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LITERATURE ANALYSIS ON IMPROVING SCIENCE LITERACY THROUGH AN INQUIRY-BASED LEARNING APPROACH FOR STUDENTS

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Abstract: Scientific literacy is a crucial part of measuring the progress of an educational process. However, to improve scientific literacy skills, it is necessary to understand how scientific literacy can be developed in the learning process. The purpose of this study is to provide an overview of improving students' scientific literacy through an inquiry-based learning approach. Data were collected through library research from various sources, including books, journals, and previous research findings. The results indicate that inquiry-based learning is effective in improving students' scientific literacy. This study demonstrates that inquiry-based learning can help students become more engaged and active in the learning process. It can also improve their critical and analytical thinking skills. This study found that inquiry-based learning methods still provide significant benefits in improving students' scientific literacy, despite several constraints, such as the amount of time required and limited availability of tools. Group learning, the use of lecture techniques, discussions, and technology such as online learning platforms are some of the suggested solutions.

Keywords: Scientific Literacy, Inquiry-Based Learning, Learning Process

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INTRODUCTION

Learning is a process whereby individuals can train their minds to think critically. In this increasingly developed era, learning is not only a necessity but has become essential for the development of humanity and the nation. Through learning, humans not only develop knowledge but also the skills and attitudes needed to face the challenges of the modern era (Diani et al., 2019; Huda et al., 2019; Yasin et al., 2020). Learning does not only take place in the classroom, but can also occur through interactions in the environment, daily experiences, and technology (Harahap, 2022). The concept of inclusive learning takes into account that each individual has a different learning style, needs, and unique potential. Therefore, a diverse approach is needed to enable effective learning for all individuals (Karwono et al., 2023).

The purpose of learning is not only limited to the acquisition of knowledge, but also includes the development of skills such as critical thinking, communication, collaboration, and creativity (Prastowo et al., 2019). Learning also plays an important role in shaping individual attitudes, values, and identities. Learning broadens your horizons, deepens your understanding, and helps you become a productive and effective member of society. The use of technology has changed the learning environment by expanding access to information and educational resources (Pangesti et al., 2020). E-learning, distance learning, and mobile applications are examples of how technology has expanded the learning space beyond traditional classrooms (Pranoto, 2023).

This makes learning more flexible, personalized, and affordable for many people around the world. In the context of globalization and technological advances, learning is becoming increasingly important. This concept emphasizes the importance of continuous learning throughout a person's life (Arifin, 2023). Therefore, learning is not just a process, but also a lifestyle that enables sustainable development and growth in an era of relatively rapid change. Improving student learning is very important in higher education. Therefore, broader access to information is needed so that it can become a learning resource for students to develop their skills and knowledge in a more in-depth and targeted manner (Diani et al., 2019; Huda et al., 2019, 2020; Yasin et al., 2020).

The use of technology in learning also gives students the freedom to learn anytime and anywhere according to their preferences and needs (Arifin, 2023). Furthermore, innovative and diverse learning approaches can improve student motivation and participation in the learning process. By using interactive, collaborative, and applied learning methods (Pranoto, 2023), students can feel the relevance of the subject matter to real life, thereby increasing their interest and understanding of the subject matter. Therefore, improving student learning not

only has an impact on academic performance but also on the development of the skills and attitudes necessary for success in our careers and lives after graduation. In particular, the development of scientific literacy is an important element in modern learning (Yusmar & Fadilah, 2023) because it enables individuals to understand, interpret, and make decisions based on scientific knowledge.

In higher education, students need to acquire scientific knowledge to gain a deep understanding of complex scientific concepts, where improvements in students' scientific abilities can be achieved through a learning approach that focuses on understanding basic scientific concepts, applying scientific methods, and analyzing and evaluating scientific information (Ridwanulloh et al., 2022).

