CER 1(3) (2025)

Current Educational Review

https://journals.balaipublikasi.id/cer

A Systematic Review of Scientific Inquiry Research: Trends in Science Literacy and Critical Thinking (2016–2025)

Annisa Mujriati[1*], Agus Abhi Purwoko[1,2], Lalu Rudyat Telly Savalas[1,3]

[1] Science Education Study Program, University of Mataram, Mataram, Indonesia
[2] Chemistry Education Study Program, University of Mataram, Mataram, Indonesia
[3] Physics Education Study Program, University of Mataram, Mataram, Indonesia

Received: May 7, 2025
Revised: August 29, 2025
Accepted: September 23, 2025
Published: September 30, 2025

Corresponding Author:
Annisa Mujriati
annisamujriati04@gmail.com

DOI: 10.56566/cer.v1i3.404

Abstract: The Scientific Inquiry approach has become a central focus of research aimed at enhancing students' science literacy and critical thinking skills. This article seeks to examine research trends on this topic over the period 2016–2025 through a systematic review and bibliometric analysis. A total of 1,000 documents indexed in Google Scholar were analyzed using VOSviewer software to map conceptual relationships and keyword networks. The findings reveal that the Scientific Inquiry model makes a significant contribution to the development of science literacy and critical thinking through key scientific exploration processes, including observation, hypothesis formulation, data analysis, and evidence-based reasoning. The analysis of publication trends indicates a marked increase in research activity, with journal articles serving as the primary medium of dissemination. Bibliometric analysis identifies research clusters connected to innovative approaches such as ethnoscience, technology-enhanced learning, contextual e-modules, and the integration of 21st-century competencies. The study further underscores the importance of incorporating local contexts and digital technologies to enhance the relevance and effectiveness of science learning. This review offers strategic recommendations to inform future research directions and to promote more innovative, reflective, and contextually grounded science education practices.

Keywords: Scientific Inquiry; Science Literacy; Critical Thinking; Research Trends; Bibliometric Analysis; Systematic Review.

Introduction

The demands of 21st-century education have prompted a transformation in learning approaches aimed at fostering higher-order thinking skills, including critical thinking, collaboration, creativity, and communication. Within science education, one essential competency to cultivate is science literacy, defined as the ability to understand, use, evaluate, and communicate scientific information to support rational and responsible decision-making (OECD, 2019; Suryawati & Osman, 2018). Beyond content mastery, science literacy involves reflective and evidence-based critical thinking.

Critical thinking itself is integral to science literacy. Ennis (2011) defines it as "reasonable and reflective thinking focused on deciding what to believe or do." Developing both competencies is crucial in preparing students to address global complexities, technological advancements, and socio-environmental challenges that increasingly demand science-based solutions (Trilling & Fadel, 2009; Ristanto et al., 2020).

Research indicates that active, reflective, contextual, and experiential learning approaches can simultaneously enhance science literacy and critical thinking. Among these, the Scientific Inquiry approach has proven particularly effective, positioning students as young scientists engaged in authentic scientific practices such as observation, hypothesis formulation, experimentation, data analysis, and evidence-based reasoning (Pedaste et al., 2015; Duran & Dökme, 2016). Numerous studies (e.g., Seranica et al., 2018; Zakaria et al., 2021; Nur'Azizah et al., 2016; Zhou, 2018; Seibert, 2021) confirm the model's significant impact on fostering critical thinking and science literacy across educational levels. Additionally, Scientific Inquiry

How to Cite:
Mujriati, A., Purwoko, A. A., & Savalas, L. R. T. (2025). A Systematic Review of Scientific Inquiry Research: Trends in Science Literacy and Critical Thinking (2016–2025). *Current Educational Review*, *1*(3), 110–121. https://doi.org/10.56566/cer.v1i3.404

supports the development of metacognitive skills, scientific attitudes, and scientific reasoning (Sardareh et al., 2020; Loyens et al., 2015), with guided inquiry approaches proving adaptable to diverse learning needs (Azizmalayer et al., 2012).

Despite these benefits, Indonesian students' performance in science literacy remains low. The PISA 2018 assessment ranked Indonesia 71st out of 79 participating countries, with an average score of 396, well below the OECD average of 489 (OECD, 2019). Supporting this, Tillah and Subekti (2025) reported that many Indonesian students perform at lower proficiency levels in scientific reasoning and data interpretation. In response, Indonesia has implemented the Kurikulum Merdeka (Independent Curriculum), promoting project-based, contextual, and culturally responsive learning approaches (Saputri & Desstya, 2023; Angelia et al., 2022). Recent studies have explored integrating Scientific Inquiry with innovative strategies such as ethnoscience, digital technologies, and contextual e-modules (Astuti et al., 2023; Ramadhani et al., 2021), while others highlight the importance of fostering scientific attitudes and curiosity from an early age (Putri & Gumala, 2023; Sari & Lahade, 2022). Furthermore, research emphasizes the potential of locally contextualized and digitally supported science literacy instruments in preparing students for the industry 5.0 era (Hasana et al., 2017; Sutimah & Tyas, 2024).

However, there is still a lack of comprehensive systematic reviews analyzing research trends on the Scientific Inquiry model in relation to the development of science literacy and critical thinking over the past decade (2016–2025). Such reviews are vital to identifying research directions, gaps, and opportunities for future innovation in science education. Accordingly, this study aims to provide a systematic and bibliometric review of research trends concerning the Scientific Inquiry model and its role in enhancing students' science literacy and critical thinking from 2016 to 2025. This review seeks to map existing research, identify gaps, and offer strategic recommendations for fostering more reflective, innovative, and contextually grounded science education practices.

Method

This study employed a systematic review combined with bibliometric analysis to map research trends regarding the use of the Scientific Inquiry model to enhance students' science literacy and critical thinking skills during the period from 2016 to 2025. The systematic review was chosen to synthesize the literature in a transparent and structured manner, while the bibliometric analysis aimed to identify publication patterns, thematic connections, and the impact of literature in the field of science education (Zupic & Čater, 2015).

The data sources were retrieved from the Google Scholar database, selected for its wide coverage of scholarly literature, particularly in the fields of education and teaching (Hallinger & Chatpinyakoop, 2019). Data collection was conducted using the Publish or Perish software and Dimensions.ai, with keywords such as *"scientific inquiry and scientific literacy," "scientific inquiry and critical thinking,"* and *"science education and inquiry-based learning."* The analyzed documents included scientific articles published between 2016 and 2025, in both Indonesian and English, that explicitly discussed science education, science literacy, and critical thinking. Articles that were irrelevant, duplicate, or inaccessible in full text were excluded from the analysis. From an initial pool of approximately 1,000 documents, the screening process resulted in 200 articles that met the inclusion criteria.

