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Teacher's Role in Enhancing Students' Environmental Literacy: A Systematic Literature Review 2019-2024

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Abstract: Environmental issues are often heard, but there are many people who do not have awareness of these issues. Environmental ethics in everyday life are sometimes overlooked. People still need to understand how environmental bad habits will have a negative impact in the future. To have environmental awareness, environmental literacy is required. Environmental literacy can be obtained through formal and non-formal education. To improve students' environmental literacy through formal education, teachers have an important role in improving students' environmental literacy. This research aims to explore the role of teachers in improving students' environmental literacy through various effective learning methods to improve students' environmental literacy. The method used in this research is a systematic literature review with a data synthesis process using qualitative data analysis through thematic analysis. Using the PRISMA method, data selection obtained 27 articles from 678 articles on the Google Scholar and Scopus page. The results showed that teachers in various subject areas and levels can adjust the curriculum by integrating environmental literacy into learning. Effective environmental education can bridge textual learning with real-world applications. Learning outside school and interacting with the surrounding community can also improve students' environmental literacy.

Keywords: environmental literacy, teacher, students, teaching methods.

▪ INTRODUCTION

There is a never-ending interaction between humans and nature. Human needs for natural resources lead to excessive exploitation of natural resources, which results in environmental problems (Lehnen et al., 2022). Many disasters originate from various prolonged processes of human activity that do not realise the impact on ecosystem ties; one mistake in the process that continues to be carried out will have an impact on the sustainability of life in an environment (Iderawumi, 2019; Kaira, Joshi, & Pant, 2023). Ecological and economic considerations must be balanced in development to avoid excessive damage (Wang & Zheng, 2024). For the sake of economic gain, many factories dump waste into the sea or rivers; one or two times, the effect may not have a broad impact, but the waste that continues to be discharged into the sea and rivers can damage the existing ecosystem, and again have an impact on human life (Gökçekuş, Kassim, George, & Morrison, 2023). Indonesia accounts for 65% of the total deforestation in tropical Asia by 2023, with total forest loss reaching 1.18 million hectares. With this area of deforestation, Indonesia will be ranked second in deforestation in 2023. The causes of high deforestation in Indonesia are mining and plantation activities (Declaration Assessment Partners, 2024). Deforestation indirectly affects climate change because it impacts average temperature variations over time, including rising sea levels, heat waves, and habitat changes. Cutting down trees also releases carbon dioxide (CO2), which alters climate variability (Leon, Cornejo, Calderón, González-Carrión, & Florez, 2022).

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Despite the obvious environmental problems, many do not take environmental issues seriously. Indonesia is the country with the slightest belief in the climate crisis. Based on Remotivi's survey of 1,097 residents in urban and rural areas, 63% of respondents consider the climate crisis harmless and do not consider it a manufactured phenomenon. Many Indonesians also need a higher awareness of global warming (Hafsyah, 2023; Nastiti, 2023). The results of a CfDS UGM survey of 2,401 respondents showed that the climate crisis is caused by more people sinning and not obeying their religion; 25% agreed that the elites control the scientists who research the climate crisis. Government efforts to reduce fossil fuels are considered against democracy, so these findings prove people's assumptions about climate crisis issues (Tasya, 2024). Ignorance of environmental knowledge creates a sense of apathy towards the environment, which causes a lack of awareness of the behaviour that has polluted the earth. Public awareness of environmental conditions is due to the need for more understanding to protect the environment, so many still throw garbage out of place (Islamiyah, Fitriah, Susanto, & Ni'amah, 2022). The Environmental Performance Index (EPI) 2024 combines 58 indicators to rank 189 countries based on progress in mitigating climate change, maintaining ecosystem vitality, and promoting environmental health. The indicators comprise 30% for climate change, 45% for ecosystem vitality, and 25% for promoting environmental health. In the EPI 2024, Indonesia is ranked 162nd out of 180 countries (Yale Center for Environmental Law, 2024).

The low understanding and awareness of the community in protecting the environment is the basis for the importance of having environmental literacy (Tian & Chen, 2023). Environmental literacy refers to the awareness, knowledge, behaviour, ability, and motivation to make informed decisions and take responsible actions related to environmental issues. It involves cognitive understanding and affective processes, such as attitudes and values shaped by societal values and norms. Thus, through environmental literacy, people can increase environmental awareness (Fang, Hassan, & LePage, 2023).

