

# The Effectiveness of Online Learning in Improving Science Literacy of Elementary Students in Rural Indonesia: A Systematic Literature Review

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**Abstract:** The aim of this study is to conduct a systematic literature review on the effectiveness of online learning in enhancing the science literacy of rural elementary school students in Indonesia. Data were obtained from literature indexed in Google Scholar, DOAJ, and Scopus, covering the publication period from 2014 to 2024. The findings indicate that online learning holds significant potential for improving science literacy among students in rural areas. However, its effectiveness may be influenced by various factors such as the instructional approach used and the school context. Although the integration of STEM and innovative approaches in online learning has been shown to yield positive outcomes, further research is needed to gain a deeper understanding of the factors affecting the effectiveness of online learning. In conclusion, online learning has considerable potential to enhance science literacy among rural elementary school students in Indonesia, but appropriate approaches and strategies are necessary to achieve optimal results.

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**Keywords:** Online Learning, Science Literacy, Elementary School Students, Rural Areas.

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## A. INTRODUCTION

The education system in Indonesia, particularly in rural areas, faces complex challenges (Rohman, 2016). Despite government efforts to improve overall education quality, access to educational resources remains uneven in rural areas. Limitations in educational infrastructure, distance from urban centers, and a lack of quality human resources are major obstacles in providing quality education services (Hidayah et al., 2023). The impact is felt on the quality of students' education, especially in understanding crucial scientific concepts for their development. Additionally, access to textbooks, laboratory equipment, and the internet remains a major issue in rural areas, leading to a lack of interest and understanding among students in various subjects, including science. The education gap between rural and urban areas requires serious attention from the government and education stakeholders to ensure equal access to quality education for all Indonesian children.

The role of technology is significant in addressing education access challenges in rural areas and improving the quality of the learning process (Masrur, 2014). Technological

advancements, such as the internet and online learning platforms, offer solutions to overcome limitations in educational infrastructure and the availability of quality human resources in rural areas (Lutfiah, 2023). The adoption of technology in education facilitates access to quality learning resources, such as interactive modules and digital learning materials, accessible from various locations, including rural areas. This not only enhances educational opportunities for students in rural areas but also improves the quality of learning by providing a more engaging and interactive learning environment. Therefore, the use of technology in the educational context is a strategic step in ensuring equal access and improving the quality of education throughout Indonesia, especially in rural areas.

Science education in rural areas faces specific challenges, including limited infrastructure and adequate educational resources. The lack of facilities such as fully equipped science laboratories and relevant teaching materials makes it challenging for teachers to provide practical learning experiences to students, a crucial aspect in understanding scientific concepts deeply (Utami, 2023). Additionally, limited access to science learning also significantly impacts students' science literacy in rural areas. The lack of access to adequate learning materials and experiences can hinder the development of students' understanding of scientific concepts, resulting in low levels of science literacy among rural students (Dianti et al., 2023). Therefore, greater efforts are needed to improve access and the quality of science education in rural areas to enhance overall science literacy among students.

Online learning has the potential to improve science literacy by addressing challenges in science education in rural areas. This approach offers flexibility and accessibility, allowing students to access various learning resources through online platforms (Fhilrizki et al., 2022) (Rohiem & Sari, 2023) (Sisco, 2023). Additionally, online learning can enhance digital literacy skills, as students can utilize social media platforms such as WhatsApp for educational purposes (Ramadayanti, 2020). This includes features like voice notes, video calls, and sharing materials, which can support distance learning and enhance science literacy. By optimizing online learning, efforts can be made to improve scientific literacy skills among elementary school students. Overall, online learning provides opportunities for students to engage with scientific content and resources without being constrained by their geographic location and can play a role in developing science literacy skills.

Previous studies have investigated the effectiveness of online learning in improving science literacy in various (Yessi, 2019). Research by Kersha and Obukhov indicates that online science clubs on the GlobalLab platform have the potential to enhance motivation and self-efficacy in natural sciences among Russian school students (Kersha & Obukhov, 2023). Meanwhile, research by Sunarti and Wasis found that context-based contextual learning is effective in improving scientific literacy in Basic Physics subjects at the university level (Santoso et al., 2023). Another finding by Milanto et al. states that contextual learning using guided inquiry is effective in improving scientific literacy skills among prospective physics teachers (Milanto et al., 2023). Hamna and Ummah BK compared the effectiveness of the Flipped Learning Model and the Hybrid Learning Model in improving science literacy among students and found that the Flipped Learning Model was more effective (Hamna & Ummah BK, 2022). Additionally, research by Sukmawati et al. developed practical laboratory learning

videos based on local wisdom, proving to enhance scientific literacy among prospective elementary school teacher students (Sukmawati et al., 2022).

