Mahir, dkk. (2025)
https://doi.org/10.70310/jet

ISSN 3063-4402
Jurnal Edukasi Terkini

ORIGINAL ARTICLE Open Access

The Level of Critical Thinking Skills of High School Students in Physics Learning Based on Local Wisdom

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Abstrak

Tujuan*-Penelitian ini bertujuan untuk mengkaji tingkat kemampuan berpikir kritis siswa SMA dalam pembelajaran fisika berdasarkan kearifan lokal. Penelitian ini menyoroti relevansi mengintegrasikan konteks budaya ke dalam pendidikan sains untuk meningkatkan keterlibatan kognitif dan pemahaman konseptual.* ***Research Metodologi/Desain/Pendekatan-*** *Survei deskriptif kuantitatif dilakukan yang melibatkan siswa SMA dalam kelas fisika yang menerapkan kearifan lokal sebagai pendekatan pembelajaran kontekstual. Data dikumpulkan menggunakan tes keterampilan berpikir kritis yang dikembangkan berdasarkan lima indikator Ennis. Hasil dianalisis secara deskriptif untuk menentukan kinerja siswa di setiap indikator.* ***Temuan****-Temuan tersebut mengungkapkan bahwa keterampilan berpikir kritis siswa secara keseluruhan berada dalam kategori moderat, dengan skor rata-rata 62,36%. Kinerja tertinggi diamati pada indikator "memberikan penjelasan sederhana" (68,2%), sedangkan yang terendah adalah "membuat penjelasan lebih lanjut" (57,3%). Hasil ini menunjukkan bahwa meskipun siswa dapat menghubungkan konsep fisika dengan fenomena lokal, penalaran yang lebih dalam dan pemikiran kritis yang maju masih membutuhkan penguatan pedagogis.* ***Orisinalitas/Nilai****-Studi ini berkontribusi pada semakin banyak literatur tentang pendidikan sains kontekstual dengan menekankan peran kearifan lokal dalam menumbuhkan pemikiran kritis. Tidak seperti penelitian sebelumnya yang berfokus pada model instruksional umum, penelitian ini memberikan bukti empiris tentang nilai potensial pembelajaran yang terintegrasi secara budaya di kelas fisika, terutama dalam mengembangkan keterampilan berpikir tingkat tinggi siswa.*
Keywords: Berpikir Kritis, Pendidikan Fisika, Kearifan Lokal, SMA, Pembelajaran Kontekstual

Abstract

Purpose*-This study aims to investigate the level of high school students' critical thinking skills in physics learning based on local wisdom. The research highlights the relevance of integrating cultural context into science education to enhance cognitive engagement and conceptual understanding.* ***Research Methodology/Design/Approach-*** *A quantitative descriptive survey was conducted involving high school students in a physics class that applied local wisdom as a contextual learning approach. Data were collected using a critical thinking skills test developed based on Ennis' five indicators. The results were analyzed descriptively to determine students' performance across each indicator.* ***Findings****-The findings revealed that students' overall critical thinking skills were in the moderate category, with an average score of 62.36%. The highest performance was observed in the indicator of "giving simple explanations" (68.2%), while the lowest was in "making further explanations" (57.3%). These results suggest that although students can connect physics concepts to local phenomena, deeper reasoning and advanced critical thinking still require pedagogical reinforcement.* ***Originality / Value****-This study contributes to the growing body of literature on contextual science education by emphasizing the role of local wisdom in fostering critical thinking. Unlike prior studies that focused on general instructional models, this research provides empirical evidence of the potential value of culturally integrated learning in the physics classroom, particularly in developing students' higher-order thinking skills.*
Keywords: critical thinking, physics education, local wisdom, high school, contextual learning

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Introduction

In the era of the industrial revolution 4.0 and towards the era of society 5.0, critical thinking skills are one of the main competencies that must be possessed by students (Mun'amah, 2023; Rusman et al., 2023). This skill allows individuals to think rationally, logically, reflectively, and metacognitively in dealing with problems, making decisions, and evaluating information from various sources (Saini et al., 2022). In the context of 21st century education, critical thinking skills are not only a necessity, but also a demand that must be accommodated in the learning process (Susetyarini & Fauzi, 2020). The Merdeka Curriculum implemented in Indonesia also emphasizes the importance of developing critical thinking skills as part of the Pancasila Student profile, which directs students to become independent, critically reasoning, and able to contribute to society.

