

Science Education and Application Journal (SEAJ)
Program Studi Pendidikan IPA
Universitas Islam Lamongan
http://jurnalpendidikan.unisla.ac.id/index.php/SEAJ

September, 2026. Vol. 8, No. 2,
p-ISSN: 2656-6672
e-ISSN: 2656-8365
pp. 120-130

A Systematic Literature Review of Discovery Learning for Improving Critical Thinking Skills in Junior High School

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Article Info
Article History
Received: February 12th, 2026
Revised: June 30th, 2026
Accepted: August 18th, 2026
Published: September 30st, 2026
Keywords
Critical Thinking, Discovery Learning, Junior High School Students.

Abstract
Critical thinking skills are among the most important in 21st-century education. Discovery Learning is considered relevant because it emphasizes active student involvement in discovering concepts through the stages of stimulation, problem identification, data collection, data processing, verification, and generalization. This study aims to analyze the application of the Discovery Learning model in improving junior high school students' critical thinking skills in science learning. The study employed the Systematic Literature Review (SLR) method. This study utilized the PRISMA approach to analyze articles published between 2021 and 2025 related to Discovery Learning and critical thinking skills, as evidenced by the increase in both posttest average scores and N-Gain scores in the experimental class. The effectiveness of learning increases when this model is combined with innovative media, such as PowerPoint, microlearning videos, augmented reality (AR), and student worksheets that incorporate local wisdom-based approaches. These media help students understand abstract concepts visually and contextually, thereby increasing motivation, participation, and independent learning. It can be concluded the reviewed studies suggest that Discovery Learning has the potential to support the development of students' critical thinking skills in science learning for strengthening junior high school students' critical thinking skills in science learning, mainly when supported by innovative and contextual learning media.

Citations: Loviana, L. F., Wahyuni, S., Astuti, S. R. D., & Barid, S. S. A. Q. (2026). A systematic literature review of discovery learning for improving critical thinking skills in junior high school science. Science Education and Application Journal (SEAJ), 8(2), 120–130.

INTRODUCTION

Education is an endeavor to use the learning process to improve human resource potential through the learning process (Suryaningsih, 2022). Soft skill development has emerged as a major goal of Indonesia's educational system in the 21st-century (Barid et al., 2025). The world of education is facing the challenge of producing superior and qualified human resources through the development of 21st-century skills, encompassing: 1) innovative thought processes, 2) analytical reasoning combined with effective resolution of difficulties, 3) proficiency in conveying ideas, and 4) the capacity to work jointly with others (Hamdani et al., 2022). These abilities serve as the foundation for students to solve problems systematically, make logical decisions, and evaluate information objectively (Anggraeni et al., 2025). According to the 2018 Programme for International Student Assessment (PISA) by the OECD, Indonesia ranked 71st in science performance (Solichah & Sari, 2023). PISA primarily measures students' scientific literacy, including their ability to analyze, evaluate, and apply scientific knowledge in problem-solving contexts. The low science performance indicates that Indonesian students still face

challenges in higher-order thinking skills, including critical thinking. This condition underscores the importance of implementing learning approaches that can foster critical thinking skills in schools. Although several studies have examined the implementation of learning approaches in science education, there is still a limited synthesis of empirical evidence regarding their effectiveness in improving junior high school students' critical thinking skills.

In school learning activities, an appropriate approach is needed to foster 21st-century skills, particularly students' critical thinking skills. Science learning ideally employs an integrated learning approach because it aims to provide students with opportunities to actively participate in comprehensively and authentically exploring and discovering concepts and principles (Chusni et al., n.d.). The use of learning strategies that promote exploration and discovery activities can enhance students' abilities to think critically, and one such strategy is the Discovery Learning model. The Discovery Learning model is an approach that emphasizes understanding the core concepts or ideas within a discipline through students' active involvement in the learning process (Setyawan & Kristanti, 2021). Discovery Learning is a model that teaches students to actively discover learning materials or concepts on their own without waiting for the teacher to present them, making these learning concepts more durable in students' memories (Kusuma & Mustari, 2023). The Discovery Learning model involves several stages, starting with the stimulation phase, problem identification, data collection, data processing, verification, and generalization, providing a structured guide for its implementation (Sinambela, 2013).