Teachers play a pivotal role in nurturing students' environmental consciousness through education (Elif, Tosun, & Sevda, 2016). Their role is not just to impart knowledge, but to instill a sense of responsibility towards the environment. Environmental education can inspire students to care for their surroundings and take responsibility for their actions that could harm the environment (Jeong, Sherman, & Tippins, 2021). The importance of protecting the environment can be ingrained in students from an early age (Lamanauskas, 2023). Education is a powerful tool in enhancing environmental literacy, especially among students. With the right teaching methods, educators can equip students with the knowledge and attitudes necessary for responsible environmental stewardship.

With real environmental problems, environmental literacy needs to be integrated into educational activities early so students can develop into environmentally literate individuals. Teachers play an essential role in improving students' environmental literacy through various activities at school that have been designed appropriately.

There is a research gap between environmental education and the indifference of the people in Indonesia. In the present Kurikulum Merdeka, there is no specific environmental subject, environmental lessons are delivered through science subjects. On the other hand, the independent curriculum gives teachers the freedom to integrate environmental lessons that can be applied to multiple grades and subjects. This provides

an opportunity for teachers both of science and other subjects to educate students in environmental literacy from an early age.

Although many studies have explored various research methods and learning models to integrate environmental literacy into the learning process, not many have made a special study that examines various teachers' involvement in improving students' environmental literacy at various grades. Therefore, the objective of this study is to explore the role of teachers in the improvement of students' environmental literacy through various effective learning methods for enhancing environmental literacy.

This research reviews various literature to understand learning approaches that can improve students' environmental literacy. Thus, this research is expected to provide teachers with insights into various learning methods that are suitable for enhancing students' environmental literacy so that they can help students in facing environmental challenges in Indonesia.

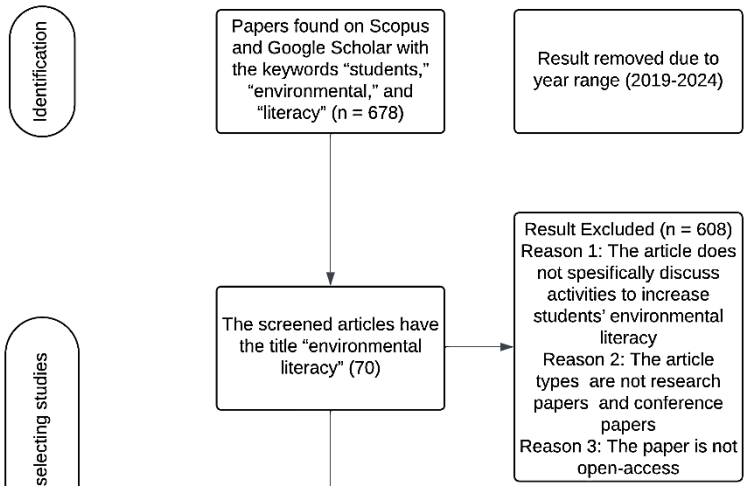
▪ METHOD

Research Design

This research uses the systematic literature review (SLR) method, which aims to identify, evaluate and interpret all research results related to a research question, topic or phenomenon. This SLR approach includes data collection, data analysis, and a conclusion to describe the activity or learning method comprehensively suited to increase environmental literacy and the teachers' role in improving students' environmental literacy (Phillips & Barker, 2021).

Search Strategy

With the systematic literature review method, a selection of papers will be used as a study in this research. Starting with the selection of keywords, namely "students," "environmental," and "literacy," on the Scopus and Google Scholar pages with content searches in the form of research papers and conference papers and papers being open-access papers. The year of publication of the documents searched is 2019-2024; this period is used to find papers relevant to the latest developments in learning to improve environmental literacy in schools. PRISMA flow chart is used to select papers to be reviewed.



