JURNAL PENDIDIKAN MATEMATIKA (JPM)
Vol. 11, No. 1, 2025, pp 01–12 e-ISSN: 2656–4564
https://doi.org/10.33474/jpm.v11i1.22341
online at: https://riset.unisma.ac.id/index.php/jpm/article/view/22341

MATHEMATICAL PROBLEM-SOLVING ABILITIES WITH A METACOGNITIVE APPROACH AT HIGH SCHOOL STUDENTS

Dini Okta Amelia[1], Alfiani Athma Putri Rosyadi[2*], Akhsanul In'am[3]
[1,2,3]*Universitas Muhammadiyah Malang, Indonesia*
Email: [1] diniokta@webmail.umm.ac.id, [2] alfi_rosyadi@umm.ac.id, [3] akhsanul@umm.ac.id

ABSTRACT

Problem solving is a sequence of mental processes for resolving an issue varying from comprehending the problem to reassessing the outcomes of addressing the problem. The purpose of this study was to determine the mathematical problem-solving abilities of students with high, medium, and low metacognitive approaches. This investigation is a descriptive study using a qualitative method. The participants in this research were students of the 10th grade of Maarif Lawang High School, comprising 6 individuals. Data gathering methods in the shape of assessments and paired discussions. Data interpretation methods are carried out through data collection, data compression, data display, and inference drawing. The findings revealed that learners in the high category fulfilled all signs ranging from the first to the fourth, and learners in the moderate categories fulfilled one to three signs on each query. In contrast, learners in the low category only met one distinct sign on each provided query. The inference is that learners in the high category fulfill all metacognitive signs, learners in the moderate category fulfill only three signs, and learners in the low category fulfill various signs. Recommendations for future researchers are encouraged to conduct further investigations with progressively extensive and diverse participants to ensure the acquired information is more comprehensive.

Keywords: Problem-solving skill, Mathematic, Metacognitive

*** Corresponding Author Email:** alfi_rosyadi@umm.ac.id

Submission	Revised	Accepted	Published
August 6, 2024	September 10, 2024	Oktober 2, 2024	March 27, 2025

How to cite (in APA style):
Amelia, D. O., Rosyadi, A., & In'am, A. (2025). Mathematical Problem-Solving Abilities with a Metacognitive Approach at High School Students. *Jurnal Pendidikan Matematika (JPM)*, *11*(1), 01–12. https://doi.org/10.33474/jpm.v11i1.22341

INTRODUCTION

The expression metacognition or metacognitive is frequently utilized in the realm of Education, as per Flavell metacognitive capacity is the capability that pertains to an individual's consciousness of his thought processes to plan, monitor, and assess his actions (Murtiyasa & Anggraini, 2022). This metacognitive consciousness pertains to an individual's consciousness of their position in the learning process or problem-solving, the specific knowledge they possess about the material, and their knowledge of personal learning strategies or problem-solving. Furthermore, metacognitive consciousness necessitates an understanding of the actions that have been executed and those that may be undertaken to achieve the goal (Kuzle, 2019). It is also posited as the capability to manage and evaluate those processes (Bal & Doğanay, 2022). Metacognition is an individual's consciousness of their cognitive processes that encompasses learners' comprehension of their thought processes as well as their capability to employ suitable learning strategies effectively (Farida Jamil et al., 2023). Metacognitive capacities are the brain's capability to think, manage information, and resolve problems that

constitute the basis of our daily activities. The metacognitive capability involves learners' comprehension and beliefs about how they think in comprehending the material to be understood. This capability also encompasses their conscious endeavours to engage in thoughts and actions that can enrich their memory and learning processes (Rustina & Muzdalipah, 2023). Consciousness relates to an individual's consciousness of the problem-solving process, the specific knowledge one possesses about the problem at hand, as well as knowledge of the strategies that can be utilized to resolve the problem. This consciousness also encompasses an understanding of steps that might be taken in resolving mathematical problems (Sukiyanto, 2020). Metacognition supports learners in the optimal utilization of knowledge and strategies. This process commences at an early age and evolves to become more intricate over time (Güner & Erbay, 2021).

A comprehension of metacognition has been acknowledged as a crucial component in the learning process. Numerous researchers have underscored its notable impact on academic outcomes. For instance, experts have conducted a multitude of studies exploring cognitive skills such as metacognition, and how it influences achievement in mathematics. A learner who has a consciousness of metacognition possesses strategies for knowing the things they need to know. Mathematical learning encompasses a variety of abilities such as critical thinking, problem solving, analysis, and reasoning. To learn mathematics effectively, a profound understanding of mathematical concepts and skills such as metacognition is imperative. In this context, the researchers deduce that there is a correlation between metacognition and mathematical learning. Some studies have also indicated that metacognition is associated with performance in mathematics. Knowledge of metacognition and intelligence in mathematics has a substantial impact on academic outcomes, and there is a correlation between metacognitive comprehension and excellence in mathematics (Sercenia et al., 2023).