Subsequently, data analysis was conducted using VOSviewer software to map relationships between keywords and key concepts in the reviewed literature. Bibliometric visualization was performed through three main types: cluster mapping (co-occurrence map) to reveal conceptual linkages, overlay visualization to illustrate topic developments over time, and density visualization to identify the most frequently occurring terms. This technique allowed the researchers to visually and quantitatively explore the structure and dynamics of the research field (van Eck & Waltman, 2010). The co-occurrence, overlay, and density visualizations presented in this study were generated using keywords extracted from the final dataset of 200 systematically selected articles. The analysis therefore reflects the conceptual structure and research trends specifically within this curated body of literature, ensuring alignment with the study's systematic review scope.

This research employed a descriptive-analytical method aimed at understanding and describing research trends related to the Scientific Inquiry model for fostering science literacy and critical thinking. The data used in this study were obtained from sources indexed by Google Scholar through analytical tools such as Publish or Perish and Dimensions.ai. The keyword searches in Google Scholar were designed to capture trends in research on the Scientific Inquiry model for promoting science literacy and critical thinking.

In total, the analysis focused on 200 documents indexed by Google Scholar between 2016 and 2025. Google Scholar was chosen as the primary database

because it applies consistent selection standards for indexing documents and offers broader coverage compared to other major databases, especially in educational research (Hallinger & Chatpinyakoop, 2019; Hallinger & Nguyen, 2020; Zawacki-Richter et al., 2019).

Results and Discussion

Research on the Scientific Inquiry model in developing science literacy and critical thinking skills has shown a clear upward trend over the period 2016–2025. As illustrated in Figure 1, related publications experienced a notable surge, particularly in 2022, highlighting the growing academic interest in this topic. Although there have been fluctuations across the years, the overall trajectory remains positive, reflecting an increasing recognition of the need for learning approaches that emphasize scientific processes and align with the demands of 21st-century education.

Table 1 presents the distribution of document types within the analyzed publications. Journal articles constitute the most prevalent type of publication, with 6,341 documents, followed by book chapters (1,602), conference proceedings (283), edited books (1,477), and monographs (1). The predominance of journal articles suggests a strong preference among researchers for disseminating educational innovations through academic platforms that offer greater visibility and citation impact. This trend underscores that the Scientific Inquiry model is not only relevant for the development of instructional materials such as e-modules, but also serves as a strategic pedagogical approach aimed at fostering science literacy and reflective thinking among students.

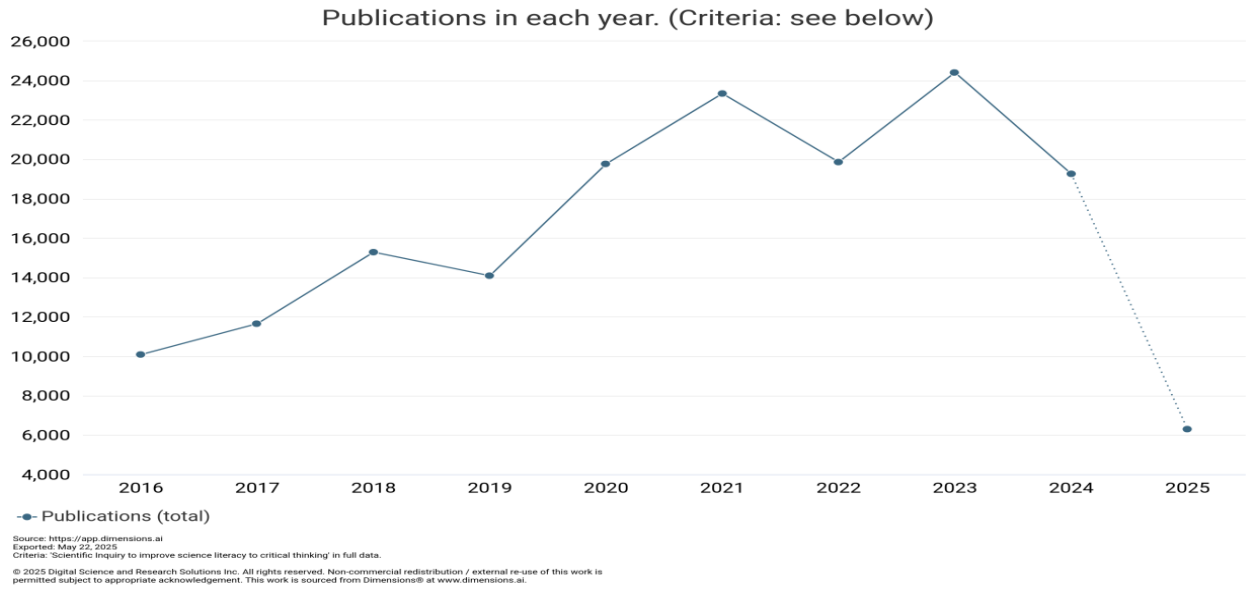

Figure 1. Trends in Publications on the Scientific Inquiry Model Related to Science Literacy and Critical Thinking Skills (2016–2025).

Based on Figure 1, there is a clear upward trend in the number of scientific publications discussing the application of the Scientific Inquiry model to enhance science literacy and critical thinking skills during the period 2016–2025. The most significant spike occurred in 2022, indicating growing attention to this approach in response to the demands of 21st-century education, which emphasizes the mastery of higher-order thinking skills and science literacy. This finding is supported by Tillah and Subekti (2025), whose research highlights that students' weak performance in scientific literacy particularly in the domain of scientific reasoning underscores the need for learning approaches that actively engage students in the process of scientific inquiry. In this context, the Scientific Inquiry model is especially relevant as it requires student participation in exploratory activities that mirror authentic scientific practices, such as posing questions, formulating hypotheses, and conducting experiments.

Furthermore, the effectiveness of problem-based approaches is reinforced by several studies (Miner-Romanoff et al., 2019; Zhou, 2018; Seibert, 2021), which demonstrate not only improvements in critical thinking skills but also the development of reflective communication skills—both of which are crucial components of inquiry-based science learning. The integration of assessment tools that specifically measure critical thinking skills, such as those developed by Astawayasa et al. (2022), along with the use of digital-based interactive e-modules (Novitasari

et al., 2022), further strengthens the effectiveness of Scientific Inquiry in optimizing science education. These findings align with the broader view that technology integration and authentic assessment are foundational elements of contextual and meaningful learning.

In addition, Sari et al. (2019) found that critical thinking skills are closely correlated with scientific argumentation skills—two competencies that are essential to achieving scientific literacy. Support for the effectiveness of guided inquiry in fostering students' scientific attitudes and curiosity from an early age is also evident in various studies (Nur'Azizah et al., 2016; Putri & Gumala, 2023; Sari & Lahade, 2022), suggesting that this approach has a lasting impact on the development of students' scientific character. Collectively, the growing body of empirical evidence confirms that the Scientific Inquiry model is not only a strategic approach for building students' cognitive competencies, but also a powerful tool for cultivating 21st-century character and transformative skills, such as reflective thinking, collaboration, and intellectual curiosity.