One way to improve students' academic literacy is through project-based or inquiry-based learning (Siregar et al., 2023). By participating directly in research projects, students gain hands-on experience in applying scientific methods, collecting data, and conducting analysis. These projects also allow students to collaborate with other students and academic supervisors, thereby improving their communication and collaboration skills in an academic context. In addition, incorporating technology into learning can also help improve students' science literacy (Dimov, 2021; Rauf et al., 2021). Through computers, data analysis software, and online learning platforms, students' learning experiences can be enriched by providing access to resources and tools related to the scientific fields they are studying (Muyassaroh & Mukhlis, 2023).

By using this technology, students can develop important information and communication technology (ICT) skills and broaden their knowledge of the application of science in various contexts. Finally, a student-centered learning approach also plays an important role in improving science literacy (Handayani & Subakti, 2021). By allowing students to work independently on science topics that interest them, learning becomes more realistic and engaging. Teachers and instructors can act as facilitators, guiding students through the learning process and providing constructive feedback to improve their scientific understanding and skills.

This diverse and integrated approach significantly improves students' scientific abilities and prepares them to be evidence-based decision makers and scientifically knowledgeable managers in the future (Nurseha et al., 2024). Research-based learning is the right choice for integrating the above learning concepts.

Through this approach, students are able to actively explore knowledge and solve problems, and explore concepts in depth. Inquiry this allows students to take charge of their

own learning process, with guidance from an educator as a facilitator. In this way, students not only gain knowledge, but also develop critical, creative, and collaborative thinking skills that are important for lifelong learning (Nurseha et al., 2024).

Research-based learning naturally supports the development of students' scientific abilities. By actively engaging with scientific concepts, students learn ask questions, design experiments, collect data, and evaluating evidence. This allows us to understand the scientific process firsthand and improve our skills in analyzing and interpreting scientific information. Therefore, research not only increases your understanding of a subject, but also helps you become a more competent and critical decision maker in a scientific context. In addition, inquiry-based learning can incorporate technology as a tool to facilitate exploration and learning more deeply (Safira et al., 2024).

By using computer simulations, data analysis software, and online learning resources, students can broaden their learning horizons and access information more easily.

This technology-based inquiry approach enables students to learn science concepts more independently and stimulates their interest and motivation to learn. Therefore, the integration of inquiry-based learning concepts and scientific competencies provides a solid foundation for the development of students' lifelong learning skills.

Therefore, to understand the extent to which the inquiry learning model can contribute to improving science literacy at various levels of education, this research was conducted through a literature analysis from various related sources. This study aims to identify patterns of findings, the effectiveness of the inquiry model, and the challenges that arise in its application based on the results of previous studies.

METHOD

The method used in this study is library research. This study collects data from books, the Qur'an, hadith, journals, papers, and research results. This research method was used because it made it easier for researchers to collect relevant data and to conclude or understand several differences from the research results to be used as comparison material. This enabled researchers to find solutions to the problems or obstacles found in the library data that was being compared or observed and **Figure 1** shows the research steps.