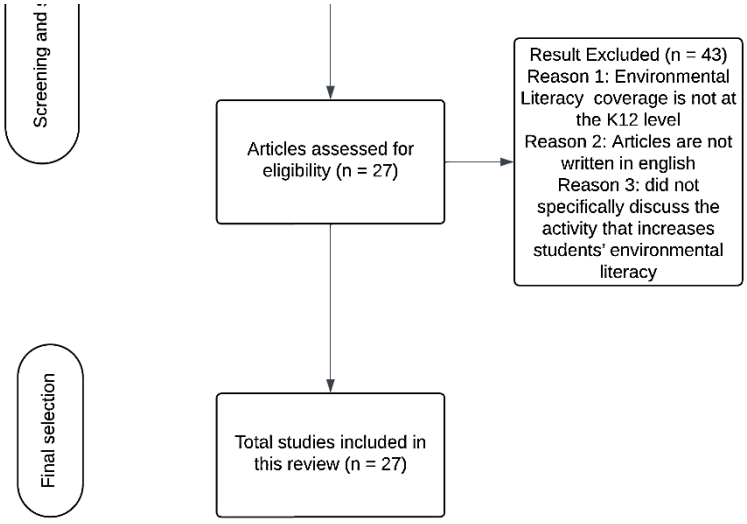


Figure 1. PRISMA Selection

Inclusion and Exclusion Criteria

The search results on the Scopus page are 335 papers containing the keywords sought, while on the Google Scholar page, 343 papers contain keywords. The papers that have been obtained are re-selected through paper abstracts with several criteria, namely (1) papers in English, (2) there are activities or learning methods to improve students' environmental literacy by teachers, and (3) The papers studied are at the K12 level (Kindergarten to Secondary School), so the University level is not included.

The papers obtained from the Scopus page were 20, while from the Google Scholar page were 7. The selected papers are from various countries; Indonesia has done much research on environmental literacy in K-12 education. In addition, there are papers from various countries in Asia, Africa, Europe and United States.

Data Analysis

After the papers are found to have met the inclusion and exclusion criteria, they will be analyzed; the analysis used is thematic qualitative analysis. Thematic analysis is used in qualitative research to find patterns or themes in the data already obtained. Thematic analysis is carried out in the following stages: (1) familiarization with the data; (2) coding, which is giving a code to each data and then compiling the entire code and extracting relevant data; (3) looking for themes; (4) reviewing themes, (5) defining themes, (6) writing reports (Clarke & Braun, 2013).

▪ RESULT AND DISSCUSSION

Data that have been found through the PRISMA method are selected using the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), a guideline for conducting and submitting systematic reviews and meta-analyses; there are 335 papers with keywords that have been found on the Scopus page and 343 papers found on the Google Scholar page. PRISMA selection has three steps: identification, screening, and including (Page et al., 2021). PRISMA selection in this

study is presented in the following figure. The results were 28 papers reviewed, 20 from the Scopus page and seven from the Google Scholar page.

The results of the data were analyzed with the research objectives based on the results of the data that had been found in the selected papers. The meta-theme determined The role of teachers is to create and present learning that can improve students' environmental literacy. There is the theme of methods and activities to improve students' environmental literacy with several sub-themes, namely environmental literacy for early students, adopting technology to increase students' environmental literacy, integrating learning models to improve students' environmental literacy, and activities to improve students' environmental literacy. And some themes describe the teacher's role in increasing student's environmental literacy.

Table 1. Results of the articles that have been sorted

No.	Authors	Year of Publication	Journal	Country	Title
1.	Masykuroh K, Yetti E, Nuraini Y, and Rahmawati Y	2024	Educational Administration : Theory and Practice	Indonesia	"Teaching Environmental Literacy in Early Childhood Education to Improve the Character of Environmental Care"
2.	A. López-Alcarria, M. F. Poza-Vilches, M. T. Pozo-Llorente, and J. Gutiérrez-Pérez	2021	Water (Switzerland)	Spain	"Water, waste material, and energy as key dimensions of sustainable management of early childhood eco-schools: An environmental literacy model based on teacher's action-competencies (ELTAC)"
3.	Susilana R, Dewi L, Rullyana G, Ardiansah, Kodama Y, Rachman I (2021)	2021	IOP Conference Series: Earth and Environmental Science	Indonesia	"Instilling environmental literacy using *Kamishibai* cards in kindergartens"
4.	N. Y. Indriyanti, K. Febryana, and B. Antrakusuma (2024)	2024	International Journal of Interactive Mobile Technologies	Indonesia	"Development of Android-Based Video Series on Climate Change Topic to Empower Students' Environmental Literacy"
5.	Y. Shuai, Q. Chen, Y. Yu, S. Wang, and R. Wan	2024	Frontiers in Artificial Intelligence and Applications	China	"Application of Digital Technology in Environmental Literacy Education for Teenagers"

