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Climate change education challenges in Indonesia: Educators' perspective

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ABSTRACT

Background: Indonesia, as an archipelago, is vulnerable to climate change. This research focuses on the importance of education in increasing community awareness and capacity for climate change mitigation and adaptation. Education is key to changing attitudes and habits, especially among children who are vulnerable but have great potential to adapt. The Indonesian government's initiative through the launch of the Climate Change Education Guidebook, which complements the independent curriculum, aims to help various stakeholders improve climate literacy and encourage collaborative action in addressing climate change. The purpose of writing this article is to identify the challenges faced by educators in teaching climate change education in schools. **Methods:** The method used in this research is qualitative, conducting in-depth interviews with three educators at different levels: elementary, junior high, and high school, each located in Lamandau District, Central Kalimantan, Bekasi, West Java, and Kaimana, West Papua. The results of the interviews are then analyzed to determine the gap between the concept of climate change education based on the independent curriculum and the implementation process in the field. **Findings:** Based on the results of the interviews, the three informants were unaware of the Climate Change Education Guidebook. Nevertheless, the three informants have begun to integrate climate change education lessons into the disciplines they teach. In addition to being directly integrated into classroom lessons, there is a Pancasila Student Profile Strengthening Project (P5) that helps students understand environmental issues and apply them directly in the school environment. However, training for educators on climate change education needs to be conducted to boost educators' confidence and enhance students' motivation to learn. **Conclusion:** This study concludes that the implementation of climate change education requires special attention because the challenges arise not only from educators but also from the weak education system in Indonesia, which creates disparities between regions. **Novelty/Originality of this article:** The study highlights the limited awareness of the Climate Change Education Guidebook among educators, despite its integration potential within the independent curriculum. This research contributes new insights into the practical challenges of implementing climate education in Indonesia and emphasizes the urgency of targeted training to strengthen both teacher readiness and student motivation.

KEYWORDS: climate change education; independent curriculum; educators.

1. Introduction

Indonesia is an archipelago that is geographically, topographically, and climatically vulnerable to climate change (Tang, 2024). Various examples of disasters that are prone to occur in Indonesia include tsunamis, tidal floods, flash floods, volcanic eruptions, hurricanes, forest fires, and droughts. Apart from natural phenomena, human intervention is also a cause of disasters. Based on National Disaster Management Authority, natural disasters that occur due to climate change and anthropogenic pressures play a role in the occurrence of 99.1% of disasters in 2023 (Setiawati et al., 2023). With this vulnerability,

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Indonesia unfortunately belongs to the lower-middle category in terms of readiness and preparedness for climate change (Tang, 2024). Based on the 4th Intergovernmental Panel on Climate Change assessment report, global warming will cause unbalanced weather in various regions on Earth, such as increased drought in mid-latitude and semi-arid areas, water shortages, increased potential for storms due to rising sea surface temperatures, and increased potential for floods and landslides (Dharmawan, 2021). Climate change poses risks to humanity, so adaptation to climate change needs to be done by understanding the nature of these risks. Adaptation has the potential to significantly reduce the adverse impacts of climate change by increasing the capacity of governments and communities to withstand the impacts of climate change (Shaw et al., 2010).

Climate change is a global challenge, but its impacts are felt more in developing and least developed countries. This is because they are more vulnerable to climate change, and there are limitations to mitigate the consequences of climate change (Kabir et al., 2023). Since 2015, Indonesia has committed to implementing the ambitious agenda of the Sustainable Development Goals (SDGs) until 2030. The SDGs themselves have 17 goals that concern social, economic, and environmental aspects. This research will focus on Goal 13: Addressing Climate Change. Goal 13 has 5 targets, and this research will focus on the third target, namely improving education, awareness-raising, and human and institutional capacity in climate change mitigation and adaptation, as well as impact reduction and early warning (Alisjahbana & Murniningtyas, 2018).