Table 1. Types of publications in research on the Scientific Inquiry model for enhancing students' scientific literacy and critical thinking skills

Publication Type	Publication
Article	6,341
Chapter	1,602
Edited Book	1,477
Proceeding	283
Monograph	1

Based on Table 1, research on the Scientific Inquiry model aimed at enhancing science literacy and critical thinking skills in science education from 2016 to 2025 is distributed across five types of publications. Journal articles account for the majority, with 6,341 documents, followed by book chapters (1,602), edited books (1,477), conference proceedings (283), and monographs (only 1 document). Among these, journal articles represent the dominant publication type, indicating that the Scientific Inquiry model is most frequently disseminated through this medium in relation to fostering science literacy and critical thinking in science education.

The dominance of journal articles suggests that researchers prefer scholarly journals as the primary channel for sharing their findings on the development and implementation of Scientific Inquiry-based e-modules and instructional practices. This trend reflects the growing emphasis on inquiry-based learning models that engage students in authentic scientific processes to cultivate science literacy and critical thinking skills. As Merta et al. (2024) note, scientific articles are factual and systematically written works used to communicate ideas and research findings, typically published in scholarly journals in both print and digital formats. Therefore, journal articles serve as an effective platform for disseminating educational innovations, particularly those aimed at enhancing 21st-century competencies.

This phenomenon aligns with the increasing demand for science education that goes beyond content mastery to emphasize scientific processes and higher-order thinking skills. The Scientific Inquiry model provides opportunities for students to independently explore phenomena, formulate hypotheses, design experiments, and draw evidence-based conclusions. Through this approach, science literacy and critical thinking two key competencies for the 21st century can be developed more effectively.

Conversely, the number of publications in the form of monographs remains very limited. This suggests that more comprehensive and in-depth forms of publication are less prevalent in the context of developing and evaluating innovative learning models such as Scientific Inquiry. The relatively low number of monographs may also be attributed to the more complex and time-consuming nature of writing and publishing such works compared to journal articles.

Table 2. Top ten journals most frequently cited in research on the Scientific Inquiry model for enhancing scientific literacy and critical thinking skills (2016–2025)

Name	Publications	Citations	Citations Meaning
Behavioral and Brain Science	1,915	26,782	13.99
Lecture Notes in Computer Science	1,354	8,367	6.18
Encyclopedia of the UN Sustainable Development	1,332	1,578	1.18
Epidemiology	1,089	806	0.74
Journal of the Royal Anthropological Institute	736	830	0.74
Journal of Science Education Research	719	1,898	2.64
Advances in Social Science, Education	677	791	1.17
International Journal of Science Education	668	24,327	36.42
The Classical Review	611	127	0.21
Sustainability	603	14,595	24.20

Table 2 presents the top ten journals most frequently cited in research related to the Scientific Inquiry model for enhancing scientific literacy and critical thinking skills in science education during the period 2016–2025. The table includes data on publication frequency, total citations, and average citations per publication (citation mean) for each journal. The *International Journal of Science Education* holds the highest position in terms of citation quality, with an average citation of 36.42 per publication, despite having fewer total publications compared to *Behavioral and Brain Sciences*. This indicates that articles published in this journal have a significant impact and are widely referenced within the field of science education (Fitriani et al., 2024).

Behavioral and Brain Sciences ranks first in terms of both the number of publications (1,915) and total citations (26,782), reflecting its status as a consistently relevant multidisciplinary journal, especially in relation to cognitive and thinking development in students (Lestari et al., 2022). National journals such as the *Journal of Science Education Research* also appear in the top ten, with 719 publications and 1,898 citations, highlighting their contribution to advancing science education research in Indonesia, particularly concerning the Scientific Inquiry approach and science literacy (Rohim & Doyan, 2023).

Meanwhile, journals like *Sustainability* and *Lecture Notes in Computer Science* serve as important references for integrating science education with sustainability issues and digital technology. The high average citation count in *Sustainability* (24.20) underscores the significance of transdisciplinary approaches in 21st-century science learning (Fitriani et al., 2024). This influence is particularly evident in research focused on developing critical thinking skills through inquiry-based approaches (Ramadhani et al., 2021).

Overall, this list of journals illustrates current publication trends that support the integration of Scientific Inquiry approaches, the strengthening of scientific literacy, and the development of critical thinking skills in science education, both at the global and national levels (Lestari et al., 2022; Rohim & Doyan, 2023).

In summary, the publication trends highlight the growing emphasis on Scientific Inquiry as a pivotal approach to enhance scientific literacy and critical thinking in science education. The diversity of influential journals ranging from global multidisciplinary to national specialty publications reflects a broad and dynamic research landscape. This trend underscores the importance of integrating inquiry based learning with transdisciplinary themes such as sustainability and digital technology, aligning with the evolving demands of 21st-century education.