Metacognitive capacities strive to enrich an individual's capability to control their mind toward a given task. When learners already possess metacognitive knowledge, then they will have added value in their learning process that is not merely confined to memorizing the subject matter alone. In cognitive activity, individuals undergo an internally running flow of information where the execution of that information becomes a pivotal prerogative. The study of mental processes and endeavours to cultivate consciousness about their cognitive processes, by exploring how individuals acquire information (Akbayir et al., n.d.). The acquisition process frequently entails misunderstandings, notably those grasped by scholars and communicated by educators. Nevertheless, through this capacity, we can supervise the advancement of learners' thinking so that we can elucidate how they reason and react (Winarti et al., 2022). Scholars who can construct a knowledge framework and possess the capability to transfer knowledge are those who have comprehended learning tactics, have an awareness of cognitive assignments, and have familiarity with their traits, and all of these components are encompassed in metacognitive comprehension (Khusna et al., 2022).

Metacognition plays a crucial role in the acquisition process, particularly in deciphering mathematical dilemmas. Issue resolution is a cooperative approach to discovering and employing new and intricate resolutions to challenging scenarios. Nevertheless, embracing the paradigm necessitates modifications to enhance issue-solving proficiencies (Yunus et al., 2021). According to Muksin et al. (2020), issue resolution is an endeavour or procedure to counteract or surmount hindrances and impediments when a response or resolution method is not yet evident. The scholars' capacity to comprehend the presented information as well as the capacity to apply pertinent tactics to ascertain the resolution of a given dilemma (Purnomo et al., 2022). The predicaments provided are not solely inquiries with solutions that can be promptly determined by the learner. Instead, the declaration is a form of dilemma that demands resolution with non-routine procedures, which ultimately becomes a trial for learners (Khasanah, 2021). The predicaments that emerge in issue resolution are atypical, infrequent,

and are something innovative for learners. Issue-solving proficiencies encompass the capability that an individual requires to solve predicaments when confronted with demanding situations. Issue resolution is a fundamental facet of an individual's cognitive functioning. How an individual perceives himself also plays a crucial role in the evolution of issue-solving proficiencies. Additionally, at times individuals resolve predicaments with a trial-and-error approach, while at other times they utilize the scientific method. This procedure is intricate and it is recommended by specialists that it be conducted gradually since segmenting the issue-solving procedure into phases can facilitate instruction and learning (Toraman et al., 2020).

In the context of issue resolution, metacognition and the capability to address predicaments collectively are indistinguishable. Metacognition emerges when an individual is confronted with an unfamiliar predicament, uncertainty, question, or quandary. Metacognitive abilities can bolster learners in making precise, diligent, logical decisions, and contemplating various perspectives (Safitri et al., 2020). This capacity amplifies success in resolving predicaments by enabling individuals to regulate their thought processes more efficiently. Metacognition can also enrich a person's capacity to identify and comprehend predicaments, as well as devise and implement the strategies needed to resolve those predicaments (Suryaningtyas & Setyaningrum, 2020). A customary set of actions undertaken by learners in issue resolution encompasses the capacity to comprehend predicaments, devise solutions, implement issue-solving schemes, and the capacity to ponder back on the issue-solving process (Muhali et al., 2020).

Issue resolution is fundamentally a fusion of cognitive activities and comprehension configurations utilized to discover methods to resolve predicaments. Recognizing the cognitive activities and comprehension configurations of learners when they resolve predicaments can offer insight into the tactics employed (Aziz & Akgül, 2020). The extent of the metacognitive capacity of learners can be manifested and evaluated through the phases of resolving mathematical issues. Learners with elevated levels of metacognition are inclined to be more proficient at issue resolution compared to learners with low metacognition. Learners with high metacognition exhibit superior competencies in comprehending the correlation between facts and issues, as well as in choosing suitable issue-solving approaches. Proficiencies in resolving such issues differ as each learner possesses a distinct degree of metacognitive and speed of thinking. Thus, this implies that the range of metacognitive capacity held by each learner is also varied (Syamsuri & Mia Aprilia, 2022). Successful issue-solving competencies can be attained by providing learners with the chance to apply metacognitive tactics as they encounter issues.

Issue-solving capacity entails the learner's cognitive process to identify the appropriate strategy for resolving an issue. The function of metacognition in the issue-solving process is that it necessitates special consideration from top educators to aid learners in enhancing their issue-solving competencies. Each learner exhibits diverse issue-solving competencies, hence to achieve optimal outcomes in issue resolution one must undergo well-structured issue-solving actions (Rustina & Muzdalipah, 2023). The resolution of challenges in mathematical education, as in numerous other domains has a repercussion that can be perceived and mirrored in an individual's daily existence. When learners trained in issue resolution undergo an educational process, they become more proficient at encountering and resolving intricate issues in the tangible world outside of the academic setting. The more they are trained in this capacity, the more effectively they surmount the intricate challenges they encounter in everyday life (Şimşek et al., n.d. 2020). Issue resolution holds a substantial influence in an educational context because it aids students in enhancing their cognitive capacities. One of its fundamental facets is adeptness in issue resolution, which enables students to apply mathematical knowledge from fundamental concepts to more intricate levels methodically, as well as utilizing information from prior learning encounters (Mayasari et al., 2021). To address the issue-solving process it

is insufficient to solely focus on its cognitive aspect, but it is also imperative to assess metacognition as a critical element in the issue-solving process. Given the significance of adequate consciousness linked to such knowledge in addition to cognitive knowledge in the issue-solving process. Moreover, it is imperative to conduct verification, planning, monitoring, and evaluation during the completion process (Beydili & Baş, 2022).

