

Analysis of Barriers to Elementary School Students' Critical Thinking Skills in Science Subjects

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Abstract

Science education in elementary school serves to equip students with fundamental scientific knowledge and skills. However, learning that is done often only emphasizes memorizing concepts without developing critical thinking skills. This study identifies the constraints in developing elementary students' critical thinking skills in science subjects through a systematic literature review using the PRISMA protocol to collect relevant data and information. The analysis revealed two main factors that become obstacles, namely internal student factors and teacher quality factors. Internal student factors include low motivation and active participation, low self-confidence, lack of learning independence, and students' unfamiliarity with learning that requires critical thinking skills. Meanwhile, teacher quality factors include the application of inappropriate learning strategies and models, teacher-centered learning, lack of development of supporting learning tools and media, lack of teacher knowledge about critical thinking competencies, and the use of evaluation methods that have not maximally explored students' critical thinking skills. These findings provide new insights into the inhibiting factors that need to be overcome so that science learning in elementary schools can optimize the development of students' critical thinking skills as one of the important 21st-century competencies.

Keywords: Critical Thinking, Elementary School, Science

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INTRODUCTION

Natural Science Education (IPA) is one of the important subjects in elementary school and serves to equip students to acquire fundamental scientific knowledge and skills. According to Carin and Sund in (Wisudawati & Sulistyowati, 2014) Science is a systematic and orderly knowledge that contains a collection of data from observations and experiments universally. The components contained in science contain scientific knowledge as a product of the work of scientists, components of science that contain how to obtain knowledge as a process, and components that contain attitudes to obtain knowledge as a scientific attitude of science. (Widodo, 2021). Students are directed to build procedural skills to study the natural world, find solutions to issues, and make judgments in order to expand their knowledge and conceptual understanding through science learning. (Pratiwi, 2021).

Science learning helps students to understand natural phenomena and their surroundings, as well as develop curiosity and critical thinking. Students studying science are expected to not just learn facts by heart, but also to focus on honing their critical thinking abilities, which will enable them to evaluate data, solve issues, and come to logical conclusions. In the current world of rapidly changing information and an abundance of digital data, critical thinking abilities are essential for preparing pupils for the challenges that lie ahead. The component abilities of critical thinking are, according to Emily R. Lai (2011), analyzing arguments, drawing conclusions using inductive or deductive reasoning, judging or evaluating, and coming to decisions or solving issues. Critical thinking ability has a tendency to think openly in making decisions on a problem based on accurate evidence. (Haryanti & Febriyanto, 2017). According to Rositawati (2018) Critical thinking is the process of interpreting and evaluating a problem that is directed, clear, skilled and active including observation, formulating problems, making decisions, analyzing and conducting scientific investigations that lead to a conclusion.

According to The Partnership for 21st Century Skills (Fadel & Trilling, 2009) in the context of 21st century education, it is very important to emphasize for students to develop several critical thinking competencies such as students' ability to think effectively, use thinking systems to make judgments and decisions, and solve problems. Learning in the classroom should lead to the development of these competencies so that students can be trained to think critically to overcome the challenges faced. Critical thinking has an important role because it allows students to analyze problems objectively using relevant data, evaluate arguments, make logical decisions, and make the right decisions. The application of critical thinking skills is very important, especially for elementary school students, in line with the commitment of the Indonesian government through the current independent curriculum. The Merdeka Curriculum emphasizes the importance of critical and analytical thinking skills by introducing project-based learning and problem-based learning (Kementerian Pendidikan dan Kebudayaan, 2022). This shows that the government through curriculum policy considers critical thinking skills important as a provision for facing future challenges that will continue to undergo transformation. Developing critical thinking skills from an early age is very important for elementary school students, because based on Piaget's cognitive development theory, the concrete operational stage at the age of 7-11 years is the period when children begin to develop logical and critical thinking skills (Harefa et al, 2024). Critical thinking skills can equip them to face future challenges. However, its application in the learning process still faces various obstacles.

