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Verbal Representation Abilities and Processes in HOTS Problem Solving Based on Adversity Quotient

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ABSTRACT

Purpose – The learning process in schools presents a variety of challenges, one of which is the impact of teaching methods, student difficulties, and external factors on the learning process. One of the main challenges is the teaching approach that still relies heavily on mechanistic methods, which often makes learning mathematics feel meaningless for students. The purpose of this study is to analyze students' verbal representation thinking ability and process in HOTS problem-solving based on the Adversity Quotient.

Methodology – The research approach employs a mixed-methods design. The subjects in this study are students of Class X (Grade 10) at SMKS Muhammadiyah 5 Srono, consisting of 35 students. Data analysis techniques utilize tests, questionnaires, interviews, and observations.

Findings – The study's results showed that students' verbal representation abilities and processes in HOTS problem-solving, as measured by the Adversity Quotient, were classified as good for students who achieved high scores. The higher a student's resilience at the Adversity Quotient stage in facing challenges, the better their verbal representation abilities and processes in HOTS problem-solving.

Contribution – The contribution of this study is to provide an overview of how the right learning stimulus, related to students' resilience, can enhance the ability and thought process of verbal representation in HOTS problem-solving.

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INTRODUCTION

The learning process in schools faces various challenges, including those rooted in teaching methods, student difficulties, and external factors that impact the learning process. In Mathematics education, one of the main challenges is the teaching approach, which still relies heavily on mechanistic methods, often making mathematics learning meaningless for students. External factors, such as a lack of variety in teaching methods and inadequate support from the family environment, also contribute to the creation of learning difficulties. (Kholil & Zulfiani, 2020; Rika Audina, 2021). To address this issue, a more realistic and contextual learning approach is proposed as a solution that can improve student understanding and engagement (Desiani et al., 2022; Haji et al., 2017). In addition, teachers also need to provide better support in the form of sufficient guidance and practice to help students overcome the difficulties they face (Hasanah, 2016; Restiani et al., 2023).

The ability to represent problems verbally is essential for students to develop a deeper understanding of mathematical concepts and improve their problem-solving skills (Fauziyah & Sujarwo, 2022). By developing the ability and skills to articulate mathematical thinking and problem-solving verbally, students not only clarify their understanding but also foster effective communication and collaboration among peers (DiNapoli & Miller, 2022; Mateus-Nieves & Devia Díaz, 2021). Based on previous research, many students still fail to master translation between verbal representations and other representations, indicating a gap in their mathematical understanding and problem-solving strategies (Tyasing Swastika et al., 2018). Therefore, a process of verbal representation thinking is necessary in learning that can overcome difficulties in engaging with cognitive domain knowledge, including mathematical forms.

Developing problem-solving skills will enhance mathematical skills and abilities, contributing to overall educational development, including concepts beyond procedural knowledge (Fatqurhohman, 2016; Safura et al., 2018). However, HOTS mathematical problem-solving in mathematics learning remains low. This is evident from the research results, which indicate that students lack the problem-solving skills necessary to solve problems that require higher-level thinking (P. Akbar et al., 2017). One reason is that students are not accustomed to solving HOTS questions through representation, resulting in many mistakes made by students in solving HOTS-based questions.

Previous studies have shown that students categorized as climbers in terms of Adversity Quotient possess superior problem-solving skills and navigate all stages of the problem-solving process (Baharullah et al., 2022; Sutisna & Pujiastuti, 2023). Other studies also highlight the importance of developing psychological aspects, such as self-efficacy, in relation to the Adversity Quotient to enhance students' problem-solving abilities (Ahmad & Dewi, 2024). However, there is still a lack of comprehensive studies that focus specifically on verbal representation in HOTS mathematics problems and the Adversity Quotient. The existing literature mainly discusses problem-solving abilities without investigating verbal representation. Therefore, this study first attempts to analyze the interaction of all three variables simultaneously: verbal representation ability, verbal representation process, and Adversity Quotient in HOTS problem-solving. Thus, the results of this study are expected to enrich the literature and serve as a basis for the development of more effective learning strategies.

Based on the above description, the purpose of this study is to analyze students' verbal representations and processes in solving HOTS problems, based on the Adversity Quotient stages. Therefore, the significance of the results of this study is expected to serve as a guide for mathematics teachers and teachers of other subjects in designing more effective learning, namely by paying attention to the importance of using verbal representation in the problem-solving process and the Adversity Quotient aspect of students in facing HOTS questions.

METHODOLOGY

Research Design

This study employs a sequential mixed-methods approach that combines quantitative and qualitative data to gain a comprehensive understanding of verbal representation abilities and processes in HOTS problem-solving based on the Adversity Quotient. Mixed methods as systematic research that combines techniques, methods, perspectives, concepts, and terminology from quantitative and qualitative approaches (Parjaman, T., & Akhmad, D., 2019). Quantitative data were obtained through HOTS problem-solving ability test scores and Adversity Quotient questionnaires. The quantitative stage aims to identify students' HOTS mathematical problem-solving skills and group students based on their Adversity Quotient (Climber, Camper, Quitter). Next, in the qualitative stage, the researcher selected five subjects with specific characteristics (Climber, Camper, Quitter) for further analysis. This stage aims to analyze and describe in depth students' verbal representation abilities and processes in solving HOTS mathematics problems.

The approach used in this study will be interpreted based on the descriptive data collected by the researcher. This study does not test hypotheses or variable relationships, but focuses on data collection through description with a proportionate integration of both approaches. The results of tests and questionnaires, which undergo quantitative descriptive analysis, are followed by the results of interviews and observations, which are presented with qualitative descriptions.

Participant and Location

The research was conducted at SMKS Muhammadiyah 5 Srono, located in Srono District, Banyuwangi Regency. The sampling technique used in this study was purposive sampling. The sample was deliberately selected based on academic criteria relevant to the research objectives, namely, 10th-grade students at SMKS Muhammadiyah 5 Srono. There were 35 students involved as respondents, who were selected based on the results of the teachers' verbal ability assessments and observations of the students' learning difficulties in the quadratic function material. Thus, this group was considered representative for the study to examine the ability and process of verbal representation in HOTS problem-solving among students who face challenges in understanding mathematical concepts.

Data Collection

The data in this study consisted of test results, questionnaires, interviews, and observations. The data collected in this study included HOTS mathematical problem-solving, the stages of students' Adversity Quotient in facing problem-solving challenges, and students' verbal representation abilities and processes when answering HOTS problem-solving questions. The instruments used in this study were adapted from several previous studies (Nurhayati et al., 2022). With updates to test materials, a combination of guidelines for questions on verbal representation skills and processes, observations, and Adversity Quotient questionnaires.