Numerous investigations have been carried out concerning issue resolution with metacognitive methodologies, (Ratu & Moza, 2024) assert with metacognitive comprehension, learners can be adept in devising the best strategies for selecting, retaining, recollecting, organizing the information they possess, and resolving issues at hand. Kurnia et al. (2023) affirmed that metacognitive methodologies play a pivotal role in enhancing issue-solving skills, with this methodology anticipated to prompt learners to acknowledge their thought processes as well as enhance their capacity to resolve mathematical issues.

Research on cognitive strategies for solving problems is crucial in educational settings because metacognition involves comprehension and control of one's cognitive processes. This approach offers a thorough insight into how students actively participate in their cognitive processes while encountering mathematical challenges. By grasping the metacognitive stages in problem-solving, educators can develop more efficient teaching techniques to enhance students' mathematical problem-solving abilities. Within the problem-solving domain, metacognitive strategies unveil a deeper understanding of how individuals tackle and resolve issues. This investigation creates possibilities for shaping a more adaptive and innovative syllabus, thereby contributing to the attainment of holistic educational objectives. Consequently, this study seeks to explore mathematical problem-solving skills using a metacognitive strategy.

METHOD

This research is an explanatory investigation with a qualitative methodology in row and sequence material learning. Data interpretation methods in this investigation involve various aspects such as data gathering, data interpretation, and inference drawing. The subjects in this study were 6 students of class X of SMA Maarif Lawang who were taken from the average scores of assignments, daily tests, mid-term and final exams. The tool in this investigation is a problem-solving capacity examination. The format of the examination in this research is a composition consisting of three inquiries, the examination problem employed is the Matrices Mathematics Olympiad (MMO) problem of 2023, which has undergone the validation stage and also trials. Subsequently, this inquiry is presented to each set of learners for each medium high, and low classification.

The data-gathering method is executed by providing each pair an examination based on a predetermined metacognitive classification based on the mean of mathematics grades acquired from the instructor. The examination was conducted for 45 minutes on each pair, the execution of this examination was carried out by deliberating with the collaborators. Deliberation in the execution of this examination is referred to as a paired dialogue. Evaluation of the results of the investigation is carried out on the grounds of the criteria inscribed in the subsequent.

Table 1. Metacognitive gauges and criteria

No.	Steps	Indicator
1	Realize	Students comprehend their actions
2	Planning	Learners ascertain the appropriate course of action in problem-solving

3	Cognitive strategy	Learners reassess the outcomes of the implementation indicators that have been utilized
4	Rechecking the result	Learners reassess the outcomes of the implementation indicators that have been utilized.

The examination outcomes will then be examined based on the signs that have been documented in Table 1. Techniques for data scrutiny in this investigation include data gathering, data compression, data demonstration, and also conclusion deduction. In the initial phase, data gathering is executed by providing learners with a prepared inquiry. The steps of data compression are carried out in a manner that simplifies the data that has been acquired. Subsequently, the stages of data demonstration are executed by amalgamating the outcomes of data scrutiny for each metacognitive grouping. Then at the ultimate phase is the deduction of conclusions, which is executed by scrutinizing the data that has been acquired with the signs that have been formulated. The diagram of the stages of this investigation is illustrated in Figure 1.

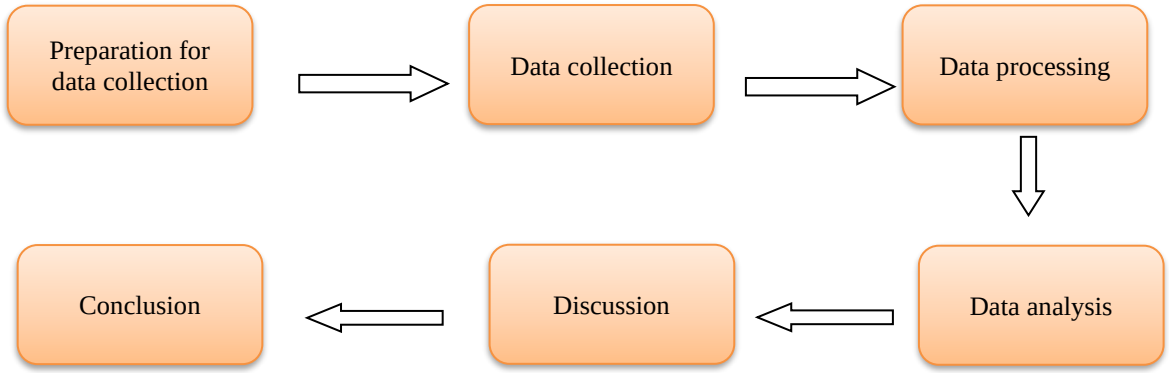

Figure 1. Diagrams of exploration flow

The explanation of the diagram in Figure 1 is as follows, initially the preparation of data collection. In this initial phase, what the scholar accomplishes is selecting the data-gathering approach that corresponds to the aims of the analysis, which is employed in this investigation are exams and discussions. Subsequently, after determining the approach to data gathering, the creation of tools is executed, the content of which corresponds to the exploration to be conducted. After the tool is finished, the planning of the timetable and site of data gathering is prepared and ensures that the site matches the requirements of the scholar. After acquiring the suitable site, then arrange for the on-site authorizations to be executed for data gathering and communicate the exploration plan to the relevant individuals at the location. In the subsequent phase, which is data collection, data collection is executed according to a previously formulated plan. Data retrieval time is adapted to the scholar's requirements in obtaining data. The third phase is data processing, the data already acquired in the subsequent phase will be processed by categorizing data for each metacognitive grouping, at this phase also identification of absent or deficient data is executed to undergo the following stage. The fourth phase, which is data analysis, this phase is executed by recognizing the data of the outcomes of the investigation and also linking the variables with Table 1, the data scrutiny carried out in this analysis utilizes narration so that it does not necessitate other applications to scrutinize it. The fifth phase is the discussion, the outcomes of the data analysis in the previous phase will be expounded in detail at this stage by delineating the outcomes of the data scrutiny into the context of the exploration question. Moreover, at this stage the outcomes of the riset we have acquired will also be