Education is a vital key in addressing climate change issues. Education can help and encourage people to change their attitudes and habits (United Nations, 2020). Children are most vulnerable to climate change in their early years, as they are exposed to more pollution, droughts, floods, and disease. However, children have great potential to increase resilience and adapt to climate change, and embrace sustainable development (UNICEF, 2023). Adapting to and mitigating the impacts of climate change is a major challenge for the future, requiring multidisciplinary collaboration and innovation to address climate change, one of which is through education. Climate change education is an important foundation for understanding and responding to the impacts of climate change. Providing innovative education can help address various environmental problems (Kumar et al., 2023). The primary goal of climate change education is to develop the knowledge, attitudes, and behaviors necessary to respond effectively to climate-related challenges. Climate change education may be implemented through both formal and informal educational settings, aiming to raise awareness, enhance critical thinking skills related to climate issues, and empower individuals to make informed and sustainable decisions (Kundariati et al., 2025).

A key challenge in Indonesia's education system is preparing qualified educators to deliver effective learning. Educators are expected to master four core competencies: pedagogical, professional, social, and personal. These competencies help educators foster essential 21st-century skills in students, such as literacy, collaboration, creativity, and critical thinking, while also motivating them to keep learning and adapting. In response, the Indonesian government introduced the independent curriculum to bridge the gap between knowledge and practical skills. This curriculum is intended to help students develop the necessary competencies to compete effectively at both national and global levels and also emphasizes the development of educators' competencies by offering various professional development programs focused on these four areas (Kusumawati & Umam, 2025).

Independent curriculum is part of the government's transformation efforts to increase interest in reading, literacy, numeracy, and character development based on Pancasila values (Kusumawati & Umam, 2025). According to Ministry of Education, Culture, Research, and Technology Regulation No. 56/M/2022, the Pancasila Student Profile Strengthening Project is a co-curricular, project-based initiative aimed at enhancing students' competencies and character in line with the Pancasila student profile, which is formulated based on Graduate Competency Standards. This project is implemented with flexibility in terms of its content, activities, and scheduling. It is conducted independently from regular curricular subjects, meaning its goals, content, and learning processes are not required to align with those of the core curriculum. Educational institutions are also encouraged to

collaborate with communities and/or the professional sector in both designing and executing the project (Satria et al., 2022).

P5 is an interdisciplinary learning in observing and thinking about solutions to environmental problems to strengthen the various competencies in the Pancasila Student Profile. There is a theme for each profile project that can be implemented in educational units. Starting in the 2021/2022 academic year. The themes are determined and developed by the Ministry of Education and Culture based on priority issues in the 2020-2035 National Education Roadmap, SDGs, and other relevant documents. The main themes that can be selected by education units in elementary to senior/vocational high school and equivalent are Sustainable Lifestyle, Local Wisdom, Unity in Diversity, Build the Soul and Body, Voice of Democracy, Engineering and Technology, Entrepreneurship, and Employment. The selection of general themes can be done based on the readiness of the teaching unit, educators, and students in carrying out profile projects; national learning calendar, or national or international celebrations; issues that are currently happening or become the focus of discussion or priorities of the education unit; and themes can be repeated in each school year if considered still relevant or can be replaced to explore all available themes (Satria et al., 2022).

In August 2024, the Ministry of Education, Culture, Research, and Technology launched the Climate Change Education Guidebook (CCE Guidebook) as part of the independent curriculum. The guide was launched with the hope of helping education partners to raise awareness of climate change and learn about collaborative actions to tackle the problem (Ministry of Education, Culture, Research, and Technology, 2024). The independent curriculum focuses on subjects that are relevant to the needs of the times and current issues. The independent curriculum has three priority issues in the learning process, one of which is climate change. This issue can be implemented across subjects through several approaches, namely intracurricular, co-curricular, extracurricular, and school culture. Some of the points set for the CCE Guidebook are studying the causes, impacts, mitigation, and adaptation of climate change (Agency for Standards, Curriculum, and Educational Assessment, Republic of Indonesia, 2024). The guidebook can be seen in Figure 1.

Fig. 1. Cover of the Indonesian guidebook *Pendidikan Perubahan Iklim* (Climate Change Education) (Agency for Standards, Curriculum, and Educational Assessment, Republic of Indonesia, 2024)

The CCE Guidebook is primarily aimed at residents in education units, including leaders, educators, and other residents, to implement climate change education appropriately and effectively. In addition, this guidebook is also intended for various stakeholders who have a relationship with climate change education, including supervisors, local governments, training institutions, non-governmental organizations, and businesses to be able to play an active role in supporting the implementation of climate change education. This guidebook consists of five sections that have specific goals and objectives so that they can be adapted to the role of the reader (Sekarwulan et al., 2024). Climate change education issued by the Ministry of Education, Culture, Research, and Technology adopts the framework as outlined in Teixeira & Crawford (2022) which consists of four elements, namely Impacts, Causes, Adaptation, and Mitigation. The competencies of climate change education are developed in stages based on the stages of student growth and development (phases A-F) (Sekarwulan et al., 2024). How knowledge in climate change education is acquired by students and how individual and collective actions can be taken in response to climate change can be achieved by using case studies that explain causes, impacts, and solutions as pedagogical tools (Teixeira & Crawford, 2022). The interaction between climate change and climate change education is presented in Figure 2.