This study began with the administration of HOTS mathematics problem-solving tests and the completion of Adversity Quotient questionnaires by students. Through this stage, data were obtained on students' HOTS problem-solving scores and Adversity Quotient categories, which included three levels: Climber, Camper, and Quitter. The research then continued with in-depth interviews and observations of several students selected based on their test scores and questionnaire results. The interviews and observations were conducted to explore and describe the students' verbal representation abilities and processes in solving HOTS problems and to identify differences in thinking patterns among students at each Adversity Quotient level.

Instrument

The tests used to collect data on students' problem-solving skills were related to indicators of verbal representation abilities and processes in the context of quadratic functions. There were two essay questions, each containing a HOTS question at the C4 level of Bloom's Taxonomy, analyzing. Before use, the test instrument was validated through an expert judgment process by two validators, namely a mathematics teacher and a mathematics education lecturer, to ensure the suitability of the questions in relation to the indicators of verbal representation skills and HOTS cognitive level. The validators' assessment covered content, construct, and language aspects. The validation results were analyzed using the Content Validity Index (CVI) and Content Validity Ratio (CVR). The overall CVI value indicated a high level of expert agreement (CVI $\geq$ 0.80), thus declaring the instrument valid in terms of content. Additionally, the reliability of the test instrument was assessed through an inter-rater reliability test, which involved comparing scores given by two independent assessors. The inter-rater reliability coefficient value indicated a good level of consistency ($r \geq 0.80$), suggesting that the assessment results were considered reliable.

The Adversity Quotient questionnaire was administered to research subjects, who were asked to complete a list of statements using a checklist scale based on the categories of Climber, Camper, and Quitter. This questionnaire was validated through expert judgment by educational psychologists who assessed the clarity, relevance, and representation of the Adversity Quotient construct. The expert assessment results showed a high CVI value (≥ 0.85), which indicates good content validity. The reliability of the questionnaire was tested using Cronbach's Alpha coefficient, with a result of α ≥ 0.80, indicating that the instrument has high internal consistency.

Next, in the interview instrument, five students were selected based on test results, taking into account the categories of verbal representation ability and Adversity Quotient level. In-depth interviews were conducted to explore the students' verbal representation thinking processes in solving HOTS mathematics problems. The next instrument was an observation sheet, which was used to record and assess the stages of skills and verbal representation thinking processes of students during interviews.

Data Analysis

Data were analyzed using the interactive model of Miles and Huberman, which includes four stages: (1) data collection, through test results, questionnaires, observation, interviews, or a combination of the these (triangulation); (2) data reduction, which involves filtering and summarizing relevant data according to the research focus; (3) data display, by presenting the data in narrative form and through supporting visualizations; and (4) conclusion drawing/verification, which involves drawing conclusions based on patterns and meanings from continuously analyzed data until saturation is reached.

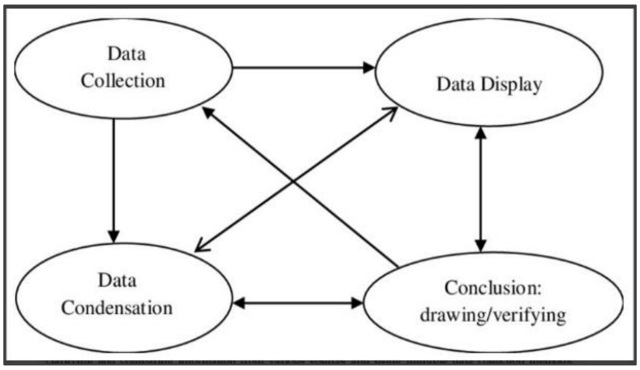


Figure 1. Data Analysis Model of Miles and Huberman (Source: Miles et al., 2014)

The data collection stage was obtained from various research instruments, namely HOTS tests, Adversity Quotient questionnaires, interviews, and observations of students' verbal representation abilities and processes in solving HOTS mathematics problems based on the Adversity Quotient stages. In the data reduction stage, the HOTS test results were analyzed to obtain student scores, which were then categorized into three levels, namely high, medium, and low. The AQ questionnaire data were processed to determine the students' Adversity Quotient categories, which consisted of Climber, Camper, and Quitter, excluding incomplete or invalid data. Then, the interview data were reduced by selecting statements that reflected the students' verbal representation abilities and processes in solving mathematical problems. Meanwhile, the data from the observation focused on how students understood and conveyed ideas while completing the questions, and were analyzed when answering the interview questions.

Next, in the data display stage, the HOTS test results are presented in a table showing the students' problem-solving results. Data from the AQ questionnaire is displayed in a table to show the proportion of each category of students: Climber, Camper, and Quitter. The results of the interviews and observations are presented in a thematic matrix that links student statements and observation results with indicators of verbal representation thinking skills and processes. In the final stage, namely verification, the researcher analyzed the HOTS test and AQ questionnaire results in conjunction with the interview and observation data to ensure the integration between verbal representation abilities and student processes in HOTS problem-solving. This verification process was carried out through the triangulation of sources and methods, specifically by confirming and comparing data from multiple instruments, ensuring that the conclusions obtained were valid and reliable.

Data Validity

Data triangulation in this study involves source triangulation, which utilizes multiple data sources to gain a more comprehensive understanding of the phenomenon being studied. This data triangulation involves the use of various data collection methods, including test results, interviews, observations, and questionnaire results. Meanwhile, method triangulation was used to validate the data by combining the results of the test, interviews, observations, and the questionnaire. These techniques complement each other in verifying the truth and accuracy of the data, thereby making the conclusions more reliable and accountable.

In addition, this study also paid attention to research ethics by obtaining informed consent from all participants prior to the data collection process. Each participant was provided with an explanation of the study's purpose, the confidentiality of their identity, and their right to participate voluntarily without coercion. This procedure was implemented to ensure that the study adhered to internationally recognized standards of research ethics in education.

FINDINGS

Implementation Process

The research began on March 1 and 2, 2025, with observations of the mathematics learning process conducted by teachers at SMKS Muhammadiyah 5 Srono. It continued on March 10 with the administration of a problem-solving test on quadratic functions to 35 students, followed by the completion of an Adversity Quotient questionnaire. Then, on March 11, the students' test results were corrected. On March 13, interviews and observations were conducted with five student representatives (in high, medium, and low score categories) to analyze their verbal representation abilities and processes.

