Journal on Math and Science Educational Technology
Vol. 1, No. 1, June 2025
e-ISSN XXXX-XXXX
http://dx.doi.org/10.309xx/jmset.v1i1.001

ORIGINAL PAPER

Critical Thinking Ability of Students on Probability Material in Class XII SMA Negeri 1 Ambon

Hidayah[1,*], Lucyana Mirel Sapulete[2], Fransina Ohoiwutun[3], Anderson Palinussa[4]
[1,2,3] Pre-service Teacher Professional Education, Pattimura University, Ambon, Indonesia
[4] Mathematics Education, Faculty of Teacher Training and Education, Pattimura University, Ambon, Indonesia

Accepted: June 11, 2025

Abstract
This study aims to describe the critical thinking skills of students in class XII SMA Negeri 1 Ambon regarding the opportunity material. The type of research used is descriptive qualitative research—the research subjects, namely students of class XII-F10 SMA Negeri 1 Ambon, are a total of three people. The subjects in this study were selected through *purposive sampling* based on the categorization of the test results of students' critical thinking skills, supported by observations from researchers during class XII-F10 and opinions from subject teachers. The objective of this research is to measure the critical thinking ability of students through research instruments, including test questions and interviews, followed by data analysis, data reduction, data presentation, and conclusion. The results showed that subject DF, with a high critical thinking ability, demonstrated good performance in analyzing, evaluating, and drawing logical conclusions, although there were deficiencies in the interpretation indicator. The HPH subject, with moderate critical thinking ability, performed well in analysis and evaluation indicators but still required improvement in interpretation and inference. Meanwhile, the JCP subject, who has low critical thinking ability, had difficulty interpreting the problem and applying the solution completely, and did not draw clear conclusions from the inference indicator. The results of this study also indicate the need to develop critical thinking skills on the inference indicator.

Keywords:
Critical Thinking Ability
Probability Material

Corresponding Author:
Name: Hidayah
Email: hhidayah145@gmail.com

INTRODUCTION

Learning that is expected in the 21st century is innovative, creative, collaborative, and learner-centred learning (Sugiyanti et al., 2018). 21st-century education faces complex demands, especially in developing relevant skills to prepare future generations. According to Siti Malikah and Wafroturrohmah (2022), 21st-century education must prioritise critical, creative, and collaborative thinking skills and utilise information technology effectively to improve the quality of learning and human resource development in Indonesia. However, in reality, in the learning process at school, students are often asked to list, explain, define, and describe rather than interpret, analyse, evaluate, and draw conclusions.

According to Kurniawati and Ekayanti (2020), critical thinking, as one of the skills in the 21st century, can be developed through the mathematics learning process by inviting students to analyze, evaluate, and draw conclusions from relevant information in a mathematical context. Research by Oktaviani et al. (2020) demonstrates that critical thinking skills not only aid students in solving math problems but also enhance their ability to argue and formulate effective solutions. Thus, mathematics activities it is expected to make an important contribution to students in developing reasoning, thinking

logically, systematically, critically, and carefully, and being objective and open in facing various problems (Damayanti & Afriansyah, 2018).

Critical thinking skills can help students think rationally in overcoming the problems faced and finding alternative solutions to these problems (Syafruddin & Pujiastuti, 2020). Critical thinking makes students more aware of their surroundings, enabling them to sort out the information they receive. Critical thinking can be described as the skill of reflecting on one's thoughts to inform decisions/actions, where the ability to think critically varies from one student to another (Khoirunnisa & Malasari, 2021).

Probability material, which relates to measuring uncertainty and decision-making, provides students with opportunities to develop critical thinking skills that can be applied in everyday life (Hidayati, 2020). In the context of learning opportunities, students are expected to understand the basic concepts of probability, identify all possible outcomes of an event, and calculate the chances of each outcome occurring logically and systematically (Kurniawati et al., 2020).

Critical thinking helps learners not only to memorize formulas but also to understand and apply probability concepts in real-world situations, enabling them to make more accurate predictions and solve problems more effectively (Rahmaini et al., 2024). The development of critical thinking skills in learning probability is necessary to prepare learners for real-world challenges that often involve analysing data and making decisions based on probability.

