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Students' Metacognition in Solving HOTS Problems in the Context of the Flag Ceremony Yard Based on Initial Mathematical Abilities

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ABSTRACT

This study aims to determine the ability of metacognition in solving HOTS problems in the context of problem related to activities in the context of the flag ceremony yard in solving problems based on initial mathematics ability. This research approach was descriptive qualitative involving 3 students as research subjects who were selected based on high, medium, and low initial mathematics abilities. The data were validated by using method triangulation techniques, namely tests and interviews. The results showed that students with high initial mathematics ability showed good metacognition skills in solving HOTS problems in planning, monitoring, and evaluating activities. However, they still need to improve their ability to evaluate the repair strategy if there is an error. Students with medium initial mathematical ability showed good metacognition skills in several aspects but needed to improve some aspects. Students with moderate mathematics ability have a good basic understanding of metacognition in planning activities. However, they need to improve their metacognition skills in monitoring and evaluating when solving HOTS problems. Meanwhile, students with low initial mathematical ability show limitations in utilizing metacognition skills in planning, monitoring, and evaluating activities, as a result, students experience difficulties in solving problems. So, teachers need to design teaching materials that can improve students' mathematical abilities and metacognition.

Penelitian ini bertujuan untuk mengetahui kemampuan metakognisi dalam menyelesaikan soal HOTS pada konteks pertanyaan yang terkait aktivitas di lapangan upacara bendera dalam menyelesaikan pemecahan masalah yang berdasarkan kemampuan awal matematika. Pendekatan penelitian ini deskriptif kualitatif dengan melibatkan 3 siswa sebagai subjek penelitian yang dipilih berdasarkan kemampuan awal matematika tinggi, sedang, dan rendah. Data divalidasi dengan menggunakan teknik triangulasi metode yaitu tes dan wawancara. Hasil penelitian menunjukkan bahwa siswa dengan kemampuan awal matematika tinggi menunjukkan kemampuan metakognisinya baik dalam menyelesaikan soal HOTS pada aktivitas perencanaan, memonitor, dan mengevaluasi. Tetapi masih perlu meningkatkan kemampuan mengevaluasi pada strategi perbaikan jika terdapat kesalahan. Siswa dengan kemampuan awal matematika sedang menunjukkan kemampuan metakognisi yang baik dalam beberapa aspek, namun perlu meningkatkan beberapa aspek. Siswa dengan kemampuan matematika sedang mempunyai pemahaman dasar yang baik dalam metakognisi pada aktivitas perencanaan. Namun, perlu meningkatkan kemampuan metakognisi dalam memonitor dan mengevaluasi saat menyelesaikan soal HOTS. Sementara pada siswa dengan kemampuan awal matematika rendah menunjukkan keterbatasan dalam memanfaatkan kemampuan metakogisi dalam aktivitas perencanaan, memonitor, dan mengevaluasi, akibatnya siswa mengalami kesulitan dalam menyelesaikan masalah. Untuk itu, guru perlu merancang bahan ajar berkualitas yang dapat mengembangkan kemampuan matematis dan metakognisi siswa.

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INTRODUCTION

Since 2022, the Minister of Education, Culture, Research and Technology, Nadiem Makarim, planned the Merdeka Learning Curriculum policy for primary and secondary education to realize Indonesia's superior human resources with the Pancasila Learning Profile (Vhalery et al., 2022). Merdeka Curriculum emphasizes student-centered learning, which demands critical thinking skills and Higher-Order Thinking Skills (HOTS) (Cholilah et al., 2023). HOTS measures higher-order thinking skills, which go beyond remembering, restating, or referring without processing (Abraham et al., 2021).

According to Abidin and Tohir (2019), HOTS skills incorporate the highest hierarchy of Bloom's Taxonomy cognitive levels (Muttaqin et al., 2020). Anderson and Krathwohl (2001) refined the knowledge of the thinking process according to Bloom's Taxonomy into six abilities, namely: knowing-C1, understanding-C2, applying-C3, analyzing-C4, evaluating-C5, and creating-C6 (Kusuma & 'Adna, 2021). HOTS problems are categorized into three levels of cognitive levels, namely analyzing (analysing-C4), evaluating (evaluating-C5), and creating (creating¬-C6) (Saputra et al., 2022).

HOTS problems not only improve critical thinking skills but also logical, reflective, metacognitive, and creative. According to Laurens (2011), students who can think critically are students who utilize their metacognition well (Carel et al., 2021). Students need to practice working on HOTS problems to increase their metacognitive awareness (Wulansari et al., 2022). Students' metacognition can be developed through repeated practice problems (Conway-smith & West, 2023). A person's metacognitive ability will be higher if it is often honed by doing problem-solving (Muttaqin et al., 2020) because metacognitive strategies can improve student achievement results (Misu et al., 2019). Metacognitive strategies are techniques to increase awareness of thinking and learning processes themselves (Hamzah et al., 2022).