Classroom Action Research conducted Sukowati & Harjono (2023) at SD Negeri Dukuh 05 Sidomukti Subdistrict on grade V students showed that science learning often emphasizes memorization of concepts without encouraging critical thinking through observation, experimentation, and problem solving. Students have difficulty expressing opinions, get bored quickly, and only memorize without understanding deep understanding. The lack of use of media and learning models that improve critical thinking skills causes learning to be meaningless and inhibits students' critical thinking skills. In addition, development research (R&D) conducted by Kurniawati & Mawardi (2023) in SD Gugus Mawar Suruh Subdistrict on grade V students showed that science learning has not been maximized in developing students' critical thinking skills. Most students are less focused and active because teachers tend to use learning

methods and models that do not actively involve students. The ability to analyze and connect science concepts with real problems is still low. This is supported by the lack of color pictures in student handbooks that can help build thinking concepts.

Researchers (Ningsih & Andari, 2020; Adiwiguna, Dantes & Gunamantha, 2019; Anisah & Carlian, 2020; Nisa & Ardani, 2023) have made various efforts to reduce the problem of low critical thinking skills in elementary school students by using innovative and creative learning models. Students become the focal point of the learning process when student-centered learning methods are used. By actively participating in learning activities, students take an active part in creating their own knowledge rather than being passive learners. Learning models that prioritize students as the main actors and make teachers as facilitators in learning guide students to find concepts, solve problems, and develop critical thinking skills. In addition to the use of learning models, the development of learning media that is interesting and tailored to student needs can help increase student interest and involvement in the learning process. The combination of interesting learning media with innovative learning models can create a conducive learning environment for the development of students' critical thinking skills.

This study uses a systematic literature review to identify obstacles in developing elementary school students' critical thinking skills in science learning. This research uncovers obstacles from two main sides, namely internal student factors and teacher quality factors to provide in-depth and targeted analysis. This restriction is made because internal student factors and teacher quality factors are the main variables that can significantly affect critical thinking skills. The findings offer insights into the inhibiting factors that need to be overcome so that science learning can optimize the development of critical thinking skills as a crucial 21st century competency. By uncovering less exposed constraints, the findings from this study provide in-depth insights into overcoming barriers in science learning. This is important considering that critical thinking skills are one of the 21st century competencies that are needed in facing future challenges.

RESEARCH METHOD

This study examines the barriers to students' critical thinking ability development in science instruction in primary schools using a comprehensive literature review methodology. The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) procedure was used to collect publications for the research, which was carried out in March 2024 (Jhon et al, 2021). The analysis process was carried out by collecting scientific articles to find the data and information needed to fulfill the research objectives. The search for scientific articles was carried out using the publish or perish application with a data base sourced from the google scholar website. The search process used a combination of the keywords "Difficulty" and "Critical Thinking" and "Elementary" and "Science" to ensure relevance and context in accordance with the obstacles faced by elementary school students in Indonesia. This keyword format is intended to obtain better search results, where only articles with similar keywords will appear. The search was limited to articles published between 2013-2024, as the 2013 curriculum began to address the development of students' critical thinking skills (Kementerian Pendidikan dan Kebudayaan, 2014).

The data search and processing process resulted in approximately 1000 scientific articles. To facilitate further analysis, several inclusion criteria were set as a reference in determining which articles were referenced or analyzed further. The following inclusion criteria were used: (a) articles published in Sinta indexed journals (SINTA 1 - 6), (b) published between 2013-2024, (c) articles are available in full text and can be accessed, (d) contain information about obstacles in developing students' critical thinking skills in science learning at SD, (e) contain direct findings, not a preliminary study sourced from previous research results, therefore articles with the SLR method are excluded.