Fithriyah et al. (2016) suggested critical thinking indicators, among others, as proposed by Facione. *Interpretation* is the ability to understand and express the intent or meaning of a problem. *Analysis* is the ability to categorise and make conclusions about the relationship between statements, questions, concepts, descriptions, or other forms. *Evaluation* is the ability to assess the credibility of statements or representations and to logically assess the relationship between statements, questions, descriptions, or concepts. *Inference* is the ability to identify and gather the necessary elements to conclude. *Explanation* is the ability to determine and provide logical reasons based on the results obtained. *Self-regulation*, the ability to monitor one's cognitive activity, is a key element in problem-solving activities.

This article describes the critical thinking skills of students in Class XII F10 SMA Negeri 1 Ambon, focusing on the material opportunity. The analysis is conducted in reference to the indicators of critical thinking skills, as outlined by Facione, specifically Interpretation, Analysis, Evaluation, and Inference. The other two indicators, namely explanation and self-regulation, are not repeated because, according to Jarmita & Hazami (2013), the skills of explanation and self-regulation both explain what they think and how they come to the conclusions obtained at the time of inference.

METHOD

The type of research used is descriptive qualitative research. Moleong (2014) reveals that "Qualitative research is research that intends to understand phenomena about what is experienced by research subjects, for example, behaviour, perceptions, motivations, actions, etc. holistically and language, in a special natural context and by utilising various natural methods" (Moleong, 2014). Holistically and linguistically, in a special natural context and by utilising various natural methods" (Moleong, 2014). This study describes the critical thinking abilities of students in class XII SMA Negeri 1 Ambon regarding the opportunity material. The subjects in this study were selected through *purposive sampling, with categorization criteria based on students' test results, which included* answer sheets for students with high, medium, and low abilities. In addition, the subjects analysed were also in accordance with the consideration of teachers at school and the results of observations from researchers while teaching in the class. The objective of this research is to examine the critical thinking ability of students. The research instruments were test questions and interview guidelines. The data analysis techniques employed in this study were based on those proposed by Miles and Huberman (Sugiyono, 2015),

specifically data *reduction*, data *display*, and *conclusion*. The results of the students' answers refer to the scoring guidelines for critical thinking skills, modified from Facione (1994), as shown in Table 1.

Table 1. Critical Thinking Ability Scoring Guidelines

Indicator	Description	Score
Interpretation	Did not write what was known and what was asked.	0
	Write what is known and what is asked incorrectly.	1
	Write only what is known correctly or only what is asked correctly.	2
	Write what is known and what is asked for regarding the problem correctly, but incompletely.	3
Analysis	It does not provide further explanation of the issues to be resolved	0
	It provides further explanation of the issues to be resolved, but is incomplete and imprecise.	1
	It provides further explanation of the main issues to be resolved, but is incomplete and inaccurate.	2
	Provides further explanation of the issues to be resolved appropriately, but incompletely.	3
	Provides further explanation of the main issues that must be resolved completely and precisely.	4
Evaluation	Did not use a strategy to solve the problem.	0
	Using inappropriate and incomplete strategies in solving the problem.	1
	Using the right strategy in solving the problem, but incompletely, or using an inappropriate but complete strategy in solving the problem.	2
	I employed the correct strategy to solve the problem and completed it, but I made errors in my calculations and explanations.	3
	Use the right strategy to solve complete problems and correct calculations or explanations.	4
Inference	It does not draw a conclusion	0
	Makes inappropriate conclusions and does not fit the context of the problem	1
	Makes inappropriate conclusions, even though they are adapted to the context of the problem	2
	Makes appropriate conclusions, appropriate to the context, but incomplete	3
	Makes conclusions appropriately, in accordance with the context of the problem, and completes	4

Facione (Normaya, 2015: 93)

To determine whether students fulfill each indicator of critical thinking ability in solving opportunity problems, the following percentage values can be observed.

$$\text{Percentage Value} = \frac{Skor\ perolehan}{Skor\ maksimal} \text{ x } 100\%$$

The percentage value of critical thinking skills obtained from the calculation is then categorised according to Table 2.