According to Schraw & Dennison (1994), metacognition is defined as the ability to reflect on, understand, and control one's learning process (Rinaldi, 2017). John Flavell introduced the term metacognition as thinking about thinking or a person's knowledge of their thinking process (Lan, 2020; Lestari, 2012). Students who have good metacognition skills in solving problems will have a good impact on the learning process and learning achievement (Ismayati et al., 2020).

Observations at SMKN 2 Jiwan showed that students had different responses to HOTS problems, with some students not reading the problems, relying on friends' answers, or looking for answers on the internet without understanding the steps (Cholilah et al., 2023). This problem shows that students do not utilize their metacognitive skills when solving problems (Siagian et al., 2013). The difficulties faced by students are caused by their low metacognitive abilities (Aziz & Akgül, 2020; Goos et al., 2002).

Success in solving mathematics problems is not only supported by cognitive and metacognitive abilities, but students' self-control in the process of solving mathematics problems also has an influence (Izzati & Mahmudi, 2018), and students' initial mathematical abilities also affect student learning outcomes (Hevriansyah & Megawanti, 2016). Students with good initial abilities tend to solve problems easily, on the other hand, students with weak initial abilities will experience many obstacles (Purnamasari & Setiawan, 2019). Therefore, activities that can be applied to hone metacognition skills are given HOTS-based problem-solving story problems (Faiziyah & Priyambodho, 2022) because HOTS problems demand more complex thinking (Diantik et al., 2022). Students will feel confused about solving problems related to everyday life (Diantik et al., 2022) so in this study, story problems will be given in the context of the ceremonial field to describe situations that are relevant to everyday life.

Previous research emphasizes the importance of metacognition in learning mathematics, especially in solving HOTS problems (Faiziyah & Priyambodho, 2022; Wicaksono et al., 2021). Sasongko (2018) conducted research on Trigonometry material in the context of observations from lighthouses. So this study will explore the metacognition of grade X vocational students when solving HOTS-based math problems by selecting Trigonometric Comparison material in the context of the Ceremony Field. The material was chosen because this material is in one of the chapters of grade X mathematics lessons that require logical and analytical skills that are important in everyday life and have never been studied before. The findings of this study are expected to contribute to the understanding of how metacognition is applied and developed in the context of vocational education (Purnamasari & Setiawan, 2019; Suryani et al., 2020) by providing a new perspective in the context of real life in the school environment.

METHOD

This type of research is descriptive qualitative which aims to describe students' metacognition when solving HOTS problems in the context of the Ceremony Field based on students' initial mathematics ability. In this study, the initial mathematics ability was obtained from the results of mathematics test scores from the prerequisite material. The scores obtained by students are grouped based on the level of mathematical ability according to Depdiknas.

Depdiknas categorizes students' mathematical abilities into 3 abilities, namely students who obtain a value range of $80 \leq \text{values obtained} \leq 100$ have high mathematical abilities, students who obtain a value range of $65 \leq \text{values obtained} \leq 80$ have moderate mathematical abilities, and students who obtain a value range of $0 \leq \text{values obtained} \leq 65$ have low mathematical abilities.

This study was conducted on students of class X.TPM.1 at SMK Negeri 2 Jiwan who were selected based on teacher considerations. The subject selection technique in this study used purposive sampling, a technique used to determine subjects based on certain criteria (Nasution, 2023). The subjects of this study were selected based on the categories of high, medium, and low mathematical abilities. There were 10 students with high mathematical ability categories, 14 students with medium mathematical abilities, and 12 students with low mathematical abilities. Based on teacher considerations, 1 student was selected for each category to be the subject of this study as shown in Table 1.

Table 1. List of research subjects

No.	Student Code	Math Ability Level	Subject Code
1.	DMGS	High	S1
2.	DAA	Medium	S2
3.	MCC	Low	S3

The research procedure begins with research preparation by observing the school to see the problems experienced at the school. Then determine the problems obtained from observation data so that the title and background of the problem in the study can be made. Next, the preparation of a proposal based on the background of the problem obtained during the observation. The instruments (written tests, grids, validators, and interview guidelines) are validated by experts. If the instrument is valid then the research can be carried out and if the instrument is not valid then there is a need for revision until the instrument is valid.

In the implementation of the research, the researcher applies for permission to the Vocational School in Madiun, Indonesia, then collects data on students' mathematics scores on the previous material obtained from the mathematics teacher to see the students' initial mathematics ability and then will be divided into three categories, namely students with high, medium, and low mathematics abilities. Then give a written test in the context of the Field Ceremony of Trigonometric Comparison material. Furthermore, conducting interviews with selected research subjects based on the interview guidelines that have been made.