6.	H. Huang and C. Te Hsin	2023	International Journal of Sustainable Development and Planning	Thailand	"Environmental Literacy Education and Sustainable Development in Schools Based on Teaching Effectiveness"
7.	A. Ardyansyah and S. Rahayu	2023	Orbital	Indonesia	"Development and Implementation of Augmented Reality-Based Card Game Learning Media with Environmental Literacy for Improving Students' Understanding of Carbon Compounds"
8.	E. Hamilton and L. Marckini-Polk	2023	Cogent Education	United States	"The impact of place-based education on middle school students' environmental literacy and stewardship"
9.	I. M. S. Hermawan, I. B. A. Arjaya, and I. M. Diarta	2022	Jurnal Pendidikan IPA Indonesia	Indonesia	"Be-Raise: A Blended-Learning Model Based on Balinese Local Culture to Enhance Student's Environmental Literacy"
10.	E. S. Lestari, S. Sajidan, F. Rahmawati, and M. Indrowati	2024	Journal of Baltic Science Education	Indonesia	"The Inquiry Ethnobotany Learning Model: an Instructional Design Model to Enhance Student Environmental Literacy"
11.	Asrizal, Desnita, Y. Darvina, E. A. Usman, and S. A. As Sidiq	2021	*Journal of Physics: Conference Series*, IOP Publishing	Indonesia	"Effects of mechanical wave learning material by integrating CTL strategy on environmental literacy of grade XI students"
12.	E. Suryawati, F. Suzanti, Zulfarina, A. R. Putriana, and L. Febrianti	2020	Jurnal Pendidikan IPA Indonesia	Indonesia	"The implementation of local environmental problem-based learning student worksheets to strengthen environmental literacy"
13.	F. Roshayanti, A. G. C. Wicaksono, I. B. Minarti, and Nurkolis	2020	Journal of Physics: Conference Series	Indonesia	"Integrated learning for improving environmental literacy in high schools"

14.	Sarbassova S., Abdugalina, Burganova, Shaikheslyamova K, Abdrasheva B, Jamaliyeva G, Anzorova S, Vlasenko L	2021	*IOP Conference Series: Earth and Environmental Science*, IOP Publishing	Kazakhstan	"Formation of environmental literacy in an educational organization"
15.	J. Cincera, R. Kroufek, and F. X. Bogner	2023	Environ Educ Res	Czech	"The perceived effect of environmental and sustainability education on environmental literacy of Czech teenagers"
16.	N. Nurwidodo, M. Amin, I. Ibrohim, and S. Sueb	2020	European Journal of Educational Research	Indonesia	"The role of eco-school program (Adiwiyata) towards environmental literacy of high school students"
17.	C. T. Pan and S. J. Hsu	2020	Sustainability (Switzerland)	Taiwan	"Effects of a one-day environmental education program on sixth-graders' environmental literacy at a nature center in eastern Taiwan"
18.	M. S. Amin, A. Permanasari, and A. Setiabudi	2019	*Journal of Physics: Conference Series*, Institute of Physics Publishing	Indonesia	"Strengthen the student environmental literacy through education with low carbon education teaching materials"
19.	A. Ilhami, R. Riandi, and S. Sriyati	2019	Journal of Physics: Conference Series	Indonesia	"Implementation of science learning with local wisdom approach toward environmental literacy"
20.	W. Anggraini, P. Karyanto, Sarwanto, and Prihantomo	2019	*Journal of Physics: Conference Series*, Institute of Physics Publishing	Indonesia	"School and Teachers' Role to Empowerment of Environmental Literacy in Prominent Middle School Based on Adiwiyata Program"
21.	Eustance, Edward,	2022	East African Journal of	Uganda	"Environmental Literacy and Practice of Environmental

	Zami, & Stella Suubi		Education Studies		Sustainability among Secondary School Students in Busia District, Eastern Uganda"
22.	GÜN ŞAHİN & ARSLAN	2022	Bartın University Journal of Faculty of Education	Turkey	"The Effects of Animated Cartoon Series on 5th Grade Students' Environmental Literacy Sub-dimensions: The Case of SU ELÇİLERİ"
23.	Panchbhai et al.	2024	International Electronic Journal of Environmental Education	India	"Engaging Students in Citizen Science Projects: A Pathway to Environmental Literacy"
24.	Durmus & Kinaci	2021	Review Of International Geographical Education	Turkey	"Opinions of Social Studies Teacher Education Students about the Impact of Environmental Education on Ecological Literacy"
25.	Alibaygi & Taghibaygi	2024	J. Agric. Sci. Technol	Iran	"Environmental Literacy of Students in Iranian Eco-Villages"
26.	BALÇIN & ÇAVUŞ	2020	e-Kafkas Journal of Educational Research	Turkey	"The Effect of Project Assignments for Environmental Problems on Secondary School Students' Environmental and Media Literacy Levels"
27.	Tsai & Chuang	2019	Proceedings of the 27th International Conference on Computers in Education. Taiwan: Asia-Pacific Society for Computers in Education	Taiwan	"The Effect of Digital Game-Base Learning on Primary School Students' Critical Thinking Skills and Environmental Literacy"