Critical thinking skills are essential for students because they enable them to analyze problems more effectively and scientifically (Zulfiana et al., 2023). Critical thinking skills refer to the ability to process and evaluate information objectively, making accurate and effective decisions (Ariadila et al., 2023). Critical thinking is a cognitive exercise that incorporates students' prior knowledge, as well as making connections between the ideas they have learnt in class and other facets of their immediate surroundings (Sa'diyah & Aini, 2022). Ennis (1996) states that critical thinking is a rational and reflective thinking process, focusing on the indicators of critical thinking ability, which include five main aspects that serve as a benchmark for determining whether someone can be considered a critical thinker (Ennis, 1996). These five aspects include: (1) delivering uncomplicated clarifications, (2) cultivating fundamental proficiencies, (3) inferring judgements, (4) furnishing additional interpretations, and (5) creating schemes and methods (Amalia et al., 2021).

Critical thinking skills play a vital role in science education because students are not only expected to understand scientific concepts but also to evaluate evidence, interpret data, and draw conclusions based on scientific reasoning. These skills help students distinguish between facts, assumptions, and misconceptions when encountering various scientific information (Wahyuni et al., 2025). Various studies indicate that student engagement in scientific explanation activities and metacognitive reflection can enhance their critical thinking skills, as students become better able to monitor and evaluate their own thinking processes (Sayangan et al., 2024). However, developing these skills requires a learning model that encourages students to actively discover concepts and construct knowledge through an investigative process. In this regard, Discover Learning is considered relevant because it provides students with the opportunity to actively engage in the processes of discovery, analysis, and problem-solving, thereby supporting the development of critical thinking skills in science education.

Nevertheless, research on the implementation of Discovery Learning in improving students' critical thinking skills still yields mixed results. Some studies report that this model is effective in improving students' analytical and evaluative abilities, while other research indicates that its success is influenced by student readiness, teacher strategies, and the learning context employed. Furthermore, the relationship between metacognitive activities, the Discovery Learning process, and the improvement of critical thinking skills in science education has not yet

been comprehensively explained in the existing literature. The situation indicates a need for a more systematic analysis of the implementation of Discovery Learning in science education at the junior high school level. Therefore, a systematic literature review is necessary to identify patterns in research findings, evaluate the consistency of previous studies, and analyze the factors influencing the effectiveness of Discovery Learning in enhancing students' critical thinking skills.

METHODS

This study adopts a structured literature review technique, guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) framework, to investigate diverse theories and research outcomes related to using the Discovery Learning model to improve science learning and critical thinking abilities among junior high school students. The PRISMA framework was chosen because it provides a structured and transparent process for identifying, screening, and selecting studies that meet predetermined criteria, ensuring the reliability and clarity of the review. Data collection was conducted by searching for journal articles published between 2021 and 2025 that specifically examined the implementation of Discovery Learning to enhance students' critical thinking abilities. The primary data source for this review was the Google Scholar database, with article retrieval and management facilitated through the Publish or Perish 8 software. This software enables the researcher to efficiently collect, organize, and filter articles based on their relevance to the research topic.

This study employs a structured narrative literature review approach to analyze the implementation of Discovery Learning in enhancing the critical thinking skills of junior high school students in science education. To enhance the transparency of the article selection process, this study adopts the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, including the stages of identification, screening, eligibility, and inclusion, and uses a PRISMA flowchart to document the article selection process. The literature search was conducted through the Google Scholar database using the Publish or Perish application with the keywords "discovery learning", "critical thinking," "junior high school students," and "science learning," which were searched in the titles, abstracts, and keywords of the articles. Google Scholar was chosen because it has a broad coverage of educational publications relevant to the context of science education in Indonesia, while Publish or Perish was used as a tool for searching and managing bibliographic data. The selected articles were limited to peer-reviewed journal articles in Indonesian and English that discussed the implementation of Discovery Learning on the critical thinking skills of junior high school students in science learning. From the 995 identified articles, a screening process was conducted by removing duplicates, reviewing titles and abstracts, and evaluating full texts based on inclusion and exclusion criteria, resulting in 12 relevant articles for analysis. Duplicate articles were identified and removed automatically using the Publish or Perish filtering feature and manually rechecked to ensure data accuracy.