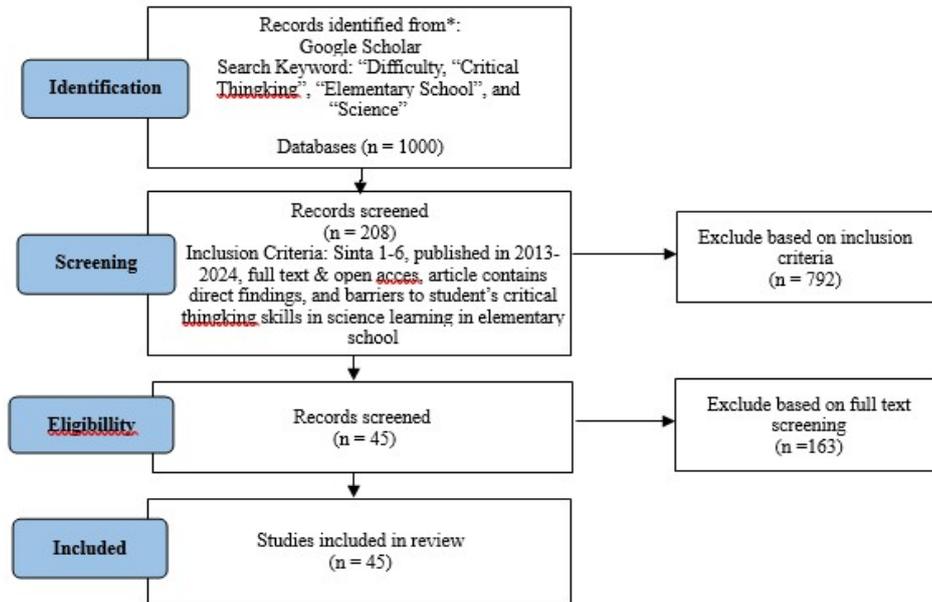


Figure 1. Flowchart of Literature Selection Based on The Prisma Protocol

After screening based on the inclusion criteria above, approximately 208 articles were obtained that met the criteria and will be included in the further analysis process. Furthermore, an in-depth review of the entire content of the article was carried out. After the further analysis process was carried out, about 45 articles were obtained that contained a complete explanation of the factors that became obstacles in developing students' critical thinking skills in science lessons in elementary schools. The data from these articles were then analyzed by marking the relevant sections and grouping the information into two categories: internal student factors and teacher quality factors. The whole article is presented and grouped based on the content of the data or information contained in relation to the research topic.

RESULTS AND DISCUSSION

After going through the in-depth analysis stage, it is known that there are several inhibiting factors in efforts to develop students' critical thinking skills in science subjects in elementary schools, including internal student factors and teacher quality factors. The following will explain further regarding these two factors.

Internal student factors

Students are the main actors in the learning process, so the active role of students in the learning process is a key indicator that learning activities can be said to have gone well (Nisa & Ardani, 2023). In connection with the efforts to form students' critical thinking skills, especially in science learning in elementary schools, of course, requires perseverance and student activeness in participating in the learning process as well as awareness to develop their learning competencies under the direction and guidance of the teacher. However, in reality, one of the main factors that make students' critical thinking competence or ability low is due to internal factors of the students themselves. The following are some of the findings of researchers related to internal student factors that are one of the obstacles in efforts to develop students' critical thinking skills in science learning in elementary schools.

Table 1. Findings

Article	Key Findings
Ningsih & Andari (2020); Adiwiguna, Dantes & Gunamantha (2019); Mareti & Hadiyanti (2021); Sari, Masfuah & Ardianti (2020).	Lack of motivation and active participation of students in learning.
Insyirah, Oktrifianty & Huliaturisa (2022).	The passivity of students in the learning process is due to their low self-confidence.
Rachamatika et al. (2021).	Students' learning independence is low.
Yampap & Bay (2020).	Students are not accustomed to learning that demands high learning competencies (critical thinking skills, analytics and so on), students have difficulty in solving problems with <i>open ended</i> or HOTS models and have not been able to compile and plan their own steps or stages of learning.

Student learning motivation is one of the main factors in ensuring the presence of an optimal learning process. High learning motivation will affect students' ability to understand and develop various learning competencies (Wahyuni, 2022). Low learning motivation is a significant obstacle in developing critical thinking skills. However, in the practice of learning in schools, there are many problems related to low student learning motivation which is triggered by various things such as students considering science subjects difficult and less interesting (Mareti, J.W., & Hadiyanti, A.H.D., 2021). Lack of interest in the science subject matter presented by the teacher, causing students not to find the urgency or necessity to master the material or lesson (Adiwiguna, et al, 2019.; Sari, et al, 2020).

