ALGEBRA : JURNAL PENDIDIKAN, SOSIAL DAN SAINS

ISSN : 2807-663X e-ISSN : 2807-629X
Journal Homepage : https://algebra.yana.or.id/index.php/ejournal/index
Volume 6 Number 4 (2026)

ANALYSIS OF STUDENTS' CRITICAL THINKING ABILITIES IN PHYSICS LEARNING IN GRADE XI OF HIGH SCHOOL

Elvrina Nainggolan, Gabriella Br Tamba, Novita Imelisa Br Sagala, Rade Yamen Tamba, Mariati Purnama Simanjuntak
[12345]Program Studi Pendidikan Fisika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Medan, Medan, Indonesia
Correspondence Email: elvrinanainggolan@gmail.com

ABSTRACT

This study aims to analyze the critical thinking skills of eleventh-grade students in physics learning at a public high school in Binjai. The study used a qualitative descriptive approach with 30 eleventh-grade students and one physics teacher as subjects. Data collection was conducted through observation, essay tests, interviews, and documentation. The critical thinking skills test was structured based on indicators of interpretation, analysis, evaluation, inference, and explanation. Data were analyzed using the Miles and Huberman interactive analysis model which includes data collection, data reduction, data presentation, and conclusion drawing. The results of the study indicate that the physics learning process is still dominated by the lecture method with limited use of media and technology so that student activeness in asking questions, discussing, and solving problems is still low. The results of the critical thinking skills test showed an average student score of 62.1 which is in the medium category. A total of 53.3% of students are in the medium category, 26.7% are in the high category, 16.7% are in the low category, and 3.3% are in the very low category, while no students reached the very high category. Interview results indicate that students still struggle to grasp physics concepts in depth, tend to memorize formulas, and are unfamiliar with solving problems that require analysis and scientific reasoning. Therefore, innovative learning strategies and materials, such as problem-based learning e-modules, are needed to support the development of students' critical thinking skills in physics.

Keywords: Critical thinking skills; Physics learning; Students.

Submited: 08 Juni 2026	***Accepted: 10 November 2026***	***Published: 19 November 2026***

INTRODUCTION

Physics is a branch of natural science that studies various natural phenomena through a scientific approach. Learning physics not only aims to master concepts, principles, laws, and theories but also develops students' ability to understand natural phenomena logically, systematically, and based on scientific evidence. Students are required to observe, identify problems, analyze data, connect concepts, and draw conclusions based on facts discovered during the physics learning process. Therefore, physics learning plays a crucial role in developing the higher-order thinking skills needed by students to face the increasingly rapid development of science and technology (Putri et al., 2023).

The development of education in the 21st century requires students to possess various skills that can support their thinking and problem-solving abilities. One of the skills that is a primary focus of 21st-century education is critical thinking. Critical thinking is part of the 4C skills (Critical Thinking, Creativity, Communication, and Collaboration) that students need to face various global challenges and the ever-evolving technological developments (Zubaidah, 2021). In addition, critical thinking skills are also needed so that students are able to filter information objectively, evaluate various information obtained, and make decisions based on logical reasons and accountable evidence (Kusuma et al., 2024).

Critical thinking is a rational and reflective thought process used to determine what to believe or do based on logical considerations (Ennis, 2018). According to Paul and Elder (2006), critical thinking is an intellectual process that involves the ability to conceptualize, analyze, synthesize, and evaluate information obtained through observation, experience, reflection, and communication. Meanwhile, Facione (2015) explains that critical thinking skills consist of several main indicators, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation. These indicators show that critical thinking skills are not only related to the ability to understand information, but also the ability to process information, evaluate evidence, and draw conclusions logically and systematically.

Critical thinking skills are closely related to physics learning. The characteristics of physics material, which includes many abstract concepts, mathematical relationships, natural phenomena, and problem-solving activities, require students to engage in in-depth reasoning. Students are not only required to memorize formulas but also to understand the meaning of concepts, analyze relationships between variables, interpret observational data, and evaluate various alternative solutions to physics problems. Therefore, critical thinking skills are one of the essential skills students must possess in physics learning (Sa'adah et al., 2022).