Learning physics as part of science subjects is very relevant in the development of critical thinking skills. Physics requires students not only to understand scientific concepts, but also to be able to relate them to real phenomena, analyze data, formulate hypotheses, and solve problems logically (Pols et al., 2021). However, physics learning in high school (SMA) is still often dominated by conventional approaches that focus on memorizing formulas and solving routine problems, so it does not provide space for students to develop critical thinking skills optimally. This has an impact on low student learning outcomes, including in high-level cognitive aspects such as analysis and evaluation.

One approach that can be used to increase student involvement and develop critical thinking skills is contextual learning, which is learning that relates subject matter to students' daily lives. In the context of Indonesia, which is rich in local culture and wisdom, the integration of local cultural elements into physics learning can be an effective strategy to bridge the understanding of physics concepts with a reality that is close to students. Local wisdom reflects the traditional values, practices, and technologies that develop in a society, which basically contain many scientific principles that can be explored in science learning (Lubis et al., 2022; Zidny et al., 2020).

The integration of local wisdom in physics learning not only has the potential to increase the relevance of teaching materials, but also strengthens students' cultural identities, as well as encourages them to think critically about the phenomena around them. For example, in learning about the concepts of force and motion, teachers can associate the material with traditional games such as stilts or tug-of-war, which naturally contain the principles of physics. Similarly, in learning about temperature and heat, students can be invited to analyze traditional cooking processes such as the making of brown sugar or the drying of fish, which involve the process of heat transfer. Thus, students not only understand the concepts of physics in the abstract, but are also able to relate them to real practices they are familiar with.

Although the integration of local wisdom in science learning has been widely suggested in various literatures, empirical studies on its impact on students' critical thinking skills are still relatively limited (Arjaya et al., 2024; Irhasyuarna et al., 2022; Prayogi et al., 2022). Some previous studies have focused more on the influence of certain learning models on cognitive learning outcomes in general, without specifically examining critical thinking skills in the context of learning based on local wisdom (Fadli & Irwanto, 2020; Martawijaya et al., 2025). In addition, there is still little research that descriptively describes the level of students' critical thinking skills in physics learning that relate the material to local wisdom. In fact, this information is important as a basis for designing more contextual and effective learning interventions.

Taking into account the importance of critical thinking skills in physics learning, as well as the potential of local wisdom as a meaningful context for students, this study was conducted to describe the level of critical thinking skills of high school students in physics learning based on local wisdom. This research is quantitative descriptive with a focus on one variable, namely critical thinking skills. This research will not only provide an overview of the extent to which critical thinking skills have developed among students, but also provide preliminary information that can be used as a consideration for teachers, curriculum developers, and educational

researchers in designing physics learning that is more contextual and in favor of 21st century skills development.

The novelty of this research lies in its focus on examining students' critical thinking skills in the context of physics learning that is integrated with local wisdom, which is still rarely discussed in previous studies. This research does not intend to test the effectiveness of a particular learning model or strategy, but rather to describe the actual conditions that occur in the field related to students' critical thinking skills. Therefore, the results of this research are expected to be the starting point for more experimental follow-up research, as well as the basis for the development of teaching materials, learning tools, and teacher training based on local potential.

In particular, the purpose of this study is to describe the level of critical thinking skills of high school students in physics learning based on local wisdom. With the results obtained, it is hoped that it can contribute to efforts to improve the quality of physics education in secondary schools, especially in the aspects of developing critical thinking skills and utilizing the local cultural context. In addition, the results of this research are also expected to strengthen the position of local wisdom as a legitimate and relevant learning source in modern science learning, as well as encourage the creation of a physics learning model that is more contextual, meaningful, and empowers students as critical and cultured individuals.