The final selection of articles was based on inclusion and exclusion criteria covering year of publication, language, document type, research focus, and methodological suitability, as presented in Figure 1. Articles were selected if they discussed the implementation of Discovery Learning in junior high school science education and examined students' critical thinking skills as a primary variable. This study used only peer-reviewed journal articles published between 2021 and 2025 in Indonesian and English, while conference proceedings, undergraduate theses, master's theses, books, and other non-academic publications were excluded from the selection process. Data were analyzed using qualitative descriptive analysis because the reviewed articles varied in research design and measurement outcomes, making a meta-analysis impractical. Extracted data included authors, publication year, research design, sample, science content, implementation of Discovery Learning, and findings related to students' critical thinking skills.

Subsequently, the research results were grouped and synthesized based on themes and key findings to identify patterns and trends across studies.

Table 1. Inclusion and exclusion criteria

Information	Inclusion	Exclusion
Design of Study	Quantitative studies, including experimental and quasi-experimental designs that measured students' critical thinking skills	Apart from quantitative research like mixed methods studies, literature reviews, and non-empirical studies
Publication years	Journals published from 2021 to 2025	Journals published before 2021
Language	Indonesian and English	Journals other than Indonesian and English
Acces	All journals are fully accessible	Journals that cannot be accessed in full
Publication type	Peer-reviewed journal articles with full text access	Conference proceedings, theses, books, and non-peer-reviewed publications
Research focus	Studies examining the implementation of Discovery Learning in junior high school science learning	Studies unrelated to Discovery Learning, critical thinking, or science learning at junior high school

The reviewed studies were further categorized based on research design, implementation characteristics of Discovery Learning, and reported outcomes related to students' critical thinking skills to facilitate thematic synthesis across studies.

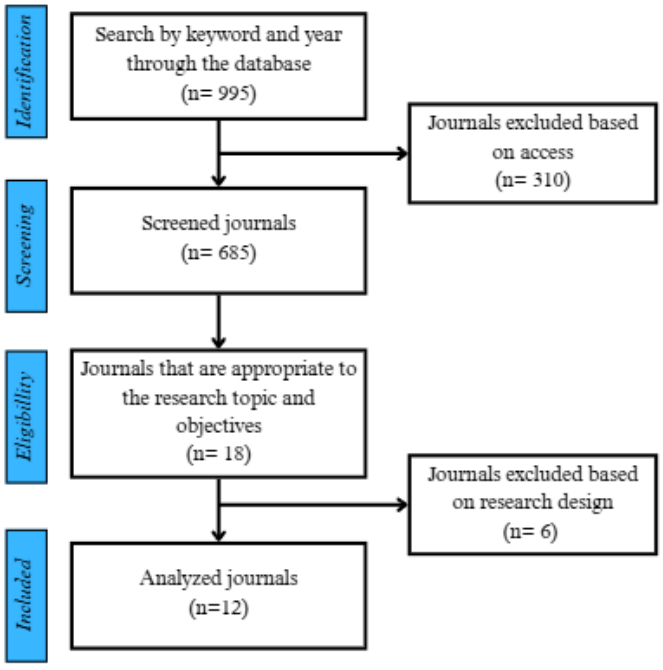


Figure1. PRISMA Study flow diagram

RESULTS AND DISCUSSION

The results of the systematic literature review were obtained through a structured search in the Google Scholar database, which initially identified 995 articles related to Discovery Learning and critical thinking skills. The search was conducted using the keywords "Discovery Learning" AND "critical thinking skills" AND "science learning" AND "junior high school students" with Boolean operators to refine the search results. The keywords were searched within

the titles, abstracts, and keywords of the articles published between 2021 and 2025. After applying the inclusion criteria, including publication year (2021-2025), relevance to Discovery Learning and critical thinking skills, availability of full-text articles, and suitability of the research focus, 12 studies were selected for further analysis. The selected studies mainly employed empirical and quasi-experimental research designs. Study quality was evaluated based on the clarity of research objectives, methodology, data analysis procedures, and consistency of the findings and conclusions.

