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Profile of Students' Critical Thinking Skills and Digital Literacy in Energy Sources Material

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Abstract: *Critical thinking skills help students analyse information deeply, make rational decisions, and solve problems creatively. Meanwhile, digital literacy is a key competency for navigating the rapid, diverse flow of information in today's technological era. The purpose of this study is to examine students' profiles of critical thinking skills and digital literacy in physics learning. This research employs a descriptive qualitative design. Data on critical thinking skills were collected through written tests containing descriptive questions. Students' digital literacy skills were measured using a questionnaire on student learning habits with digital media. The results of this study indicate that, in general, students' critical thinking skills in physics learning are currently in the category, with an average percentage of 68,4% however, students' weaknesses are visible in the indicators, conclude and set strategy and tactics, each with a percentage 62% and 56%, which is in the category low. Skill analysis results: digital literacy students showed better achievement, with an average percentage of 68,2%, which is in the good category. However, as with critical thinking skills, challenges arise in indicators' digital content production (58%) and personal data security (63%), both of which are in the 'enough' category. These results indicate that although students already possess basic critical thinking and digital literacy skills, several important aspects need improvement. This improvement can be achieved through a more integrated physics learning, with activities that emphasise in-depth analysis, information synthesis, and the safe and secure production of digital content.*

Keywords: *critical thinking, digital literacy, energy source, science learning*

Profil Keterampilan Berpikir Kritis dan Literasi Digital Siswa pada Materi Sumber Energi

Abstrak: Keterampilan berpikir kritis membantu siswa menganalisis informasi secara mendalam, mengambil keputusan yang rasional, serta memecahkan masalah secara kreatif. Sementara itu, literasi digital menjadi kunci dalam menghadapi arus informasi yang begitu cepat dan beragam di era teknologi saat ini. Tujuan penelitian ini adalah untuk mengkaji profil keterampilan berpikir kritis dan literasi digital dalam pembelajaran fisika. Jenis penelitian ini adalah deskriptif kualitatif. Pengumpulan data untuk mengukur keterampilan berpikir kritis dilakukan menggunakan teknik tes tertulis dengan soal-soal deskriptif. Keterampilan literasi digital siswa diukur menggunakan angket tentang kebiasaan belajar siswa dalam menggunakan media digital. Hasil penelitian ini menunjukkan bahwa secara umum keterampilan berpikir kritis siswa dalam pembelajaran fisika berada pada kategori sedang (68,4%), namun kelemahan siswa terlihat pada indikator menyimpulkan dan menyusun strategi dan taktik, masing-masing dengan persentase 62% dan 56% kategori rendah. Hasil analisis keterampilan literasi digital siswa menunjukkan prestasi yang lebih baik, dengan persentase rata-rata 68,2% yang berada pada kategori baik. Namun demikian, seperti halnya keterampilan berpikir kritis, tantangan muncul pada indikator produksi konten digital (58%) dan keamanan data pribadi (63%) kategori cukup. Hasil ini menunjukkan bahwa meskipun siswa telah memiliki keterampilan berpikir kritis dan literasi digital dasar, masih terdapat beberapa aspek penting yang perlu ditingkatkan. Peningkatan ini dapat dicapai melalui pembelajaran fisika yang lebih terpadu, dengan aktivitas yang menekankan analisis mendalam, sintesis informasi, serta produksi konten digital yang aman dan kreatif.

Kata kunci: berpikir kritis, literasi digital, pembelajaran sains, sumber energi

INTRODUCTION

Science learning has an essential function in fostering students' abilities to think critically and to develop digital literacy. Several studies indicate that students' levels of scientific literacy and critical thinking are closely related to COVID-19 are moderate to low, necessitating improvements in learning materials (Ferdyan & Arsih, 2021). Recent research highlights the importance of integrated digital literacy and critical thinking skills in to education. Digital media can enhance critical thinking in elementary school science education through various tools such as educational games, videos, and augmented reality (Jannah & Atmojo, 2022). A strong foundation in literacy contributes significantly to the development of students' critical thinking, with increased literacy linked to enhanced reasoning abilities. (Putri et al., 2024). Research shows that digital literacy and learning styles positively influence students' critical thinking skills in economics (Rochmatika & Yana, 2022). These findings emphasize the need to integrating digital literacy and critical thinking skills into the educational curriculum is essential to equip students with the competencies needed to face the challenges of the 21st century.

Critical thinking represents an advanced cognitive ability that is fundamental for understanding abstract concepts and solving complex problems. Critical thinking involves comprehensive analysis, reasoning, inference, comparison, hypothesis formulation, synthesis, testing, and drawing conclusions (Rahardhian, 2022). Through critical thinking, students have the ability to solve problems logically and correctly (Setianingsih et al., 2024). Developing critical thinking skills is a primary goal in education, especially in the 21st century (Huda & Susilo, 2020; Alami et al., 2021). However, research shows that students often struggle with critical thinking, particularly in understanding basic concepts and terminology, which can lead to low academic achievement (Ristanto, 2020). This highlights the need for effective teaching strategies to develop critical thinking skills across various subjects.