Data validity was obtained by triangulating time by comparing the results of the first data acquisition with the results of the second data acquisition to obtain valid data. The data analysis stage was carried out using the qualitative data analysis technique of the Miles and Huberman model which consists of three stages, namely: (1) data reduction, (2) data presentation, and (3) drawing conclusions (Nasution, 2023). At the reduction stage, the problem-solving steps in the subject's answers were adjusted to the indicators of metacognition. At the data presentation stage, it is presented in narrative form to understand what happened to the subject when solving HOTS problems. This will provide an overview of the possibility of concluding. And at the stage of concluding is done by paying attention to the results of tests and interviews in the process of students' metacognition when solving HOTS problems. After the data is analyzed with a qualitative approach, the final stage is to make a research report and the researcher concludes the results of the study.

The data collection techniques used HOTS problem tests, interviews, and documentation. The HOTS problem tests consist of 1 problem given to subjects with cognitive level C4 (analyzing) as follows.

HOTS Problem Test Instrument

Figure 1. Flag Ceremony Yard

A man stood in the schoolyard as in Figure 1. In front of him is a tree and a flagpole. If the pole is 50 meters high, the angle between the man and the top of the pole is 45°, and the angle between the tree and the top of the pole is 60°, what is the distance between the man and the tree?

The interview guideline was used to reveal the metacognition of the subject under study while working on the given HOTS problem. This study used semi-structured interviews that included interview guidelines, but the problem were not the same according to the interview process and the answers of each individual. The test instruments and interview guidelines have been validated by 3 validators (1 mathematics education lecturer and 2 vocational math teachers). The results of validation of test instruments and interview guidelines get valid results so that researchers can use them as instruments in this study. Documentation was used to obtain recordings of the results of interviews with subjects, which were taken in the form of photos of subject answer sheets, recordings, and other data needed during the study.

Furthermore, to describe students' metacognition in solving HOTS problems, indicators of metacognition ability were used which include planning, monitoring, and evaluating activities (Anderson & Krathwohl, 2001; Sutarto et al., 2022). The indicators were further developed to solve the problems presented in Table 3 (Amir & Kusuma W, 2018; Schraw & Dennison, 1994).

Table 3. Code Description of Metacognition Indicators

Metacognitive Activity	Indicator	Description	Code
Planning	Understanding the problem	Considers how to understand the problem and gathers all known information on the given problem	RA1
		Reviewing the given problem more than 1 time	RA2
	Presenting prerequisite material and creating a mathematical model of the problem	Considering how to model the problem in the form of a picture	RB1
		Considering how to provide notation, and symbols on the modeling image	RB2
		Considering the basic concepts/knowledge needed before solving the problem	RB3
	Solving strategy used	Trying to remember whether I have solved this problem before	RC1
		Considering the steps needed to solve the problem systematically	RC2
Monitoring	Controlling the implementation of	Considering the suitability of relevant concepts to the problem at hand	MD1
		Checking each step sequentially to minimize errors	MD2

Metacognitive Activity	Indicator	Description	Code
	problem-solving activities	Controlling the calculation of each step	MD3
Evaluating	Repair strategy if there is an error	Making corrections to the problem-solving steps to get the right results	VE1
		Looking for other ways when the steps obtained are still wrong	VE2
	Evaluating the results obtained	Checking the suitability of the answer to what was asked	VF1
		Rechecking the method used to ensure the answer is correct	VF2
	Evaluating the method/strategy used to solve the problem	Looking for different strategies/alternatives to solve the problem	VG1
		Thinking about whether the method applied can be used to solve other problems	VG2

RESEARCH RESULTS

Based on the recommendation of the mathematics teacher at the school where the research was conducted, three students were selected as research subjects to examine their metacognitive abilities in completing the HOTS problem test given. The results of interviews with the three subjects, which aimed to understand their metacognitive processes after completing the test, are explained as follows. The three subjects had different mathematical abilities: high, medium, and low, represented by S1, S2, and S3 respectively.

Subjects with high initial math ability (S1)