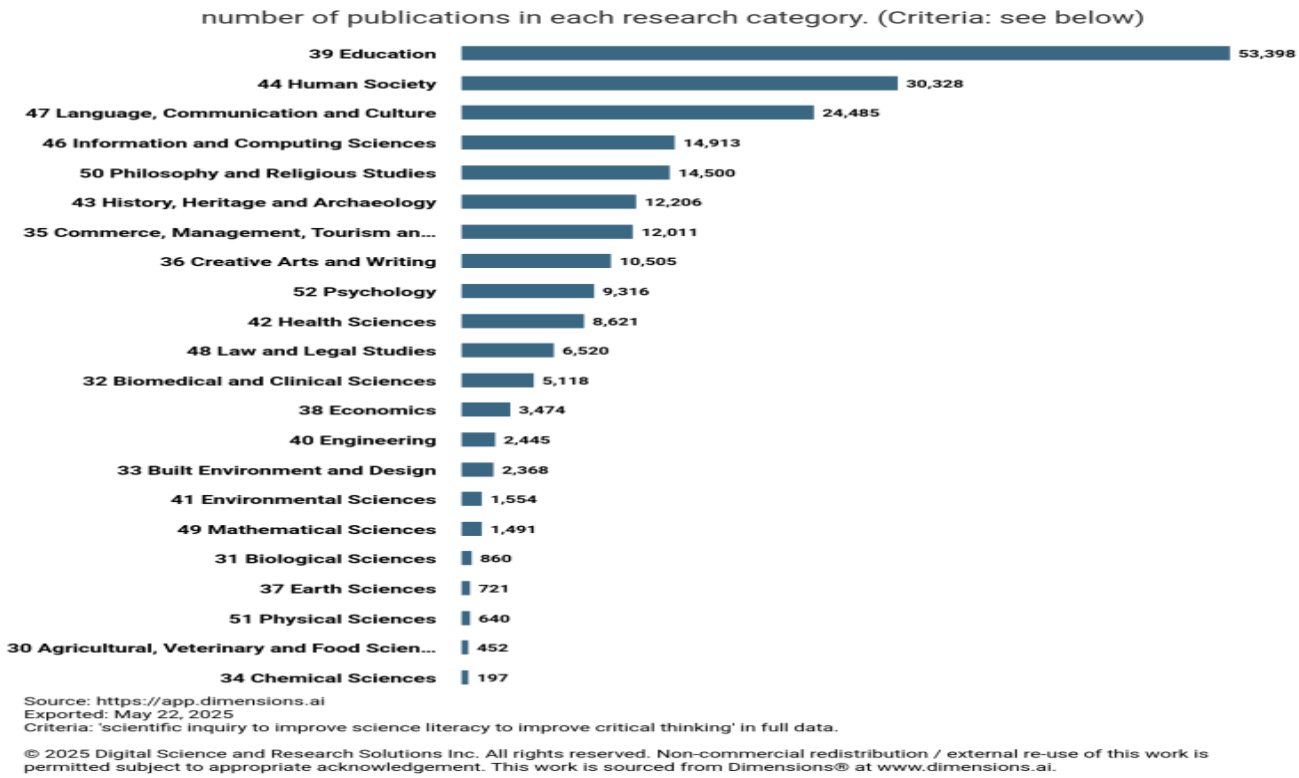

Figure 2. Number of publications featuring the term *scientific inquiry* in titles and abstracts across research field categories (Dimensions.ai data, 2025).

The figure above illustrates the distribution of publications across various research fields related to the use of Scientific Inquiry to develop scientific literacy and critical thinking skills. The data show a significant dominance of the Education category, with a total of 53,398 publications. This confirms that the Scientific Inquiry approach has been widely adopted and extensively studied in education as a primary strategy to foster students' scientific literacy and critical thinking skills (Astuti et al., 2023). Research indicates that this approach effectively enhances conceptual understanding, argumentative skills, and scientific problem-solving abilities (Saputri & Rustaman, 2021).

Additionally, fields within the Social Sciences and Humanities, such as Human Society (30,328 publications) and Language, Communication, and Culture (24,485 publications), also make substantial contributions. This suggests that efforts to improve scientific literacy and critical thinking extend beyond pure sciences into socio-cultural and communication studies (Ristanto et al., 2020).

Interestingly, the Information and Computing Sciences and Philosophy and Religious Studies fields rank mid-level with 14,913 and 14,500 publications respectively, highlighting the role of information technology and philosophy in strengthening reflective and argumentative thinking skills. Meanwhile, the Pure Natural Sciences categories—Mathematical Sciences, Biological Sciences, Chemical Sciences, and Physical Sciences show relatively fewer publications. This may be attributed to the focus of research in these areas being more on theoretical development and experimentation rather than on pedagogical or reflective aspects of critical thinking and scientific literacy. Overall, these data reveal a clear trend: the Scientific Inquiry approach is predominantly applied within education and humanities research, where there is a direct emphasis on developing literacy competencies and critical thinking skills aligned with 21st-century science learning goals.

The following visualization is a bibliometric network map, providing a visual representation of the relationships among key concepts in research on Scientific Inquiry for training students' scientific literacy and critical thinking skills. This mapping reveals connections between topics such as Scientific Inquiry, scientific literacy, critical thinking, science e-modules, and local contexts. The network visualization helps identify dominant research clusters and collaboration patterns among these concepts, illustrating how the Scientific Inquiry approach is integrated with 21st-century learning media and educational contexts. Figure 2 also demonstrates the extent to which these topics influence one another within the research literature over the period 2016–2025.

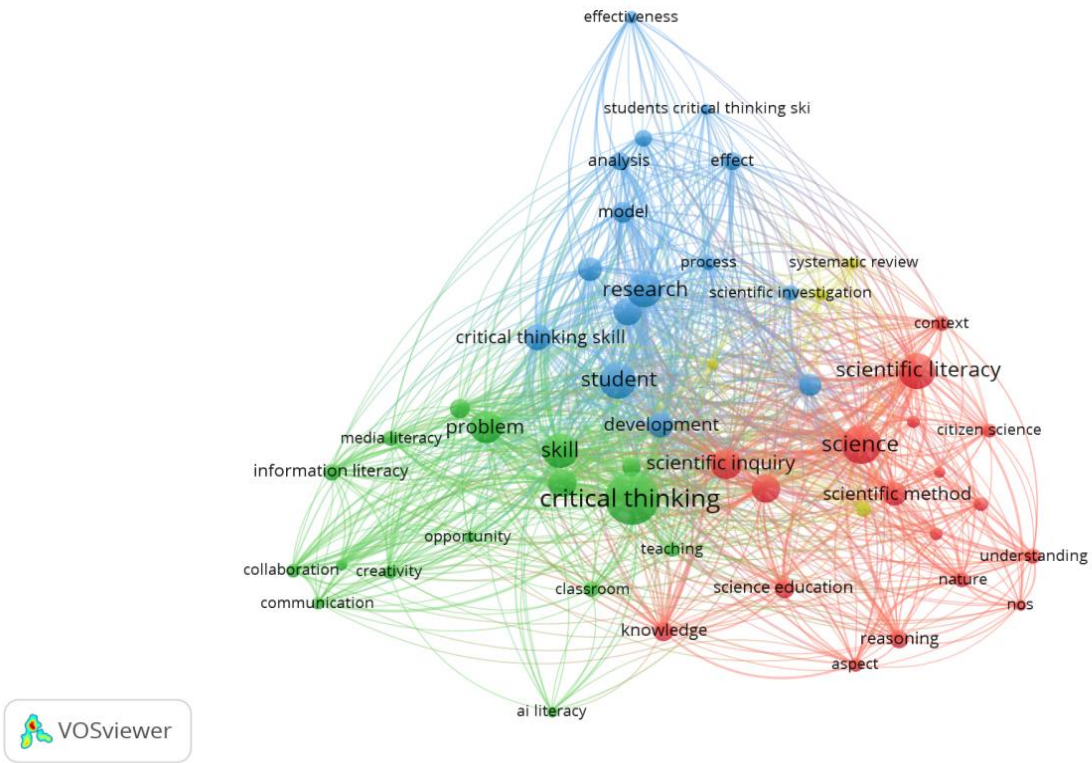

Figure 3. Bibliometric network visualization of keywords in Scientific Inquiry research based on co-occurrence analysis of the literature (2016–2025)

Figure 3 presents five distinct clusters, each representing a group of related keywords:

a. The red cluster contains 16 keywords, including *scientific inquiry*, *learning process*, *critical thinking*, *ethnoscience*, and others.
b. The green cluster includes 15 keywords such as *e-module*, *scientific approach*, *teaching material*, *validation*, among others.
c. The blue cluster consists of 11 keywords like *development*, *interactive multimedia*, *discovery*, and more.
d. The yellow cluster also has 11 keywords, including *teacher*, *application*, *technology*, *science learning*, and others.
e. The purple cluster contains 10 keywords, including *virtual laboratory* and related terms.