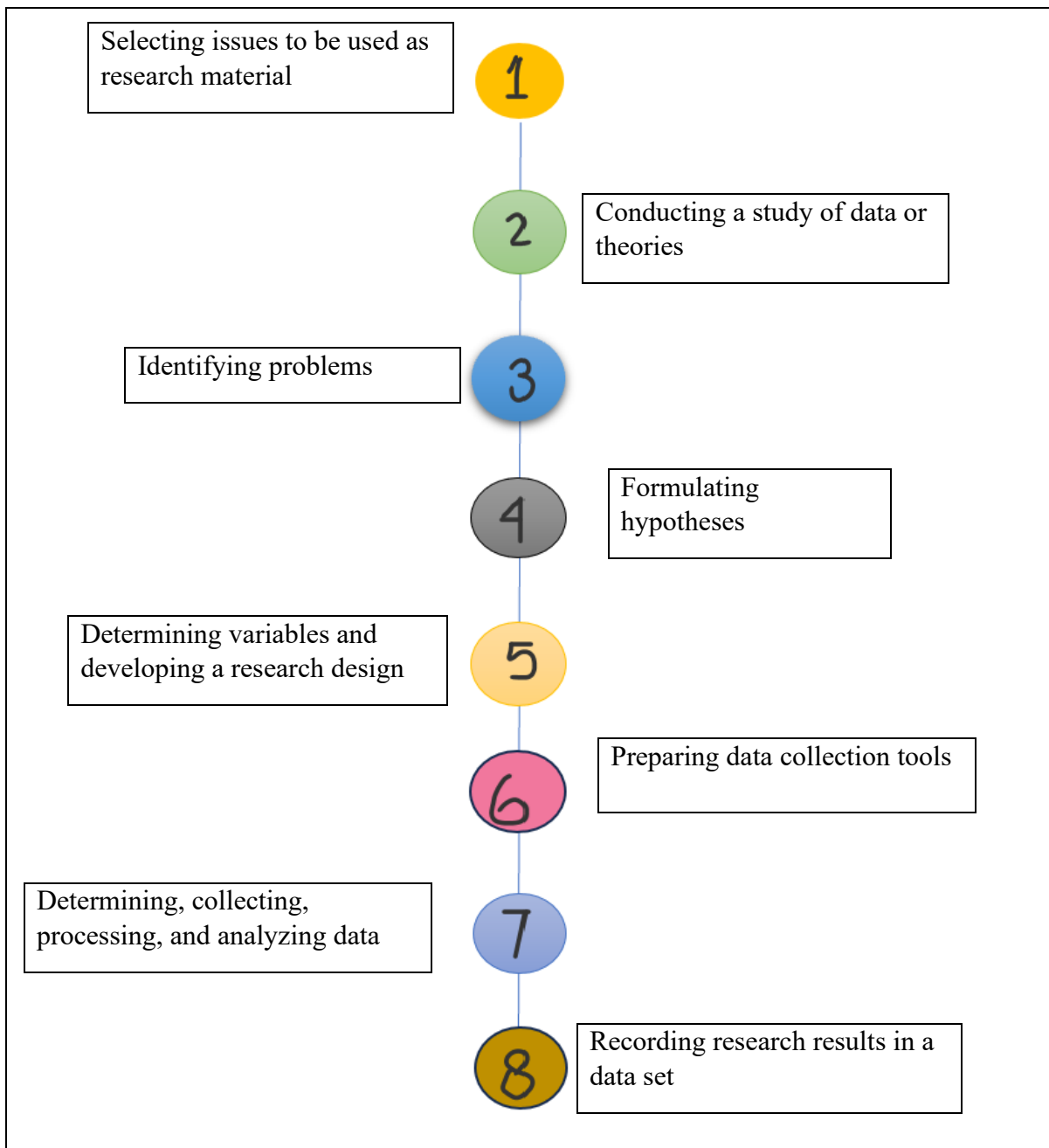


Figure 1. Research Steps

FINDING AND DISCUSSION

To obtain a more comprehensive picture of the effectiveness of inquiry-based learning in improving science literacy, the researcher reviewed various relevant articles and research results. This analysis focused on the research objectives, topics of study, and main findings in each source, thereby providing a deeper understanding of the consistency of research results related to the application of the inquiry model at various levels of education. A summary of the analyzed articles is presented in Table 1 below as a basis for observing the patterns, similarities, and trends that emerged from the various studies.

Table 1. Summary of Article Publications Based on the Lybrary Research Method or Literature Research