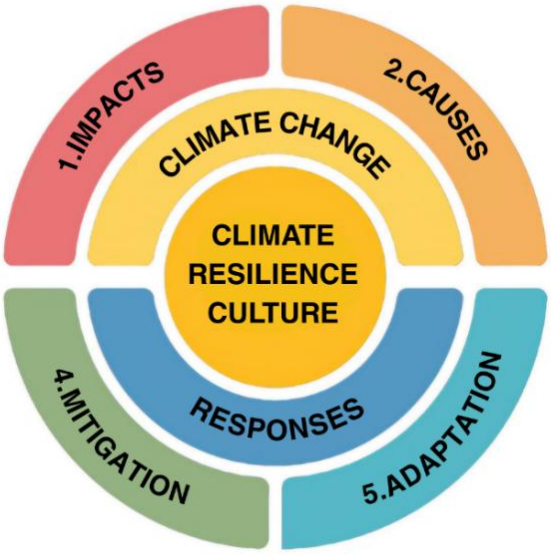

Fig. 2. Four competencies of climate change education
(Satria et al., 2022)

This research aims to identify the challenges faced by educators in teaching climate change education in schools. The connection will be seen through the relevance of the material taught to the climate conditions and challenges around the school, educators' understanding of climate change topics, and students' participation in climate change education. Analysis of these aspects is expected to provide an overview of the gap between the concept of climate change education based on the independent curriculum and the implementation process in the field as well as the development of climate change education in Indonesia.

2. Methods

This research is a qualitative study conducted through an in-depth interview process to obtain primary data. The environmental literature still lacks relevant examples of fieldwork that clearly demonstrate how important information is gathered from qualitative data, highlighting the significance of a qualitative approach (Bercht, 2021). In-depth interviews are one of the qualitative research techniques used to gather information about

participants' subjective experiences. The purpose of in-depth interviews is to collect detailed information that elucidates individual perspectives and perceived meanings regarding a topic, issue, or process (Rutledge & Hogg, 2020). The interview process was conducted in March 2025. The subjects of this research are educators in educational units at the elementary, junior high, and high school levels who teach under the independent curriculum, with three individuals from each level.

The research subjects were selected from three different levels because the CCE Guidebook issued by Ministry of Education, Culture, Research, and Technology can be utilized at all levels. The educators' locations for this study vary and were chosen based on differences in regional vulnerability to climate change. The elementary school is a private institution located in the Lamandau District of Central Kalimantan, part of a private foundation situated on an oil palm plantation site. Additionally, the elementary school has received the Adiwiyata award at the provincial level. At the junior high school level is a private institution located in the city of Bekasi, West Java, situated in an urban area and awarded the Adiwiyata at the city level. The high school is a public institution located in the city of Kaimana, West Papua, positioned in a coastal area, not far from the shoreline. The differences in the study areas, which also exhibit variations in ecosystems, habits, and cultures, are expected to provide insights into the differences in education delivered based on vulnerability to climate change.

To facilitate the interview process, the questions were divided into several segments. The first segment began by asking about general teaching experience, subjects taught, educators' awareness of climate change issues, and how climate change education has been integrated into the independent curriculum. The next segment addresses the challenges educators face in teaching climate change education, how the education aligns with prevailing climate conditions and challenges, and how local knowledge and community traditions are incorporated into climate change education. The third segment focuses on student involvement in climate change education within schools. The results of the in-depth interviews will then be analyzed to ascertain the relationship between climate change education being taught and the regional vulnerability of educational units, as well as to understand the development of climate change education in Indonesia within the context of the independent curriculum. Based on the explanation, the interview focus and the analysis for this study can be seen in Table 1.