Strong critical thinking skills can help students understand physics concepts more deeply and meaningfully. Students who possess critical thinking skills tend to be able to connect learned concepts to everyday phenomena, provide scientific arguments for a problem, and solve problems based on relevant concepts. Conversely, low critical thinking skills can cause students to have difficulty understanding concepts comprehensively, resulting in the learning process being more oriented toward memorization than actual conceptual understanding (Putri et al., 2023).

Developing critical thinking skills cannot be achieved instantly, but requires a learning process that actively engages students in investigation, discussion, analysis, and problem-solving activities. Student-centered learning is known to help improve critical thinking skills because it provides students with the opportunity to construct their own knowledge through thought and investigation. A literature study conducted by Nababan et al. (2023) shows that the inquiry learning model has the potential to improve students' critical thinking skills in physics learning because students are actively involved in the process of discovering concepts and solving problems.

In addition to learning models, the use of media and learning tools also plays a crucial role in supporting the development of students' critical thinking skills. Prihandono et al. (2023) explain that the use of interactive E-LKPD based on problem-based learning can help improve students' critical thinking skills and physics learning outcomes. This suggests that learning involving problem-solving activities can provide students with opportunities to optimally develop analytical, evaluation, and scientific reasoning skills.

Various studies have shown that students' critical thinking skills still require attention in the physics learning process. Rahman et al. (2022) explained that students' critical thinking skills are still in the category that needs improvement, especially in indicators related to analytical and evaluation skills. Other research results also show that the implementation of a Problem-Based Learning model and the use of appropriately designed Student Worksheets (LKPD) can have a positive

influence on students' critical thinking and problem-solving skills in physics learning (Muslimin & Purwaningsih, 2023). Furthermore, a meta-analysis conducted by Tulung et al. (2023) showed that the implementation of the problem-based learning model has a significant influence on improving students' critical thinking skills.

Based on initial observations and interviews with physics teachers and students at a public high school in Binjai, it was discovered that some students still experience difficulties in analyzing physics problems that require conceptual reasoning. Students tend to find it easier to solve routine problems than those that require analysis, evaluation, and scientific justification for their answers. Furthermore, the learning process, which is still dominated by lectures, means that students' opportunities to develop critical thinking skills through discussion, investigation, and problem-solving are not optimal.

Based on the description, an analysis of students' critical thinking skills in physics learning is needed to determine the level of students' abilities in each critical thinking indicator. This analysis is important because it can provide an overview of students' abilities in interpreting information, analyzing problems, evaluating evidence, drawing conclusions, and providing scientific explanations. Therefore, this study aims to analyze the critical thinking skills of 11th grade students at a public high school in Binjai in physics learning based on the indicators of interpretation, analysis, evaluation, inference, and explanation.

RESEARCH METHODS

This study employed a qualitative descriptive approach. The qualitative approach was used to deeply understand and describe students' critical thinking skills in physics learning based on actual conditions. According to Yusuf (2017), a qualitative approach is used to uncover a situation or phenomenon in a natural setting and to understand its meaning through data in the form of words, behavior, and directly observed events.

This study was conducted with eleventh-grade high school students in the 2025/2026 academic year. The study subjects consisted of one physics teacher and 30 eleventh-grade students who served as respondents.

Data collection techniques in this study were carried out through observation, essay tests, student and teacher interviews, and documentation of the learning process. Observations were conducted to observe teacher and student activities during the physics learning process and to observe indicators of students' critical thinking skills in the classroom. Interviews were conducted with teachers and students to obtain information about the learning conditions, the level of students' critical thinking skills, and obstacles encountered during the learning process. Essay tests were distributed to 30 grade XI students to determine their ability to understand and solve physics problems. The essay tests used included several indicators of critical thinking skills, such as interpretation, analysis, evaluation, inference, and explanation. Documentation was conducted to obtain supporting data in the form of photos and notes during the learning process.

The data analysis technique used in this study was the interactive analysis model adopted by Miles and Huberman (1994), which includes data collection, data reduction, data presentation, and conclusion drawing. Data obtained from observations, descriptive tests, interviews, and documentation were then grouped according to the research focus for easier analysis and understanding. The analysis results were then presented in descriptive form based on the data obtained in the field. Data validity was ensured through triangulation, comparing the results of observations, interviews, descriptive tests, and documentation to ensure the data obtained reflected the actual situation.