No	Title & Author	Topic	Results
1	Development of a guided inquiry learning model on students' science literacy skills (Rosita, 2023)	Development of an inquiry model to improve science literacy.	The use of posttests in inquiry-based learning models has been proven to improve science literacy, although the results are not significant.
2	The effect of guided inquiry learning on students' science literacy skills (Awaluddin & Firmansyah, 2022)	The effect of inquiry learning on science literacy	The results show that the experimental class was higher and more effective than the control class in improving science literacy in the use of the inquiry learning model.
3	The effect of guided inquiry learning on the science literacy of 11th grade students on hydrocarbon compounds at SMAN 1 Soromandi (Nuri et al., 2023)	The effect of inquiry-based learning on science literacy in hydrocarbon compound material	The results show that the use of the inquiry learning model in the experimental class was higher and more active than in the control class in terms of improving science literacy.
4	Guided inquiry learning model design to improve science literacy (Nuri et al., 2023)	design of inquiry-based learning in improving science literacy.	The results show that guided inquiry learning can be an effective model for improving science literacy. Although it has several shortcomings, such as requiring a long time and there are obstacles, especially in the availability of tools to conduct experiments. By designing group learning and using lecture, presentation, discussion, and question and answer methods, these shortcomings can be overcome. The use of videos and worksheets discussion participant students can also help motivate students. The results of the pretest and posttest show a significant increase in science literacy.
5	The effect of guided inquiry learning models on improving science literacy among students at X MAN 1 Bima City in the 2022/2023 academic year (Fahrudin et al., 2023)	The effect of inquiry learning on improving science literacy.	Research shows that the use of inquiry learning can improve science literacy. The average pretest score of 38.50 in the experimental class was higher than that of the control class, which was 32.87. The results this shows that the use of inquiry-based learning can improve students' science literacy among students.
6	Application of guided inquiry model to improve students' science literacy in biology learning (Aprizanti, 2023)	Inquiry-based learning to improve science literacy.	The results of this study involved 20 people who were then divided into 4 groups in two cycles. Orientation, problem formulation, hypothesis proposal, data collection, hypothesis testing, and conclusion formulation were all part of the first cycle. The results of the first cycle did not meet

- 7 The Effect of the Guided Inquiry Learning Model on Students' Science Literacy Skills at SMP Negeri 35 Palembang (Erdani et al., 2020) Science literacy of students at SMP Negeri 35 Palembang the requirements. The generative plant development system was the focus of the second cycle. The results indicated that the learning process and outcomes were successful; students were more meticulous and enthusiastic, and the class remained calm and according to schedule.

Research at SMP Negeri 35 Palembang shows that science literacy is very important in modern society. Science literacy includes the ability to understand, apply, and engage with science in everyday life. The main objective of science education is to create a scientifically literate society that is able to face the challenges of the modern era with the right knowledge, skills, and attitudes. Science literacy is important for personal satisfaction, daily decision-making, participation in public discourse, and meeting the demands of the world of work, which increasingly requires scientific skills reasoning, creativity, and problem solving.
- 8 Application of the guided inquiry learning model to improve the science literacy skills of high school students (Shellawati & Sunarti, 2018) Improving science literacy skills in high school Science literacy is the ability to understand, apply, and engage with science in various contexts of life, including solving problems with scientific knowledge. The curriculum in Indonesia has changed several times to improve the quality of students. In the latest curriculum, one of the main objectives is to achieve literacy, including science literacy.
- 9 The effect of the inquiry learning model on science literacy skills and students at SDN Babakan Madang 3 in Bogor district (Nurseha et al., 2024) The effect of inquiry-based learning on science literacy skills in elementary school students In this study, the science literacy of students in the experimental and control classes was measured both before and after the learning process. After using the inquiry learning model, the pretest showed an average score of 70.80 for the experimental class and 62.61 for the control class. The posttest showed an average score of 83.80 for the experimental class and 68.35 for the control class. Statistical tests indicated significant changes, with showing that the inquiry can help students better understand science.
- 10 The effect of the inquiry learning model with realia media on the science literacy of 4-5-year-old The effect of inquiry learning with realia media on improving science literacy. This study examined the validity and reliability of the instrument and the impact of the inquiry learning model on the science literacy of 4-5-year-