Method

This study uses a quantitative approach with a descriptive method (Sugiyono, 2013). This approach is used to obtain an objective picture of the level of critical thinking skills of high school students in physics learning based on local wisdom. The subjects in this study are high school grade XI students who have participated in physics learning with a local wisdom-based approach in the even semester of the 2024/2025 school year. The sampling technique used is purposive sampling, with the criterion that teachers at the school have implemented physics learning that integrates elements of local wisdom, both explicitly in the lesson plan and through learning practices.

The main instrument in this study is a critical thinking skill test developed based on critical thinking indicators according to Ennis (Sarwanto et al., 2020; Septiany et al., 2024), namely: providing simple explanations, building basic skills, concluding, making follow-up explanations, and establishing strategies and tactics. The test is prepared in the form of a two-tier test and a brief description, with the validity of the content being consulted with a physics education expert and declared suitable for use.

The data obtained from the test results were then analyzed quantitatively using descriptive statistics (Hinton, 2024), such as average scores, percentages, and categorization of students' critical thinking skill levels. The data is presented in the form of tables and diagrams to facilitate interpretation. The entire process of data collection and analysis was carried out by paying attention to the ethical principles of research, including maintaining the confidentiality of the respondents' identities and obtaining approval from the school. The results of this method are expected to provide an initial overview of students' critical thinking skills in the context of physics learning based on local wisdom, as well as become the basis for the development of more relevant and effective learning policies and practices.

Findings and discussion

The results of the study show that the level of critical thinking skills of high school students in physics learning based on local wisdom is in the medium category. The data was obtained from test results developed based on five indicators of critical thinking skills, according to Ennis. Here is a recap of the results per indicator.

Yes	Critical Thinking Skills Indicators	Average Score (%)	Category

1	Provide a Simple Explanation	68,2	Keep
2	Building Basic Skills	65,5	Keep
3	Conclude	61,0	Keep
4	Compiling a Follow-up Explanation	57,3	Low
5	Determining Strategies and Tactics	59,8	Keep
	Rata-rata Total	**62,36**	**Keep**

From the data above, it can be seen that the indicator "providing a simple explanation" obtained the highest score, which was 68.2%. This shows that students are quite capable of identifying problems and explaining basic concepts of physics in the context of local wisdom. For example, many students can explain the principle of frictional forces that occur when using traditional tools such as mortars or stilts. An understanding of everyday phenomena that are close to their lives makes it easier for students to relate physics concepts learned in class to real practice in their environment. This proves that the integration of local wisdom can help improve students' basic conceptual understanding, which is an important foundation in critical thinking (Arti & Ikhsan, 2020). When students can explain phenomena based on scientific concepts in a simple and precise manner, this indicates the ability to think critically in the form of the ability to identify important information and organize it in a logical frame of mind.

Meanwhile, the indicator "compiling a follow-up explanation" obtained the lowest score (57.3%). This low score indicates that although students can understand and explain basic concepts, they still struggle in developing more complex high-level reasoning (Az et al., 2025). In practice, these abilities include developing scientific arguments, identifying hidden assumptions, connecting multiple concepts, and crafting logical justifications for a statement or conclusion. This is a challenge for teachers in developing learning that not only emphasizes basic understanding, but also encourages students to think more deeply. Learning strategies are needed that encourage students to conduct comparative analysis, evaluate information from various sources, and develop evidence-based opinions (Patelarou et al., 2020). For example, teachers may assign project-based assignments that require students to analyze physics principles in local cultural practices, such as the efficiency of traditional looms or working principles on traditional irrigation systems.

The indicators of "building basic skills" and "determining strategies and tactics" are also still in the medium category (Mujaddi et al., 2022; Yuliarti et al., 2023). This suggests that students have begun to be able to identify sources of information, observe physical symptoms, and choose problem-solving approaches, but are not yet fully able to use strategies consistently in more complex situations. To develop these skills, it is necessary to conduct systematic training through laboratory activities, problem-based discussions, and simulations of real-life situations that demand decision-making (Ahmed et al., 2020; Elendu et al., 2024). The "conclude" indicator that obtained a score of 61% also indicates that students still need guidance in making logical inferences based on the data or information obtained. In physics learning based on local wisdom, inference activities can be carried out through reflection on the results of observations on cultural practices, where students are asked to formulate the principles of physics that underlie the practice (Brookes et al., 2020).