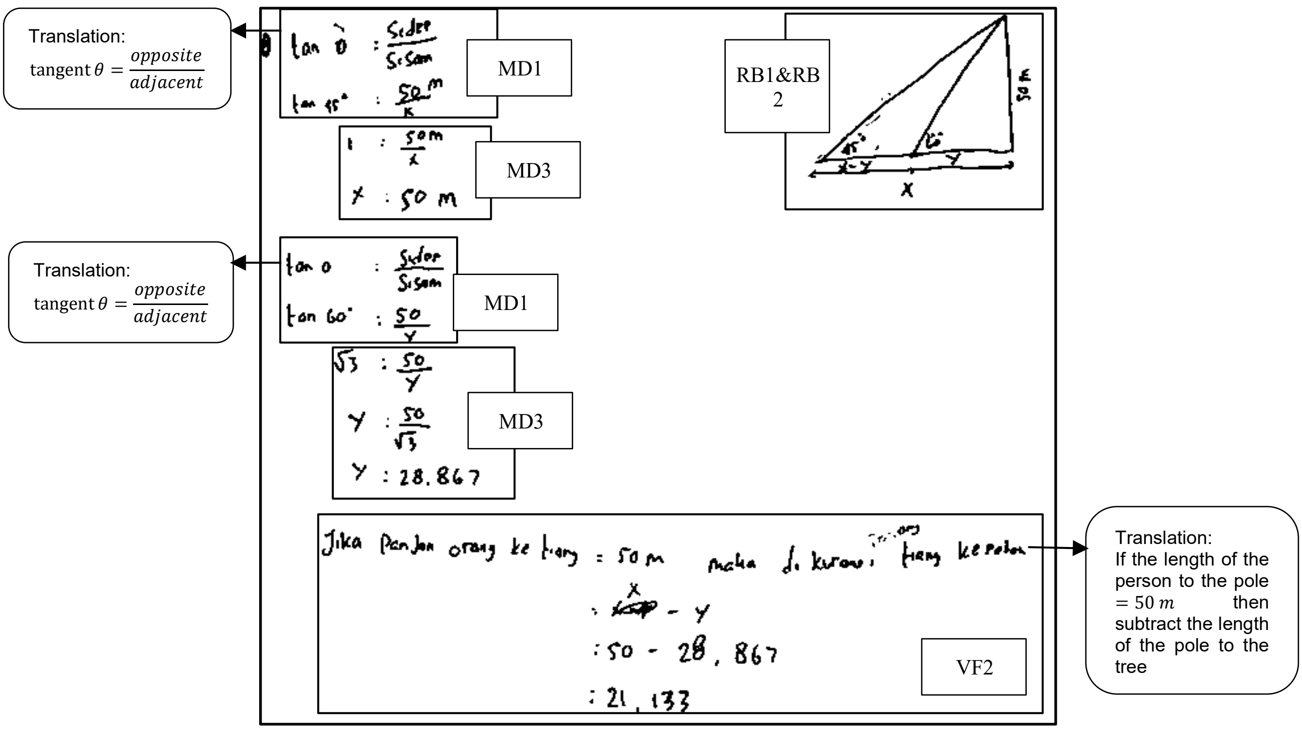

Figure 2. S1 Answer Sheet

Planning activities

Seen in Figure 2, S1 did not write information from the problem such as what was known and what was asked on the answer sheet, but S1 was able to collect information supported by the subject who said "what is known is the angle between the tree and the top of the pole is 60 degrees, the angle between the man and the top of the pole is 45 degrees, then the height of the pole is 50". The subject will read twice if he is still confused about the problem.

Furthermore, S1 considers making mathematical models in the form of drawings and is able to consider how to provide notation information on the modeling that S1 makes in the RB1 & RB2 codes. S1 considers the basic concepts to solve the problem by using tangent comparison. S1 remembers having solved this problem before supported by the subject who stated "I used to do problems like this in math class" so S1 is able to consider and know the sequence of problem-solving steps used.

Monitoring activity

As seen in Figure 2, S1 carried out problem-solving by writing down the formula and was able to solve the problem with coherent steps in codes MD1 & MD3. S1 is able to consider the suitability of the concept from the consideration of what is known supported by the subject who states the reason for using the tangent formula because what is known is only the front side and the side side. Furthermore, S1 checks the final results obtained and controls the calculation of each step by realizing the method used is correct supported by the subject who states the reason for using the tangent method "because what is known in the problem is the front side and the side side".

Evaluation Activity

As seen in Figure 2, S1 is able to apply the plan appropriately so that the correct answer is obtained in code VF2, but S1 has not concluded his answer. S1 corrected the problem-solving by realizing that he did not add units to his answer seen in Figure 2. S1 has not thought of another way when the answer is still wrong supported by the subject who stated "I'm not looking for another way, but just looking for the wrong place, if there is another way I choose another easier way, but that can't use another way".

Furthermore, S1 checked the suitability of the answer to what was asked by correcting the subtraction operation in the final answer obtained and found the distance between a man and a tree. S1 rechecked the method used by checking the calculation.

S1 thinks of looking for different alternatives to solve the problem by looking for problems that are almost the same as the given problem. And S1 thinks the method used can be applied to solve other problems supported by the subject who stated "the method I use can be used to solve other problems but there must be a front side and a side side".