Analysis of the 12 selected articles indicates that the implementation of the Discovery Learning model generally has a positive impact on improving the critical thinking skills of junior high school students in science learning. Most studies reported on improvement in students' abilities to analyze problems, formulate hypotheses, interpret data, and draw conclusions following the implementation of Discovery Learning. Although the reviewed articles differed in research design, science content, and learning context, the findings showed a consistent pattern that Discovery Learning is capable of encouraging active student participation and supporting the development of higher-order thinking skills. The characteristics and main findings of each reviewed article, including the authors' names and year of publication, are presented in the following section.

Table 2. Research results of the reviewed studies

No.	The author's identity and the publication year	Findings
1.	(Putri et al., 2023).	The method of learning through discovery significantly sharpens students' abilities to think critically, which is clearly demonstrated by the improvement in students' average critical thinking scores with each learning phase.
2.	(Novitasari & Laili, 2023)	The Discovery Learning model, supported by PowerPoint media, influences the critical thinking of students at SMP Negeri 4 Tulungagung in the science classroom. The significance value (2-tailed) of 0.000, which is less than 0.005, as demonstrated by the independent-samples t-test performed on the posttest data for both the experimental and control groups, makes this clear.
3.	(Bahtiar et al., 2022).	The model Discovery Learning through integrated science practicum activities has been proven to have a positive impact on critical thinking skills, as evidenced by a 24 % increase in posttest score.
4.	(Fadillah et al., 2021).	Based on the posttest findings, it's clear that the Discovery Learning model greatly improves students' abilities to think critically in science, as the experimental class did much better than the control group.
5.	(Rizkia et al., 2024)	The implementation of the Discovery Learning approach resulted in enhanced critical thinking capabilities among the students, demonstrated by an average assessment score of 78.00, which indicates a substantial degree of critical thought.
6.	(Ruhana et al., 2023).	The experimental teaching strategy within science studies, known as the Discovery Learning framework, boosts students' aptitude for critically analyzing information. The group engaged in experiments scored 85, while the control group scored 75.
7.	(Marhamah et al., 2025).	Discovery Learning is efficacious in improving the critical thinking skills of School 2 Dayun, as evidenced by the increasing learning outcomes of students in each learning cycle.
8.	(Marinda & Rakhmawan, 2025).	The employment of AR media during the 2022/2023 school year led to gains in students' critical thinking abilities at SMP Negeri Kamal, which was demonstrated by the experimental group's higher average critical thinking abilities when compared to the control group.
9.	(As'adah & Setiawan, 2024).	The critical thinking abilities of SMP 2 Gresik students are positively impacted by the Discovery Learning model, which is aided by worksheets grounded in local knowledge, as demonstrated by a rise in the N-Gain percentage score of about.

10	(Tuara & Tasanif, 2025).	Following the use of the Discovery Learning approach, the capacity for critical thought among pupils at SMP Negeri 52 SATAP South Halmahera was enhanced, as evidenced by a rise in the mean N-Gain score to 0.45.
11.	(Mahardika et al., 2024).	The utilization of microlearning videos within the Discovery Learning framework considerably shapes the critical thinking capabilities of 8th-grade learners at SMP 1 Sampang, a fact underscored by the enhancement seen between students' initial and subsequent assessments.
12.	(Firdaus et al., 2022)	There was an improvement in students' critical thinking skills after the implementation of the Discovery Learning model, as evidenced by the score values in cycle I, which was 74,44 %, and in cycle II, which was 82,78%.

The reviewed research findings show relatively consistent results regarding the positive relationship between the implementation of Discovery Learning and the critical thinking skills of junior high school students in science learning. Most studies reported higher posttest scores and positive N-Gain values in the experimental classes that implemented Discovery Learning compared to conventional learning, although the magnitude of the improvement varied across studies due to differences in research design, sample characteristics, intervention duration, and measurement instruments used.