juxtaposed with other riset or prior riset to determine whether the outcomes acquired by scholars are pertinent to other researchers, this can aid in fortifying the discoveries and ascertain the contribution of the to existing knowledge. At this stage, the researcher's findings will also be explained which emerged from the data that has been explained. The final stage is concluding, at this stage the researcher combines the results of data analysis and discussion to obtain clear and comprehensive findings and explains how the conclusions are related to the research questions. Conclusions include identifying patterns or relationships that emerge from data presented concisely and systematically.

RESULT

The unveiling and examination of the data utilized to delineate the discoveries in this investigation stemmed from paired interviews of the students while engaging with the provided test inquiries, video recordings, and also audio recordings captured during the process, and observations noted by the researcher regarding the subject during the process. This scrutiny was carried out to discern how to address learners' mathematical issues with a metacognitive methodology. The metacognitive cues to be scrutinized are consciousness, planning, and cognitive methodologies, and the final one is to reassess the outcomes of the responses. The ensuing segment presents the outcomes of the responses and also the data scrutiny of the outcomes of paired interviews in each classification:

Subjects with high categories

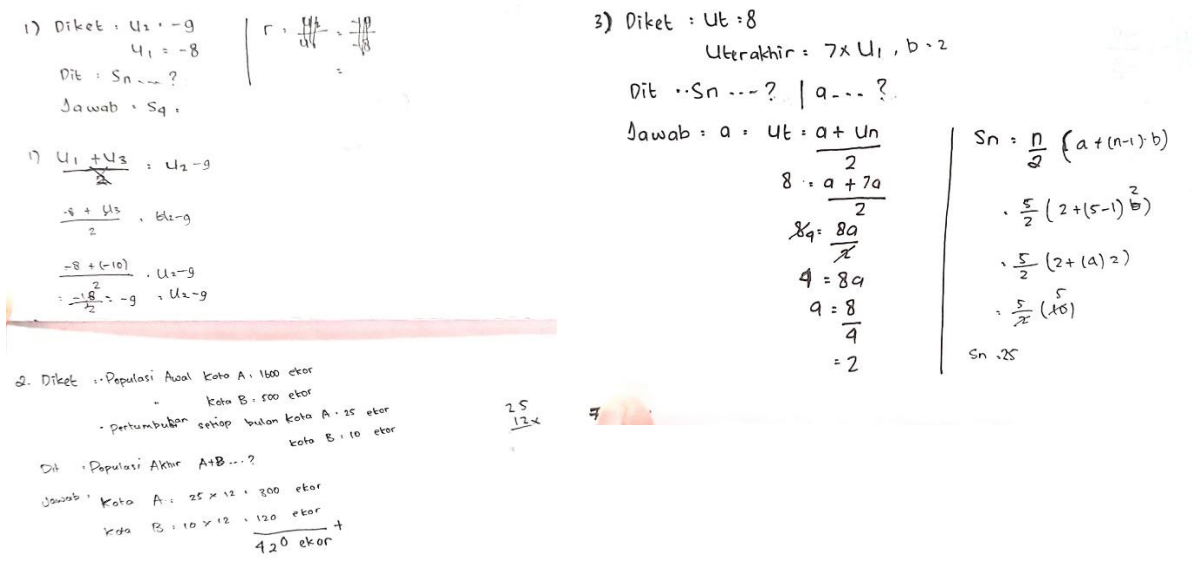

Figure 2. Subject answers in the high category

As per Figure 2, it can be observed that learners with elevated metacognitive levels can fulfill four cues in all instances. The initial cue of comprehension can be perceived by inscribing know, inquire, and respond. The primary and secondary cues were satisfied according to the video footage as there was a deliberation, there was one excerpt of the conversation as below:

FSA : beyond the inquiry, it is known that $U_2 = 9$ *and* $U_1 = -8$*, and asked* S_n

LSR : implies that the mean acknowledged equation is inscribed initially and then computed affirmatively to ascertain the subsequent term, thus it can be pursued

In the conversational segment, it is evident that FSA subjects satisfy the initial cue of comprehending the issue, analyzing what is acknowledged and what is queried. Conversely, the LSR subject satisfies the secondary cue which is in the planning phase, from the subject's declaration it can be discerned that the subject is strategizing what measures will be utilized to resolve the issue on the query. Moving forward to the tertiary cue we can perceive in figure 1, after the planning that has been executed to acquire a response from the computations that have been carried out. The ultimate cue which is re-evaluation is accomplished if it is assessed based on the researcher's observations since they consistently prompt each other to double-check the outcomes of the responses that have been resolved. The dialogues conducted by FSA and LSR subjects who were deemed proficient in fulfilling the fourth cue were as below:

FSA : Is this the correct result?
LSR : Yes, that's right.
FSA : try checking again
LSR : I already did.