Problem-Solving Tests

Figure 2. Student Problem-Solving Test Documentation

Figure 2 illustrates the implementation of HOTS problem-solving tests conducted by 35 students at SMKS Muhammadiyah 5 Srono. The problem-solving test consisted of two essay questions related to quadratic functions in mathematics, where students were asked to answer by writing in the order specified in the questions and according to the descriptions provided. The results of the problem-solving test are presented in Table 1 below.

Table 1. Summary of The HOTS Problem-Solving Test

No	Score interval	Category	Number of students
1	0-8	Low	12
2	9-16	Medium	18
3	17-24	High	5

The results of the HOTS problem-solving test questions in Table 1 show that students who scored in the medium category, ranging from 9 to 16, outnumbered those in the other categories, while the high category had only five students. However, this study focuses on the representation of student test results with representatives from each category. Five student representatives were selected, comprising two students from the high category, two students from the medium category, and one student from the low category. Five students were selected based on their test results, taking into account their ability categories, verbal representation processes, and Adversity Quotient levels. These five students were then interviewed and observed to analyze their data processing abilities and verbal representation processes. In-depth interviews were conducted to explore the students' abilities and verbal representation processes in solving HOTS mathematics problems on the tests they had taken. The data was then analyzed using the results of the Adversity Quotient questionnaire.

Adversity Quotient Questionnaire

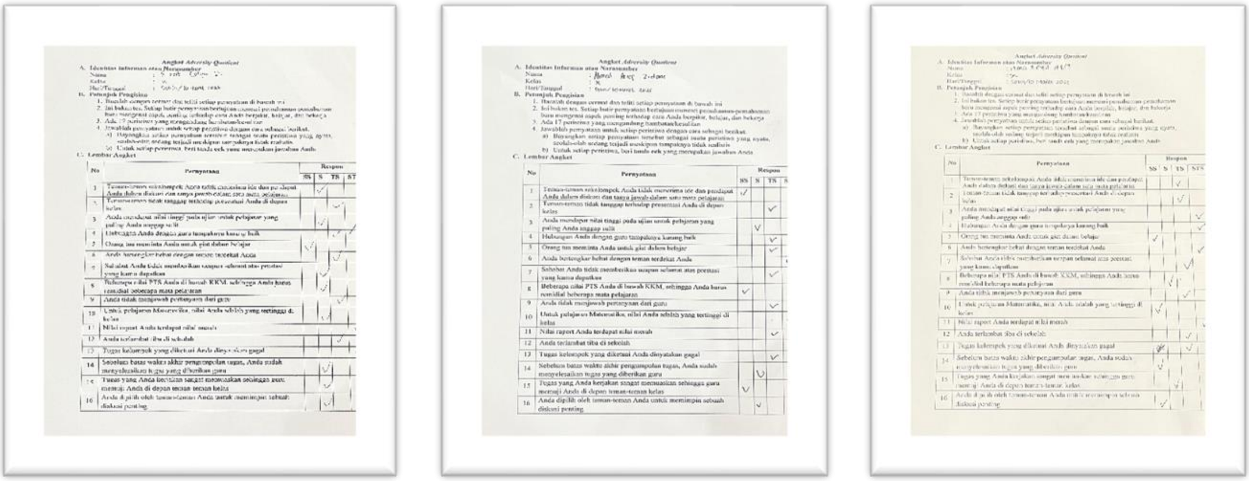
After assessing the results of the HOTS problem-solving test scores, the study proceeded with an analysis of the students' Adversity Quotient questionnaire responses. The results of the Adversity Quotient questionnaire completed by these five students were then analyzed. During the interview process, students who answered questions were scored at each stage of problem solving based on their abilities and verbal representation processes.

Table 2. Summary of Student's Adversity Quotient Questionnaire

No	Adversity Quotient Stages	Students Achieved	%
1.	Climber	7	20 %
2.	Camper	17	49 %
3.	Quitter	11	31 %

Table 2 shows that there were 20% climber category students, with seven students achieving, 49% camper category students, with 17 students achieving, and 31% quitter category, with 11 students achieving. Based on the results analyzed from each problem-solving process, it can be said that students' verbal representation abilities and processes are interrelated with their Adversity Quotient categories. Students in the climber category exhibit better verbal representation thinking processes at every stage, from understanding the problem to planning the solution, implementing the steps, and reflecting on the results. Meanwhile, students in the camper category demonstrate moderate abilities and tend to provide inconsistent answers. In contrast, students in the quitter category continue to experience difficulties in almost all stages of the verbal representation process. This analysis is also evident in Figure 6, which illustrates the students' Adversity Quotient questionnaire responses at each stage.

The Adversity Quotient questionnaire consists of 16 questions to be answered with a checklist. Figure 6 presents the results of the analysis for each of the three stages of the students' Adversity Quotient, categorized as Climber, Camper, and Quitter. When linked to the results of problem-solving test analysis, it can be explained that there is a close relationship between HOTS mathematical problem-solving and the Adversity Quotient category in students. Figure 6 shows that AQ levels affect the quality and consistency of solving HOTS mathematical problems. Climber students demonstrate integration between mental resilience and cognitive skills. Camper students indicate untapped potential. Students who quit have low self-control and motivation to face challenges.



Climber Adversity Quotient Camper Adversity Quotient Quitter Adversity Quotient

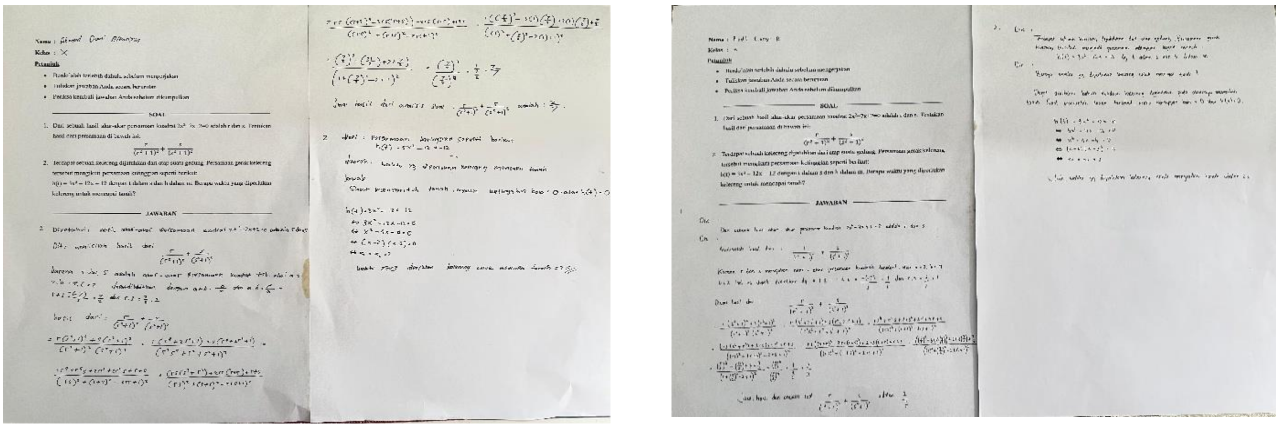
Figure 6. Student Adversity Quotient Questionnaire