Several studies also integrated learning support media, such as PowerPoint, microlearning videos, augmented reality-based media, a worksheet based on local wisdom, and integrated science laboratory activities. Of the 12 studies reviewed, five explicitly used additional media and generally showed an increase in critical thinking skills in the experimental classes. Most studies employed a quasi-experimental design with pretest-posttest comparisons, while some utilized classroom action research across multiple learning cycles. Despite methodological variations among the studies, the review's findings generally indicate that Discovery Learning is associated with improved analytical and reflective thinking skills in students' science learning. The characteristics and results of each reviewed article are presented in Table 2.

The Effectiveness of the Discovery Learning Model on Improving Junior High School Students' Critical Thinking Skills

The research findings, when reviewed as a whole, indicate that the implementation of the Discovery Learning model is associated with improved critical thinking skills among junior high school students in science education. Several studies report higher posttest scores and positive N-Gain values in classes that implement Discovery Learning compared to those using conventional instruction. These findings can be interpreted in relation to the characteristics of Discovery Learning, which encourages students to actively explore problems, identify information, and build understanding through a process of independent discovery (Indah, 2024). The stages of Discovery Learning also have the potential to provide students with opportunities to think systematically and develop the ability to analyze and evaluate information. This interpretation aligns with the characteristics of 21st-century learning, which emphasizes logical, reflective, and evidence-based thinking. However, because the reviewed studies vary in methodological quality, research design, and measurement instruments, this interpretation must be understood with caution and should not be interpreted as a direct causal relationship (Zulfa et al., 2025).

Improvements in critical thinking skills are evident from the results of several studies showing an increase in students' average critical thinking scores following the implementation of Discovery Learning in science education, as reported by Putri et al. (2023) and Fadillah et al. (2021). These findings can be interpreted in relation to the stages of Discovery Learning, which encourage students to identify problems, collect data, verify information, and draw conclusions independently. These stages align with the components of critical thinking according to Robert H. Ennis, which include the ability to analyze information, evaluate evidence, and make rational

and reflective decisions. However, most of the reviewed studies only measured critical thinking skills through final test scores or N-Gain scores without specifically identifying each component of critical thinking according to Ennis' framework. Therefore, the relationship between the stages of Discovery Learning and the components of critical thinking is more interpretive in nature, based on the patterns of research results found.

In addition to enhancing critical thinking skills, several studies have also reported increased student engagement, motivation, and independence during the Discovery Learning process. These findings are evident in the higher posttest scores in the experimental class compared to the control class, as reported by Ruhana et al. (2023). Student engagement in the processes of observation, data analysis, and verification of findings is believed to provide greater opportunities for students to actively express their opinions and evaluate information independently. Although motivation and learning independence are not the primary variables in this study, several studies indicate that these aspects can support the development of students' critical thinking skills during the Discovery Learning-based science learning process.

Based on the findings of the reviewed studies, the implementation of Discovery Learning in science education has the potential to support the development of critical thinking skills among junior high school students, particularly when implemented with adequate teacher guidance and supported by appropriate learning materials. Several studies indicate that students' active engagement in exploration, data collection, and conceptual discovery can help them understand concepts more deeply and contextually. Furthermore, this learning process is also linked to students' ability to analyze information and reflect on solutions to scientific problems. However, the effectiveness of implementing Discovery Learning appears to be influenced by differences in learning contexts, research designs, as well as students' characteristics and the instruments used in each study.

The Contribution of Instructional Media to the Application of the Discovery Learning Model

Based on the reviewed studies, the use of instructional media appears to support the implementation of the Discovery Learning model in science education. Several studies report on the integration of Discovery Learning with various types of media, such as PowerPoint by Novitasari & Laili (2023), microlearning video media, as conducted by Mahardika et al (2024), Augmented Reality (AR) media, as conducted by Marinda & Rakhmawan (2025), and local wisdom-based worksheets, as conducted by As'adah & Setiawan (2024). Each type of media is used to support different stages of Discovery Learning. PowerPoint and microlearning videos are generally used in the stimulation stage to introduce concepts and capture students' attention, while AR media is used to support observation activities and concept exploration through visualization. Additionally, worksheets based on local wisdom are used to guide students through the process of data collection, analysis, and conclusion. These findings indicate that instructional media can help facilitate student engagement and understanding during the Discovery Learning process, although the effectiveness of each type of media varies depending on the learning context and the characteristics of the research conducted (Billah et al., 2025).