Subject in the medium category

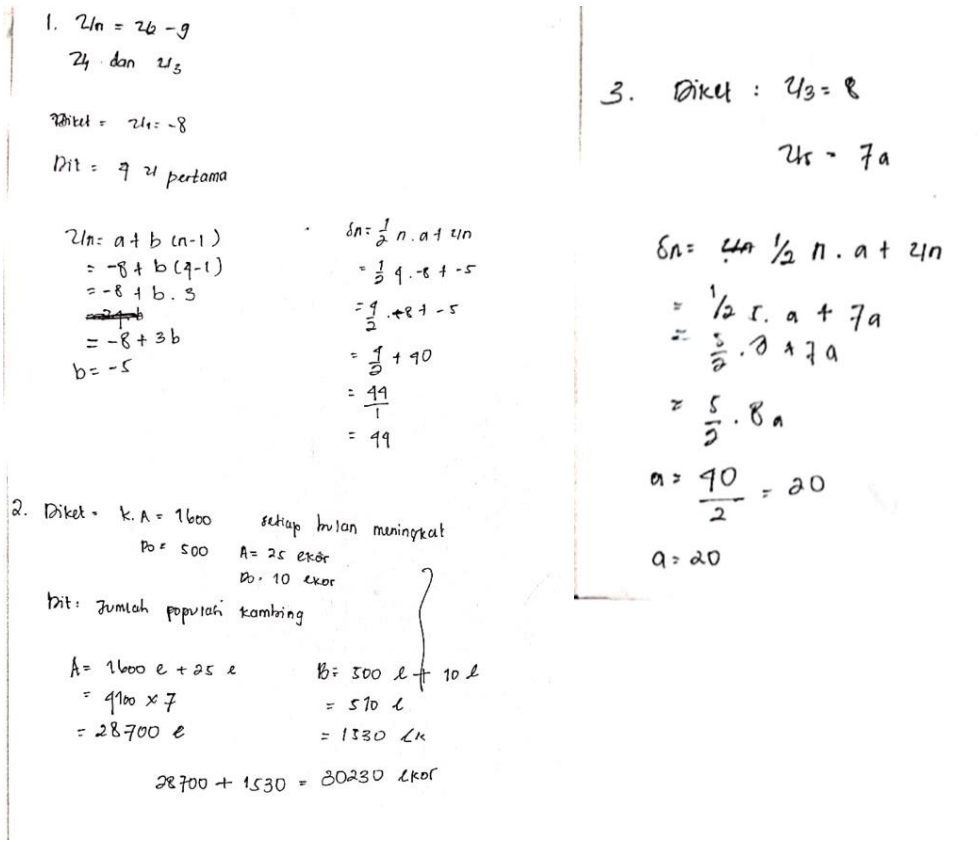

Figure 3. Subject answers in the medium category

Based on Figure 3, it can be observed that learners with moderate metacognitive levels can fulfill all three cues in all instances. The initial cue of understanding can be perceived from inscribing what is acknowledged and inquiring about the problem so that they comprehend what is asked in the inquiry thereby meeting the initial cue. The secondary cue was fulfilled according to the video recording as there was a discussion, there was one excerpt of the conversation as below:

SA : This is to find the number of each city first, then add them up, right?
J : Yes

In the dialogue fragment, it is evident that the duo is engaged in the formulation of strategies to address the issue, which pertains to achieving the third criterion. Upon closer inspection of the third criterion through the lens of Figure 2, they adhere to a predetermined scheme to derive solutions from the computations conducted. Conversely, in terms of the final criterion of reassessment, there is a deficiency noted when scrutinized based on the researchers' observations, as there is an absence of mutual prompts to review the outcomes of the solutions deliberated for all the inquiries tackled. Consequently, the participants within this intermediate classification only satisfy three criteria.

Subject in the low category

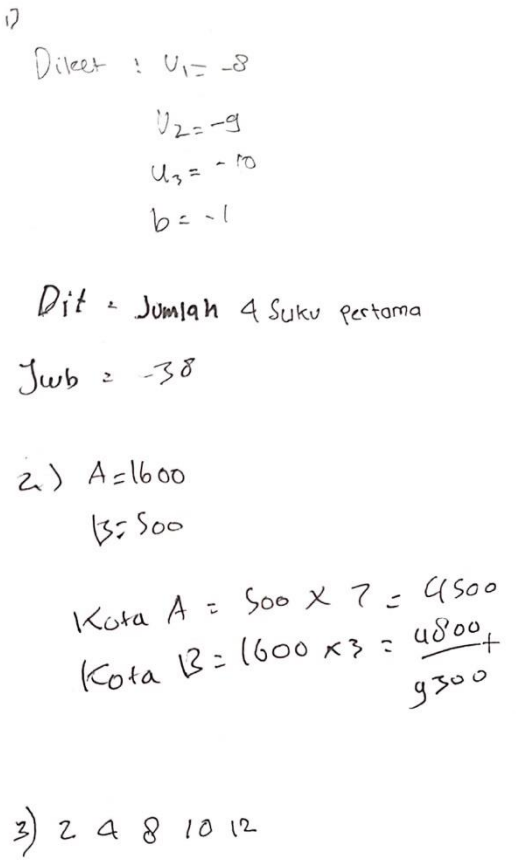

Figure 4. Subject answers in the low category

Illustrated in Figure 4, it is discernible that in the first instance, only one criterion, specifically the initial one, is fulfilled. The subjects in the low proficiency group can comprehend and document the known information and queries posited in the problem; however, the subsequent two criteria are unmet as they directly transcribe responses without implementing any completion scheme or cognitive strategy. Subsequently, in the second scenario, the second criterion is fulfilled, as deduced from the researcher's observations of a particular conversational excerpt:

TA : This is multiplied and then added.
SK :Yes, just write it down.

