in the *relate* stage by VSS 2

Third (explore stage), VSS 2 found a solution to this word problem starting by making a right triangle image, in question 1(a) VSS 2 used the trigonometric ratio $\cos 60°$. At this stage VSS 2 began to solve the problem based on the connect and relate stages. VSS 2 started this with the Pythagorean formula first, then he continued by finding the value or size of the corresponding angles using the trigonometric ratio $\cos \alpha$.
The results of the VSS 2 interview are as follows:

R : *Why did you use the rasio* $\cos 60°$ *to determine question 1(a), and how was your problem solving process for the next question?*
VSS 2 : *Because I wanted to prove this question that had a true or false statement, and I got the correct answer, the reason is because what was sought was the comparison of the side and the hypotenuse at the distance between Kania and the river across. Then for the second statement, it is also true, because the angle of the opposite river between the initial place where Kania played and the place where Kania is standing now is* $180° - (90° + 60°) = 180° - 150° = 30°$. *Then for the third statement, it is wrong, the reason is that the sum of the angles between the initial place where Kania played and the place where Kania is standing now is* $150°$ *not* $180°$.
R : *Okay, thanks for the idea.*

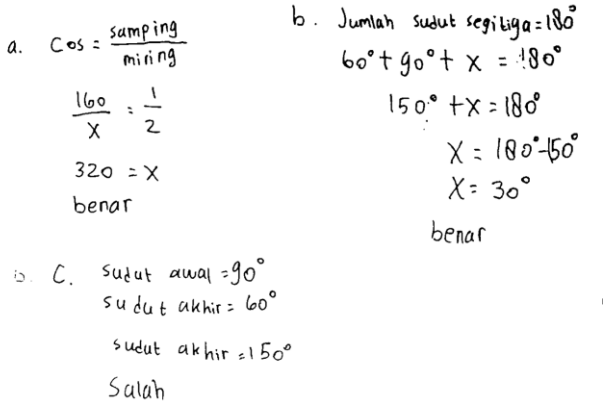

Figure 11. Results of solving *word problems* in the *explore* stage by VSS 2

At this Experience stage, VSS 2 solves more complex word problems using trigonometric ratios which aim to build meaningful understanding and make it easier to find solutions based on VSS 2 experience after going through the previous three stages, namely Connect, Relate, and Explore, which initially VSS 2 used Pythagoras because VSS 2 thought that what had been obtained was the front side and side of the river so he wanted to find the hypotenuse as the width of the river.

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The results of the VSS 2 interview are as follows.

R : *Thank you, the process has been very good, what about question 1(b)?*

VSS 2 : *For question 1(b) I initially used Pythagoras because if I were looking for the width of the river, if it was illustrated it would form a right angle and a special angle, with* $a^2 + b^2 = c^2$*, after I calculated it, the width of the river was* 277,17 *m.*

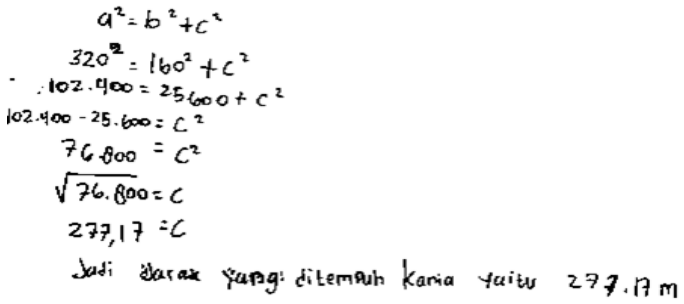

Figure 12. Results of solving *word problems* in the *experience* stage by VSS 2

Based on the four stages in the SSV 2 metaphorical thinking process, it can be concluded that VSS 2 has fulfilled the *Metaphorical Thinking CoRelEx* indicators.