RESULTS AND DISCUSSION

Based on the analysis of data obtained through observation, descriptive tests, interviews, and documentation during the physics learning process of grade XI high school in Binjai, an overview of the condition of physics learning and the level of students' critical thinking skills was obtained. Based on the results of observations made during the physics learning process, including learning methods, media use, student activeness, questioning skills, analytical skills, discussion activities, technology use, and the relevance of the material to everyday life. The results of the observations are summarized in Table 1 below.

Table 1. Learning Observation Results

Observed aspects	Observation Results
Learning methods	Lecture Dominance
Media use	Still Limited
Student activity	Low
Question-asking skills	Still Insufficient
Analytical skills	Not Optimal
Discussion activities	Less Active
Technology use	Not Optimal
Critical thinking skills	Still Insufficient/Low
Relationship of material to daily life	Still Insufficient
Need for innovative teaching materials	Very Necessary

These observations indicate the need for learning innovations that can increase active student engagement, provide contextual learning experiences, and facilitate student analysis and problem-solving. One potential alternative is the use of interactive e-modules combined with learning models such as problem-based learning (PBL), which integrate real-world problems into learning activities, thereby helping to improve students' critical thinking skills.

Based on a descriptive test to more objectively measure students' critical thinking skills, a 10-question essay test was conducted on the topic of static fluids. Each question represents an indicator of critical thinking skills, including interpretation, analysis, evaluation, inference, and explanation. Student responses were grouped into four categories, as presented in table 2.

Table 2. Assessment categories

Value	Category
85-100	Very high
70-84	High
55-69	Moderate
40-54	Low
0-39	Very low

Next, the assessment of students' descriptive answers is carried out using the assessment rubric presented in table 3 below.

Table 3. Assessment Rubric for Descriptive Questions

Score	Criteria
4	The answer is very complete, correct, and includes a scientific reasoning.
3	The answer is correct but the explanation is incomplete.
2	The answer is partially correct.
1	The answer is not quite correct.
0	No answer or incorrect answer.

Based on tables 2 and 3, the results of this study consist of the results of the critical thinking ability test of grade XI high school students consisting of 30 students, the student score data obtained is presented in table 3 below.

Table 4. Results of Students' Critical Thinking Ability Test

Category	Value Range	Number of Students	Percentage
Very high	85-100	0	0,0
High	70-84	8	26,7
Moderate	55-69	16	53,3
Low	40-54	5	16,7
Very low	0-39	1	3,3

Based on Table 3, no students achieved the very high category. These results indicate that students' critical thinking skills in physics are still predominantly in the moderate category, with an average class score of 62.1, also in the moderate category. This finding indicates that students' critical thinking skills still need to be improved through the implementation of more innovative learning strategies and teaching materials oriented toward developing higher-order thinking skills.

Based on interviews with physics teachers and grade XI high school students, several information findings were obtained, which are listed in table 4.

Table 4. Results of Teacher and Student Interviews

Teacher	Student
1. Students still have difficulty understanding physics concepts in depth. 2. Some students simply memorize formulas without understanding the concepts. 3. Students' ability to analyze and provide scientific reasoning remains low. 4. Students are less active in discussions and problem-solving activities. 5. Teachers still use textbooks and simple worksheets. 6. The use of digital media is not optimal due to limited teaching materials. 7. Teachers need interactive teaching materials that can increase student motivation. 8. Teachers stated that the problem-based learning model is suitable for developing students' critical thinking skills. 9. E-modules are considered more engaging because they can include images, videos, animations, and practice problems. 10. Teachers hope for the development of PBL-based e-modules for static fluids.	1. Students find physics quite difficult to understand. 2. Students understand the material more easily if it is accompanied by images, videos, or simulations. 3. Physics lessons are still considered monotonous. 4. Students are rarely involved in solving real-world problems. 5. Some students find it difficult to answer questions that require reasoning and analysis. 6. Students are more interested in using digital learning materials than printed textbooks. 7. Students stated that interactive e-modules would facilitate independent learning. 8. Students are interested if learning is connected to everyday life. 9. Most students are not yet accustomed to working on critical thinking problems. 10. Students agree that e-modules based on problem-based learning should be developed.

Based on interviews with physics teachers and eleventh-grade high school students, it was found that the physics learning process still faces several obstacles that impact students' critical thinking skills. Teachers stated that students still have difficulty understanding physics concepts in depth, tend to memorize formulas, and have low analytical and scientific reasoning skills. Furthermore, the limited use of teaching materials and media results in students being less active in discussions and problem-solving.