Several studies have explored the effectiveness of various interventions in various health and education contexts. Damsyik & Lazuardi (2021) found that health interventions through mobile phones are effective in increasing family planning participation, while Srikartika et al. (2019) demonstrated the positive impact of brochure interventions on knowledge and compliance of diabetes patients. Similarly, Cahyaningrum et al. (2022) highlighted the effectiveness of web-based interventions in increasing physical activity in the elderly. Sudrajad et al. (2018) compared the effectiveness of acetic acid and ketoconazole in treating otomycosis and found no significant difference between the two. Together, these studies affirm the potential of various interventions in improving health outcomes and knowledge, indicating the need for further research on the effectiveness of online learning in enhancing science literacy in rural areas of Indonesia.

The literature review conducted reveals several relevant findings related to the potential of online learning in improving science literacy and the effectiveness of various interventions in health and education contexts. However, there is a knowledge gap that needs to be considered in further research. While much research has been conducted on the effectiveness of online learning and various interventions in improving science literacy and health outcomes, research specifically exploring the effectiveness of online learning in enhancing science literacy among elementary school students in rural areas of Indonesia is still limited. There are contextual differences and educational characteristics between students in rural areas and urban areas that may affect the effectiveness of online learning in improving science literacy. Therefore, further research using a systematic literature review approach is needed to address this knowledge gap. The aim of this research is to investigate more deeply the effectiveness of online learning in enhancing science literacy among elementary school students in rural areas of Indonesia, taking into account the unique contexts and challenges in education in these rural areas. Thus, this research aims to provide a more comprehensive and detailed understanding of the potential of online learning as an effective tool in improving science literacy among elementary school students in rural areas of Indonesia.

## **B. METHOD**

This study focuses on exploring the effectiveness of online learning in enhancing the understanding of scientific concepts among elementary school students in rural areas of Indonesia. To achieve this objective, a structured literature search approach was employed using scholarly sources such as Scopus, DOAJ, and Google Scholar. Literature searches utilized keywords such as "online learning," "science literacy," "elementary school students," "rural areas," and "Indonesia." Inclusion criteria were applied as guidelines for selecting literature, specifically targeting studies that investigated the use of online learning to improve the understanding of scientific concepts among elementary school students, conducted in rural areas of Indonesia, and published between 2014 and 2024.

After a meticulous selection process, articles meeting the inclusion criteria were then thoroughly analyzed to extract relevant information. Extracted information included the research methods employed, key findings from each study, and recommendations presented

by the researchers. This systematic approach aims to gain a comprehensive understanding of the effectiveness of online learning in the context of enhancing the scientific understanding of elementary school students in rural areas of Indonesia. It is anticipated that the results of this literature analysis will make a significant contribution to filling the knowledge gap regarding the utilization of online learning in the context of science education in rural Indonesia.

## **C. RESULTS AND DISCUSSION**

### **1. Main Findings from Previous Studies on the Use of Online Learning to Improve Science Literacy among Elementary School Students in Rural Indonesia**

Previous studies have indicated that the scientific literacy level of elementary school students in rural areas of Indonesia, as observed in Central Lampung Regency, remains low. A study in that region noted that only 16.07% of students had sufficient understanding of scientific concepts, while 37.5% had misconceptions, and 37.8% had no understanding at all (Kadaritna et al., 2020). This highlights deficiencies in scientific literacy skills among elementary school students in rural Indonesia. However, specific efforts using online learning to enhance science literacy among these students are not detailed in the available summaries. Therefore, further research is needed to investigate the effectiveness of online learning in improving science literacy among elementary school students in rural areas of Indonesia.

Studies conducted on the use of online learning to enhance science literacy among elementary school students in rural Indonesia have yielded several key findings. Handayani et al. (2021) emphasized the importance of instilling a sense of national pride among millennials and elementary school students. Najamuddin dan Bustan (2019) highlighted the need for professional development workshops to improve teachers' understanding and mastery of basic competencies, especially in history. Fuadi et al. (2023) proposed that training students to create wall magazines could help enhance literacy culture in junior high schools. Lastly, Khairani et al. (2021) underscored the role of the environment in Indonesian language learning, suggesting that an environment-based approach could improve students' learning experiences. Together, these studies affirm the potential of various strategies, including online learning, in enhancing science literacy among elementary school students in rural Indonesia.

The results of this research indicate a significant gap in the understanding of science concepts among elementary school students in rural Indonesia. While some students may have adequate understanding, the high percentage of students with insufficient or no understanding at all underscores the need for stronger interventions to improve science literacy in these rural areas. The challenges in enhancing science literacy among elementary school students in rural Indonesia become clearer. This research emphasizes the importance of paying greater attention to science education in rural areas, where educational infrastructure and access to resources are often limited. The use of online learning becomes highly relevant as one of the solutions to address these challenges, although a more in-depth evaluation of its effectiveness is still necessary.