Verbal Representation Abilities and Processes

This analysis of verbal representation abilities and processes is adapted to the problem-solving stages outlined in Polya's model, which comprises four steps: problem comprehension, planning the solution, implementing the plan, and reviewing the solution. Reflectively, the researcher acknowledges that the limited number of subjects in this study does not permit the results to be generalized to a broader population. The five subjects were not selected for statistical generalization, but to demonstrate the depth of variation in the phenomenon of verbal representation ability and its relationship with Adversity Quotient. The selection of five students was also in accordance with the principle of data saturation, whereby a limited but representative number of subjects was sufficient to obtain meaningful patterns and categories from the results of observations and in-depth interviews.

Problem Comprehension Stage

Students' verbal representation abilities and processes in HOTS problem-solving will be described based on an assessment rubric tailored to the results of problem-solving tests in the mathematics subject, interview answers, and observations. At the problem comprehension stage of the HOTS problem-solving essay test, students who can create problem situations based on the data or representations provided are attentive to the questions. These students are also able to mention all important information thoroughly and systematically. This is in accordance with the test results of students who obtained high scores, as shown in Figure 3.



(a) Test Result – student AD (b) Test Result – student R

Figure 3. High Problem-Solving Test Results

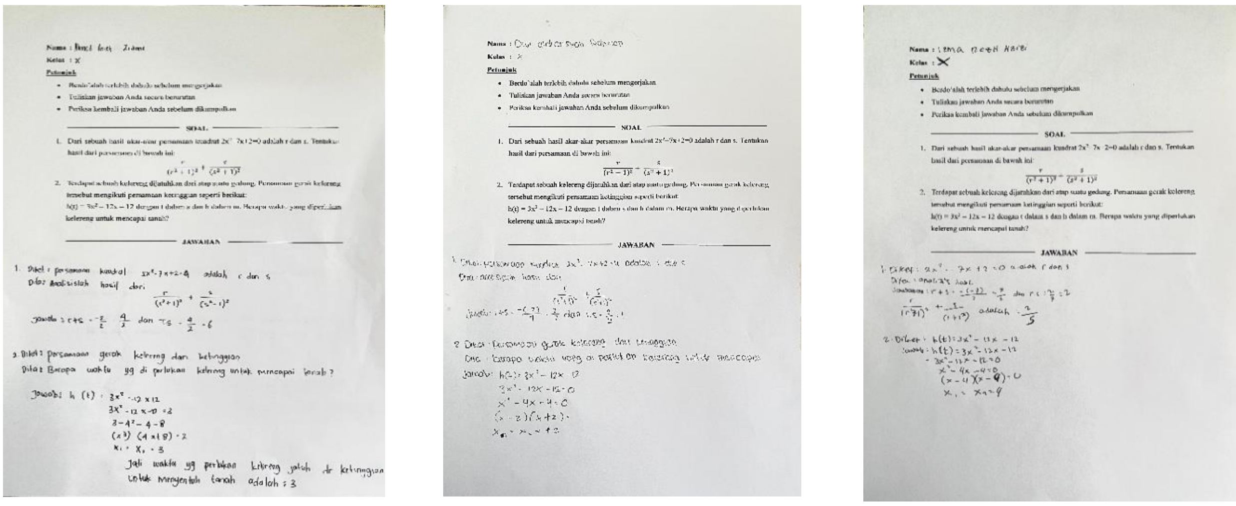
The test results from student AD and student AR, as shown in Figure 3, were also consistent with the interview results regarding their understanding of the questions presented during the problem comprehension stage.

I read slowly, underlining important points, data, and the key information requested in the question (AD/S/14/03/2025).

I first look for the numbers that need to be calculated and what is related to the question asked (R/S/14/03/2025).

In terms of Adversity Quotient, this student is a climber because they possess intrinsic motivation and high perseverance to thoroughly understand the content of the questions, as well as the ability to recognize what they already understand and what they do not yet comprehend.

The test results of students who scored in the medium category showed a difference from the results of students in the high category in terms of their understanding of the questions. Although these students were able to understand the questions well, the interview results indicated that they only read the questions superficially without grasping their meaning in depth. The test results for students with medium scores are shown in Figure 4.



Test Result – student AA Test Result – student D Low Test Results

Figure 4. Medium and Low Problem-Solving Test Results

Based on the interview, the test results for students in the medium category in representation and verbal process skills were good, as they provided important information; however, they still lack systematicity.

I read it once, ma'am, then I looked at the numbers (AA/S/18/03/2025).

I just read it, and if I do not understand, I will ask a friend who does (D/S/18/03/2025).

In terms of Adversity Quotient, these students still lack systematic thinking because they read and interpret questions superficially. They are easily satisfied when they feel they "understand enough," without double-checking their answers. In addition to the test results of students with high and medium scores, the test results of students with low scores are also presented below. As shown in Figure 5, IR students answered questions briefly without providing detailed explanations or elaborations on the presented problems.

The test results were also reinforced by the following interview responses, which provided spontaneous answers to questions related to understanding the issues in the test questions.

I will just scan it, ma'am. If I do not understand it, I will just leave it (IR/S/14/03/2025).

From the interview responses of student IR, it is evident that students' verbal representation abilities and processes are still lacking, as they are unable to provide relevant information, instead answering hurriedly. Students with low abilities often fail to express the information in the questions thoroughly. They tend to skim through the questions without fully understanding the context, so they are unable to verbally represent the meaning of the questions accurately. This misunderstanding often persists into the next stage because students lack a clear understanding of the concepts.

The differences at this stage indicate that verbal representation serves as the cognitive basis for subsequent stages. High-ability students possess a knowledge structure that enables them to construct comprehensive representations of meaning, whereas low-ability students are limited to surface-level linguistic processing. The quality of understanding the problem plays a direct role in determining the accuracy of the solution plan.

Planning Stage

During the planning stage, students' verbal representation abilities and processes were analyzed based on how they formulated strategies for solving problems after understanding the given problems. According to the test results, students with high and moderate scores demonstrated effective plans for solving the problems in the test. This is related to the question of what to do after understanding the problem. The test results were also confirmed by the results of student interviews, which showed that their verbal representation thinking skills and processes were in the good category.