In addition to critical thinking, the rapid advancement of information technology in the 21st century has made digital literacy a crucial competency that enables individuals to locate, interpret, and utilize information available on the internet. Digital literacy, also known as computer literacy, is the expertise in using computers, the internet, and other digital tools (Suminarsih, 2023). Digital literacy has become an important competency in the 21st century, which is characterized by rapid technological advances (Sujana & Rachmatin, 2019). Digital literacy encompasses the capacity to locate, comprehend, and apply digital information efficiently(Cahyani et al., 2024). Educators must develop digital literacy competencies to face the challenges of 21st-century learning, by incorporating technology-based teaching methods (Setianingrum et al., 2024). By improving digital literacy, individuals can improve their critical thinking skills, creativity, and the positive use of digital media in their daily lives (Cahyani et al., 2024).

In the context of science learning, particularly physics, critical thinking skills are essential for understanding complex scientific concepts. Improving the quality of learning can begin by establishing appropriate learning objectives. One of the main goals of Physics education at the high school level is to cultivate students' reasoning abilities through inductive and deductive analytical thinking, enabling them to apply physics concepts and principles to explain natural phenomena and solve problems both qualitatively and quantitatively (Khoiri et al., 2017). Furthermore, digital literacy is becoming increasingly important as technology advances that enable real-time access to information. Critical thinking skills and digital literacy are essential in science education, particularly physics, for understanding complex scientific concepts and navigating the digital era. Digital literacy, the ability to access, understand, and utilize digital information, is crucial for

participating in modern society (Cahyani et al., 2024). Teachers must develop digital literacy skills to create and communicate digital content effectively, employing critical thinking in their interactions with digital media (Mahardika, 2022).

Several recent studies have examined critical thinking skills in physics learning in various high schools in Indonesia. The results of these studies indicate that students' critical thinking skills are still relatively low (Nuroso, 2021; Nurhayati, 2022). Research focusing on solving PISA-type problems and other complex assignments also reveals student weaknesses, particularly in interpretation, analysis, inference, and evaluation (Anggaraini et al., 2025; Suriati et al., 2021; Wulandari & Warmi, 2022). Empirical evidence suggests that implementing the Problem-Based Learning (PBL) model has a considerable positive effect on the development of students' critical thinking skills (Arifah et al., 2021). These findings highlight the necessity of implementing targeted learning interventions to strengthen critical thinking skills across various cognitive domains. In addition to PBL, other studies also recommend the use of alternative learning models, such as Children Learning in Science (CLIS), to support the development of critical thinking skills in physics learning (Renjani et al., 2018).

Research on digital literacy shows that respondents scored 154.2 in the agree category on the intensity of use and utilization indicator, while a score of 97.8 was in the disagree category regarding digital literacy in learning (Dityasari et al., 2022). Another study examining students' digital literacy in physics learning found that digital literacy levels in vocational high schools are generally still low, particularly in socio-emotional aspects such as ethics, discovery, presentation, and creativity (Rahayu et al., 2019). Further research revealed a very weak correlation between digital literacy and physics learning achievement in high school students (Simarona et al., 2023). On the other hand, a study on hybrid learning in vocational high schools showed that the majority of students (65.7%) had moderate digital literacy skills across four competencies: digital skills, culture, ethics, and safety (Sas et al., 2023). These findings confirm the variation in digital literacy levels among students and the need for deeper integration of digital literacy into physics education. Furthermore, strengthening critical thinking skills is also important, where students are encouraged to be more active in the learning process, while teachers play a role in coaching and guiding by providing opportunities for discussion and problem-solving (Ardiyanti & Nuroso, 2021). Based on this description, it can be inferred that students' critical thinking and digital literacy skills still require further development. Therefore, this study aims to analyze these two competencies among students at SMA Negeri 1 Belik, with the expectation that the findings will serve as a foundation for teachers to enhance the quality of the learning process.

Based on the description above, students' critical thinking skills and digital literacy are essential aspects that still require improvement in Physics learning, particularly on the topic of Energy Sources. Therefore, this study aims to describe the profile of students' critical thinking skills and digital literacy at SMA Negeri 1 Belik. The findings of this study are expected to serve as a reference for teachers in designing more effective learning strategies to enhance these two skills.

METHOD

A descriptive qualitative research design was utilized in this study to examine students' critical thinking abilities. The research subjects consisted of students from SMA Negeri 1 Belik, with the sample chosen randomly. The assessment of critical thinking skills was carried out using essay tests designed according to the critical thinking indicators formulated (Ennis, 2011).