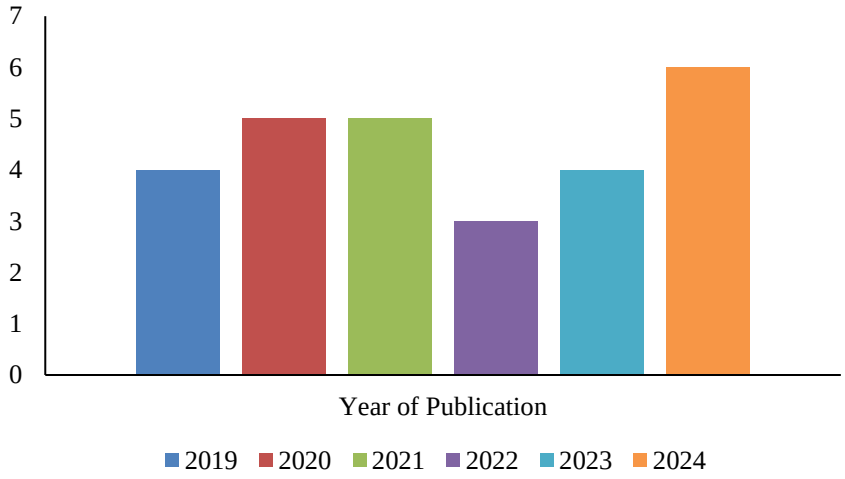


Figure 2. Year of publication

Table 2. Results of the learning methods that can improve student's environmental literac

No.	Learning methods and models
1.	Curriculum design that integrates environmental concepts
2.	Interactive games
3.	Experiment and Project
4.	Android-based video
5.	Virtual digital technology
6.	Augmented reality-based card games
7.	Place-based education (PBE) learning model
8.	Blended-learning model
9.	Inquiry-Ethnobotany (Ieb) learning model
10.	Contextual teaching and learning (CTL) model
11.	Problem-based learning model
12.	Integrated learning approach for environmental concept
13.	Interactive activities

This discussion presents the results of data analysis in the form of activities and learning that teachers can do to improve students' environmental literacy with the following themes.

Theme 1: Programs and Activities to Improve Students' Environmental Literacy in Early Education

In early education, teachers can develop various programs and activities that they can carry out by creating a special program that aims to improve environmental literacy; this activity aims to create a sense of love for students and the environment. Teachers have specific steps: designing curriculum, essential competencies, learning activities, assessment, and collaboration. In addition to creating a program, teachers can create field trips to natural environments such as parks, forests, beaches, or anywhere that can build interaction with nature and learn about ecosystems, biodiversity, and efforts (Masykuroh, Yetti, Nurani, & Rahmawati, 2024). Activities such as experiments and projects related to water conservation, waste management, or energy efficiency can improve students'

environmental literacy, such as making compost bins for organic waste, monitoring water use at school, or designing energy-saving devices such as solar cookers (López-Alcarria, Poza-Vilches, Pozo-Llorente, & Gutiérrez-Pérez, 2021). Improving students' environmental literacy can also be done with interactive games such as Kamishibai, which is a storytelling method from Japan that can effectively present environmental messages to children. Using Kamishibai, students can understand the visuals and interpret environmental conditions, leading to a better understanding of environmental concepts (Susilana et al., 2021).