Learning content in elementary school, especially in science subjects, is presented quite complexly and contains various concepts and natural phenomena to the mechanisms and laws that work in it. Thus, making this subject often considered difficult by students (Fitria & Prastowo, 2021). This affects students' interest or motivation to learn science material tends to be low, which has an impact on the quality of learning so that critical thinking skills cannot be formed properly. Critical thinking skills will not develop optimally without the active role, willingness, and high learning motivation of students (Lidawa et al, 2021). Therefore, various steps or efforts are needed from teachers to increase student participation and motivation to learn.

Low student confidence is an obstacle in developing critical thinking skills in science learning in elementary school. Students who lack confidence tend to be passive and less involved in learning such as asking questions, expressing opinions, discussions, and communicating about the findings obtained in science discussions (Insyirah, 2022). Students cannot show their best potential and participate in learning optimally without self-confidence (Widyaningrum & Hasanah, 2021). Teachers must guide students to increase self-confidence so that students can participate optimally in the learning process, understand material concepts, and develop important competencies such as critical thinking, collaboration, and communication. The low level of student learning independence has an impact on inhibiting the development of students' critical thinking skills in learning science in elementary school. Students' dependence on teachers makes students less skilled in analyzing and exploring science concepts independently (Rachamatika et al, 2021). Students have difficulty connecting the science knowledge learned with natural phenomena around students without the guidance of teachers who should be able to develop their critical thinking skills (Prasetyo & Rosy, 2021). In learning science that contains abstract and complex concepts, learning independence is important so that students can understand a concept or material in science lessons as a whole without relying solely on explanations from the teacher (Mareti & Hayati, 2021).

Students are not accustomed to learning that demands high learning competencies, such as working on open ended or HOTS questions, and designing their own learning steps (Yampap & Bay, 2020). This is an obstacle in forming critical thinking skills that require the ability to criticize or examine concepts independently. This ability can be formed through experimental activities or discussions that are organized by students themselves. Getting students used to solving open ended or HOTS questions is also important, because it involves a process of study, analysis and reasoning so that they do not just memorize the subject matter that has been given by the teacher (Acesta, 2020).

The various obstacles above arise largely due to the lack of quality of learning practices that have been carried out so far. The low motivation or enthusiasm of students in learning science occurs because the teaching methods or models that are carried out do not facilitate students' interests and competencies (Ningsih & Andari, 2020). Low learning independence and lack of student confidence in participating in the science learning process occurs because the learning that has been carried out so far has not been oriented to form or develop student confidence without depending on the teacher (Susilawati, 2022). The condition where there are still many students who are not accustomed to working on questions with the HOTS approach in science lessons, occurs because the learning evaluation model that is

applied only tests memorization without testing students' understanding of the material comprehensively (Sinta et al, 2022).

Teacher Quality Factors

Teachers play a central role in the learning process and are required to always be able to manage and create a good learning climate for students (Harta et al., 2021; Mubarak, 2022). A good learning process will be able to facilitate the development of various types of student competencies and skills. This can be realized by maximizing the use of various components or main aspects in the learning process such as approaches, models, media and learning strategies that are interesting and in accordance with student needs. Ideal learning conditions will be able to form complete knowledge for students and be able to produce mastery of various learning competencies for students (Fadillah et al., 2021).

The role of teachers in learning is not only to maximize the cognitive aspects of students. Teachers must be able to guide and direct students in forming various important competencies such as critical thinking, communication, collaboration and creativity as provisions for students in facing real life (Marwahningsih & Darsinah, 2023). However, in reality, teachers are one of the factors that make the quality of the learning process low. The lack of teacher competence makes the learning process unable to run optimally, so it is unable to form various student learning competencies (Sijabat et al., 2022). In relation to the development of students' critical thinking skills in science lessons in elementary schools, it can be seen through the teacher quality factor which is one of the main obstacles. The following will show what factors hinder efforts to develop students' critical thinking skills related to teacher quality.