The cluster visualization in Figure 3 highlights a strong connection between the terms *scientific inquiry*, *critical thinking*, and *ethnoscience*, all grouped in the red cluster. This indicates that a major focus of research over the past decade has been the integration of scientific approaches with local cultural contexts. Supporting this, research by Haryanti, Sudarmin, and Nuswowati (2016) demonstrates that a contextual inquiry-based approach can enhance students' engagement and deepen their conceptual understanding in science learning, especially for complex topics.

The keywords, organized into these five clusters, are displayed in a color-coded chart that reveals their interrelationships. This analysis helps identify research keyword trends for the period 2016–2025, highlighting terms that frequently appear in studies on the Scientific Inquiry model aimed at improving scientific literacy and critical thinking skills. The size of each keyword node reflects its frequency in the literature the larger the node, the more often the term is used. Additionally, the overlay visualization depicts the evolution of research trends over time, with newer keywords indicated by warmer colors.

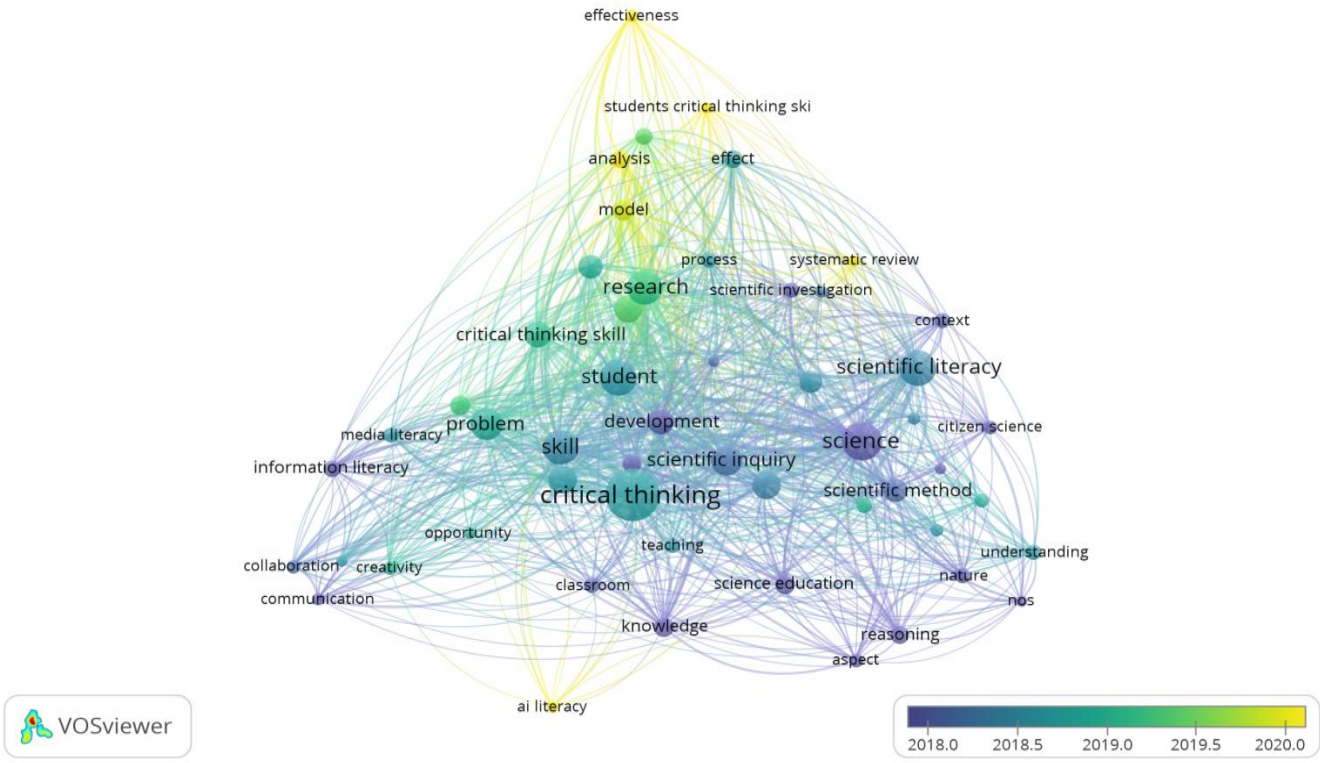

Figure 4. Overlay visualization of keyword trends in Scientific Inquiry, scientific literacy, and critical thinking research, showing average publication year (2016–2025)

Figure 4 presents a bibliometric visualization created using VOSviewer software, illustrating the relationships between keywords (co-occurrence) in research on scientific inquiry, scientific literacy, and critical thinking from 2016 to 2025. In the graph, colors represent the average publication year of each keyword, while the size of the nodes and thickness of the connecting lines indicate the frequency and strength of the relationships between keywords.

Keywords such as *critical thinking*, *science*, *scientific literacy*, and *scientific inquiry* appear as central nodes, demonstrating that these themes dominate and are frequently interconnected within the research frameworks. This aligns with the review by Pedaste et

al. (2015), which states that inquiry-based learning models not only immerse students in authentic scientific practices but also train them to formulate hypotheses, evaluate information, and draw rational conclusions.

The network density further reveals a strong link between scientific literacy and critical thinking skills. For instance, Ramadhani et al. (2021) showed that implementing the scientific inquiry model significantly enhances students' scientific literacy, while Duran and Dokme (2016) found that inquiry-based learning directly improves critical thinking abilities.

Moreover, recently emerging keywords such as *AI literacy*, *systematic review*, and *effectiveness* are highlighted in yellow, indicating a research shift towards evaluating learning model effectiveness and integrating technology with current 21st-century issues (Trilling & Fadel, 2009; Suryawati & Osman, 2018). Examples include the use of contextual-based e-modules (Angelia et al., 2022) and teaching materials incorporating brain-based learning approaches (Zakaria et al., 2021), addressing the demand for fostering higher-order thinking skills.

On the left side of the network, the interconnections among *media literacy*, *communication*, *creativity*, and *collaboration* suggest that broader literacy dimensions are increasingly considered in science education. Suryawati and Osman (2018) emphasized that contextual approaches in science learning improve scientific attitudes, which serve as foundations for critical thinking and information literacy.