Table 1. Interview focus and analysis

Interview segment	Interview focus	Analysis
Segment 1	Experience, awareness, curriculum integration	Assessing educator readiness to teach climate change education
Segment 2	Challenges, climate conditions, local knowledge	Assessing teaching challenges based on local context
Segment 3	Students' participation	Assessing teaching approach and student engagement

3. Results and Discussion

3.1 Educators' perspectives on climate change education

The first informant is an elementary school educator who teaches at a private school owned by an oil palm plantation company in Lamandau District, Central Kalimantan, so the elementary school is located within the oil palm plantation site. The informant is assigned to teach all subjects in grade 6. When asked whether the informant knows the impacts of climate change, the informant said that the impacts of climate change can already be felt, especially regarding weather changes. However, when the informant was asked about training on the importance of climate change education, the informant said that she had never received special training but only saw and learned through YouTube channels.

Oil palm is often regarded as a controversial crop, mainly due to the significant environmental and ecological consequences tied to its expansion, particularly in Indonesia over the last 20 years. Much of this growth has involved converting untouched tropical ecosystems into plantations, jeopardizing the survival of key wildlife species like the orangutan. The rapid expansion has led to substantial habitat destruction, a decline in biodiversity as rich ecosystems are replaced by monocultures with low species diversity, and escalating concerns over increased greenhouse gas emissions related to land-use change (Murphy et al., 2021). Furthermore, monoculture can lead to elevated temperatures and drier air. For the villagers surrounding the farms, non-climate stressors interacting with climate change can result in food insecurity and poverty issues, along with market and institutional failures. Consequently, climate change adaptation and mitigation must be carried out in an integrated manner, and integrated landscape management is essential (Widayati et al., 2021).

The concept of climate-smart landscapes can be applied to jointly support carbon sequestration, increased adaptive attitudes, and food security to deal with unavoidable climate change. For the forested tropics, this can be done by combining different agricultural fields, agroforestry, and natural forests to provide multiple functions. This can maintain or increase carbon stocks to provide long-term mitigation benefits, provide immediate adaptation benefits, reduce vulnerability, and increase the resilience of local populations to climate change (Widayati et al., 2021). The school where the informant teaches has its own curriculum tailored to the needs of oil palm plantation activities but the school still adopts the independent curriculum. The informant said that there were no difficulties in teaching climate change material. Usually, climate change lessons are integrated into Indonesian language lessons through reading and hands-on practice or natural and social sciences lessons by observing the differences in morning, afternoon, and night weather. Learning about climate change has not been taught according to the conditions of climate challenges in the school where the informant teaches, but because oil palm plantation sites have different regional characteristics, students have been taught to adapt to the weather conditions that occur in the plantation area. For example, students are taught to wear goggles and masks, especially during the dry season, as their environment is very dusty.

Sekarwulan et al. (2024) the CCE Guidebook has some suggestions regarding climate change lessons for grade 6 or phase C students that can be integrated into several subjects. In the context of Indonesian language lessons, the introduction of vocabulary related to climate change can be done to learn the causes of climate issues. Furthermore, in the context of art lessons, it can also be done by drawing the surrounding natural conditions regarding the impact of environmental changes, such as the Earth melting due to increased heat and drought. This topic can also be integrated into religion lessons as an adaptation effort, by making religious sermons about the importance of preserving and protecting water sources. Furthermore, in mitigation efforts, it can be integrated into natural and social sciences lessons, namely by practicing at home and school, planting local plant seeds that can be adjusted to the conditions and constraints in the local area. Based on the vulnerability of the first informant's school area, this practice can be carried out due to the existence of monoculture agriculture, which is at risk to the food security of residents. The lesson reference can certainly be adjusted to the needs of the school.

Teaching climate change education by considering local knowledge has not been done because the informant is still unfamiliar with the material. The informant said that during learning activities, students are always actively involved in discussions and projects, for example, by making ecobricks, hydroponics, and clothes from plastic materials for fashion shows. The school where the informant teaches is a school with the Adiwiyata Province Level award, so there are already many environmental activities implemented at the school. Examples of these activities are sorting organic and inorganic waste and not using plastic in the canteen. The first informant did not know about the CCE Guidebook and felt that limited network and electricity access prevented her from updating information. Informants felt the gap between access in Java and Kalimantan in terms of getting information. Regarding

climate change education, the informant evaluated that learning materials should be made simpler so that students can understand them.