Table 2. Category of Critical Thinking Skills Percentage

Value Interval (%0	Category
$81.25 < X \leq 100$	Very High
$71.50 < X \leq 81,25$	High
$62.50 < X \leq 71,50$	Medium
$43.75 < X \leq 62,50$	Low
$0 < X \leq 43,75$	Very Low

(Normaya, 2015: 96)

RESULTS & DISCUSSION

During the learning process, the researcher's observations and test results were shared with 33 students in class XII-F10 at SMA Negeri 1 Ambon. It was noted that some students were able to answer opportunity questions with correct results. However, if the results of students' answers are classified by examining indicators of critical thinking skills, according to Facione, some students have not fulfilled them optimally. Although students were able to answer correctly, they still did not fully fulfill the indicators of critical thinking skills, namely interpretation, analysis, evaluation, and inference.

The critical thinking ability of students is based on Facione's indicators, specifically the results of individual answers to probability questions, which researchers and mathematics teachers directly supervise at SMA Negeri 1 Ambon. The level of critical thinking ability of students in working on probability problems is evident in Table 3.

Table 3. Level of Critical Thinking Ability of Learners

Value Interval (%)	Many Learners	Percentage	Category
$81,25 - 100$	0	0%	Very High
$71,50 - 81,25$	1	3,03%	High
$62,50 - 71,50$	2	6,06%	Medium
$43,75 - 62,50$	4	12,12%	Low
$0 - 43,75$	26	78,78%	Very Low
Total	**33**	**100%**	

Based on Table 3, the level of critical thinking skills among students is very diverse. The results above show that no students meet the very high category, and one student meets the high category, which accounts for 3.03%. Then two students meet the medium category, or 6.06%; four students meet the low category, or 12.12%; and 26 students are in the very low category, or 78.78%. Meanwhile, the percentages of each indicator of critical thinking skills from the two questions are presented in Table 4.

Table 4. Percentage of Each Critical Thinking Ability Indicator

Critical Thinking Ability Indicator	Percentage (%)
Interpretation	26,10%
Analysis	37,13%
Evaluation	43,01%
Inference	1,47%

Based on Table 4, it can be seen that the evaluation indicator is more dominantly mastered by students in solving critical thinking skills test questions given by researchers, with a percentage of 43.01%, which reflects the students' ability to analyze and assess information critically. While the inference indicator is the lowest indicator mastered by students in completing the test questions, given

with a percentage of 1.47%, it is the lowest critical thinking ability indicator achieved by students; this indicates that students still have difficulty in concluding the information available, thus indicating the need for improved learning strategies that focus more on developing their inferential abilities.

Furthermore, three subjects were analysed who were selected and who met each category, namely one subject in each of the high, medium, and low categories. In contrast, for the very low category, the average student did not answer the question and left the answer sheet blank, so the researcher did not analyse it further. The results of the following analysis pertain to only one probability question, which is considered difficult by researchers.

Analysis of Test Results of High-Category Subjects (DF)