> *I will write down the steps to solve it on paper first, then I will try to write down the formula that matches the question* (AD/S/14/03/2025).
> *I will first think about what can be matched with the question, then I will work on the solution* (R/S/14/03/2025).
> *I will remember the example questions that were given by the teacher before* (AA/S/14/03/2025).

AD has excellent verbal representation abilities and processes, as he can explain plans accurately, in detail, and systematically. Furthermore, R has good verbal representation abilities and thought processes, which enable him to explain his plans for completion fairly accurately, although he still lacks detail. When linked to Adversity Quotient, Climber students possess high self-confidence and a fighting spirit, enabling them to devise the most effective strategies. They can think logically, weigh several alternatives, and explain the reasons for their choices verbally. The driving factors are a sense of responsibility for results and a solution-oriented mindset. As for AA, who is classified as having good verbal representation abilities and processes, he still requires the assistance of books to complete tasks in his learning.

Furthermore, D, who obtained an average test score, had verbal representation abilities and processes that were still lacking. He did not explain his problem-solving process and simply answered the final result. This result was also confirmed by an interview regarding the planning that had to be done for question number one, as he was still confused about the question and needed help from the book.

> *Just do what you can, Mom. If I am confused, please refer to the book* (D/S/14/03/2025).

In addition to D, IR, who is a student, also exhibits poor verbal representation skills and thought processes, as evidenced by her responses to the interview questions below.

> *I do not make plans, ma'am, I just do it because I think that is what I can do* (IR/S/14/03/2025).

From the answers of these two students, it can be inferred that they began working immediately without developing a clear plan. D still has the drive to make plans, but IR can be said to have given up on the situation in the problem-solving process. Verbal skills in the planning stage are highly dependent on the clarity of representation in the problem comprehension stage. The stronger the initial understanding, the more focused the students' ability to explain logical steps verbally. This indicates a vertical cognitive chain between comprehension and planning: conceptual errors at the beginning will reduce the quality of strategic planning.

Implementation Stage

During the implementation stage, students' verbal representation abilities and thought processes will be analyzed based on how they apply the planned solution steps and then convey the process verbally, either orally or in writing. At this stage, students are expected to be able to implement the strategies that have been developed correctly and systematically, as well as explain the process clearly and coherently.

The results of verbal representation abilities and thought processes at the implementation stage indicate that, after interviews, only one student demonstrated excellent verbal representation abilities. This student scored high on the test. The following student interview results evidence this.

I worked on the questions according to the steps I wrote down on paper earlier. I rechecked all the questions because they were lengthy and the formulas were different, so I was concerned about making mistakes. The questions were quite long, so it took me a while (AD/S/14/03/2025).

The interview results from AD illustrate how this student can coherently explain the steps to answer questions correctly and his persistence in double-checking his previously written plan before applying it to his answers. This result also aligns with the problem-solving test that was completed. As for students with good verbal representation, there was only one student who was able to complete the test questions well, as shown in the following interview answers.

I will work on the questions in order. I asked about question number one because I was confused, but I will reread question number two before I work on it (R/S/14/03/2025).

When the result is linked to Adversity Quotient, climber students possess cognitive discipline and the ability to control their emotions when facing difficulties, which serve as supporting factors. As for the other three students, each of whom has moderate and poor verbal representation abilities and processes, they did not complete the questions in the expected order or according to plan. This is supported by their test results regarding how to solve the questions given. According to the test results, AA immediately began working on the questions without following the specified steps or method of completion. After being interviewed, it was found that this student worked slowly because question number one was considered too difficult to answer.

I worked on it slowly. Question 1 was quite long, and I was confused about the formula for question 2, so I just tried to answer it anyway (AA/S/14/03/2025).

I have just answered all the questions, but I was unable to answer question 2 (D/S/14/03/2025).

I was confused about question 1, and I skipped question 2 because I did not know the answer (IR/S/14/03/2025).

Based on the interview, it can be said that these students have similar patterns in their verbal representation abilities and thought processes. They tend to skip questions they do not understand and cannot explain how to solve. Weaknesses at this stage suggest that verbal representation serves not only as a communication tool but also as a means of internal thinking. When students are unable to explain the process verbally, it indicates a lack of metacognitive awareness and control over thinking strategies. Conversely, strong verbal abilities support the integration of thinking between concepts and procedures.

Reviewing Stage

In the reflection stage, verbal representation thinking skills and processes are analyzed through students' ability to review their answers, evaluate the correctness of their answers, and explain the process they used and the reasoning behind their answers. Students are expected to be able to check their work, identify mistakes, and provide alternative solution when necessary, as well as explain them verbally in their own words. The highest score for verbal representation abilities and processes in the reflection stage was achieved with a score of three, indicating an excellent category. This result aligns with the problem-solving test results of students who scored high, as they were able to express the answers to the questions in their own words. This result was also confirmed by interviews about questions related to the review of students' answers, as follows.

Yes, I rechecked the answers from the beginning, then I matched them with the questions (AD/S/14/03/2025).

I review the final results, and if I am unsure that the answers are incorrect, I recheck them (R/S/14/03/2025).

At this reflection stage, many students still do not review their answers, despite the final results not being satisfactory. This is evidenced by the results of interviews with students in the camper and quitter categories, as shown below.

I sometimes forget to check again, I usually just submit my answers (AA/S/14/03/2025).
I rarely check, unless I still have time, then I might check briefly (D/S/14/03/2025).
I never check again, I just answer and submit (IR/S/14/03/2025).

The reflection stage is the final indicator of the maturity of students' verbal and cognitive representation. The quality of reflection is greatly influenced by the thought process from the early stages. Students who are accustomed to expressing their ideas verbally at each stage will be better able to evaluate the process. In contrast, students who think mechanically without explicit verbalization tend to fail to detect errors. Students with high HOTS mathematics problem-solving results can clearly explain problems using their own words, develop appropriate solution strategies, sequence the steps of the solution, and effectively reflect on the results of their work. Conversely, students with low HOTS problem-solving scores in mathematics had difficulty expressing information verbally, were less able to devise systematic solution strategies, and were less effective in explaining the process or final results of problem-solving.

Table 3. Summary of Observations of Verbal Representation Abilities and Processes

No	Student	Verbal Representation Abilities and Processes Scores				Total Score
		Problem comprehension	Planning	Implementation	Reflection	
1	AD	3	3	3	3	12
2	R	3	2	2	0	10
3	AA	2	2	1	1	6
4	D	1	0	1	1	3
5	IR	0	0	0	0	0

Table 3 presents the results of observations on students' verbal representation abilities and processes across four stages of problem-solving: problem comprehension, planning, implementation, and reflection. The scores for each stage describe the level of students' ability to express ideas, explain the steps involved in solving problems, and verbally restate the results of problem-solving.