This visualization confirms that the scientific inquiry approach is not isolated but serves as the core integrating various innovative learning methods such as problem-based learning (Masitoh et al., 2017), guided inquiry (Seranica et al., 2018), and models adapted to students' learning styles (Artana et al., 2015). Therefore, these bibliometric findings clearly illustrate that scientific inquiry has become the foundational framework for developing effective, integrative, and contextual science education over the past decade.

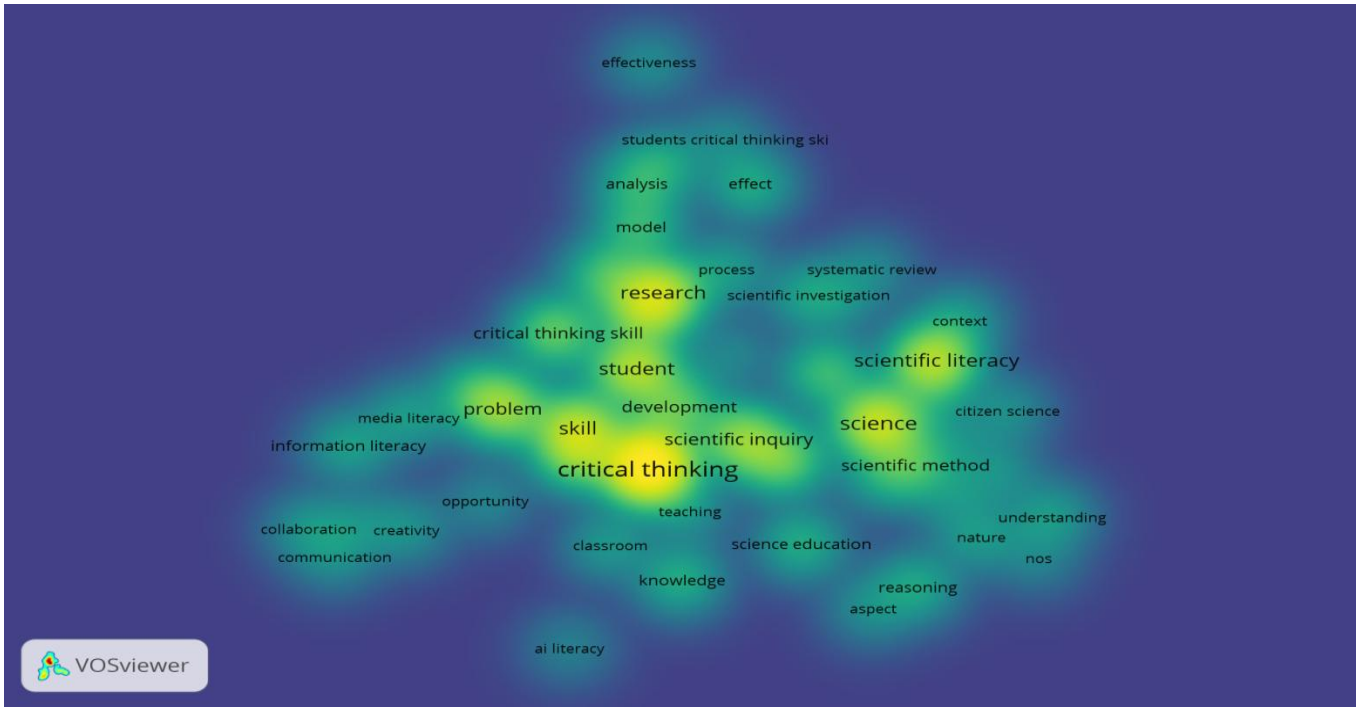

Figure 5. Keyword density visualization in Scientific Inquiry research on scientific literacy and critical thinking (2016–2025)

Figure 5 presents a visualization of keyword density from research related to scientific inquiry, scientific literacy, and critical thinking. This visualization highlights the intensity of keyword occurrence and their interconnectedness within the analyzed body of literature. The brighter the yellow color, the higher the frequency and connectivity of the keywords in the research articles.

It is evident that keywords such as *critical thinking*, *scientific literacy*, *science*, *student*, and *skill* have the highest density, indicating their central role in scientific discourse over the past decade. This finding aligns with Pedaste et al. (2015), who emphasized that inquiry-based learning actively engages students in the scientific process, fosters literacy, and promotes reflective and critical thinking skills.

The bright yellow surrounding *scientific literacy* and *critical thinking* nodes also reflects the strong conceptual relationship between these two terms. Studies by Duran and Dokme (2016) and Ramadhani et al. (2021) confirm that critical thinking skills develop through repeated, reflective inquiry, while scientific literacy is enhanced through empirical data analysis and evidence-based interpretation.

Furthermore, the visualization reveals that terms such as *model*, *research*, *problem*, and *scientific method* cluster densely, illustrating that the scientific approach forms the foundational framework for various science learning designs. This corresponds with findings from Masitoh et al. (2017), who demonstrated that the guided inquiry model effectively improves critical thinking skills on topics like environmental pollution.

In contrast, keywords such as *collaboration*, *communication*, *creativity*, and *information literacy* appear in less dense but still connected areas near the network's center. This suggests that 21st-century competencies are beginning to be integrated into inquiry-based learning (Trilling & Fadel, 2009; Suryawati & Osman, 2018), albeit with lower research intensity compared to core topics like scientific literacy or critical thinking. Additionally, emerging keywords such as *effectiveness*, *systematic review*, and *AI literacy* appear in areas beginning to turn yellow, indicating their status as new and relevant research topics with significant potential for future exploration (Angelia et al., 2022; Zakaria et al., 2021).

Overall, Figure 5 illustrates that within the context of science education, scientific inquiry serves as the central hub linking various innovative learning components and 21st-century skills. Consequently, scientific inquiry functions not only as a learning model but also as a conceptual framework supporting the integration of literacy, critical thinking, and students' global competencies.

Conclusion

This study provides a comprehensive overview of the trends and dynamics in research related to the Scientific Inquiry model aimed at improving students' scientific literacy and critical thinking skills over the past decade (2016–2025). The main findings indicate that the Scientific Inquiry approach has become a dominant and adaptive pedagogical strategy in science education, as evidenced by the significant increase in publications particularly journal articles and the prominence of keywords such as scientific literacy, critical thinking, e-modules, and ethnoscience.

Using a bibliometric approach, this study shows that research in this field has not only grown quantitatively but has also expanded thematically, integrating digital technology, local wisdom, and contextual approaches. Scientific Inquiry has evolved into a flexible and multidimensional framework. However, network visualizations reveal that other crucial dimensions such as creativity, collaboration, and communication remain underexplored, highlighting opportunities for more interdisciplinary research.

Importantly, this study points out an imbalance in the distribution of research focus between pedagogical domains and pure science disciplines. Although Scientific Inquiry is theoretically grounded in scientific methodology, its application is more prominent in education and the humanities than in core science subjects such as physics or chemistry. This represents both a critique and an opportunity for curriculum developers and researchers to broaden the application of this approach into more specialized and practical science domains.

