



SCIENCE LITERACY BASED ON CRITICAL THINKING: A COGNITIVE SOLUTION TO THE CHALLENGES OF UNDERSTANDING BASIC SCIENCE CONCEPTS IN ELEMENTARY SCHOOL

Raysyah Putri Sitanggang^{1*}, Chandra Fhutu Neva², Amin Basri³

^{1,3*}Universitas Muhammadiyah Sumatera Utara, ²Universitas Negeri Medan.

Email: Raysyahputri@umsu.ac.id, Chandraneva@unimed.ac.id, aminbasri@umsu.ac.id

ARTICLE INFO	ABSTRACT
Article History Receive: 25-04-2026 Revision: 10-05-2026 Accept: 30-06-2026	Based on the findings of the literature review, it can be concluded that the limited understanding of basic science concepts at the elementary school level remains a serious challenge in education. This is caused by learning approaches that are still teacher-centered, insufficiently contextual, and provide limited encouragement for students to engage in higher-order thinking. As a result, many students develop misconceptions and experience difficulties in connecting scientific concepts with real experiences. Science literacy based on critical thinking has emerged as an effective approach to addressing these problems. Science literacy not only emphasizes conceptual understanding but also the application of knowledge in making decisions based on data and evidence. When science literacy is combined with critical thinking skills, students do not merely become memorizers of information but active learners who are able to analyze, evaluate, and construct understanding independently. Recent studies show that the implementation of learning strategies integrating science literacy and critical thinking, such as problem-based learning, guided inquiry, and project-based learning, has been proven to improve student learning outcomes, particularly in terms of conceptual understanding and higher-order thinking skills. Therefore, the development of science literacy based on critical thinking is highly important to integrate into science curricula and instructional practices in elementary schools in order to develop a generation that not only understands science but also thinks scientifically, critically, and constructively when addressing real-life problems.
Keywords	Science Literacy, Critical Thinking, Conceptual Understanding, Science Learning, Elementary School

1. INTRODUCTION

Natural Science (IPA) at the elementary school level plays an important role in establishing the foundations of scientific and logical thinking, as well as critical reasoning skills, from an early age. However, a number of studies have shown that students' understanding of fundamental science concepts

remains relatively low (Nuryani, 2020; Handayani & Setiawan, 2021). This is often caused by students' inability to connect abstract science content with real-life situations they encounter in their daily lives, which ultimately leads to misconceptions and decreased learning motivation. One of the main causes of this problem is a learning approach that still tends to

emphasize superficial knowledge acquisition without developing higher-order thinking skills such as analyzing, evaluating, and synthesizing information (Bloom, 1956; Ennis, 1987).

Over the past several decades, the concept of science literacy has become a central issue in science education reform across various countries. Science literacy does not merely refer to the ability to read scientific information; it also encompasses a deep understanding of scientific concepts, the ability to apply them in real-life contexts, and the skills needed to make decisions based on valid evidence (OECD, 2019). Yore et al. (2007) stated that science literacy requires students to become reflective thinkers and effective communicators when responding to issues related to science and technology.

In the context of science learning, critical thinking is also an important dimension that cannot be overlooked. Ennis (1993) described critical thinking as a form of rational and reflective reasoning directed toward deciding what to believe or what to do. Integrating a critical thinking approach into the development of science literacy is believed to help students develop a deeper understanding of concepts while equipping them with the skills to evaluate arguments, solve problems, and make logical decisions (Zubaidah, 2016; Facione, 2015).

A number of studies support the idea that science learning based on the development of critical thinking can improve students' conceptual understanding (Sari & Rahmawati, 2018; Rosdiana et al., 2020). This approach encourages students to actively explore, ask questions, and construct their own knowledge independently, thereby helping them move beyond learning patterns based solely on memorization. Therefore, a science literacy approach combined with critical thinking skills can serve as a promising cognitive strategy for addressing the various challenges encountered in science learning at the elementary school

level.

2. RESEARCH METHOD

This study employed a literature review method. The literature review was conducted by examining various scholarly readings and reference sources that support and are related to the research topic as an accurate theoretical foundation, as stated by Hakim (2024). The study aimed to explore and analyze the concept of science literacy based on critical thinking and its relevance to improving the understanding of basic science concepts at the elementary school level. This approach was selected to examine in depth various theories, findings from previous studies, and learning practices that have been applied in the context of science literacy and critical thinking. The data sources were obtained through a systematic review of relevant scientific articles, academic books, conference proceedings, and research reports published over the past ten years (2013–2023). The databases used included Google Scholar, ScienceDirect, ERIC, and DOAJ, with search keywords such as "science literacy in elementary education," "critical thinking in science learning," "elementary school science," and "development of critical thinking skills." The inclusion criteria were determined based on topic suitability, relevance to the elementary school level, and publication quality (Q1–Q4 or nationally accredited).

The analysis procedure employed a descriptive qualitative approach by reading, classifying, and synthesizing the literature based on major themes, including: (1) challenges in understanding science concepts in elementary schools, (2) the definition and dimensions of science literacy, (3) the definition and indicators of critical thinking, and (4) strategies for integrating science literacy and critical thinking into learning. Each source was analyzed to identify the relationship between theory and

practice and to identify research gaps that may contribute to the development of more effective learning models in the future.