This table shows variations in verbal representation abilities among the five students. The student AD obtained the highest score (12), indicating excellent and consistent verbal representation abilities across all stages of problem-solving. Student R was in the good category but showed weaknesses in the reflection stage (score of 0), indicating suboptimal metacognitive abilities in reviewing their thinking process. Meanwhile, students AA and D showed moderate to low abilities, with the main constraints being in the planning and strategy implementation stages. The student's IR score was 0 in all aspects, indicating significant difficulty in verbally representing thoughts. In addition to these observations, Table 4 presents the synthesized data from the three sources (tests, interviews, and questionnaires) for comparison or as a concept map illustrating the correlation between variables (climber, camper, and quitter).

The Table 4 shows that Adversity Quotient levels have a strong relationship with students' verbal representation abilities and processes in HOTS-oriented mathematical problem solving. Students in the Climber category can think consistently and reflectively at every stage of problem-solving, explain ideas logically, and revise strategies as necessary. Meanwhile, Camper students are only able to follow the steps of the solution without understanding the conceptual reasons behind them, demonstrating limited and procedural verbal representation. Quitter students tend to be passive, have difficulty articulating their ideas verbally, and often give up easily when faced with challenges. This table implies that the higher a student's Adversity Quotient, the stronger their ability to express, reason, and reflect on the process verbally. Conversely, a low Adversity Quotient hinders the emergence of meaningful verbal representation and higher-level thinking, thereby emphasizing the role of Adversity Quotient as a crucial factor in the quality of students' mathematical thinking.

Table. 4 Summary of Source Data Synthesis

No	Adversity Quotient	Test	Interviews	Synthesis/Creative Patterns
1	Climber	Consistent at all stages (understanding, planning, implementation, reflection)	Demonstrates the ability to explain ideas and reasons clearly, able to revise strategies when necessary	Consistency and reflectiveness show a positive correlation between high AQ and stable verbal representation abilities throughout all stages of problem solving
2	Camper	Most verbal responses are incomplete, tending to follow patterns without argumentation	Can name the steps but cannot explain the reasons or concepts behind them	Limited and superficial verbal representation; shows a correlation between moderate AQ and a tendency toward procedural thinking without conceptual reflection
3	Quitter	Unable to formulate a relevant verbal explanation	Tends to be quiet, unable to express ideas even with guidance	Demonstrates a strong correlation between low AQ and minimal verbal representation; dominant emotional and motivational barriers inhibit HOTS thinking.

DISCUSSION

The findings of this study indicate that mental toughness, also known as Adversity Quotient, significantly influences the quality of HOTS problem-solving processes in mathematics. Consequently, students' verbal representation thinking skills and processes are classified as good. Thus, the results of this study are expected to enrich the literature and become the basis for the development of more effective learning strategies. These results align with previous studies (Utami et al., 2020), which suggest that an individual's thinking process, particularly during problem-solving, is significantly influenced by their ability to evaluate steps, correct mistakes, and adjust strategies when encountering difficulties. In addition, this is also supported by other studies, which show that students who can express mathematical ideas verbally can more easily find solutions to complex problems (Sapitri et al., 2019). It can also be noted that the results of this study demonstrate that students with strong verbal representation skills are able to articulate problem-solving steps clearly and in a structured manner, reflecting a deep understanding of the material (Brata et al., 2023). From the analysis results, it is evident that various factors affect students' verbal abilities in solving HOTS problems, influencing their capacity to face difficulties and overcome them. These factors are related to the Adversity Quotient of each student analyzed, which varies, and not all students can solve problems in the HOTS category.

The results of this study indicate that students in the climber category have the best verbal representation skills in solving HOTS-oriented mathematical problems. Based on the results of interviews and observations, students with a Climber Adversity Quotient can describe the steps to solve problems clearly and logically, as well as explain the relationships between mathematical concepts in their own easy-to-understand language. They show high perseverance when faced with complex problems and do not give up easily before finding a solution. According to Information Processing Theory, Adversity Quotient facilitates adaptive cognitive assessment of stress factors, enabling increased emotional support and the development of psychological resilience (strengthening mental toughness) (Peng et al., 2025).

This mental resilience influences their more structured and reflective way of thinking, enabling them to transform abstract mathematical ideas into meaningful verbal expressions. This suggests that, cognitively, a high Adversity Quotient enhances students' self-regulation abilities in thinking and enables them to articulate their reasoning in a coherent and meaningful manner during the problem-solving process. Individuals with higher AQ are often better at recognizing their needs during adversity, proactively seeking help, and effectively utilizing emotional support offered by others (e.g., friends, family, colleagues) (Peng et al., 2025).

This aligns with research indicating that their resilience and problem-solving skills may make them more receptive to and adept at leveraging supportive relationships (Azriddin et al., 2024).

It can be said that the Adversity Quotient plays an important role as an indicator in determining how effectively students process and convey information verbally, especially in the context of problem-solving. These results suggest that the Adversity Quotient serves as a mediating factor between emotional intelligence and adaptive performance. This finding aligns with the results of the study by Nugroho et al. (2022), which show that individuals with a high Adversity Quotient tend to be better at conveying and analyzing information in confusing or challenging situations. Therefore, it can be said that individuals who can manage stress and challenges (in this case, those with a high Adversity Quotient) will find it easier to use their verbal abilities to explain complex ideas. Additionally, this study has demonstrated that individuals who take responsibility for challenges tend to be more confident in their ability to overcome them, aligning with previous research (Li et al., 2022).

This study is also related to previous studies in which students' ability to represent ideas greatly influences their success in solving problems, especially those oriented towards HOTS (Astutik et al., 2020; Rahayuningdewi & Faradillah, 2020). The results of this study also show that students with a high Adversity Quotient (climbers) have better and more structured verbal representation thinking processes than students with a moderate (campers) or low (quitters) Adversity Quotient. These results are also supported by interview findings that not only reinforce the test results but also provide insight into how the dimensions of Adversity Quotient and its supporting factors work within students when facing HOTS mathematics questions.