Table 2. Findings

Article	Findings
Dewi, Dantes & Arnyana (2017); Purnaningsih, Relmasira & Hardini (2019); Wijaya & Handayani (2021); Wanelly & Fitria (2019); Hidayah & Anisa (2019).	The application of inappropriate teaching strategies for developing students' critical thinking skills.
Indriani, Rabbani & Pratama (2021); Ningsih & Andari (2020); Chan (2017); Laelasari & Adisendjaja (2018); Maburoh (2019); Maulidati, Dantes & Tika (2018); Rusnah & Mulya (2018); Upadani, Agustiana & Astawan (2021).	Continuing conventional, teacher-centered learning, resulting in a monotonous learning process.
Fitriyah (2016); Yusuf (2019).	Teachers do not prepare appropriate learning tools to develop students' critical thinking skills.
Fadillah, Ramadhani & Kuswidyarko (2021); Sarimuddin, Muhiddin & Ristiana (2021); Susilowati (2018); Ardyanto, Koeswati & Giarti (2018); Anisah & Carlian (2020).	Lack of teacher knowledge regarding various learning models that can be implemented to enhance students' critical thinking skills.

Wicaksono et al. (2022).	Teachers do not use learning media that align with the needs of competency development and the material being studied.
Harta, Arnyana & Suarni (2021).; Markhamah, Supardi & Sudiby (2021).	Teachers' limited ability to develop instruments, relying solely on textbooks.
Yusuf (2019); Winarti et al. (2022); Yusuf (2018); Hartati, Koto & Hambali (2020); Listyawati, Suarjana & Sudana (2013); Wariyanti (2019); Sari et al. (2020); Yuanita & Yuniarita (2018);	The use and selection of methods that are not suitable for developing students' critical thinking skills.
Noviani, Dantes & Suastra (2021); Budiarti & Airlanda (2019); Putra, Lasmawan & Suarni (2021); Listyawati, Suarjana & Sudana (2013).	Evaluation models used in learning do not sufficiently explore students' critical thinking abilities.
Insyirah, Oktrifianty & Huliatusunisa (2022).	Teachers do not adequately foster student motivation and build their self-confidence.
Pratama & Arini (2020); Khomaidah & Koeswanti (2020).	Teachers have limited knowledge about critical thinking competencies.

The science learning process is often not in accordance with the learning needs of students because teachers only focus on fulfilling teaching obligations. As a result, students are less helped in developing their critical thinking skills. This situation is indicated by the application of conventional learning practices that are teacher-centered and only rely on the use of one-way lecture methods between teachers and students without involving students in active exploration and discovery of concepts. This situation is one of the obstacles in improving students' critical thinking skills in science learning which cannot run optimally if only using conventional learning (Ningsih & Andari, n.d.). According to Dewi et al. (2017), *teacher-dominated learning (teacher centered)* causes students to be passive in the learning process so that various efforts to develop student learning competencies cannot run optimally.

The lack of teacher competence in preparing effective learning tools. Fitriyah (2016) explains that most teachers only copy and copy learning tools from the internet or those prepared by the government, without adjusting to the circumstances and learning needs of students. Teachers have difficulty in designing science learning activities that stimulate students' critical thinking skills such as analyzing natural phenomena or solving simple environmental problem learnings tools are often seen as administrative requirements, not as a tool to improve the quality of learning (Yusuf & Jatmiko, 2019).

A good learning tool must meet the needs of students so that the learning process gets maximum results. Learner Worksheets (LKPD) is one example of a learning tool that can develop student learning competencies in science learning which can be used to train students' critical thinking skills in understanding the

concepts or material being studied. However, in practice, many teachers still have difficulties in developing science LKPDs that are effective in training students' critical thinking skills. LKPD only contains instructions for experimental steps without questions that encourage further analysis because they are used to relying on student books in learning, resulting in monotonous learning and low student learning outcomes (Harta et al., 2021; Ni Made Trisna Noviani et al., 2021).