Instructional media in the implementation of Discovery Learning are used to support the process of exploring concepts and help students understand scientific phenomena more contextually. Of the five studies that integrated learning media, two used digital visual media in the form of PowerPoint and microlearning videos, while one study used augmented reality-based media and another used a worksheet based on local wisdom. PowerPoint and microlearning videos are generally used to help convey core concepts concisely and in a structured manner, whereas AR media is more frequently utilized to support the visualization of objects or phenomena that are difficult to observe directly. The study by Mahardika et al. (2024) indicates that the use of microlearning videos in Discovery Learning is associated with improved students'

critical thinking skills, while the study by Zega & Susanto (2024) reports that AR media supports student engagement during the observation and exploration of concepts. However, the number of studies using each type of media remains limited, so the effectiveness of specific media cannot yet be directly compared. In general, research findings indicate that learning media can support the stages of exploration, observation, analysis, and conclusion drawing in Discovery Learning (Gaol et al., 2022).

Learning media can also increase student motivation and participation during the learning process (Syamsiandari et al., 2025). The local wisdom-based worksheets implemented in learning encourage students to think more deeply and connect concepts with everyday life. As'adah & Setiawan (2024) research indicates that using local wisdom-based student worksheets increased the N-Gain score for critical thinking skills by 64,26%. This finding suggests that learning media developed in accordance with students' cultural and environmental contexts strengthen the relevance of the material and increases learning activity. In this case, the integration of learning media not only enriches the learning experiences but also enhances them. The use of learning media makes the instructional process easier and more engaging, allowing students to understand the material more quickly. Media that is appropriate for learning goals and needs also helps improve students' abilities and concentration because it is clearer and easier to understand (Agustira & Rahmi, 2022). Thus, the use of technology-based media makes learning more engaging, interactive, and contextually relevant, thereby addressing the increasingly diverse challenges of education (Puspita et al., 2025).

In general, the reviewed research findings indicate that the use of instructional media can support the implementation of Discovery Learning in science education, particularly when the media is used to align with learning objectives and student characteristics. Several studies report greater improvement in critical thinking skills in applications without additional media. However, the effectiveness of media use appears to depend on the learning context, the type of media used, and how the media is integrated into the stages of Discovery Learning. In addition, the number of studies discussing each type of media is still limited, so it's not yet possible to generalize about the most effective media. These findings suggest that the selection of relevant learning media has the potential to support student engagement, the process of concept exploration, and the development of critical thinking skills in science learning, while also serving as a basis for further discussion in the conclusion section.

CONCLUSION

The results of this review indicate that the implementation of Discovery Learning is generally associated with improvements in junior high school students' critical thinking skills in science learning, as evidenced by higher posttest scores and N-Gain values in most of the studies reviewed. Several studies also suggest that the use of learning media, such as PowerPoint, microlearning videos, augmented reality, and worksheets based on local wisdom, can support student engagement during the Discovery Learning process. These findings align with Brune's constructivist theory, which emphasizes active knowledge construction through exploration and problem-solving activities. However, the research findings need to be interpreted with caution due to variations in research design, sample characteristics, intervention duration, and the measurement instruments used. This review contributes by synthesizing research from 2021 to 2025 on the implementation of Discovery Learning in junior high school science education and by identifying learning media as a supporting factor in the development of students' critical thinking skills.

SUGGESTION

Future studies are encouraged to explore the integration of digital-based Discovery Learning environments, such as virtual labs and interactive simulations, to further enhance students' critical thinking skills. In addition, professional development programs for teachers should be strengthened to improve their ability to design, facilitate, and assess Discovery Learning effectively. Further research could also expand the participant scope across different regions and school levels to obtain more generalizable results. A broader literature review using international databases such as Scopus and Web of Science is recommended to enrich theoretical foundations and provide more comprehensive insights into improving critical thinking skills.

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