Strengthening the Adversity Quotient character needs to be a focus in learning strategies, especially to improve students' resilience in facing learning challenges. In addition, belief in one's ability to succeed has been shown to correlate positively with Adversity Quotient, as individuals who believe they can overcome challenges are more likely to use proactive strategies (S. Akbar et al., 2023). Thus, students with a good Adversity Quotient tend to think positively that difficulties are challenges that must be overcome. These results are supported by research (Damastuti et al., 2023), which states that students with high Adversity Quotient tend to have good emotional resilience and metacognitive abilities in dealing with HOTS-oriented mathematics questions. Based on the study's results, the factors that support the existence of students' Adversity Quotient are not only individual characteristics but also environmental factors. This finding aligns with previous studies, which suggest that a supportive environment can enhance student resilience (Gampu et al., 2022).

This study first attempts to analyze the interaction of all three variables simultaneously: verbal representation ability, verbal representation process, and Adversity Quotient in HOTS problem-solving. This study also has limitations, including a small sample size of only five interview subjects, which limits its representativeness of the broader Adversity Quotient category. In addition, the questions applied in the test focused only on quadratic functions, so they did not accurately describe students' abilities and verbal representation processes in other mathematical materials. External factors, such as the psychological condition of students during tests and interviews, could not be fully controlled.

The results of this study have important implications for classroom learning practices and the development of HOTS and Adversity Quotient-based curricula. In mathematics learning, teachers need to design learning strategies that not only focus on cognitive achievement but also foster students' resilience and tenacity in facing learning difficulties. This can be done through the application of learning models that challenge students to express their ideas and problem-solving strategies verbally, such as problem-based learning or discovery learning integrated with self-reflection and emotion regulation training. From a curriculum perspective, the results of this study support the need to strengthen HOTS aspects with an approach that takes into account students' Adversity Quotient profiles, so that each stage of learning can develop higher-order thinking skills as well as mental resilience in the problem-solving process.

This study opens up opportunities for further research, for example, by exploring verbal representation abilities and Adversity Quotient at other educational levels, such as junior high school or college, thereby obtaining a more comprehensive picture of the development of these abilities. Subsequent research could also focus on developing Adversity Quotient instruments that are more contextually relevant to the characteristics of mathematics learning, thereby enhancing the validity and applicability of measurement results for improving the quality of HOTS-based learning. Therefore, future research should expand the subjects, HOTS question variations, test materials, and other supporting factors.

CONCLUSION

This study presents the problem formulation, objectives, analysis results, and discussion. It can be concluded that the verbal representation abilities and processes of students in solving HOTS problems based on Adversity Quotient in mathematics are relatively good for students who obtain high scores. This indicates that climber students excel compared to camper and quitter levels in expressing ideas and thoughts in both oral and written forms during the problem understanding and implementation stages. However, at the planning and reflection stages, further training is still needed in determining the steps to solve the problem. The higher the students' resilience at the Adversity Quotient stage in facing challenges, the better their verbal thinking abilities and processes in solving HOTS problem-solving in mathematics. This study presents results that facilitate the identification of types of mental resilience in students when working on HOTS questions through verbal representation. However, there are still limitations, so it is recommended that future researchers expand the research subjects and examine the representation process in more varied types of HOTS questions for other learning materials, allowing the results to be further developed.

It is also recommended that mathematics teachers provide appropriate learning stimuli to train students' verbal representation skills and thinking processes through discussions, question and answer sessions, and oral presentations in solving HOTS mathematics problems. In addition, schools are expected to hold training or activities that support the strengthening of students' resilience through the Adversity Quotient, to develop more students into the climber category.

REFERENCES

Ahmad, S., & Dewi, N. (2024). Pengaruh Efikasi Diri dan Adversity Quotient terhadap Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Dasar. *JUDIKDAS: Jurnal Ilmu Pendidikan Dasar Indonesia*, *3*(3), 134–143. https://doi.org/10.51574/judikdas.v3i3.1239

Akbar, P., Hamid, A., Bernard, M., & Sugandi, A. I. (2017). Analisis Kemampuan Pemecahan Masalah dan Disposisi Matematik Siswa Kelas XI SMA Putra Juang dalam Materi Peluang. *Cendekia: Jurnal Pendidikan Matematika*, *2*(1), 144–153. https://doi.org/10.31004/cendekia.v2i1.62

Akbar, S., Putri, Y. K., & Rizdanti, S. (2023). Analysis of Factors Affecting Students' Adversity Quotient on Completing Undergraduate Thesis. *International Journal of Research in Education and Science*, *9*(1), 124–133. https://doi.org/10.46328/ijres.3011

Astutik, D., Nusantara, T., Sa'dijah, C., & Susiswo, S. (2020). Proses berpikir siswa kelas XI dalam menyelesaikan soal berorientasi HOTS pada materi deret aritmatika. *Aksioma: Jurnal Matematika dan Pendidikan Matematika*, *11*(2), 229–239. https://doi.org/10.26877/aks.v11i2.5998

Azriddin, A. L., Nisak Ahmad, D. N., Dr Hazliza Haron, P. M., Zaghlol, D. A. K., & Bin Tuan Kub, T. M. N. (2024). Exploring the Impact of Managerial Coaching, Emotional Intelligence and Social Support on Employee Retention: The Mediating Role of Employee Resilience in Malaysian Public Healthcare. *Information Management and Business Review*, *16*(3S(I)a), 317–327. https://doi.org/10.22610/imbr.v16i3S(I)a.4213

Baharullah, B., Wahyuddin, W., Usman, M. R., & Syam, N. (2022). Profil Kemampuan Pemecahan Masalah Matematika Siswa Ditinjau dari Adversity Quotient (AQ). *Aksioma: Jurnal Program Studi Pendidikan Matematika*, *11*(2), 1039. https://doi.org/10.24127/ajpm.v11i2.4766

Brata, S. K., Sari, D. V., Muftiyah, S., Herman, T., & Hasanah, A. (2023). Kemampuan Representasi Verbal Siswa SMA dalam Mengerjakan Soal Numerasi Asesmen Kompetensi Minimum. *Gauss: Jurnal Pendidikan Matematika*, *6*(2), 78–94. https://doi.org/10.30656/gauss.v6i2.7863

Damastuti, A. S., Triyanto, T., & Nurhasanah, F. (2023). Reflective Thinking Students with Different Adversity Quotients in Solving Mathematics Problems. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *7*(4), 1128. https://doi.org/10.31764/jtam.v7i4.16552

Desiani, A., Yahdin, S., Hermansyah, H., Amran, A., Suprihatin, B., Annas, M. A., Tiara Putri, M., Rahman, C., & Mahida, A. (2022). Pembelajaran Pengukuran Menggunakan Pendekatan Matematika Realistik Untuk Peserta Didik SD Negeri 04 Indralaya Selatan. *Bakti: Jurnal Pengabdian Kepada Masyarakat*, *2*(1), 21–32. https://doi.org/10.51135/baktivol2iss1pp21-32