Subsequently, the learner conducts computations by the devised plan, thereby verifying the fulfillment of the third criterion. The third scenario fails to adhere to the first, second, and third criteria, as solely a sequence of numerals is inscribed on the response sheet. Moreover, the fourth criterion in the low proficiency bracket remains unsatisfactory, as the pairs in this

category neglect to engage in cross-verification, merely engaging in discussions with their partners to validate their resolutions, albeit without follow-through. The conversational snippets from this participant are as follows:

TA : Isn't this checked first?
SK : No need to go already

From the excerpt, it is apparent that individuals in the lower proficiency tier exhibit unwavering confidence in their finalized outcomes despite the absence of reevaluation, which is a prerequisite for fulfilling the fourth criterion.

DISCUSSION

The initial action undertaken by students when tackling a problem typically involves comprehending the problem statement, recording the pertinent details, formulating queries, devising a solution strategy, executing the planned strategy, and ultimately reassessing. Based on the study's outcomes, it was ascertained that participants classified as having high proficiency levels consistently meet all four metacognitive criteria. This phenomenon can be attributed to the adeptness of high-proficiency participants in discerning the requisite problem-solving steps, bolstered by effective collaborative interviews or discussions that foster mutual assistance and comprehension-sharing in cases of ambiguity. Furthermore, individuals in the low proficiency category exhibit a meticulous approach toward their documented conclusions, as substantiated by researchers' observations of multiple cross-verification instances of their derived responses. Participants falling within the moderate proficiency range fulfill the first three metacognitive criteria, encompassing comprehension, planning, and cognitive strategy. They adeptly grasp and transcribe the relevant problem elements, strategize the requisite solution approach, and diligently execute the planned procedural steps. However, the final criterion remains unmet within the moderate category, as during paired interviews, there is an absence of reminders to cross-verify the accuracy of their responses, with discussions often being dominated by a solitary participant. This occurs because these intermediate category pairs are masculine and feminine, they are also equally reserved so by the analysts' examination both aspects influence their discourse process. Concerning the lower category, it satisfies solely the initial cue in query number 1, for number 2 it satisfies the subsequent and third cues, and number 3 fails to satisfy any cue. Consequently, the outcomes derived from this lower category are diverse. This occurs because the subjects with lower categories are not earnest concerning the issue, they merely jot down whatever comes to mind, and desire to resolve it promptly. For paired conversations within this classification, it emerges that solely one individual contemplates, one other individual does not earnestly endeavor on it and consistently desires to jot down responses without elaboration or computation.

Assessing the outcomes of the pupils' responses, there were 66.6% of pupils systematically utilized the primary to third cues, specifically subjects with elevated and intermediate categories. For the fourth cue, only 33.3% of me put it into practice i.e. subjects with elevated categories. Whereas the subjects of the intermediate and lower categories did not re-evaluate the responses that had been acquired. This indicates that solely high-category subjects were optimal in resolving predicaments by metacognitive cues, whereas intermediate and low-category subjects were not optimal in resolving predicaments corresponding to metacognitive cues.

On the grounds of this depiction, it can be inferred that not all scholars can resolve arithmetical dilemmas employing metacognitive cues. Scholars' predicament resolution is executed in a myriad of methods that are influenced by their manner of cogitation. The discoveries from this exploration manifested that scholars with elevated levels of metacognitive capability were capable of applying their metacognitive competencies efficaciously. This is consistent with the exploration that has been conducted by Murtiyasa & Anggraini (2022) which articulates that scholars with elevated metacognitive levels can utilize their metacognitive adeptly since scholars with commendable metacognitive learning procedures are not confined to the rote of the subject matter unaided. These findings are also validated by an exploration that has been carried out by Waskitoningtyas (2020) which states that scholars' mathematical resolving capabilities through metacognitive methodologies are superior to traditional learning. Another exploration conducted by Adinda et al. (2023) articulates that the proficiency of high-category scholars can unravel the dilemma of effortlessly distinguishing precise information by

employing efficient tactics. Another research conducted by (Malaysıan Onlıne Journal Of Educatıonal Scıences, n.d.) explains that metacognitive abilities can improve problem-solving performance, because metacognitive abilities can increase awareness of how to learn. The outcomes of paired conversations or group discussions will simplify for pupils to unravel the designated predicaments since they can deliberate with their comrades and can interchange viewpoints to secure a resolution to the provided dilemma. This is by exploration conducted by Tachie (2019) asserting that scholars can resolve predicaments more effortlessly through group discussions and can articulate their musings to their comrades. Exploration conducted by Sholihah et al. (2022) articulates that having group discussions will render scholars self-reliant in predicament-solving. This occurs because, during a discourse, we contemplate the act of sharing our viewpoints collectively with our cohort rather than merely awaiting the resolution like when the instructor elucidates the answer, in which case our only action is to observe and listen to the solution procedure. Consequently, this approach of collaborative discussion within a group is deemed highly efficient in the resolution of mathematical issues.