Theme 2: Adopting Technology to Increasing Student's Environmental Literacy

Adopting innovative technological approaches in environmental education is essential for improving environmental literacy. Various technologies have been used, such as the development of an Android-based video series on the topic of climate change. The video series is designed to increase knowledge and understanding of environmental issues. The video content was carefully designed to balance education and visual appeal. The video series was created explicitly to achieve competencies related to climate change for grade 8 students. Overall, the strategies used to improve environmental literacy in this study include developing climate change educational videos, aligning with competency indicators, and analyzing data using mixed methods to evaluate students' environmental literacy. The response to using this video can be categorized as very positive (Indriyanti, Febryana, & Antrakusuma, 2024). Then, there is the integration of virtual digital technology into the curriculum. Students can engage with immersive and interactive learning that increases understanding and awareness of environmental issues. A digital technology approach can improve learners' environmental literacy by making learning more engaging and effective. Virtual digital environments provide students with a more engaging and immersive learning experience. By simulating various environmental situations, students can experience challenges firsthand and gain a deeper understanding and a more profound sense of the urgency of environmental issues (Shuai, Chen, Yu, Wang, & Wan, 2024). It is important to integrate environmental education into the learning process. This can be done by integrating environmental content with various fields such as science, social science, and linguistics. By presenting real examples through activities related to environmental issues, students can better understand the importance of environmental conservation and develop responsibility for the environment. In this study, teachers can use innovative learning media, such as augmented reality-based card games, that can effectively improve the understanding of environmental concepts. Interactive media is exciting and can bring together theoretical understanding and real-world practice (Ardyansyah & Rahayu, 2023).

Theme 3: Integrating learning models to improve students' environmental literacy

In learning, there are many ways for teachers to convey a message, one of which is with a learning model. To improve students' environmental literacy, teachers can develop a learning model. There are several learning models that teachers can develop to improve environmental literacy. First, experiential learning, such as place-based education (PBE.), with this model, students can be involved in applied learning that is directly supported by the surrounding environment. By engaging students in the community, students can interact with local cultures, landscapes, and experiences and develop a greater

understanding of environmental issues. PBE. learning can impact various factors, including program and school-based factors and external factors such as weather and community partnerships (Hamilton & Marckini-Polk, 2023). With PBE, students perceive learning activities as having a positive impact on the local community and environment, so they believe their activities impact improving environmental literacy.

Secondly, a blended-learning model was developed based on the Tri Hita Karana culture in accordance with Balinese customs to integrate cultural values to improve students' environmental literacy. This learning model not only focuses on environmental knowledge but also helps improve technological literacy and cultural sensitivity (Hermawan, Arjaya, & Diarta, 2022). Thirdly, through the Inquiry-Ethnobotany (Ieb) learning model, students can increase the activity of questioning, investigation, and application of knowledge related to plants and their daily use, and students can gain a deeper understanding of the relationship between humans and nature. Students also understand natural resources, local wisdom, and efforts to protect the environment and improve environmental literacy skills (Lestari, Sajidan, Rahmawati, & Indrowati, 2024). The fourth learning model that can improve students' environmental literacy is contextual teaching and learning (CTL). By connecting learning materials to real-world environmental issues, students can understand the relevance and importance of environmental literacy. In addition, incorporating hands-on activities, field trips, and interactive projects related to environmental topics can increase student engagement and understanding (Asrizal, Desnita, Darvina, Usman, & As Sidiq, 2021). Fifth, there is a problem-based learning model that can be used to improve students' environmental literacy. Problem-based learning orientates students to learn the subject through experience to solve real-world problems. In environmental education, P.B.L. is an effective way to hone students' ability to identify, analyze, and solve environmental problems. In this study, P.B.L. improves students' environmental literacy by providing learning experiences focusing on identifying problems in the surrounding environment through a scientific approach (Suryawati, Suzanti, Zulfarina, Putriana, & Febrianti, 2020). To improve environmental literacy, one effective activity is to implement an integrated learning approach, which in this study includes problem-based learning, using environmental literacy kits (such as experimental tools related to pollution and waste management), and incorporating environmental literacy textbooks. Students are asked to investigate using the available tools to collect data and information related to environmental issues. Then, they hold discussions, develop plans, and express their commitment to environmental conservation. Learning includes evaluating and reflecting on environmental issues (Roshayanti, Wicaksono, Minarti, & Nurkolis, 2020). Some various methods and approaches can be incorporated into the learning process. One effective one is to integrate environmental topics into various subjects and learning, not limiting it to one specific learning, such as integrating environmental themes in art, music, literature, and technology for learning that can build a holistic understanding of environmental issues (Sarbassova et al., 2021).