Interviews with students indicate that physics is still considered a difficult subject and its teaching tends to be monotonous. Students understand the material more easily when presented through images, videos, or simulations, and are more interested in using digital learning materials than printed textbooks. Most students also admitted they are not yet accustomed to working on problems that require critical thinking and problem-solving skills.

Overall, the results of observations, descriptive tests, interviews, and documentation indicate that the physics learning process in grade XI high school students still does not fully support the development of students' critical thinking skills. Observations show that learning is still dominated by lecture methods with limited use of media and technology, resulting in low student engagement in asking questions, discussing, analyzing, and solving problems. This condition results in students having less opportunity to develop the higher-order thinking skills needed in physics learning.

CONCLUSIONS

Based on the results of observations, descriptive tests, interviews, and documentation, it can be concluded that the critical thinking skills of eleventh grade students in physics learning at a public high school in Binjai are still not optimal. The results showed that students' critical thinking skills were dominated by the moderate category with an average score of 62.1. During the learning process, students still experienced difficulties in analyzing physics problems, evaluating information, drawing conclusions, and providing scientific explanations. In addition, learning that is still dominated by lecture methods causes students' opportunities to develop critical thinking skills through discussion and problem solving to be less than optimal. Therefore, the implementation of more innovative

strategies and teaching materials is needed to support the development of students' critical thinking skills in the indicators of interpretation, analysis, evaluation, inference, and explanation.

BIBLIOGRAPHY

Ennis, R. H. (2018). *Critical thinking across the curriculum: A vision. Topoi, 37*(1), 165–184.

Facione, P. A. (2015). *Critical thinking: What it is and why it counts* (6th ed.). Insight Assessment.

Kusuma, E. S. J., Handayani, A., & Rakhmawati, D. (2024). Pentingnya pengembangan kemampuan berpikir kritis pada siswa sekolah dasar: Sebuah tinjauan literatur. *Jurnal Wawasan Pendidikan, 4*(2), 369–379.

Martatis. (2023). Pengaruh model pembelajaran inkuiri terbimbing terhadap berpikir kritis siswa pada mata pelajaran fisika. *Journal of Educational Research and Humaniora (JERH), 1*(2), 24–33.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook (2nd ed.).* SAGE Publications.

Muslimin, M., & Purwaningsih, E. (2023). Meta-analisis: Pengaruh LKPD berbasis PBL terhadap kemampuan berpikir kritis dan pemecahan masalah dalam fisika. *Jurnal Pendidikan Matematika dan Sains, 11*(2).

Nababan, L. R., Manalu, M., & Ramadani, N. P. (2023). Studi literatur: Analisis model pembelajaran inkuiri dalam meningkatkan kemampuan berpikir kritis siswa pada pembelajaran fisika. *Jurnal Pendidikan Fisika, 12*(2), 197–203.

Paul, R., & Elder, L. (2006). *Critical thinking: Tools for taking charge of your learning and your life* (2nd ed.). Pearson Education.

Prihandono, T., Supriyono, A., Meilina, I. L., & Ernasari. (2023). Penerapan E-LKPD interaktif berbasis *Problem Based Learning* berbantuan Liveworksheets untuk meningkatkan kemampuan berpikir kritis dan hasil belajar fisika. *Jurnal Pembelajaran Fisika, 12*(3).

Putri, W. I., Sundari, P. D., Mufit, F., & Dewi, W. S. (2023). Analisis keterampilan berpikir kritis siswa SMA pada materi pemanasan global. *Jurnal Ilmiah Profesi Pendidikan, 8*(4), 2428–2435.

Sa'adah, S., Wulandari, A. Y. R., Fikriyah, A., & Muharrami, L. K. (2022). Analisis kemampuan berpikir kritis siswa SMP materi pemanasan global dengan soal berbasis pendekatan *Socioscientific Issues* (SSI). *Natural Science Education Research, 4*(3), 231-241.

Yusuf, A. M. (2017). *Metode penelitian kuantitatif, kualitatif, dan penelitian gabungan. Kencana.*

Zubaidah, S. (2021). Keterampilan abad ke-21: Keterampilan yang diajarkan melalui pembelajaran. *Jurnal Pendidikan dan Kebudayaan, 6*(2), 1–17.