	children (Febriani et al., 2023)		old children. The instrument showed good validity and reliability (Cronbach's Alpha 0.876). After six sessions using the inquiry model, the posttest results showed a significant improvement in the experimental group. The T-test showed a significance of $0.000 < 0.05$, indicating the effectiveness of the inquiry model in improving children's science literacy.
11	The effect of using inquiry-based science teaching materials on the excretory system to improve science literacy (Fidiantara et al., 2020)	The effect of inquiry-based science teaching materials on improving science literacy.	This study shows that eighth-grade students at MTs Negeri 1 Mataram can improve their science knowledge by using inquiry-based science teaching materials. Data analysis results show that the experimental class performed better than the control class. Additionally, student responses to the lessons indicate that the lessons considered interesting by students.
12	The effect of the guided inquiry learning model on the science literacy skills of 10th grade students on the subject of biodiversity at Wera 1 Public High School in the 2021/2022 academic year (Kuswanto et al., 2021)	The effect of guided inquiry learning on science literacy in senior high school students.	Compared to other learning models, this study shows that the open-ended question learning model significantly improves students' science literacy skills. The hypothesis test results indicate a significant difference between the two groups, with a p-value < 0.05 . These results suggest that the open-ended question learning model influences students' understanding of about biodiversity
13	Literacy skills in substance material through a guided inquiry learning model assisted by multimedia (Agustina et al., 2020)	Literacy skills in substance-related material through the inquiry learning model	Research shows that the guided inquiry learning model with multimedia is better than the direct learning model assisted by non-temporal multimedia. The results show that the inquiry model can be used as an alternative to improve students' abilities in science literacy
14	The influence of the free inquiry model on science literacy skills (Haerani et al., 2020)	The influence of the free inquiry model on science literacy skills.	Research shows that guided inquiry learning models with multimedia are better than direct learning models with non-temporal multimedia. The results show that inquiry models can be used as an alternative to improve students' science literacy skills.
15	Student science literacy through guided inquiry learning models (Nasir et al., 2023)	The effect of the inquiry model on science literacy	This study shows that the guided inquiry learning model is effective can improve students' science literacy. In terms of science content, the control class achieved 58.01% (fair), while the experimental class achieved 71.78% (good). In terms of

science context, the control class only achieved 38.44% (low), while the experimental class achieved 78.22% (good). In terms of the science process, the control class scored 68.20% (good), and the experimental class scored 87.21% (very good). Overall, this model has been proven to improve understanding and science skills of students. Thus, it is evident that the inquiry model can help improve science literacy

Table 1 shows that the use of posttests in the inquiry learning model can improve science literacy students, although the results are not significant. The inquiry learning model is an approach that emphasizes open exploration and experimentation, allowing students to explore and understand scientific concepts more deeply. By using the inquiry learning model, students can develop a better understanding of science material and develop critical thinking and problem-solving skills (Rosita, 2023). The results of the study show that the inquiry model can be used as an alternative to improve students' science literacy skills. This study highlights the importance of promoting science literacy in young students, as it can help them understand and explore the natural world and technology. The inquiry learning model can be a useful tool for achieving this, as it allows students to take an active role in their learning and develop a deeper understanding of science material.

Tables 2 & 3 show the results of the study, which indicate that the experimental class scored higher than the control class. This is because the experimental class may have received effective treatment or interventions designed to improve results, and this may have led to an increase in science literacy through the use of the inquiry learning model (Awaluddin & Firmansyah, 2022; Nuri et al., 2023). Guided inquiry learning also has a significant effect on improving science literacy in both the experimental and control classes.

Table 4 shows that the results of guided inquiry learning can be an effective model. This is done to produce an increase in science literacy. However, this has many shortcomings, such as requiring a long time and having limitations in the availability of tools needed for the experiment. Therefore, a group learning design was developed. This group learning design also usually uses several methods to make it easier, such as lectures, presentations, discussions, and question and answer sessions. Although this has many shortcomings, these shortcomings can be overcome by using videos and student discussion sheets (LDPD)

(Siregar et al., 2023). This can also easily help motivate students. Meanwhile, the posttest and pretest results show that there has been a significant increase in the use of science literacy.