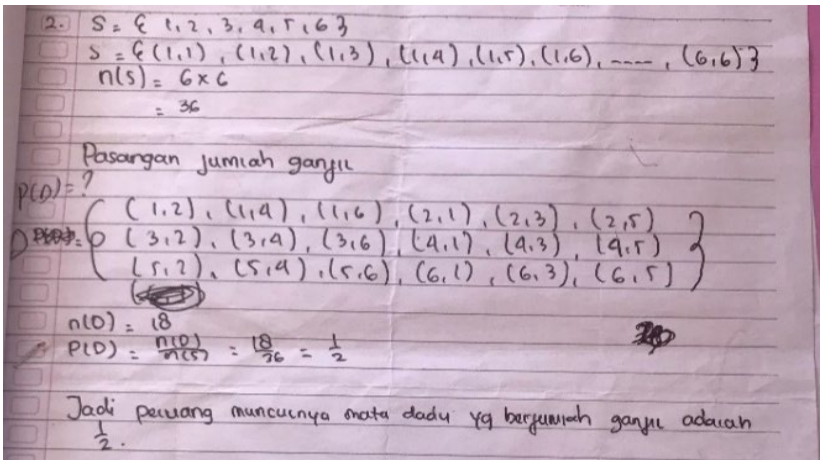

Figure 1. Test Results of Subject DF

P : What information do you know?
DF : It is known that one die is rolled twice.
P : What do you understand from this information?
DF : This means that there are dice thrown twice, so the sample space must be 36 because one throw of the dice has a sample space of 6. After all, it is rolled twice, 6 times 6.
P : What are you looking for from this question, and what information did you find?
DF : This problem asks for pairs of odd numbers of dice.
P : How did you model the problem into a mathematical model? What did you do to answer this problem?
DF : First, I know that the sample space of a single die is 6, so I noted it first, namely S = {1, 2, 3, 4, 5, 6}. After that, because the sample space of rolling one die twice is 36, I need to find all odd pairs of dice. You can see I wrote it like this.
S = {(1,1), (1,2), (1,3),.....,(6,6)}
P : What strategy did you use to solve the problem?
DF : I denote D as the occurrence of an odd number of dice and write down the sample space, i.e. :
Solution:
D = {(1,2), (1,4), (1,6),.....(6,5)}
After that, count the number of members of the sample space D
n(D) = 18
In the next step, I use the formula for probability, which is
$P(D) = \frac{n(D)}{n(S)}$
$P(D) = \frac{18}{36} = \frac{1}{2}$

I simplified $\frac{18}{36}\frac{1}{2}$

P : What can you conclude from the answer using your strategy?

DF : The first thing I did was to determine the sample space of the dice that were rolled twice. Then, calculate the number of members of the sample space by sorting them into a set of consecutive pairs. A simpler approach is to use 6 × 6 multiplication, which results in 36 sample spaces. After that, determine the probability of an even number of dice using the probability formula. The probability formula is P(D) $=\frac{n(D)}{n(S)}$; I substituted the value in the formula so that the final answer is $\frac{1}{2}$.

P : What can you conclude from this answer?

DF : The probability of an odd number of pairs of dice enumerator, one end numerator over 2, meaning that there will be as many as 18 odd-numbered pairs from rolling one die.

Based on the test and interview results from subject DF, the interpretation indicator is fulfilled by writing what is known but incomplete, as well as addressing the questions about the problem. However, the subject can correctly answer the problem, understand its meaning, and devise a good solution. DF was able to understand and explain the steps in determining the sample space. In the analysis indicator, subject DF was able to write the chance formula model correctly and compile it correctly, which demonstrates that he understood how to calculate the probability of an event occurring. This is a fundamental skill in probability.

In the evaluation indicator, subject DF showed good ability by writing down the solution method and performing calculations correctly. Subject DF used the correct strategy to work on the problem, which reflected a deep understanding of the material tested. The use of the right strategy in solving the problem shows that DF has developed critical and analytical thinking skills. Meanwhile, in the inference indicator, the subject DF can write the conclusion correctly. This ability reflects DF's understanding of the analyzed data and the ability to draw logical conclusions from the provided information. The ability to conclude is one of the important aspects of critical thinking. According to Ennis (2018), critical thinking involves the ability to analyse information, evaluate arguments, and draw logical conclusions. DF demonstrated these skills effectively, which are crucial in learning mathematics and other sciences.

Analysis of Test Results of Moderate Category Subjects (HPH)