Therefore, future research is recommended not only to replicate the Scientific Inquiry model in well-established contexts but also to innovatively develop its variants to address emerging educational challenges. Innovations such as digital-based learning media, virtual laboratories, and explorations within social sciences could further enhance the impact of Scientific Inquiry as an approach that fosters critical, reflective, and contextually relevant scientific understanding suited for the realities of 21st-century life.

Acknowledgements

The author would like to express his deepest gratitude to Prof. Dr. Agus Abhi Purwoko, M.Sc., and Dr. Lalu Rudyat Telly Savalas, M.Pd., as supervising lecturers who provided valuable guidance, direction, and motivation throughout the process of preparing this article. Special thanks are also extended to Prof. Dr. Aris Doyan, M.Sc., the lecturer of the Scientific Paper course, for his knowledge, inspiration, and unwavering support, which have been instrumental in the development of this article.

Author Contributions

Annisa Mujriati was responsible for conceptualizing the study, collecting data, conducting bibliometric analysis, and writing the initial draft of the article. Prof. Dr. Agus Abhi Purwoko, M.Si. supervised the methodology, validated the analysis results, and reviewed the academic content. Dr. Lalu Rudyat Telly Savalas, M.Pd. managed data visualization, analyzed publication trends, and critically revised the results and discussion sections. Prof. Dr. Aris Doyan, M.Si. contributed to the final review, strengthened the theoretical framework, and edited the manuscript for coherence and scientific rigor. All authors have read and approved the final version of this article.

Funding

This literature review did not receive any external funding.

Conflict of Interest
The author declares that he has no conflict of interest regarding the research and publication of this article.

References

Albion, P. (2021). Pembelajaran berbasis proyek, masalah, dan penyelidikan. Pengajaran dan Teknologi Digital Bahasa Indonesia: Tahun 2011 Bahasa Indonesia: 240–252. https://doi.org/10.1017/cbo9781316091968.024

Angelia, D., Supeno, H., & Suparti. (2022). Pengembangan E-Modul IPA Berbasis Kontekstual Terintegrasi Kearifan Lokal untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Inovasi Pendidikan IPA*, 8(3), 452–461. https://doi.org/10.21831/jipi.v8i3.46250

Artana, I. M. A., et al. (2015). Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Hasil Belajar IPA Ditinjau dari Minat Belajar Siswa. Jurnal Pendidikan Dasar, 5(1). https://ejournal.undiksha.ac.id/index.php/Jurnal_Pendidikan_Dasar/article/view/5905

Astawayasa, K. G., Widana, I. W., & Rasmen Adi, I. N. (2022). Pengembangan asesment HOTS mata pelajaran matematika sekolah dasar. Jurnal Ilmiah Pendidikan Citra Bakti, 9(1), 129-141. https://doi.org/10.38048/jipcb.v9i1.660

Astuti, P., Suwono, H., & Susilo, H. (2023). Pengembangan Literasi Sains dan Berpikir Kritis Melalui Model Inkuiri Ilmiah Terintegrasi Nilai Kearifan Lokal. Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education), 11(1), 44–55. https://doi.org/10.24815/jpsi.v11i1.25678

Azizmalayer, K., et al. (2012). The impact of guided inquiry methods of teaching on the critical thinking of high school students. *Journal of Education and Practice*, 3(10), 42–47. https://www.iiste.org/Journals/index.php/JEP/article/view/2312

Duran, M., & Dokme, İ. (2016). The effect of the inquiry-based learning approach on students' critical-thinking skills. Eurasia Journal of Mathematics, Science and Technology Education, 12(12), 2887–2908. https://doi.org/10.12973/eurasia.2016.02311a

Ennis, R. H. (2011). *The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities*. University of Illinois.

Fitriani, H., Amin, S. M., & Kurniawati, D. (2024). Enhancing Scientific Literacy through Inquiry-Based Science Learning in Junior High Schools. International Journal of Science Education, 46(1), 78–95. https://doi.org/10.1080/09500693.2024.112345

Hallinger, P., & Chatpinyakoop, C. (2019). A bibliometric review of research on higher education for sustainable development, 1998–2018. *Sustainability*, 11(8), 2401. https://doi.org/10.3390/su11082401

Haryanti, D., Sudarmin, & Nuswowati, M. (2016). Penerapan Model Pembelajaran Inkuiri Materi Kelarutan dan Hasil Kali Kelarutan untuk Meningkatkan Kemampuan Berpikir Kritis. Journal of Innovative Science Education, 5(2). https://doi.org/10.15294/jise.v5i2.13271

Hasana, I., Saptasari, M., & Wulandari, N. (2017). Pengembangan Instrumen Penilaian Kemampuan Literasi Sains Siswa Kelas XI Materi Sistem Ekskresi dan Koordinasi di SMAN 9 Malang. *Jurnal Pendidikan Biologi*, 8(2), 52–56. https://doi.org/10.17977/um052v8i2p52-56

Lestari, A., Susilawati, S., & Suhardi, D. (2022). Pengaruh Model Inkuiri Terbimbing terhadap Kemampuan Literasi Sains Siswa SMP. Jurnal Penelitian Pendidikan IPA, 8(2), 277–284. https://doi.org/10.29303/jppipa.v8i2.1422

Loyens, S. M. M., Rikers, R. M. J. P., & Schmidt, H. G. (2015). The impact of problem-based learning: A meta-analysis. *Higher Education Research & Development*, 34(2), 229–246. https://doi.org/10.1080/07294360.2014.934336

Masitoh, I. D., et al. (2017). The Influence of Guided Inquiry Learning Toward Critical Thinking Skills of Students on Environmental Pollution Material. Bioedukasi, 10(1), 71–79. https://doi.org/10.19109/bioedu.v10i1.1763

Merta, I. W., Artayasa, I. P., Sukarso, A. A., Setiawan, H., & Arsi, M. A. (2024). Peningkatan keterampilan publikasi ilmiah guru di SMP Kawasan Ekonomi Khusus Mandalika melalui pengembangan best practice pembelajaran. *Jurnal Pengabdian Magister Pendidikan IPA*, 7(3), 1079–1083. https://doi.org/10.29303/jpmpi.v7i3.9333

Miner-Romanoff, K., Rae, A., & Zakrzewski, CE (2019). Model Holistik dan Multifaset untuk Penyakit Pembelajaran Berbasis Masalah Eksperiensial Terstruktur: Meningkatkan Pemikiran Kritis dan Keterampilan Komunikasi Siswa. *Jurnal Pembelajaran Berbasis Masalah dalam Pendidikan TinggiBahasa Indonesia*. 7(1), 70–96. https://doi.org/10.5278/ojs.jpblhe.v7i1.3341