Tables 5 and 6 show that the results of their research are similar and indicate that the use of inquiry-based learning can improve science literacy. Fahrudin proved this by conducting a pretest on the experimental class and the control class which consisted of 20 students divided into 4 groups that could be conducted in two cycles. Meanwhile, the average score on the pretest in the experimental class was 38.50, which was higher than the control class, which scored 32.87 (Fahrudin et al., 2023). The results of this pretest show that the use of inquiry-based learning can improve students' science literacy. The groups were divided into two cycles, such as orientation, problem formulation, hypothesis proposal, data collection, hypothesis testing, and formulation. However, the first cycle did not meet the requirements. Meanwhile, the second cycle produced a generative plant development system (Aprizanti, 2023). The conclusion is in the first cycle. The results show that the learning process and its outcomes were successful. Students were more careful and enthusiastic, and the class was calm and on schedule.

Table 7 explains that the research conducted at SMP Negeri 35 Palembang shows that science literacy is very important in modern society, for example, in today's society, where it is rather difficult to preserve science literacy. Science literacy also includes the ability to understand and apply science. It also includes being involved with science in everyday life. Science education here has the main objective of creating a scientifically literate society that also has the ability to face challenges in the modern era. This is achieved by using the right knowledge, skills, and attitudes. Scientific literacy is also important in personal satisfaction, daily decision-making, and participation in public discourse. It can also meet the needs of the world of work, which increasingly demands skills in science, reasoning, creativity, and problem-solving (Erdani et al., 2020). Thus, it shows that the use of guided inquiry models can improve students' science literacy.

Table 8 states that science literacy is the ability to apply and understand science and engage with science in various contexts of daily life, such as solving problems using scientific knowledge. The curriculum in Indonesia has undergone several changes to improve the quality of students' abilities. Meanwhile, the latest curriculum has a main objective of achieving literacy, including science literacy (Shellawati & Sunarti, 2018). Inquiry-based learning in the control and experimental classes was proven to improve science literacy.

Table 9 shows that the results of the study indicate that the scientific literacy of students in the experimental class and the control class can be measured both before and after learning,

and after using this inquiry learning model. The pretest showed that the average score for the experimental class was 70.80, while for the control class it was 62.61. In the next process, the posttest showed that the experimental class obtained an average score of 83.80, while the control class obtained an average score of 68.35. The results of this statistical test show a significant change (Nurseha et al., 2024), indicating that the inquiry model can help students better understand science.

In Table 10, the researchers tested the validity and reliability of the instruments and the impact of the inquiry learning model on the science literacy of 4-5-year-old children. Validity refers to the extent to which the instrument measures what it is intended to measure, while reliability refers to the extent to which the instrument produces consistent results over time. Using Cronbach's Alpha consistency of 0.876, the researchers found that the instrument showed good validity and reliability. Furthermore, the researchers tested the effectiveness of the inquiry learning model in improving children's science literacy. The inquiry learning model is an approach that emphasizes facilitation and open exploration, allowing children to explore and understand scientific concepts more deeply. After six meetings using the inquiry model, the posttest results showed a significant increase in the experimental group. The T-test showed a significance of $0.000 < 0.05$ (Febriani et al., 2023), indicating that the use of the inquiry learning model was effective in improving children's science literacy.

Table 11 of this study shows that eighth-grade students at MTs Negeri 1 Mataram can improve their science knowledge by using inquiry-based science teaching materials. The inquiry method is an approach that emphasizes exploration and open experimentation, allowing students to explore and understand scientific concepts more deeply. By using the inquiry method, students can develop a better understanding of science material and develop critical thinking and problem-solving skills. The results of the data analysis show that the experimental class, which followed the inquiry method, performed better than the control class. This shows that the inquiry method is effective in improving students' science knowledge. In addition, the students' responses to the lessons show that the lessons were generally considered interesting by students (Fidiantara et al., 2020). This shows that the use of the inquiry method can help make science lessons more interesting and engaging for students.