Subject with Moderate Mathematics Initial Ability (S2)

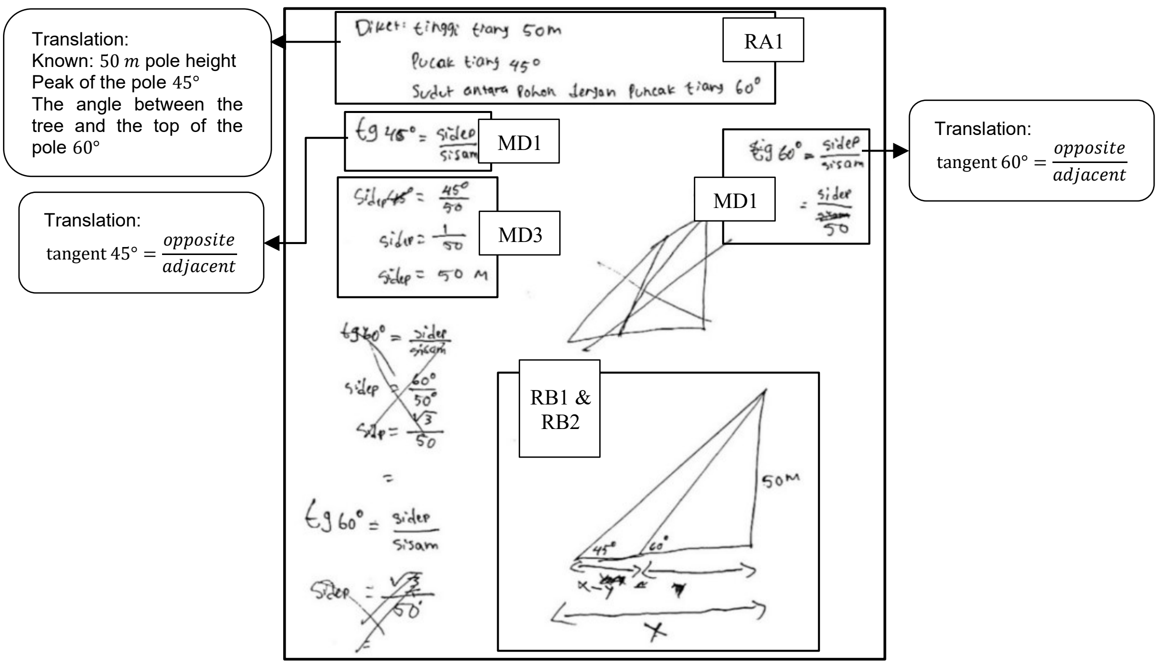

Figure 3. S2 Answer Sheet

Planning activity

As seen in Figure 3, S2 wrote the known problem seen in code RA1 supported by the subject who stated that he wanted to solve the problem, namely "the distance between a man and a tree then the known height of the pole is 50, the top of the pole is 45 degrees, and the top of the pole is 60 degrees". S2 also stated that if he was still confused about the problem S2 would "ask the teacher".

As seen in Figure 3, S2 also described mathematical modeling in the form of drawings and provided information on the RB1 & RB2 codes even though the information on the drawings he saw from his friends. S2 is able to consider the basic concepts needed before solving the problem by using trigonometric comparison. Furthermore, S2 can do the problem because he remembers being explained by the teacher where the problem is similar so S2 is able to remember the necessary solution steps.

Monitoring activity

As seen in Figure 3, S2 wrote the tangent comparison formula in MD1 code but the steps used were not coherent in MD3 code. S2 was able to consider the suitability of concepts relevant to the problem at hand supported by the subject who stated S2 used the tangent method "because there are only front and side sides, and in class, I was taught like that". S2 also checks each step by realizing the mistakes in the method used to solve the problem so that S2 is able to control the calculation of each step.

Evaluation Activity

Seen in Figure 3, S2 has not obtained the correct final result and has not made a conclusion from his answer. S2 made corrections to the solution steps and S2 thought of other ways when the steps obtained were still wrong supported by the subject who stated other methods to solve problems such as "using the cos formula but it will be more complicated".

S2 has not checked the suitability of the answer with what was asked then S2 thought of rechecking the method used to ensure the answer was correct supported by the subject who stated to be sure of the answer "look again at the method, and this 45 degrees is correct but 60 degrees is not correct". S2 has not looked for different strategies but can explain the method used can be used to find the same solution under the condition that the problem is the same.

Subject with Low Mathematics Initial Ability (S3)

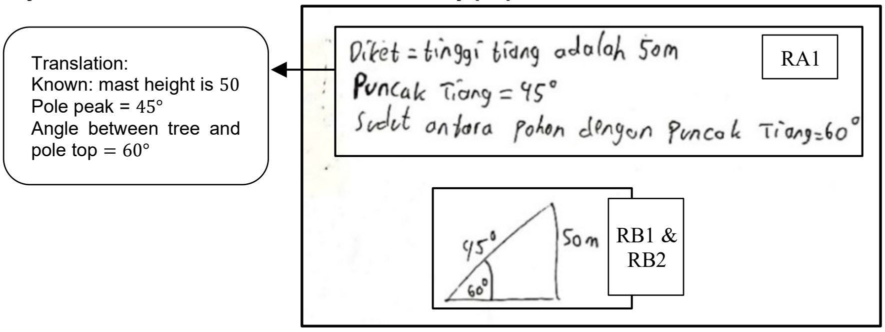

Figure 4. S3 Answer Sheet

Planning activity

Seen in Figure 4. S3 wrote down what was known as the problem in code RA1 and was supported by the subject who stated that the problem he wanted to find was "the distance between a man and a tree". S3 reads the problem many times if it is still confused by the problem.