3. RESULT

Based on the review of various studies, it was found that elementary school students' understanding of basic science concepts remains a challenge in learning. Students experience difficulties in understanding topics such as force, energy, and changes in the state of matter because instruction tends to be delivered theoretically and is insufficiently connected to everyday experiences. Lestari, Sugihartono, and Prasetyo (2023) showed that science learning remains teacher-oriented, limiting students' opportunities to think actively, explore knowledge independently, and gain direct experience. Sari and Rahayu (2022) found that limited analytical thinking ability is one of the factors contributing to misconceptions in science learning. Students tend to memorize definitions without understanding how concepts are applied in real situations. This condition indicates that the learning methods used have not been optimal in developing higher-order thinking skills. The findings also show that science literacy can serve as an approach to improving students' understanding of science concepts. Damayanti and Suryani (2022) explained that science literacy encourages students to understand concepts critically and apply them in everyday contexts. Sari (2023) also showed that literacy skills help students read, analyze, and use information.

According to OECD (2019), science literacy includes the ability to apply scientific knowledge, formulate questions, and draw conclusions based on evidence in order to understand the environment and make responsible decisions. Furthermore, Facione (2015) explained that critical thinking includes the ability to analyze information, evaluate arguments, and make decisions based on rational consideration. In science learning, these skills enable students to question information and develop ideas independently. Utami and Prasetyo (2021) found that integrating science literacy and critical thinking has a positive impact on students' understanding of science concepts. Students

become more active in solving problems that require reasoning and problem-solving, as well as in asking questions, participating in discussions, and presenting arguments logically. Fitriani and Kusumawardani (2023) found that observation- and experiment-based learning can meaningfully improve students' understanding of science concepts. Meanwhile, Wahyuni et al. (2021) showed that problem-based learning (PBL), guided inquiry, and project-based learning support the development of science literacy, critical thinking, and higher-order thinking skills (HOTS). Overall, the findings indicate that science learning integrating science literacy and critical thinking has the potential to improve conceptual understanding, reasoning ability, problem-solving, student engagement, and students' ability to connect science concepts with everyday life.

4. DISCUSSION

The findings indicate that elementary school students' limited understanding of science concepts is caused not only by the difficulty of the subject matter but also by learning approaches that still tend to be theoretical and teacher-centered. When students merely receive information and memorize definitions, they have limited opportunities to understand the relationship between science concepts and the phenomena they encounter in everyday life. The findings of Lestari, Sugihartono, and Prasetyo (2023), as well as Sari and Rahayu (2022), reinforce the view that learning which provides limited opportunities for students to conduct analysis and gain direct experience can lead to misconceptions and weak analytical thinking skills.

Science literacy is important because it provides students with opportunities to use scientific knowledge to understand and solve real problems. Science literacy is not only related to the ability to understand scientific information but also to the ability to analyze information, use evidence, draw conclusions, and make decisions. Therefore, the implementation of science literacy from elementary school can help students develop more logical, systematic, and reflective ways of thinking. In practice, science literacy is closely related to critical thinking. Critical thinking

enables students to evaluate information and evidence before accepting a conclusion. Thus, students not only understand science concepts but are also able to question, compare, analyze, and provide reasons for a phenomenon.

The findings of Utami and Prasetyo (2021) show that integrating these two abilities can make students more active in reasoning, problem-solving, discussion, and presenting arguments. Science learning will also become more meaningful when students are given opportunities to conduct observations and experiments. For example, in learning about changes in the state of matter, students can observe the melting of ice or changes in water caused by heating. Such activities enable students to connect concrete experiences with scientific concepts. The findings of Fitriani and Kusumawardani (2023) show that observation- and experiment-based learning can help students understand science concepts more meaningfully.

In addition, the use of active learning models such as PBL, guided inquiry, and project-based learning can serve as relevant strategies for integrating science literacy and critical thinking. These models provide students with opportunities to identify problems, gather information, conduct investigations, analyze evidence, develop solutions, and communicate their findings. Thus, the learning process is not only oriented toward the acquisition of knowledge but also toward the development of higher-order thinking skills. Based on these findings, it can be understood that the integration of science literacy and critical thinking has considerable potential to improve the quality of science learning in elementary schools. This approach can transform learning from a process originally oriented toward memorization into one that is more contextual, active, investigative, and problem-solving oriented. Teachers play an important role as facilitators by providing learning experiences, guiding questions, observation activities, experiments, discussions, and contextual problems that encourage students to think critically.

5. CONCLUSION

Based on the findings of the literature

review, it can be concluded that the limited understanding of basic science concepts at the elementary school level remains a serious challenge in education. This is caused by learning approaches that are still teacher-centered, insufficiently contextual, and provide limited encouragement for students to engage in higher-order thinking. As a result, many students develop misconceptions and experience difficulties in connecting scientific concepts with real experiences.

Science literacy based on critical thinking has emerged as an effective approach to addressing these problems. Science literacy not only emphasizes conceptual understanding but also the application of knowledge in making decisions based on data and evidence. When science literacy is combined with critical thinking skills, students do not merely become memorizers of information but active learners who are able to analyze, evaluate, and construct understanding independently.

Recent studies show that the implementation of learning strategies integrating science literacy and critical thinking, such as problem-based learning, guided inquiry, and project-based learning, has been proven to improve student learning outcomes, particularly in terms of conceptual understanding and higher-order thinking skills. Therefore, the development of science literacy based on critical thinking is highly important to integrate into science curricula and instructional practices in elementary schools in order to develop a generation that not only understands science but also thinks scientifically, critically, and constructively when addressing real-life problems.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all parties who provided support throughout the completion of this study. Special appreciation is extended to the academic community and colleagues who provided guidance, input, and support during the research preparation process. The authors also acknowledge the researchers

and authors of scholarly works that served as reference sources for this literature review. The findings of previous studies used as sources for this review have made an important contribution to strengthening the theoretical foundation and discussion of this study. The authors are also grateful to everyone who provided direct or indirect support, enabling this study to be completed successfully.

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