Table 12 of this study shows that the open-ended question learning model significantly improves students' science literacy skills. The open-ended question learning model is an approach that emphasizes facilitation and open exploration, allowing students to explore and understand scientific concepts in greater depth. By using the open-ended question learning

model, students can develop a better understanding of science material and develop critical thinking and problem-solving skills. The hypothesis test results show that there is a significant difference between the two groups, with a $p\text{-value} < 0.05$. This shows that the open-ended question learning model affects students' understanding of biodiversity (Kuswanto et al., 2021). This study highlights the importance of science literacy in young students, as it can help them understand and explore the natural and technical world. The open-ended question learning model can be a useful tool to achieve this, as it allows students to take an active role in their learning and develop a deeper understanding of science material.

Table 13 of this study shows that the guided inquiry learning model with multimedia is better than the direct learning model with non-temporal multimedia. The inquiry learning model is an approach that emphasizes open exploration and experimentation, allowing students to explore and understand scientific concepts more deeply. By using the inquiry learning model, students can develop a better understanding of science material and develop critical thinking and problem-solving skills. The results of the study show that the inquiry model can be used as an alternative to improve students' science literacy skills. This study highlights the importance of promoting science literacy in young students, as it can help them understand and explore the natural world and technology (Agustina et al., 2020). The inquiry-based learning model can be a useful tool for achieving this, as it allows students to take an active role in their learning and develop a deeper understanding of science material.

Table 14 of this study shows that guided inquiry learning models with multimedia are better than direct learning models with non-temporal multimedia. Inquiry learning models are approaches that emphasize exploration and open experimentation, allowing students to explore and understand scientific concepts in greater depth. By using the inquiry learning model, students can develop a better understanding of science material and develop critical thinking and problem-solving skills. The results of the study show that the inquiry model can be used as an alternative to improve students' science literacy skills. This study highlights the importance of promoting science literacy in young students, as it can help them understand and explore the natural world and technology (Haerani et al., 2020). The inquiry learning model can be a useful tool for achieving this, as it allows students to take an active role in their learning and develop a deeper understanding of science material.

Table 15 of this study shows that the guided inquiry learning model can effectively improve students' science literacy. The inquiry learning model is an approach that emphasizes exploration and open experimentation, allowing students to explore scientific concepts in greater depth. By using the inquiry learning model, students can develop a better

understanding of science material and develop critical thinking and problem-solving skills. The results of the study show that the inquiry model can be used as an alternative to improve students' science literacy skills. This study highlights the importance of introducing science literacy to young students, as it can help them understand and explore the natural world and technology (Nasir et al., 2023). The inquiry-based learning model can be a useful tool for achieving this, as it allows students to take an active role in their learning and develop a deeper understanding of science material.

CONCLUSION

Based on an analysis of fifteen articles reviewed, inquiry-based learning consistently shows a positive contribution to improving science literacy at various levels of education. The results of the discussion show that inquiry models—whether guided inquiry, free inquiry, or inquiry combined with multimedia—can improve conceptual understanding, critical thinking skills, and student engagement in the learning process. Experimental classes that used the inquiry approach almost always obtained higher posttest scores than the control classes, demonstrating the effectiveness of inquiry steps in strengthening analytical and problem-solving skills.

Although there were several obstacles, such as time constraints, the readiness of experimental facilities, and the need for more intensive assistance, these studies also showed that these challenges could be overcome through appropriate learning design, the use of technology, group discussions, and the use of supporting media such as videos and Student Discussion Sheets (LDPD). Overall, inquiry-based learning not only makes the learning process more meaningful, but also fosters learning motivation and encourages students to be more active and creative in understanding scientific phenomena.

Thus, improving science literacy through an inquiry-based learning approach has proven to be effective. The steps in inquiry-based learning can significantly improve learning outcomes, not only in terms of academic achievement but also in the learning process itself. This approach complements the shortcomings of conventional learning and provides a more in-depth learning experience. Based on the overall literature analysis, it can be concluded that inquiry-based learning is a relevant strategy that can have a positive impact on improving students' science literacy skills.

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