CONCLUSION AND SUGGESTIONS

From the research that has been conducted, it can be concluded that there is an urgent and important need to improve metacognitive capacity among students at various levels. This need arises from the results of observations that show that only students at the upper level are able to effectively fulfill all the metacognition indicators given effectively, while students at the middle level are only able to fulfill three metacognition indicators, and students at the lower level are only able to fulfill one metacogition indicator for each problem given. The results of this study are increasingly important for students to develop a deeper understanding and more advanced skills in applying advanced metacognitive principles in their learning. This finding highlights the importance of the function of metacognitive capacity in the process of solving mathematical problems, especially in the context of education.

The results of this study provide invaluable guidance for educators in designing and developing educational schemes that are not only centered on mathematical problem-solving tasks, but also strengthen students metacognitive abilities. In addition, in the context of onging scientific and research developments, it is hoped that future research will involve more diverse subjects and larger sample sizes. With this approach, it is hoped that the research result obtained will be more comprehensive, representative, and able to provide a more comprehensive understanding of the importance of metacognitive capacity in mathematics education.

REFERENCES

Adinda, A., Purnomo, H., Rahmatina, D., & Siregar, N. C. (2023). Characteristics of Students' Metacognitive Ability in Solving Problems using Awareness, Regulation and Evaluation Components. Jurnal Didaktik Matematika, 10(1), 48–62. https://doi.org/10.24815/jdm.v10i1.29041

Akbayir, K., Topçul, İ., Akbayır, K., & Yıl, Y. (n.d.). Special Issue 1: Primary and Secondary Education. Education Quarterly Reviews, 4, 617–626. https://doi.org/10.31014/aior.1993.04.02.272

Aziz, T. A., & Akgül, M. B. (2020). Proses Kognitif dan Metakognitif Siswa dalam Memecahkan Masalah Matematika. Jurnal Riset Pendidikan Matematika Jakarta, 2(2), 71–86. https://doi.org/10.21009/jrpmj.v2i1.10446

Bal, A. P., & Doğanay, A. (2022). Problem-Solving and Students' Use of Metacognitive Skills. Educational Policy Analysis and Strategic Research, 17(4), 142–163. https://doi.org/10.29329/epasr.2022.478.7

Beydili, R., & Baş, F. (2022). Metacognitive Behaviours of Eighth Grade Students With Different Mathematics Achievement Levels During Problem-Solving Process Conditions Of The Creative Commons Attribution License (CC BY-NC-ND) (http://creativecommons.org/licenses/by-nc-nd/4.0/). In International Journal of Curriculum and Instruction (Vol. 14, Issue 3). https://orcid.org/0000-0002-0035-4912

Farida Jamil, A., Yuli, T., Siswono, E., & Setianingsih, R. (2023). The Emergence and Form of Metacognitive Regulation: Case Study of More and Less Successful Outcome Groups in Solving Geometry Problems Collaboratively. In Mathematıcs Teachıng Research Journal 25 Early Sprıng (Vol. 15, Issue 1).

Güner, P., & Erbay, H. N. (2021). Metacognitive Skills and Problem-Solving. International Journal of Research in Education and Science, 715–734. https://doi.org/10.46328/ijres.1594

Khasanah, N. (2021). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Quitters Ditinjau dari Kemampuan Metakognitif. Pythagoras Jurnal Pendidikan Matematika, 16(1), 44–58. https://doi.org/10.21831/pg.v16i1.34509

Khusna, A. H., Baiduri, B., & Pratama, A. (2022). Analısıs Kreatıvıtas Sıswa dalam Menyelesaıkan Soal Open Ended Dıtınjau darı Kemampuan Metakognıtıf. Aksıoma: Jurnal Program Studi Pendidikan Matematika, 11(1). https://doi.org/10.24127/ajpm.v11i1.4470

Kurnia, T., Pujiastuti, H., & Fathurrohman, M. (2023). Kemampuan Pemecahan Masalah Matematis dengan Pendekatan Metakognitif: Systematic Literature Review. JIIP - Jurnal Ilmiah Ilmu Pendidikan, 6(1), 616–622. https://doi.org/10.54371/jiip.v6i1.1398

Kuzle, A. (2019). Second Graders' Metacognitive Actions in Problem Solving Revealed Through Action Cards. In The Mathematics Educator (Vol. 28, Issue 1).

Malaysıan Onlıne Journal Of Educatıonal Scıences. (n.d.). http://mojes.um.edu.my/EISSN:2289-3024

Mayasari, D., Natsir, I., & Taufik, A. R. (2021). Analysis of Students' Mathematical Problem-Solving Ability in Term of Multiple Intelligence. Jurnal Didaktik Matematika, 8(2), 250–266. https://doi.org/10.24815/jdm.v8i2.20369

Muhali, M., Asy'ari, M., & Sukaisih, R. (2020). Analisis Kemampuan Regulasi Kognisi Peserta Didik dalam Pembelajaran. Empiricism Journal, 1(2). https://doi.org/10.36312/ej.v1i2.333