The data on students' critical thinking skills were collected through a written test consisting of essay questions related to the topic of Energy Sources. The selection of this instrument is intended to enable students to analyze in depth where students do not only use physics formulas in the solution process. The questions presented are expected to enable students to understand, analyze, evaluate, and conclude the results of the solutions asked.

Table 1. Thinking Ability Percentage Categories

No	Description	Information
1	$81{,}25 < X \leq 100$	Very high
2	$71{,}50 < X \leq 81{,}25$	High
3	$62{,}50 < X \leq 71{,}50$	Currently
4	$43{,}75 < X \leq 62{,}50$	Low
5	$0 < X \leq 43{,}75$	Very low

Students' digital literacy skills were measured using a questionnaire on student learning habits with digital media. The instrument was designed with reference to The Dig Comp 2.1 framework details digital literacy into five main areas, namely: (1) information access and search, (2) information evaluation and analysis, (3) digital content production, (4) communication and collaboration through digital media, and (5) security and protection of personal data (Carretero et al., 2017).

RESULT AND DISCUSSION

Result

The research data were collected from the results of a critical thinking skills test using essay-type questions. The obtained data were then analyzed and categorized based on the levels of students' critical thinking skills. The participants of this study were 33 students from the 11th grade. This study aims to describe high school students' critical thinking abilities on the topic of Waves. The critical thinking skills were measured through an essay-based test instrument. The questions were developed according to five indicators of critical thinking proposed by Ennis namely: giving simple explanations, building basic skills, drawing conclusions, providing further explanations, and organizing strategies and tactics. Each indicator was represented by one question (Ennis, 2011). These indicators served as benchmarks in determining students' levels of critical thinking skills. The results of students' critical thinking performance are presented in Figure 1.

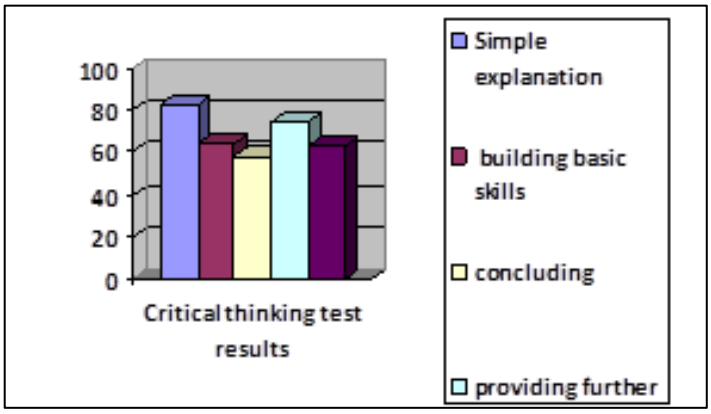

Figure.1. Critical Thinking Test Result

Based on Figure 1, the average percentage of each indicator aspect is 68.4%, with a medium category. The percentage for the providing simple explanation indicator reached 82%, which falls into the very high category. The building basic skills indicator obtained a score of 78%, categorized as high. The drawing conclusions indicator achieved 62%, classified as *low*. Meanwhile, the providing further explanation indicator reached 64%, which belongs to the medium category, and the organizing strategies and tactics indicator obtained 56%, also falling into the *low* category (Widiyoko, 2009).

The technique used to collect digital literacy data is a questionnaire, using a scale of 1-5. Digital literacy indicators include:(1) access and search for information, (2) evaluation and analysis of information, (3) production of digital content, (4) communication and collaboration through digital media, and (5) security and protection of personal data.The scores obtained are then adjusted to the criteria in table 2 (Widiyoko, 2009).

Table 2. Criteria for achieving Digital Literacy

No	Intepretation	Category
1	$84 < X \leq 100$	Very good
2	$68 < X \leq 84$	Good
3	$52 < X \leq 68$	Sufficient
4	$36 < X \leq 5$	Insufficient
5	$0 < X \leq 36$	Very insufficient

The results of the student digital literacy questionnaire are as shown in Figure 2.

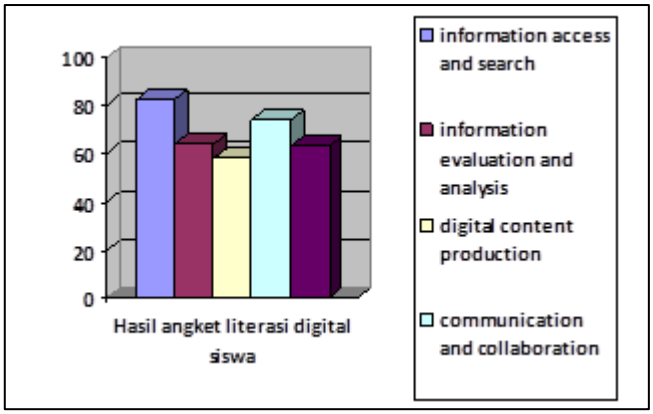

Figure. 2. Results of the Student Digital Literacy Questionnaire

Based on Figure 2, the average percentage results for all digital literacy indicators areah 68.2% with a good category. The percentage of the information access and search indicator was 82% in the very good category, the information evaluation and analysis indicator aspect obtained 64% in the sufficient category, the digital content production indicator was 58% in the sufficient category, the communication and collaboration indicator aspect through digital media was 74% in the good category, and the security and personal data protection indicator aspect was 63% in the sufficient category.