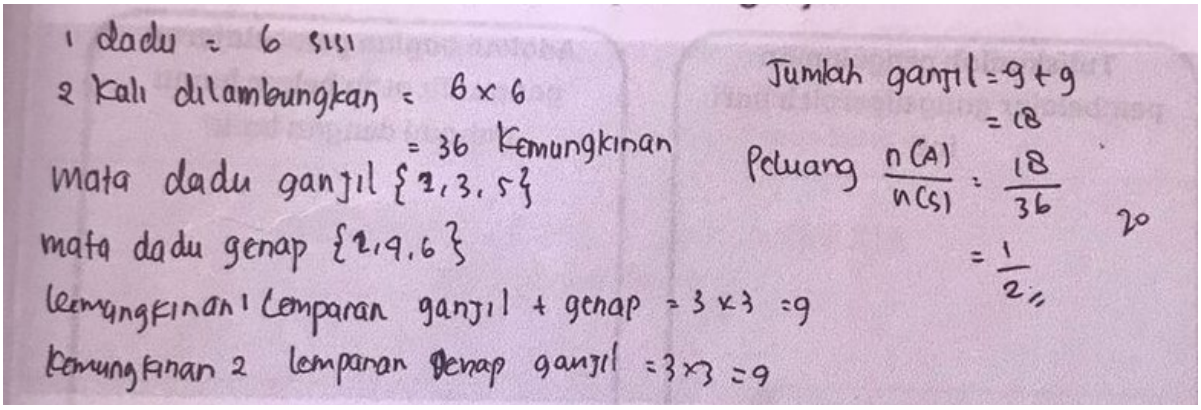

Figure 2. Test Results of HPH Subject

P : After reading the problem, what information do you know?

HPH : It is known that one die is rolled twice...

P : What is being asked in the question?

HPH : What is the probability that a dice roll will result in a ganji?
P : Okay, so how do you model the problem into a mathematical model?
HPH : Write down 1 dice = 6 sides; if rolled 2 times, then 6x6 = 36
P : What strategy did you use to solve the problem?
HPH : I first counted the number of starry dice and even dice, i.e.:
Odd die = {1,3,5}
Even number of dice = {2,4,6}
Oh, the number of odd and even dice eyes is three each.
In the next step, I calculated the probability of 2 throws. After that, determine the value of the odds using the odds formula.
P : Can you solve the problem using a strategy that you are good at?
HPH : He is the first (while looking for the answer on the paper)
Completion:
Possible role = number of odd dice x number of even dice
Possible 1st throw = 3x3 = 9
Possible 2nd throw = 3x3 = 9
Number of possible two throws = 18
$P(A) = \frac{n(A)}{n(S)}$
$P(A) = \frac{18}{36} = \frac{1}{2}$
P : What can you conclude from this answer?
HPH : So the conclusion is that the probability of an odd-edged die is .$\frac{1}{2}$
P : What do you think the answer to half means? Try to relate it to the question.
HPH : Eeee, that is the answer.

Based on the test and interview results from the HPH subject, it can be seen that in the interpretation indicator, the subject did not indicate which parts were known and which were asked in the problem. However, the HPH subject was able to write down the steps for determining the sample space of the given problem. In the analysis indicator, the HPH subject was able to write and explain the chance formula model correctly; moreover, the subject was able to make groupings when working on problems involving dice with odd and even numbers. Overall, HPH's ability to write the chance formula correctly reflects a strong analytical understanding and critical skills in analysing the meaning of the given problem.

In the evaluation indicator, the HPH subject demonstrated a good ability by writing down the solution method and performing the calculations correctly. The HPH subject chose a different working strategy from the DF subject, but the chosen strategy was also the right one. Although HPH chose a different strategy from subject DF, the choice was still appropriate and effective in the context of the problem. This demonstrates that HPH has the flexibility to think critically and adjust approaches based on a personal understanding of the problem. In the inference indicator, the HPH subject did not draw or write the conclusion of the answer obtained from the test results. This shows a lack of ability to draw inferences from existing data. However, the subject has a basic understanding of the material presented. It can provide the correct answer. However, it is unable to provide a conclusion to the answer, indicating a gap in understanding, and the subject does not fully grasp the relationship between the answer and the underlying concept.

Analysis of Test Results of Low Category Subjects (JCP)