DiNapoli, J., & Miller, E. K. (2022). Recognizing, supporting, and improving student perseverance in mathematical problem-solving: The role of conceptual thinking scaffolds. *The Journal of Mathematical Behavior*, *66*, 100965. https://doi.org/10.1016/j.jmathb.2022.100965

Fatqurhohman, F. (2016). Pemahaman Konsep Matematika Siswa dalam Menyelesaikan Masalah Bangun Datar. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *4*(2), 127. https://doi.org/10.25273/jipm.v4i2.847

Fauziyah, F. D., & Sujarwo, I. (2022). Kemampuan Penalaran Matematis dalam Menyelesaikan Soal Geometri ditinjau dari Persepsi Siswa. *Galois: Jurnal Penelitian Pendidikan Matematika*, *1*(2), 10–22. https://doi.org/10.18860/gjppm.v1i2.2188

Gampu, G., Pinontoan, M., & Sumilat, J. M. (2022). Peran Lingkungan Sekolah Terhadap Pembentukan Karakter Disiplin dan Tanggung Jawab Siswa. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(4), 5124–5130. https://doi.org/10.31004/edukatif.v4i4.3090

Haji, S., Abdullah, M. I., Maizora, S., & Yumiati, Y. (2017). Developing Students' Ability of Mathematical Connection Through Using Outdoor Mathematics Learning. *Infinity Journal*, *6*(1), 11. https://doi.org/10.22460/infinity.v6i1.234

Hasanah, N. (2016). Teachers In Overcoming Students Learning Dificult Math in Class IV SDIT Ukhuwah Banjarmasin. *Jurnal PTK Dan Pendidikan*, *2*(2). https://doi.org/10.18592/ptk.v2i2.1028

Kholil, M., & Zulfiani, S. (2020). Faktor-Faktor Kesulitan Belajar Matematika Siswa Madrasah Ibtidaiyah Da'watul Falah Kecamatan Tegaldlimo Kabupaten Banyuwangi. *Educare: Journal of Primary Education*, *1*(2), 151–168. https://doi.org/10.35719/educare.v1i2.14

Li, H., Xu, Y., Jing, M., Wei, X., Li, L., & Guo, Y. (2022). The mediating effects of adversity quotient and self-efficacy on ICU nurses' organizational climate and work engagement. *Journal of Nursing Management*, *30*(7), 3322–3329. https://doi.org/10.1111/jonm.13773

Mateus-Nieves, E., & Devia Díaz, H. R. (2021). Development of Mathematical Thinking Skill from the Formulation and Resolution of Verbal Arithmetic Problems. *Acta Scientiae*, *23*(1), 30–52. https://doi.org/10.17648/acta.scientiae.5845

Nugroho, O. F., Juwita, S. R., & Nuraeni, F. (2022). Kemampuan Pengajaran Guru dalam Menunjang Pengembangan Pendidikan Yang Berkelanjutan. *Eduscience : Jurnal Ilmu Pendidikan*, *7*(02). https://doi.org/10.47007/edu.v7i02.5544

Nurhayati, Jamilah, & Astuti, R. (2022). Analisis Kemampuan Pemecahan Masalah dalam Menyelesaikan Soal HOTS. *Jurnal Prodi Pendidikan Matematika (JPMM)*, *Volume 4, Nomor 2*, 407–416.

Parjaman, T., & Akhmad, D. (2019). Pendekatan Penelitian Kombinasi: Sebagai "Jalan Tengah" Atas Dikotomi Kuantitatif-Kualitatif. Moderat: Jurnal Ilmiah Ilmu Pemerintahan, 5(4), 530–548.

Peng, Q., Zhang, Y., Liang, S., & Xu, M. (2025). Influence of adversity quotient, emotional support, mental toughness and blunt sensitivity on college students' well-being: A framework based on structural equation modeling and multi-criteria decision-making. *Acta Psychologica*, *259*, 105437. https://doi.org/10.1016/j.actpsy.2025.105437

Rahayuningdewi, P. D., & Faradillah, A. (2020). How Does Problem-solving Method Affect Students' Self-confidence and Mathematical Understanding? *Indonesian Journal of Science and Mathematics Education*, *3*(2), 165–177. https://doi.org/10.24042/ijsme.v3i2.6640

Restiani, N. D., Rahmawati, A. F., Amalia, N. Y., Suryandari, K. C., & Hidayah, R. (2023). Analysis of Mathematical Difficulties Facing Class IV Students in Dealing with Numeration Ability in the Age of Independent Curriculum. *Social, Humanities, and Educational Studies (SHES): Conference Series*, *6*(1), 120. https://doi.org/10.20961/shes.v6i1.71066

Rika Audina, D. F. D. (2021). Analisis Faktor Penyebab Kesulitan Belajar Matematika Kelas IV Sekolah Dasar Negeri. *Cybernetics: Journal Educational Research and Social Studies*, 94–106. https://doi.org/10.51178/cjerss.v2i3.256

Safura, N. A., Aisyah, N., Hiltrimartin, C., & Indaryanti, I. (2018). Student's Mathematical Value in Mathematics Learning Using Non-Routine Problem. *Jurnal Cakrawala Pendidikan*, *37*(3). https://doi.org/10.21831/cp.v38i3.19032

Sapitri, Y., Utami, C., & Mariyam, M. (2019). Analisis Kemampuan Pemecahan Masalah Matematis Siswa dalam Menyelesaikan Soal Open-Ended pada Materi Lingkaran Ditinjau dari Minat Belajar. *Variabel*, *2*(1), 16. https://doi.org/10.26737/var.v2i1.1028

Sutisna, E., & Pujiastuti, H. (2023). Systematic Literature Review: Adversity Quotient pada Kemampuan Pemecahan Masalah Matematis Siswa Berdasarkan Tahapan Polya. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *7*(1), 192. https://doi.org/10.33603/jnpm.v7i1.8052

Tyasing Swastika, G., As, A., Bambang Irawan, E., Nusantara, T., & Irawati, S. (2018). Representation Translation Analysis of Junior High School Students in Solving Mathematics Problems. *International Journal of Insights for Mathematics Teaching*, *01*(2), 115–129.

Utami, N. A., Murtianto, Y. H., & Nizaruddin, N. (2020). Profil kemampuan representasi matematis ditinjau dari kemampuan berpikir kritis dan kecerdasan emosional. *Aksioma: Jurnal Matematika Dan Pendidikan Matematika*, *11*(2), 274–285. https://doi.org/10.26877/aks.v11i2.6501