Muksin, M., Siswono, T. Y. E., & Ekawati, R. (2020). Pengaruh Model Pembelajaran Pair Cheks Berbasis Tugas Pengajuan Masalah terhadap Kemampuan Pemecahan Masalah Matematis Siswa. Jurnal Didaktik Matematika, 7(2), 188–199. https://doi.org/10.24815/jdm.v7i2.17334

Murtiyasa, B., & Anggraini, O. R. (2022). Metacognitive Identification in Solving Mathematics Problems of Junior High School Students. Al-Ishlah: Jurnal Pendidikan, 14(4). https://doi.org/10.35445/alishlah.v14i4.1808

Purnomo, D., Sunuyeko, N., Rochsun, R., Sumarti, E., Pradipta, A. W., & Hindun, N. (2022). The Effectıveness of Vırtual Metacognıtıve Learnıng to Analyze Student Awareness, Evaluatıon, and Regulatıon Processes in Problem Solvıng. Aksıoma: Jurnal Program Studi Pendidikan Matematika, 11(4). https://doi.org/10.24127/ajpm.v11i4.5842

Ratu, M., & Moza, F. (2024). Analisis Kemampuan Pemecahan Masalah Matematika Siswa Kelas VII pada Materi Bilangan Pecahan Melalui Pendekatan Metakognitif-Diskursif di SMPK St. Paulus Karuni. Indo-MathEdu Intellectuals Journal, 5(1), 635–652. https://doi.org/10.54373/imeij.v5i1.738

Rustina, R., & Muzdalipah, I. (2023). Metakognısı Matematıs Sıswa Berdasarkan Intellegence Quotıent (IQ). AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 12(1). https://doi.org/10.24127/ajpm.v12i1.6671

Safitri, P. T., Yasintasari, E., Putri, S. A., & Hasanah, U. (2020). Analisis Kemampuan Metakognisi Siswa dalam Memecahkan Masalah Matematika Model PISA. Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang, 4(1), 11. https://doi.org/10.31331/medivesveteran.v4i1.941

Sercenia, J. C., Ibañez, E. D., Pentang, J. T., & De, 1. (2023). Thinking Beyond Thinking: Junior High School Students' Metacognitive Awareness and Conceptual Understanding of Integers (Vol. 15, Issue 1).

Sholihah, M., Amaliyah, N., & Muhammadiyah Hamka, U. (2022). Peran Guru dalam Menerapkan Metode Dıskusı Kelompok untuk Menıngkatkan Keterampılan Berpıkır Krıtıs Sıswa Kelas V Sekolah Dasar. Jurnal Cakrawala Pendas, 8(3). https://doi.org/10.31949/jcp.v8i2.2826

Şimşek, İ., Güner, P., & Yucel, H. A. (n.d.). Problem-Solvıng Performance and Mathematıcs Achıevement: The Medıatıng Role of Eye Trackıng Measurements Problem Solvıng Performance and Mathematıcs Achıevement: The Medıatıng Role Of Eye Trackıng Measurements. In International Online Journal of Education and Teaching (IOJET) (Vol. 7, Issue 3). https://iojet.org/index.php/IOJET/article/view/828

Sukiyanto, S. (2020). Munculnya Kesadaran Metakognısı dalam Menyelesaıkan Masalah Matematıka. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 9(1). https://doi.org/10.24127/ajpm.v9i1.2654

Suryaningtyas, S., & Setyaningrum, W. (2020). Analisis kemampuan metakognitif siswa SMA kelas XI program IPA dalam pemecahan masalah matematika. Jurnal Riset Pendidikan Matematika, 7(1), 74–87. https://doi.org/10.21831/jrpm.v7i1.16049

Syamsuri, & Mia Aprilia. (2022). Kemampuan Metakognitif Siswa SMK dengan Gaya Kognitif Field Dependent dalam Menyelesaikan Masalah Program Linier. Jurnal Educatio FKIP UNMA, 8(3). https://doi.org/10.31949/educatio.v8i3.2573

Tachie, S. A. (2019). Meta-cognitive Skills and Strategies Application: How This Helps Learners in Mathematics Problem-Solving. Eurasia Journal of Mathematics, Science and Technology Education, 15(5). https://doi.org/10.29333/ejmste/105364

Toraman, Ç., Orakcı, Ş., & Aktan, O. (2020). Analysis of the Relationships between Mathematics Achievement, Reflective Thinking of Problem Solving and Metacognitive Awareness. International Journal of Progressive Education, 16(2), 72–90. https://doi.org/10.29329/ijpe.2020.241.6

Waskitoningtyas, R. S. (2020). Pengaruh Kemampuan Pemecahan Masalah Matematis Mahasiswa Universitas Balikpapan melalui Pendekatan Metakognitif. Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah Di Bidang Pendidikan Matematika, 6(1). https://doi.org/10.29407/jmen.v6i1.13696

Winarti, Ambaryani, S. E., & Putranta, H. (2022). Improving Learners' Metacognitive Skills with Self-Regulated Learning based Problem-Solving. International Journal of Instruction, 15(2), 139–154. https://doi.org/10.29333/iji.2022.1528a

Yunus, M., Setyosari, P., Utaya, S., Kuswandi, D., Amirullah, & Rusdi, M. (2021). The Relationship Between Achievement Motivation, Metacognitive Awareness, Attitudes and Problem-Solving Abilities İn Students. Cypriot Journal of Educational Sciences, 16(1), 32–45. https://doi.org/10.18844/cjes.v16i1.5506