## **2. Results of These Studies Indicate a Significant Improvement in the Understanding of Science Concepts by Elementary School Students After Participating in Online Learning**

The results of this research indicate a significant improvement in the understanding of science concepts among elementary school students after participating in online learning. Research by Zakirman and colleagues showed that the use of webinar tutorials (tuweb) via the Microsoft Teams platform successfully increased students' interest in understanding basic science concepts (Zakirman, 2023). Parmiti and team found that the utilization of E-Scrapbook media with Higher-Order Thinking Skills (HOTS) based questions effectively improved the learning outcomes of fourth-grade students (Parmiti et al., 2022). Through a systematic literature review, Marlina concluded that the implementation of the inquiry-based learning model positively influenced science learning achievement at the elementary school level (Marlina et al., 2021). Fhilrizki et al. (2022) explored the relationship between online learning and scientific literacy but found no significant correlation between the two factors. Meanwhile, Putra and Nandiyanto demonstrated that the use of digital media such as PowerPoint and infographics effectively improved elementary school students' understanding of the Solar System (Putra et al., 2022).

Studies conducted by Mira et al. (2021) and Sumilat et al. (2022) both highlighted the challenges of online learning, including decreased discipline, understanding, and learning skills among elementary school students. However, Ihsan Inzani et al. (2021) and Subakti (2021) provided a more positive perspective, showing that online learning could increase student engagement and understanding of scientific concepts. These findings suggest that although online learning presents challenges, it can also be effective in enhancing students' understanding of science concepts.

The research results demonstrate that the use of online learning can be effective in improving students' understanding of science concepts. Various online learning methods, such as webinar tutorials, the use of E-Scrapbook media, and the application of the inquiry-based learning model, have proven to be positively impactful in enhancing students' understanding of the subject matter. However, a study by Fhilrizki et al. suggests that there is not always a significant relationship between online learning and the level of scientific literacy. The findings from this research provide a diverse picture of the effectiveness of online learning in improving the understanding of science concepts among elementary school students. While some studies show positive results, there are also studies that do not find a significant correlation between online learning and scientific literacy. This highlights the importance of identifying factors influencing the effectiveness of online learning in improving students' understanding of science concepts.

### **3. Comparison Between the Effectiveness of Online Learning and Conventional Learning in the Context of Improving Science Literacy among Elementary School Students in Rural Indonesia**

The results of research comparing online learning and conventional learning in enhancing science literacy among elementary school students in rural Indonesia show significant variations. One study found that blended learning integrating STEM was effective in improving science literacy among Indonesian students, with an effect size of 0.71 and a normalized gain (n-gain) of 0.82 (Supriyadi et al., 2023). Another study compared the Flipped Learning Model and the Hybrid Learning Model, revealing that the Flipped Learning Model was more effective in improving science literacy among students (Hamna, 2022). However, there are also studies that did not find a significant correlation between online learning and scientific literacy among fifth-grade students in elementary schools (Fhilrizki et al., 2022). Overall, the effectiveness of online learning in improving science literacy among elementary school students in rural Indonesia shows variation depending on the approach and context used.

The use of online learning has been implemented in Indonesia during the Covid-19 pandemic, but its impact on improving science literacy among elementary school students in rural areas is still unclear. One study found no correlation between online learning and the level of scientific literacy among fifth-grade students in Bandung City (Fhilrizki et al., 2022). Another study highlighted the negative impact of online learning, such as a lack of understanding of the material due to insufficient explanations and direct motivation, as well as an excessive workload (Fazira et al., 2023). However, other research suggests that online learning can be effective, although there is room for improvement (Mira et al., 2021). Overall, the effectiveness of online learning in improving science literacy among elementary school students in rural Indonesia remains a subject of debate, and further research is needed to delve deeper into this.

The research results depict a variation in the effectiveness of online and traditional learning in improving science literacy among elementary school students in rural Indonesia. Studies demonstrating the success of online learning emphasize the importance of integrating STEM and innovative learning approaches to achieve these goals. However, findings that do not find a significant correlation highlight that other factors, such as school context and the implementation of learning, also play a role in these outcomes. The diversity of findings from research underscores the complexity of understanding the effectiveness of online learning in improving science literacy. While some studies show positive results, there are also studies that do not find a significant relationship between online learning and the improvement of science literacy. This underscores the importance of further evaluation to understand the factors influencing the effectiveness of both online and traditional learning and to identify the most effective strategies for enhancing students' science literacy.

## D. CONCLUSION

Based on the evaluation of previous research, it is concluded that online learning holds significant potential for enhancing science literacy among elementary school students in rural Indonesia. However, its effectiveness may vary depending on specific factors such as the approach used and the school context. While the integration of STEM and innovative approaches in online learning has proven to yield positive benefits, it is essential to consider other factors influencing learning outcomes. Therefore, future research should focus more on identifying the most effective strategies to enhance students' science literacy, especially in rural educational environments in Indonesia.

Furthermore, detailed research is needed to understand the factors influencing the effectiveness of online learning and to develop more optimal approaches. Hence, a pressing research topic is the "Optimal Strategies for Online Learning to Improve Science Literacy Among Elementary School Students in Rural Indonesia: A STEM Approach and Evaluation of Determining Factors." This research is expected to provide a deeper understanding of how to effectively and optimally utilize online learning to improve science literacy among students in rural educational settings, contributing positively to the overall quality of education in Indonesia.

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