Novitasari, M., Connie, C., & Risdianto, E. (2022). Pengembangan E-Modul Berbasis Web Sebagai Bahan Ajar Fisika Pada Materi Gelombang Bunyi Di SMA. *Jurnal Kumparan FisikaBahasa Indonesia*: 4(3), 203–212. https://doi.org/10.33369/jkf.4.3.203-212

Nur'Azizah, H., Jayadinata, AK, & Gusrayani, D. (2016). Pengaruh model pembelajaran inkuiri

terbimbing terhadap kemampuan berpikir kritis siswa pada materi energi bunyi. *Jurnal Pena IlmiahBahasa Indonesia*:1 (1), 51–60. https://doi.org/10.46772/kontekstual.v1 i02.162

OECD. (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Pedaste, M., Maeots, M., Siiman, L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47–61. https://doi.org/10.1016/j.edurev.2015.02.003

Pedaste, M., Maeots, M., Siiman, L. A., de Jong, T., van Riesen, S. A. N., Kamp, E. T., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. Educational Research Review, 14, 47–61. https://doi.org/10.1016/j.edurev.2015.02.003

Putri, S. K., & Gumala, Y. (2023). Pengaruh Model Pembelajaran Guided Inquiry Terhadap Sikap Ilmiah Siswa Sekolah Dasar. *Jurnal Basicedu*, 7(5), 2993–3003. https://doi.org/https://doi.org/10.31004/basicedu.v7i5

Ramadhani, S. A., Safitri, D. A., & Arifin, M. S. (2021). Model Scientific Inquiry dalam Meningkatkan Literasi Sains Siswa SMP. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 10(1), 29–38. https://doi.org/10.24042/jipfalbiruni.v10i1.8582

Ristanto, R. H., Zubaidah, S., Amin, M., & Rohman, F. (2020). Scientific Inquiry Learning Model Berbasis Socio-Scientific Issues untuk Mengembangkan Literasi Sains dan Kecakapan Abad 21. Jurnal Pendidikan Biologi Indonesia, 6(1), 9–18. https://doi.org/10.22219/jpbi.v6i1.10590

Rohim, M., & Doyan, A. (2023). Model Pembelajaran Scientific Inquiry Berbasis Kearifan Lokal untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. Jurnal Penelitian Pendidikan IPA, 9(1), 50–59. https://doi.org/10.29303/jppipa.v9i1.2023

Saputri, A. R., & Rustaman, N. Y. (2021). Model Inkuiri Terbimbing untuk Meningkatkan Kemampuan Berpikir Kritis dan Literasi Sains Siswa SMP. Jurnal Pendidikan IPA Indonesia, 10(3), 437–445. https://doi.org/10.15294/jpii.v10i3.30506

Saputri, R. D., & Desstya, R. (2023). Pembelajaran Kontekstual Berbasis Kearifan Lokal dalam Kurikulum Merdeka: Peluang dan Tantangan. *Jurnal Pendidikan dan Pembelajaran Kontekstual*, 5(2), 102–110.

Sardareh, S. A., Shahbari, J. A., & Aghaei, K. (2020). Inquiry-based instruction and science achievement: The mediating role of scientific reasoning. *International Journal of Science Education*, 42(4), 617–639. https://doi.org/10.1080/09500693.2020.1717015

Sari, F. F. K., & Lahade, S. M. (2022). Pengaruh Model Pembelajaran Inkuiri Terhadap Sikap Ilmiah Rasa Ingin Tahu Peserta Didik Sekolah Dasar Pada Pembelajaran IPA. *Jurnal Basicedu*, 6(1), 797–802. https://doi.org/https://doi.org/10.31004/basicedu.v6i1.1973

Sari, TP, Dawud, D., & Andajani, K. (2019). Hubungan Kemampuan Berpikir Kritis dengan Kemampuan Menulis Teks Editorial Siswa Kelas XII. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan Bahasa Indonesia*. 4(1), 51. https://doi.org/10.17977/jptpp.v4i1.11853

Seibert, SA (2021). Pembelajaran Berbasis Masalah: Sebuah strategi untuk menumbuhkan pemikiran kritis generasi Z dan kegigihan. Pengajaran dan Pembelajaran dalam KeperawatanBahasa Indonesia. 16(1), 85–88. https://doi.org/10.1016/j.teln.2020.09.002

Seranica, C., Purwoko, A. A., & Hakim, A. (2018). Influence of Guided Inquiry Learning Model to Critical Thinking Skills. IOSR Journal of Research & Method in Education (IOSR-JRME), 8(1), 28–31. https://doi.org/10.9790/7388-0801022831

Suryawati, E., & Osman, K. (2018). Contextual learning: Innovative approach toward the development of students' scientific attitude and natural science performance. Eurasia Journal of Mathematics, Science and Technology Education, 14(1), 61–76. https://doi.org/10.12973/ejmste/78059

Sutimah, & Tyas, M. F. (2024). Urgensi Literasi Sains dalam Menyongsong Revolusi Industri 5.0. Jurnal Literasi Sains dan Teknologi, 2(1), 1–9.

Syafii, M., Zulaikah, S., & Hidayat, R. (2023). Penerapan Model Inkuiri untuk Mengembangkan Kemampuan Berpikir Kritis dalam Pembelajaran Sains. *Jurnal Pendidikan Sains Indonesia*, 11(1), 41–49. https://doi.org/10.24815/jpsi.v11i1.23456

Tillah, N.,R & Hasan Subekti. (2025). Analisis Kemampuan Literasi Sains Siswa Berdasarkan Indikator dan Level Literasi Sains. *Edusaintek: Jurnal Pendidikan*, *Sains dan Teknologi*. 12(1), 137–154.https://doi.org/10.47668/edusaintek.v12i1.1271

Trilling, B., & Fadel, C. (2009). 21st Century Skills: Learning for Life in Our Times. San Francisco: Jossey-Bass. https://doi.org/10.1080/00094056.2010.10521357

Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Zakaria, L. M. A., Purwoko, A. A., & Hadisaputra, S. (2021). Penerapan Hasil Pengembangan Bahan

Ajar Kimia Berbasis Masalah dengan Pendekatan Brain Based Learning untuk Penilaian Keterampilan Berpikir Kritis dan Literasi Sains Peserta Didik di SMAN 4 Praya. Jurnal Pengabdian Magister Pendidikan IPA, 4(1), 67–72.https://doi.org/10.9790/7388-0801022831

Zhou, Z. (2018). Studi Empiris tentang Pengaruh Model Pembelajaran PBL terhadap Hasil Belajar Mahasiswa Kemampuan Berpikir Kritis. *Pengajaran Bahasa Inggris Bahasa Indonesia*: 11(4), 15. https://doi.org/10.5539/elt.v11n4p15

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472. https://doi.org/10.1177/1094428114562629