If viewed as a whole, physics learning based on local wisdom makes a positive contribution to students' critical thinking skills. The local cultural context turns out to be able to arouse curiosity, emotional engagement, and high relevance of learning. Nevertheless, this approach still needs to be supported by teaching strategies that encourage active exploration, decision-making, and critical reflection. These findings are also in line with constructivistic learning theory which states that knowledge is actively constructed by individuals based on relevant experiences and contexts (Suhendi et al., 2021). In this case, local wisdom serves as a meaningful context that allows students to construct meaning independently through interaction with their social and cultural environment (Sakti et al., 2024). Furthermore, the integration of local wisdom in learning not only strengthens cognitive aspects, but also builds cultural awareness, local identity, and a sense of responsibility for cultural preservation.

However, the results of this study also show that the positive impact of integrating local

wisdom has not been fully optimal in developing high-level critical thinking skills. There is still a gap in the mastery of critical thinking indicators, especially in the aspects of advanced explanations and problem-solving strategies. This indicates that a contextual approach based on local culture is not enough if it is not accompanied by an active and reflective learning model that challenges students to think critically in depth. Therefore, it is important for teachers to not only use local wisdom as teaching materials, but also to design learning activities that demand real problem-solving, scientific debate, and data-driven decision-making. The application of inquiry-based learning models, problem-based learning, or project-based learning can be a suitable alternative to support the development of critical thinking as a whole.

In addition, critical thinking skills are not only the responsibility of students and teachers, but also require the support of the education system as a whole. The curriculum should provide ample space for local exploration, school policies should support teachers' creativity, and teacher training should focus on developing pedagogical competencies in context-based learning. With results showing that most students are in the medium category, continuous efforts are needed to systematically improve students' critical thinking skills. This can be done by strengthening on: The development of locally-based teaching materials that are not only informative but also interactive and challenging. Teacher training in compiling questions or activities that measure aspects of high-level thinking. The use of technology to digitally explore local culture as part of physics learning. A holistic evaluation, which measures not only the cognitive, but also the affective and metacognitive aspects of critical thinking skills.

Overall, the results of this study show the great potential of physics learning based on local wisdom in the development of students' critical thinking skills. However, the success of this approach is highly dependent on the right learning design, policy support, and teacher competence. This research can be a starting point for further studies with a quasi-experimental approach or the development of more targeted learning tools. Thus, integrating local culture in learning not only strengthens students' national identity, but also becomes a means to form a young generation that is able to think critically, creatively, and adaptively in facing global challenges while remaining grounded in local values.

Conclusion

This study shows that the critical thinking skills of high school students in physics learning based on local wisdom are in the medium category, with an average score of 62.36%. The highest indicator is found in the ability to give simple explanations, while the lowest is in compiling advanced explanations. This shows that the approach based on local wisdom is effective in helping the understanding of basic concepts, but it still needs to be improved in the development of high-level reasoning. In general, physics learning based on local wisdom has the potential to be positive in fostering students' critical thinking skills, but it needs to be supported by a more exploratory and reflective learning strategy. The results of this study show that physics learning based on local wisdom has the potential to improve students' critical thinking skills. Therefore, teachers are advised to integrate the local cultural context in learning through active and contextual approaches, such as problem-based learning or project-based learning. The government and schools also need to provide support in the form of teacher training and curriculum development that contains elements of local wisdom explicitly. This approach not only strengthens the understanding of concepts, but also shapes the character and cultural identity of students. This study has limitations on the limited number of samples and is only conducted in one school, so the results cannot be generalized widely. In addition, the quantitative descriptive approach used only describes the condition of critical thinking skills without testing the direct influence of learning based on local wisdom. The instruments used are also limited to written tests. Further research is suggested using more varied experimental approaches and instruments to get a more comprehensive picture.

Declaration

All manuscripts must contain the following sections under the heading 'Declarations':

Competing interests

If you do not have any competing interests, please state "The authors declare that they have no competing interests" in this section.

Author contributions

MAM conducted the data analysis and interpretation related to students' critical thinking skills in physics learning based on local wisdom. M was responsible for instrument development and data collection, and was a major contributor in drafting and revising the manuscript. All authors read and approved the final version of the manuscript.

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