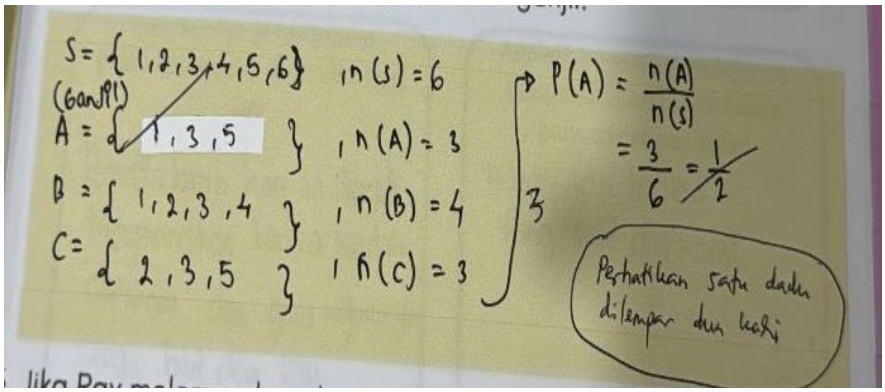

Figure 3. Test Results of JCP Subject

P : After reading the problem, what information is known?
JCP : Given the sample space of a die, S = {1,2,3,4,5,6}
P : What is being asked in the question?
JCP : What is the probability that the dice will appear with several ganji?
P : How can you model the problem into a mathematical model?
JCP : The first one I
A = {1,3,5}, n(A) = 3
B = {1,2,3,4}, n(B) = 4
C = [2,3,5}, n(C) = 3
P : What strategy did you use to solve the problem?
JCP : I used the odds formula.
P : Can you solve the problem using a strategy that you are good at?
JCP : He is the first (while looking for the answer on the paper)
Solution:
$P(A) = \frac{n(A)}{n(S)}$
$P(A) = \frac{3}{6} = \frac{1}{2}$
P : What can you conclude from a half-answer? That is, what about the question asked?
JCP : That is half the answer, sis. That is what I understand.
P : Are you sure about the answer you have solved?
JCP : I am still unsure of my answer, but I hope it is correct.

Based on the test and interview results from the JCP subject, it can be seen that in the interpretation indicator, the JCP subject wrote what was known incorrectly and did not write what was asked. This can indicate an error in understanding or interpreting the information provided by the problem. The subject has recorded the known things, but when trying to explain or answer the questions asked, there are errors or inaccuracies in explaining the relationship or context between the information. In the analysis indicator, it can be seen that the JCP subject has written a mathematical model in the form of an exact chance formula. This indicates that the JCP subject possesses a solid analytical understanding of the fundamental concepts employed in the problem, particularly in relation to the odds formula.

In the evaluation indicator, the JCP subject employed the correct strategy to solve the problem; however, the results obtained were incomplete. This shows that although the subject has chosen the correct approach to solving the problem, the application is not done correctly. This incomplete solution reflects a gap in the evaluation process, either in terms of understanding the problem, applying the

solution steps, or fully utilising the strategy. Meanwhile, in the inference indicator, the JCP subject did not conclude at the end of the solution and was unable to explain the answer obtained.

CONCLUSION

Based on the results and discussion, it can be concluded that the critical thinking skills of students in class XII SMA Negeri 1 Ambon, particularly those in subjects with high critical thinking skills (DF), have demonstrated good critical thinking skills in solving math problems, especially in probability material. DF was able to understand the problem well, plan the problem-solving steps, and answer the question correctly. Although there is a slight lack of complete information in the interpretation indicator, DF's ability to analyse, formulate formulas, and use appropriate strategies shows a deep understanding of the material. Additionally, DF was able to draw logical and appropriate conclusions, reflecting strong critical thinking skills. Overall, DF showed a good ability to analyse information, evaluate arguments, and draw in-depth conclusions, which are important aspects of learning mathematics and science. Subjects with moderate critical thinking ability (HPH) have demonstrated good critical thinking skills, particularly in analyzing and evaluating problems. Despite shortcomings in interpreting information and drawing conclusions, HPH was able to solve the problem with the right strategy and effective grouping. This demonstrates a strong understanding of the material, although there is still room to improve skills in making inferences and drawing logical conclusions from answers. Subjects with low critical thinking ability (JCP) have demonstrated a good understanding of analyzing the chance formula, but they encounter difficulties in interpreting the problem and applying complete solution steps. Although the strategy used was appropriate, the results obtained were still not comprehensive, and the subject did not draw clear conclusions from the answers given. This indicates that the subject needs to enhance their skills in comprehending information, applying solutions more effectively, and drawing logical conclusions. Overall, the indicator of critical thinking ability that students achieve most dominantly is the evaluation indicator. In contrast, the inference indicator is the lowest indicator of critical thinking ability achieved by students. This indicates that learners can comprehend the problem's meaning and devise effective strategies or steps to solve the given problems correctly. However, learners cannot draw logical and relevant conclusions from the results obtained. There needs to be an increased focus on inference skills so that students can draw more effective conclusions and connect information with the results obtained. This is crucial for enhancing overall critical thinking skills.