Theme 4: Hands-on Activities and Activities to Improve Students' Environmental Literacy

Schools and teachers can consider adjusting teaching strategies and curriculum design accordingly. Teachers can bring together more case studies related to

environmental issues, improve curriculum practices, focus on fostering students' cooperation and responsibility in teams, and improve teaching effectiveness in areas such as basic environmental knowledge, teamwork and communication, environmental responsibility, and knowledge dissemination. In addition, strengthening practical teaching to guide students to pay attention to environmental issues through environmentally themed activities and encouraging students to participate in environmental actions to integrate environmental concepts into daily life can help improve students' problem-solving ability, environmental awareness, and environmental behavior (Huang & Hsin, 2023).

In the Czech Republic, students' environmental literacy levels can be influenced by various factors, including gender and age. Various environmental and sustainable education strategies and approaches can be used to improve students' environmental literacy. One effective way is to engage students in hands-on activities, experiments, and investigations related to environmental issues. These practical experiences can improve students' environmental attitudes and understanding. However, it's the incorporation of a community-based approach, where students work on real-world sustainable projects within the local community, that can positively impact pro-environmental behavior. By providing opportunities for students to participate in decision-making processes related to environmental learning, we can increase a sense of empowerment and motivation to take environmentally mindful action (Cincera, Kroufek, & Bogner, 2023).

Experiential learning and direct engagement with real-world conditions are practical approaches to improving students' environmental literacy. Organizing out-of-school programs or activities can bring students closer to environmental issues that they can see. By providing opportunities for students to participate actively in environmental initiatives, students' understanding and appreciation of environmental issues can increase (Nurwidodo, Amin, Ibrohim, & Sueb, 2020). Integrating community research projects into learning can improve students' environmental literacy. By participating in this project, students can understand more about environmental issues and scientific concepts that can provide students with real-life challenges (Panchbhai et al., 2024).

Hands-on and interactive activities can help students understand the impact of their actions on the environment and promote pro-environmental behavior. Furthermore, one-day programs include field trips, group discussions, and hands-on workshops to learn about environmental issues. These activities aim to improve students' environmental knowledge, attitudes, and behaviors by connecting everyday experiences with environmental issues (Pan & Hsu, 2020). By incorporating experiential, hands-on activities and classroom learning, educators can effectively strengthen students' environmental literacy and promote sustainable behavior (Amin, Permanasari, & Setiabudi, 2019). Schools can create festivals with an environmental conservation theme and monitor environmental actions in the community. Teachers then support these activities by strengthening environmental literacy and encouraging practical application (Alibaygi & Taghibaygi, 2024).

Implement science learning with local wisdom, such as the tradition of ikan larangan, in teaching materials. Students are asked to connect culture with science learning. This approach allows students to observe and analyze the conservation values present in the local wisdom, leading to more contextualized and engaging science learning. In addition, integrating cultural content in science learning through

experimentation and observation can make learning more meaningful as it relates to everyday life (Ilhami, Riandi, & Sriyati, 2019).

Teachers' Roles to Improve Students' Environmental Literacy

This category explains the role of teachers in improving students' environmental literacy skills, which is divided into two categories. The roles of teachers in enhancing students' environmental literacy are discussed below:

Role 1: Integrating Learning with Environmental Literacy

A teacher has a role in improving students' environmental literacy with various integrations into all learning areas at all levels because ecological literacy is not only owned by one field, such as science education. Teachers can integrate environmental content into learning in everyday life so that the ecological content can build an understanding of environmental literacy in students. Students can improve critical thinking through problem-solving that can foster ecological awareness (Ardyansyah & Rahayu, 2023; Huang & Hsin, 2023; Masykuroh et al., 2024). Biology and geography teachers can integrate environmental topics into learning, such as deforestation in geography lessons, plant studies in biology, and other materials that connect with environmental literacy. Teachers help students articulate their knowledge, attitudes, and behaviors related to environmental issues such as waste management and deforestation so that students can understand environmental sustainability (Eustance et al., 2022). Teachers can also integrate animations that align with educational objectives related to humans and the environment into learning; teachers can guide discussions during animation viewing activities to think critically so that students can develop a deeper understanding of the environment (GÜN ŞAHİN & ARSLAN, 2022). In early education, teachers can start learning activities integrating environmental literacy to increase students' environmental awareness (Masykuroh et al., 2024; Susilana et al., 2021).