S3 modeled the problem in the form of a picture on the RB1 code, although it was still not the right way to model the problem supported by the subject who stated: "how to draw this imitates the picture in the problem and then formed a line". S3 also provides notation information on the image in code RB2 but still does not exactly put the correct notation information. S3 has not considered the basic concepts needed before solving the problem.

S3 did not write anything to solve the problem and did not remember solving the problem given supported by the subject who stated "forgot" and had worked on the problem as given. So S3 did not think of a solution strategy that could be used.

Monitoring activity

As seen in Figure 4, S3 does not carry out consideration of the suitability of the concept, does not think of double-checking, and does not control the calculation of each step. This is because S3 has not thought of a solution plan and has not written any answers.

Evaluation activity

As seen in Figure 4, S3 also does not perform evaluation activities which include the stage of repair strategies if there are errors, evaluating the results obtained, and the method/strategy used to solve the problem.

The recapitulation of test and interview results from subjects with high, medium, and low initial mathematical abilities is presented in the following Table 4.

Table 4. Test and Interview Data Recapitulation

Mathematics Ability Level	Subject Code	Metacognition Activity	Metacognition Indicator	Description
High	S1	Planning (R)	RA1 RA2	All indicators met
Medium	S2		RB1 RB2	Indicator RB2 is not met
Low	S3		RB3 RC1 RC2	Indicator RB3, RC1, RC2 not met
High	S1	Monitoring (M)	MD1	All indicators are met
Medium	S2		MD2	MD1 indicator not met
Low	S3		MD3	Not fulfilled all indicators
High	S1	Evaluation (V)	VE1 VE2	Indicator VE2 is not met
Medium	S2		VF1 VF2	Indicators VF1 and VG1 not met
Low	S3		VG1 VG2	Does not fulfill all indicators

DISCUSSION

S1, S2, and S3 have different metacognition in solving HOTS problems in the context of the flag ceremony field. The differences in metacognition in students with high, medium, and low initial mathematics abilities are then discussed where each activity is given a different color, namely planning activities are given the color red, monitoring activities are given the color blue, and evaluation activities are given the color orange.

Metacognition of High Mathematics Ability Students (S1)

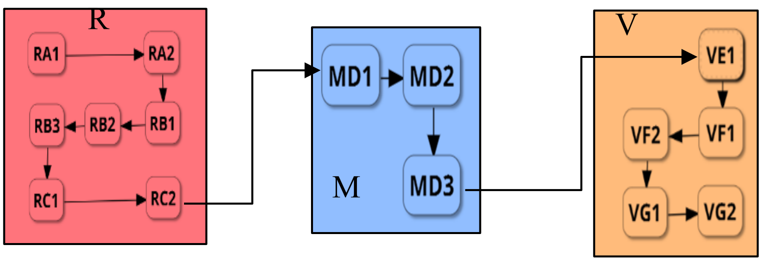

Figure 5. Flow of S1 Metacognition Ability

Planning activity (R)

As seen in Figure 5, S1 understands the meaning of the problem well so S1 is able to understand the problem by showing what is known and what is asked (RA1) this shows S1 can do good planning which will affect learning outcomes (Nasution et al., 2021), although S1 does not write it on the answer sheet. S1 has also reviewed the problem by reading it repeatedly (RA2). S1 analyzes the information asked well in the given problem, showing S1 has a high ability to solve problems (Izzati & Mahmudi, 2018; Muttaqin et al., 2020).

S1 presented the problem by making a mathematical model (RB1) by drawing straight lines from objects to other objects, and providing relevant notations and symbols (RB2). In accordance with research (Siagian et al., 2013) students try to convey problems using their own language, for example making analogies or modeling using symbols. S1 considers the basic concepts needed before solving HOTS problems (RB3) this shows S1 thinks about strategies to solve problems so that the right strategy will be obtained (Sutama et al., 2021).

S1 tried to remember solving similar problems (RC1) during math lessons. S1 is able to think metacognitive reflection because it is able to integrate previous experiences in the problem solving process (Baiq & Hidayati, 2024). S1 remembers the sequence of solution steps so that it can solve problems systematically (RC2) so that it can be said that S1 has high mathematical ability (Setyaningrum & Mampouw, 2020).