Developing learning tools must be adjusted to the strategies, approaches, methods, and learning models that will be used. These components must be in accordance with the characteristics, materials, and learning needs of students. Through the right strategies, approaches, methods, and learning models, teachers can carry out the learning process effectively, efficiently, conducive, and fun so that students' critical thinking skills can develop and students are actively involved in learning. However, teachers often have difficulty determining the right learning strategy and tend not to consider suitability to the conditions and needs of students (Ni Made Trisna Noviani et al., 2021; Dewi et al., 2017). The selection of learning models is also often done without a clear basis and seems to impose a model even though it is not relevant to the needs of students (Yusuf, 2018). Science learning with complex material will be maximized if teachers are able to choose and apply various strategies, approaches, methods, and learning models that are in accordance with learning competencies and suit the background and learning needs of students.

Learning media is very important because it helps students understand concepts that are abstract and difficult to imagine in science lessons. However, in the practice of learning in the classroom, teachers do not always provide learning media to support the quality of learning that is carried out. Generally, teachers make teacher books and student books the main learning media, which will reduce the effectiveness of the learning process. Abstract concepts in science will be difficult to understand only through reading. Students need a variety of media that can help visualize concepts in science lessons. Interactive learning media also increases student interaction or activeness so that it affects the quality of learning (Jannah & Atmojo, 2022). Teacher creativity in determining suitable learning media by utilizing various available resources as learning resources is needed to achieve learning goals (Ni Made Trisna Noviani et al., 2021).

Students' critical thinking skills in science learning can be improved through evaluations that stimulate students' critical thinking such as open-ended questions or HOTS type questions. These questions encourage students to analyze and interpret the information they receive. However, in practice, many teachers still apply evaluations that only test material understanding without developing students' critical thinking skills (Noviani et al, 2021; Putra et al, 2021). Current evaluations tend to focus on the cognitive aspects of students and ignore the overall learning process (Budiarti & Arlinda, 2019). Teachers' lack of knowledge about critical thinking competencies is a major obstacle. Many teachers do not comprehensively understand the forms of critical thinking skills that need to be developed in science learning in elementary schools (Pratama & Arini, 2020), and teachers are confused in determining learning steps and the right evaluation system (Khomaidah & Koeswanti, 2020).

A teacher must create a learning atmosphere that involves the active role of students, fostering students' motivation and confidence to be involved in every process or stage of learning. Students who have good learning motivation and self-

confidence will actively participate and achieve maximum learning results. But in reality, teachers still pay less attention to the importance of instilling students' self-confidence and learning motivation. Students who lack confidence become passive and hinder the learning process. (Insyirah et al., 2022). Low learning motivation will also have an impact on not maximizing learning outcomes. Therefore, teachers need to provide guidance and motivation to students with low self-confidence to ensure equal learning opportunities for all students (Ni Made Trisna Noviani et al., 2021).

CONCLUSIONS

This research is a systematic literature review that examines the constraints of developing critical thinking skills of elementary school students in science subjects. The research context includes the level of elementary school education, science subjects, and the development of critical thinking skills. The main focus of this research is to identify factors that become obstacles in developing elementary school students' critical thinking skills in science subjects, both from the internal side of students and the quality of teachers. Internal student factors include low motivation and active participation, low self-confidence, lack of learning independence, and students' unfamiliarity with learning that demands critical thinking competencies. Meanwhile, teacher quality factors include the application of inappropriate learning strategies/models, teacher-centered learning, lack of development of supporting learning tools and media, lack of teacher knowledge about critical thinking competencies, and the use of learning models that have not developed students' critical thinking skills to the fullest. This research is limited to data sources from Sinta and Google Scholar-indexed articles in the 2013-2024 timeframe and focuses on the context of education in Indonesia. For future research, it is recommended to expand data sources, develop innovative learning models, conduct experimental studies, and conduct comparative studies between countries so as to provide more comprehensive insights.

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