Some of the critical roles of a teacher in improving students' environmental literacy are incorporating environmental topics into the curriculum, providing opportunities for hands-on learning, encouraging critical thinking and inquiry, modeling sustainable behavior, collaborating with the community by involving local organizations, experts, and environmental initiatives can enrich students' learning experiences (Amin et al., 2019). Teachers' roles must be optimized by integrating ideal ecological concepts into environmental materials. Teachers can develop various learning tools that support the achievement of environmental literacy (Anggraini, Karyanto, Sarwanto, & Prihantomo, 2019).

Role 2: Designing Lessons and Activities to Improve Students' Environmental Literacy

Teachers have a role in organizing learning, and designing a learning model is needed to suit the learning objectives. Teachers can design learning models like place-based learning, allowing students to participate in environmental management. An appropriate learning model can improve critical thinking and problem-solving skills in environmental management. Students can be allowed to express their ideas and creativity on environmental issues. By evaluating and adapting appropriate learning models,

teachers can promote environmental literacy to students at various levels (Cincera et al., 2023; Hamilton & Marckini-Polk, 2023; Hermawan et al., 2022; Sarbassova et al., 2021).

Through the contextual teaching and learning (CTL) model, teachers can use innovative learning methods such as journal writing, group discussions, and multimedia resources, which can also improve students' environmental literacy (Asrizal et al., 2021). Teachers can effectively teach children about environmental safety, personal hygiene, waste disposal, and environmental sensitivity (López-Alcarria et al., 2021).

Teachers can organize out-of-school programs such as summer camps and after-school activities to raise awareness of environmental issues and engage communities, academics, and educators. By providing hands-on experience and involving students in real-world environmental activities, teachers can effectively increase students' understanding and appreciation of environmental issues (Nurwidodo et al., 2020). Parents and teachers can inspire students to reject social injustice and environmentally destructive behavior by serving as role models promoting students' environmental literacy (Pan & Hsu, 2020). Teachers can design hands-on learning with community projects that can bridge students' knowledge with real-world challenges; teachers can also develop students' critical skills from the results of these projects (Panchbhai et al., 2024).

Meta-Theme: The Role of Teachers is to Create and Present Learning That Can Improve Students' Environmental Literacy

Teachers play an important role in improving students' environmental literacy. Environmental issues are crucial because they directly impact people's daily lives. Therefore, teachers can integrate environmental literacy into learning. Teachers can facilitate environmental education, raise awareness, develop cognitive, affective, and psychomotor skills, promote sustainable concepts, and solve problems so that schools and teachers can integrate education across the curriculum; teachers should strive to include environmental topics in various subjects, make environmental education a comprehensive part of the learning experience so that students can see the relevance of environmental literacy in various contexts and disciplines (Durmus & Kinaci, 2021). Teachers can provide exceptional guidance to students to increase their understanding and awareness of environmental issues. Schools and teachers can work together to integrate environmental education into the learning curriculum (Tsai & Chuang, 2019). Therefore, schools must also provide facilities that support learning that can improve students' environmental literacy. With the integration of the curriculum, teachers can integrate environmental learning with learning models, activities, and activities directly with the environment and society and utilize technology to improve students' environmental literacy.

With all the findings presented, there are implications, namely that schools can provide facilities and flexibility to teachers to integrate environmental education into learning, especially with the Kurikulum Merdeka. Schools can allow hands-on activities that can improve students' environmental literacy; teachers are aware of environmental issues around the school area, integrate the curriculum with environmental education, guide students in various models or learning methods related to the environment to be critical, and have sustainable principles. There are several limitations in this study, namely, the discussion has not covered many countries, so it has not been able to present a variety of learning to improve environmental literacy in many countries; this limitation

is also due to the inclusion criteria; the papers reviewed are open-access papers. From the results of this study, the researcher can propose further research to study the technology used in learning to improve environmental literacy.

▪ CONCLUSION

Environmental literacy is an essential provision for a student to run their future life with consideration and decision-making that considers the ecosystem. People in Indonesia often forget the importance of environmental aspects and ignore aspects that will eventually damage the environment and cause disasters in the surrounding area. Teachers have an essential role to play in educating the young generation of Indonesia. In all levels and subjects, aspects of protecting the environment must be integrated and taught to all students so that the earth is not further damaged in future generations. With the importance of the role of teachers in improving students' environmental literacy, many variations of learning methods can be used; teachers must also bridge textual knowledge with everyday reality so that ecological learning is not uninteresting, can be understood by students, and can genuinely be implemented by students in everyday life.

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