Monitoring activity (M)

The next metacognition flow is as shown in Figure 5, S1 designed a problem-solving strategy, considering the suitability of concepts relevant to the problem at hand (MD1). S1 plans the strategy by applying the tangent comparison formula from the consideration of what is known from the problem. This shows S1 has very good metacognitive knowledge because it tries to relate previously obtained information to help the solution process (Baiq & Hidayati, 2024). S1 used the formula to solve the HOTS problem until he got the right result (MD2). S1 controlled the calculation so that he was sure the answer was correct (MD3), although there were calculation errors in the second test.

Evaluating activity (V)

The next metacognition steps for subject 1 can be seen in the Figure 5, S1 is able to solve the problem and find the correct final result, although he has not given a conclusion on the answer. According to research (Baiq & Hidayati, 2024) the reason students do not write the conclusion of the final result or problem solving process is because students feel enough with the final result of the calculation. S1 evaluates by correcting the plan (VE1) at the evaluation stage (Santoso et al., 2021). However, S1 has not considered alternative methods if the method used produces the wrong answer because he thinks that the problem given only has one way of solving (Güner & Erbay, 2021) and S1 believes that the strategy used is correct (Ahmadah & Ekawati, 2021).

S1 checks the suitability of the answer to the problem given (VF1), this shows S1 performs metacognition (Purnomo et al., 2017). In addition, S1 double-checks (VF2) by verifying the subtraction results to determine the distance between a man and a tree.

S1 considered different alternative ways to solve the problem by looking for problems that have similar concepts (VG1), and thinking about whether the methods used can be applied to other similar problems (VG2). S1 has strong metacognition skills so that he can pass the stages of metacognition independently, at the planning, monitoring, and evaluation stages (Anwarudin & Dafik, 2019).

Metacognition of Medium Mathematics Ability Students (S2)

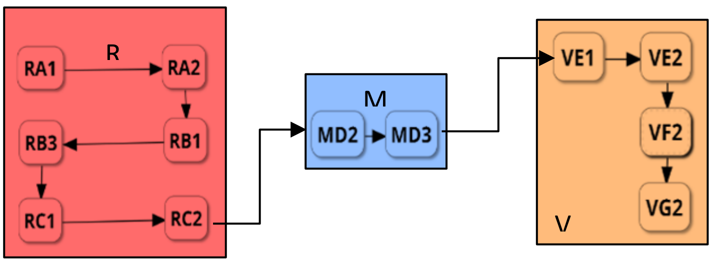

Figure 6. Flow of S2 Metacognition Ability

Planning activity (R)

Seen in Figure 6, S2 is able to collect known information and express what is asked in the problem (RA1). When the subject faces difficulties in understanding the problem, the subject reviews the given problem more than once (RA2), if necessary the subject asks and asks for help from the teacher. S2 presented the prerequisite material by making a mathematical model in the form of a picture (RB1). Although the subject has not been able to provide notation information on the drawings made, S2 is able to consider the basic concepts needed before solving the problem (RB3). In research (Tampi et al., 2017) students make problem plans usually done after students think about what is known related to the problem at hand but not only make plans but also determine the steps to answer the problem. S2 is able to utilize its metacognitive abilities well because it can determine the right strategy (Adinda et al., 2023).

S2 was able to solve the problem because he tried to remember working on the same problem before (RC1). S2 wrote the tangent comparison formula in the problem solving plan. However, on the answer sheet, the subject has not completed the calculation properly so that he has not succeeded in getting the results sought in the problem. S2 considered the steps used to solve the problem (RC2) but was still hesitant. In accordance with research (Wicaksono et al., 2021) where students who have moderate metacognitive abilities experience doubts in determining the steps used. S2's work steps are also not coherent and organized.

Monitoring activity (M)

The next metacognition flow is as shown in Figure 6, at the stage of controlling the implementation of problem solving activities, S3 checks each step sequentially (MD2) and is able to control the calculation of each step (MD3) until it is sure the answer is correct.

Evaluating activity (V)

The next metacognition steps for subject 2 can be seen in the Figure 6, S2 considers making corrections to the problem-solving steps (VE1), although it has not had time to complete it due to limited time. S2 realized the error in the solution used, this shows S1 using his metacognition skills (Exintaris et al., 2023). S2 also considered using other methods if the steps used were still not correct (VE2), despite realizing that the alternative could be more complicated.

S2 thought of rechecking the method used in the work to ensure the answer was correct (VF2). So, S2 evaluates the problem-solving strategy where S2 will make a conscious decision to correct the mistakes made (Suliani et al., 2024) when solving HOTS problems. S2 thought about whether the method used could be applied to solve similar problems (VG2). S2 showed an understanding of the strategies used in the context of other problems, although he had not explored alternative strategies.