3) Kinesthetic Spatial Subject 3 (KSS 3)

Initially, KSS 3 manipulated the river image from the given word problem. KSS 3 immediately said that the given question was about a right triangle, not a river. However, after he studied the meaning of the question, KSS 3 stated that he had previously worked on this right triangle problem repeatedly and finally he realized that the purpose of this question was to find the width of a river that was very wide. So he linked this to Pythagoras because there was a right triangle but previously he had not thought about trigonometric ratios because he still had other alternative processes such as finding the hypotenuse first. At this connect stage, KSS 3 made a relationship between the ideas he had with the given word problem by making pictures of two different right triangles while connecting them with the known angles in the question, namely $\alpha = 60°$ and a right angle $\alpha = 90°$.

The results of the KSS 3 interview are as follows:

R : *What was on your mind when you first read the question?*

KSS 3 : *This question tells about a right triangle, sis, which turns out to be related to the width of the river and can be found using the Pythagorean ratio. I still haven't found its connection with trigonometry, because there is a right angle, namely* 90°. *But here there is an angle that is its partner, sis, namely an angle that is* 60°.

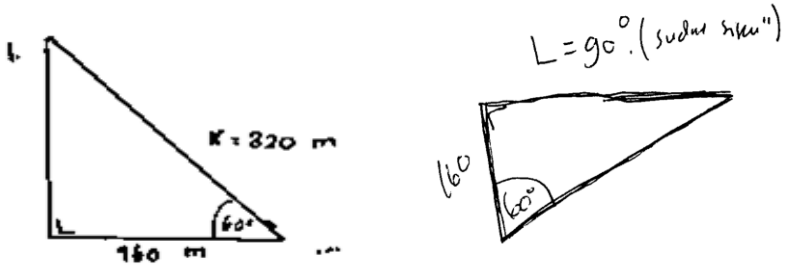

Figure 13. Results of solving *word problems* in the *connect* stage by KSS 3

After KSS 3 read the trigonometry word problem repeatedly, then KSS 3 stated that there was another idea that had similarities to solve this word problem. When asked what the similarities were between the other ideas, KSS 3 answered that this problem could be solved using trigonometry. Furthermore, KSS 3 thought that from the picture there was a right angle of 90°. t this stage, KSS

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3 wrote down things that were known in the question, such as a right angle of 90° along with the known distance in the picture and wrote down what was asked.
The results of the KSS 3 interview are as follows.

KSS 3 : *So this Pythagorean ratio is similar to another idea, namely using Trigonometry ratios.*
R : *Why can this problem use Trigonometry ratios?*
KSS 3 : *Because in the picture there is a special angle of* 60°. *So we can solve this story problem using Pythagoras to find the hypotenuse first and then continue by applying the rules of trigonometry ratios.*

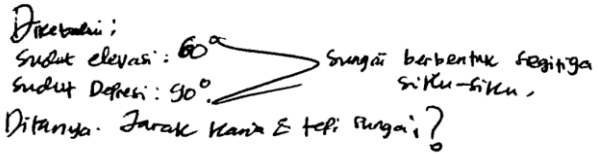

Figure 14. Results of solving *word problems* in the *relate* stage by KSS 3

Third (explore stage), in question 1(a) KSS 3 applies the trigonometric ratio, namely $\cos 60°$. In this Explore stage, KSS 3 begins to solve the problem based on the connect and relate stages. KSS 3 starts this by finding the angle values first, then he continues by finding the corresponding angle value using the trigonometric ratio $\cos \alpha$.
The results of the KSS 3 interview are as follows.

R : *Why did you use* $\cos 60°$ *to determine question 1(a), and how was your problem solving process for the next question?*
KSS 3 : *Because I wanted to prove this question that had a true or false statement, and I got the correct answer, the reason being that what was sought was the comparison of the side and the hypotenuse at the distance between Kania and the river across. Then for the second statement, it is also true, because the angle between the starting point of Kania playing and the point where Kania is standing now is* $180° - (90° + 60°) = 180° - 150° = 30°$. *Then for the third statement, it is wrong, the reason is that the sum of the angles between the starting point of Kania playing and the point where Kania is standing now is* $150°$ *obtained from* $90° + 60°$ *not* $180°$.