Discussion

The results of this study indicate that, overall, students' critical thinking skills in physics learning fall into the moderate category, with an average percentage of 68.4%. However, there is considerable variation among the different indicators of critical thinking. The providing simple explanation indicator achieved the highest score of 82%, categorized as very high. This finding suggests that most students are capable of understanding and

communicating basic information effectively. This finding is consistent with previous local research which found that students often cluster around the moderate to low levels of critical thinking when dealing with physics problems (Ariani, 2020). Meanwhile, the building basic skills indicator reached a high category with a score of 78%, indicating that students are able to identify and systematically apply relevant information within the context of physics learning. However, students' weaknesses are apparent in the indicators conclude And set strategy and tactics**,** each with a percentage 62% And 56%**,** which is on the category low**.** These low results indicate that many students still have difficulty drawing conclusions from available information and designing effective thinking or problem-solving strategies give further explanation also only reached 64%**,** included in the category currently**,** which shows that there is room for improvement in developing arguments or explanations in a more complex way. Among the indicators, providing simple explanation achieved the highest score, indicating that most students are capable of understanding and communicating basic information effectively a skill aligned with Facione's (Facione, 2000).

Meanwhile, the results of the skills analysis digital literacy students showed better achievement, with an average percentage 68,2%**,** is in a category Good. Indicator information access and retrieval recorded the highest achievement of 82% (category Very good**,** which reflects students' ability to use digital technology to access various information sources effectively. This aligns with the DigComp framework (Carretero et al., 2017). Indicator communication and collaboration through digital mediaas big as 74%**,** in category Good**.** This indicates that students are accustomed to and capable of communicating and collaborating through digital media. However, as with critical thinking skills, challenges arise in the indicators, information evaluation and analysis (64%), digital content production **(**58%**)** and personal data security **(**63%**),** which is on the category Enough. Low content production skills indicate that students are not yet fully equipped to utilize technology to create meaningful or original learning content. Meanwhile, the lack of attention to digital security indicates the need to strengthen education related to ethics and security in the digital space.

The findings of this study reveal an intriguing relationship between students' critical thinking skills and their digital literacy within the context of ESD-oriented, website-based physics learning. Overall, students demonstrated *good* digital literacy skills, with an average score of 68.2%, while their critical thinking skills were categorized as *moderate*, with an average score of 68.4%. These findings suggest that although students are relatively adaptive in using digital technology to access, search, and communicate in the learning environment, they still face difficulties in developing higher-order thinking skills, particularly in the areas of inferring and strategizing. These results align with previous research showing a significant correlation between digital literacy and critical thinking skills in high school biology student (Putri et al., 2025). The integration of educational technology, particularly augmented reality, has been shown to be effective in improving critical thinking skills and digital literacy in elementary school students (Fajari & Meilisa, 2022). Digital literacy strategies have been shown to strengthen critical thinking in fourth-grade science classes, with students demonstrating improved ability to articulate critical ideas and solve problems (Wijayanti et al., 2025).

CONCLUSION

Based on the results of the data analysis, it can be concluded that students' critical thinking skills in physics learning at SMA Negeri 1 Belik fall into the *moderate* category, with an average percentage of 68.4%. The highest-performing indicators were the ability

to provide simple explanations and to develop basic skills, demonstrating students' strengths in understanding and conveying basic information. However, the ability to draw conclusions and organize strategies and tactics remained low, indicating the need for improved learning that encourages in-depth analysis and systematic problem-solving.

Meanwhile, students' digital literacy skills were in the good category, with an average of 68.2%. Students demonstrated good abilities in access and search for information and communicate and collaborate through digital media**.** However, the ability to produce digital content, evaluate and analyze information, and indicators for maintaining personal data security are still at a sufficient level, which indicates the need for intervention to increase awareness of digital ethics and creative abilities in the context of technology-based physics learning.

Thus, the results of this research recommend the need for a more contextual and digital-based physics learning strategy to develop students' critical thinking skills and digital literacy in a balanced manner as part of 21st-century competencies. Furthermore, these findings highlight that integrating digital platforms with meaningful learning experiences can more effectively foster students' readiness to face complex challenges in modern scientific and technological environments.

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