Metacognition of Low Mathematics Ability Students (S3)

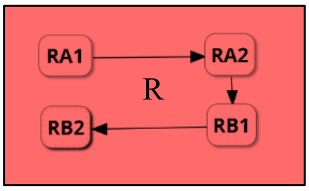

Figure 7. Flow of S3 Metacognition Ability

Planning activity (R)

As seen in Figure 7, S3 understood the problem by writing down the known and questionable information (RA1). The subject was able to consider how to understand the problem, although the information written down was not entirely correct. This shows that S3 has not used his metacognition skills well to be able to select important information to solve problems because HOTS problems require high reasoning so metacognition skills are needed to improve HOTS skills (Albab et al., 2020) and S3 failed to utilize his metacognition because he did not rethink the information in the given problem (Adinda et al., 2023). In addition, the subject can review the problem given by reading the problem more than once (RA2).

S3 makes mathematical modeling in the form of images (RB1) and provides information on the modeling made (RB2) even though the image modeling made is still not correct. S3 tried to provide information on the modeling. In accordance with research (Ikhsan et al., 2017) when students are faced with problems that are rarely given, students feel confused about converting them to the form of mathematical modeling. S3 does not write problem-solving strategies/plans in problem solving planning (Suliani et al., 2024). This will result in the subject not getting the final result to be sought in the given problem. In line with research (Sutama et al., 2021) students have difficulty in planning problem solving, so that student tasks often get the wrong answer. S3 does not try to remember previous experience in solving similar problems so the subject needs to improve the ability to plan problem solving strategies.

Monitoring Activity (M)

The next metacognition flow is as shown in Figure 7, S3 subjects do not perform monitor activities because they have not planned the problem-solving steps. S3 will stop at the planning stage because it has not planned problem solving. This is in accordance with research (Siagian et al., 2013) stating that students who do not make a solution plan, the work will stop at that stage, because there will be no completion without a proper plan.

Evaluating Activity (V)

The next metacognition steps for subject 3 can be seen in the Figure 7, S3 or students with low mathematical ability tend not to carry out evaluation activities (Suliani et al., 2024) and do not fulfill all indicators on evaluating activities due to difficulties in understanding the problems given (Salsabil et al., 2024) and do not know what strategy to use to solve the problem. In accordance with research (Kuzle, 2019) where students often have difficulty solving problems because they do not have the ability about strategies, tasks and goals or metacognition knowledge, so it can be said that the quality of metacognition is low. S3 did not explore the problems given and did not find the right solution to problems that S3 had never encountered before, this S3 did not utilize his metacognitive abilities (Lan, 2020).

In planning, students with high initial mathematical abilities can meet all indicators well. Meanwhile, students with medium and low abilities can meet the indicators but not completely. This planning activity is important to be carried out properly so that students can understand the problems given (Albab et al., 2020). In monitoring, students with high initial mathematical abilities can meet all indicators well. Students with medium abilities can meet the indicators but not completely, while students with low initial mathematical abilities do not meet all indicators. This monitoring activity is also an important activity to do because students must exercise control in implementing problem-solving strategies (Chapman, 2015). In evaluating, students with high and medium initial mathematical abilities can meet the indicators but not completely. Meanwhile, students with low initial mathematical abilities do not meet all indicators. This evaluation activity is highly dependent on the planning and monitoring activities carried out by students (Spangenberg & Pithmajor, 2020; Salsabil et al., 2024). If students can plan and monitor well, then students have the opportunity to carry out evaluation activities well.

CONCLUSIONS

Based on the research and discussion that has been carried out, it can be concluded that students' metacognition abilities on Trigonometric Comparison material are viewed from Initial Mathematical Ability. Students with high initial mathematical ability show good metacognition skills in solving HOTS problems in planning, monitoring, and evaluating activities. However, they still need to improve their ability to evaluate the repair strategy if there is an error. Students with medium initial mathematical ability showed good metacognition skills in several aspects, but needed to improve some aspects. Students with moderate mathematics ability have a good basic understanding of metacognition in planning activities. However, they need to improve their metacognition skills in monitoring and evaluating when solving HOTS problems. Meanwhile, students with low initial mathematics ability show limitations in utilizing metacognition skills and are less optimal in planning, monitoring and evaluating activities. As a result, students experience difficulties in solving problems due to a lack of understanding of the problem, the strategies that should be used, and the lack of utilization of metacognition skills. For this reason, teachers need to design teaching materials that can improve students' mathematical abilities and metacognition.

Based on this, teachers are advised to adjust learning strategies to students' initial mathematical abilities, and provide feedback to help reflect on the learning process. The use of interactive technology can also be utilized to increase student engagement in training metacognition. Future research can focus on the long-term impact of metacognition training, and perhaps integrate technology to strengthen students' metacognitive skills in solving HOTS problems.

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