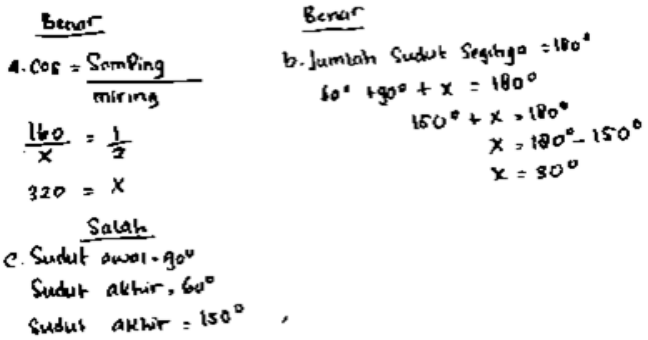

Figure 15. Results of solving *word problems* in the *explore* stage by KSS 3

Next, in this experience stage, KSS 3 solves more complex word problems using trigonometric ratios which aim to build meaningful understanding and make it easier to find solutions based on KSS 3 experience after going through the previous three stages, namely *Connect, Relate, and Explore*, which initially KSS 3 used Pythagoras because KSS 3 thought that what had been obtained was the front and side of the river so he wanted to find the hypotenuse as the width of the river. However, he drew another right triangle to clarify the instructions for solving the problem so that there were no errors in the process.
The results of the KSS 3 interview are as follows.

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R : *Thank you, what about question 1(b)?*
KSS 3 : *For question 1(b), initially I drew another right triangle and then I looked for it using Pythagoras because if I look for the width of the river, it will definitely be illustrated to form a right angle and a special angle, with* $a^2 + b^2 = c^2$*, after I calculated it, the width of the river was 277,17 m then rounded to 278 m.*
R : *Okay, thanks for the idea.*
KSS 3 : *I rounded the final result so that the result remains the same and does not have decimals, sis.*

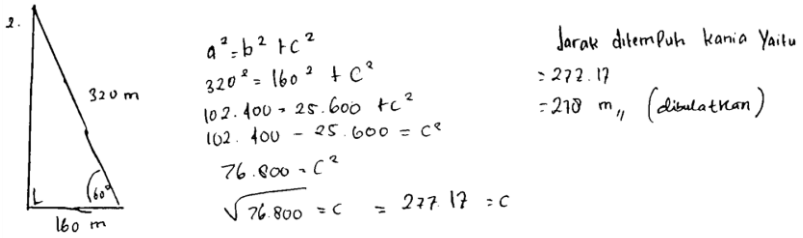

Figure 16. Results of solving *word problems* in the *experience* stage by KSS 3

At this *experience* stage, KSS 3 solves more complex word problems by using trigonometric ratios to build relational understanding and make it easier to find solutions based on KSS 3 experience after going through the previous three stages, namely *Connect*, *Relate*, and *Explore*.

Based on the four stages in the KSS 3 metaphorical thinking process, it can be concluded that KSS 3 meets the Metaphorical Thinking CoRelEx indicator. The following is a summary of the achievement of the Metaphorical Thinking CoRelEx indicator in Table 2.

Table 2. Summary of Achievement of *Metaphorical Thinking CoRelEx* Indicators by each Spatial Subject based on the three types of Learning Styles

Subjek	*Connect*	*Relate*	*Explore*	*Experience*
ASS 1	✓	✓	✓	✓
VSS 2	✓	✓	✓	✓
KSS 3	✓	✓	✓	✓

Thus, in metaphorical thinking abstract concepts will be transformed into real objects in everyday life. To determine success in learning mathematics, students can use metaphorical thinking which is closely related to metaphors that can conceptualize abstract concepts into more concrete and more familiar concepts (Makrufah & Fiangga, 2021).

CONCLUSION

Based on the results of the study, it was concluded that the three spatial students with visual, auditory and kinesthetic learning styles had good Metaphorical Thinking abilities and met the four ability indicators, namely CoRelEx (Connect, Relate, Explore, Experience) used in this study. Students were able to communicate a concept into a mathematical model by connecting several mathematical concepts. And were able to understand basic concepts and use the right formulas using trigonometric operations and processes and students were able to explain the systematic results of problem solving in real phenomena in detail in solving Trigonometry Word Problems. By using metaphorical thinking skills, students' Problem Solving process becomes more meaningful because they can see, form and map mathematical concepts to real life.

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