REFERENCES

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.)*. Thousand Oaks, CA: Sage Publications.

Damayanti, R., &Afriansyah, E. A. (2018). Perbandingan kemampuan representasi matematis siswa antara contextual teaching and learning dan problem-based learning. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, 7(1), 30-39.

Ennis, R. H. (2018). *Critical Thinking*. New Jersey: Prentice Hall. Education (RME). Jurnal Ilmiah Didaktika, 13(2): 92 – 104.

Fithriyah, I., Sa'dijah, C., & Sisworo, S. (2016). Analisis kemampuan berpikir kritis siswa kelas IX-D SMPN 17 Malang. *Prosiding Konferensi Nasional Penelitian Matematika dan Pembelajarannya*, 580-590.

Facione, A.P. (1994). *Holistic Critical Thinking Scoring Rubric*. California Academia Press, San Francisco

Hidayati, N. (2020). Pengembangan kemampuan berpikir kritis peserta didik melalui pembelajaran matematika. *Jurnal Pendidikan Matematika*, 4(1), 45-58.

Iskandar, A. (2019). Analisis kesulitan peserta didik dalam memahami materi peluang di sekolah menengah atas. *Jurnal Penelitian Pendidikan*, 12(2), 123-135.

Karim, A. (2015). Pengaruh gaya belajar dan sikap peserta didik pada pelajaran matematika terhadap kemampuan berpikir kritis matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 4(3).

Khoirunnisa, P. H., & Malasari, P. N. (2021). Analisis kemampuan berpikir kritis matematis siswa ditinjau dari self confidence. *JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika)*, 7(1), 49–56. https://doi.org/10.37058/jp3m.v7i1.2804.

Kurniawati, N., & Ekayanti, D. (2020). Penerapan model pembelajaran kooperatif untuk meningkatkan kemampuan berpikir kritis peserta didik pada materi peluang. *Jurnal Pendidikan dan Pembelajaran*, 7(2), 89-98.

Malikah, S., & Wafroturrohmah, N. (2022). Pendidikan abad 21: Tantangan dan peluang. *Jurnal Pendidikan dan Teknologi*, 5(1), 1-10.

Mardhiyah, R. H., & lainnya. (2021). Pembelajaran matematika abad 21: Meningkatkan keterampilan berpikir kritis peserta didik. *Jurnal Pendidikan Matematika*, 6(1), 12-22.

Moleong, L. J. (2014). *Metodologi Penelitian Kualitatif*. Bandung, Indonesia: PT Remaja Rosdakarya.

Miles, M. B., & Huberman, A. M. (2014). *Qualitative Data Analysis: A Methods Sourcebook (3rd ed.)*. Thousand Oaks, CA: Sage Publications.

Jarmita, N., & Hazami, H. (2013). Ketuntasan hasil belajar siswa melalui pendekatan realistic mathematics education (rme) pada materi perkalian. *Jurnal Ilmiah Didaktika: Media Ilmiah Pendidikan dan Pengajaran*, *13*(2).

Oktaviani, S., et al. (2023). Pengaruh pembelajaran berbasis masalah terhadap kemampuan berpikir kritis peserta didik. *Jurnal Ilmiah Pendidikan*, 10(2), 101-110.

Rahmaini, R., et al. (2024). Menerapkan konsep peluang dalam kehidupan sehari-hari: analisis kemampuan berpikir kritis peserta didik. *Jurnal Matematika dan Pendidikan*, 8(1), 23-34.

Sugiyono. (2015). *Metode Penelitian Kuantitatif Kualitatif dan R&D.* Bandung, Indonesia: Alfabeta.

Sugiyanti, D., et al. (2018). Inovasi pembelajaran di era digital. *Jurnal Pendidikan dan Pembelajaran*, 4(2), 77-85.

Syafruddin, I. S., & Pujiastuti, H. (2020). Analisis kemampuan berpikir kritis matematis: Studi kasus pada siswa MTs Negeri 4 Tangerang. *Suska Journal of Mathematics Education*, 6(2), 89–100