The second informant is a junior high school educator from a private school located in the middle of an urban area in Bekasi city, West Java province. When the informant was asked about the knowledge of the impacts of climate change, the informant said that the informant already knew the impacts of climate change because the impacts are already visible in everyday life, so the informant already understood the basics. Unfortunately, when asked about official training, the informant said that she had never received training on the importance of climate change education, even though the topic was included in the independent curriculum. The informant also did not know about the CCE guidebook issued by Ministry of Education, Culture, Research, and Technology, as well as the principal at the school. As a school located in an urban area, many climate change education topics can be discussed and explored.

Cities cause climate change through greenhouse gas emissions, and ultimately, feel the impacts of climate change (Short & Farmer, 2021). Global warming is causing cities to become warmer, while urbanization is intensifying the issue with the formation of urban heat islands and aerosol radiative forcing. The interaction between climate change, the urban heat island effect, and air pollution is expected to have consequences in the form of increased risks to human health in urban areas globally by the middle of the twenty-first century. Investigations into the relationship between climate variables (e.g., temperature, relative humidity, air quality index) and health risks (e.g., oral, foot, and hand diseases) show that the health impacts of climate change are greater in areas with low air quality (Du et al., 2019; Kumar, 2021). Cities also experience more weather-related disasters. The occurrence of climate extremes in urban areas has a greater impact on the poor and marginalized communities (Short & Farmer, 2021). Extreme weather events have an impact on urban livability. For example, a study of 288 Chinese cities revealed that more heat waves and extreme rainfall happen in cities in Southern China, and more cold weather impacts in cities in the northern region (Liang et al., 2020; Short & Farmer, 2021).

As a Indonesian language educator, informants have inserted explanatory texts that explain social, cultural, and natural phenomena once or twice. An example of an issue that has been linked is about flooding, to find out the cause and effect. In addition to linking to the phenomenon of disasters due to extreme weather, understanding the urban heat island effect and the increased risk of disease can also be linked to lessons at school. According to Sekarwulan et al. (2024), in the context of Indonesian language lessons, lessons on climate change can be done by analyzing and explaining climate change through reading as well as presentations.

The informants felt that explaining the material about climate change is not difficult, but finding accurate texts through trusted sources is difficult, so the informants anticipated borrowing science textbooks that are also taught at the school. Informants have not yet taught climate change material based on climate conditions and challenges in the school area, but if socialization about climate change education has been given, informants will try to collaborate with texts in Indonesian language lessons, because texts are very useful for student's knowledge. This also applies to teaching in the context of local knowledge and traditions of local communities, which have not been practiced because informants find it difficult to find out about these topics in the context of urban communities. Based on the informants' experience, the topic of climate change education, apart from being taught through subjects, is also taught through P5. Although in practice it has not specifically referred to taking adaptive or mitigative actions regarding climate change, environmental actions in the school environment have often been carried out. Through P5 with the theme of Sustainable Lifestyle, one of the activities carried out is using cooking oil that should not be disposed of carelessly. On this topic, students are taught to collect used cooking oil, which can be processed into new products such as hand washing or dishwashing soap.

As a school that received the Adiwiyata award at the city level, the school practices many activities related to the environment. The informant said that each class in the school has a place to plant hydroponics. The school has also done waste segregation, with simple

terms that are easily understood by students. Instead of using the terms organic and inorganic, the school separates waste more specifically, such as plastic waste, which is grouped into plastic bottles and snack packs, paper, and dry leaves. The movement of bringing lunch from home has also been carried out, and if there are food scraps that can be composted, they will be disposed of in biopore holes made by the local Environmental Agency.

In general, students have been actively involved in environmental projects and initiatives at the school because the center of learning activities is the students. The proportion of learning activities is also more through practice than theory. As a Indonesian language educator, in the procedure text subject matter, the lesson was changed from just reading or watching the material to the practice of explaining the procedure. For example, making hydroponic pots, where the assessed aspect is speaking. Based on these activities, the informants felt that students would understand environmental issues, or more specifically climate change, because they did hands-on practice and applied the information they got. At least students will understand the basic knowledge. In addition, P5 has its own assessment system and report card for each child so that the level of student achievement can be measured. The third informant is a physics educator at a state high school in Kaimana, West Papua, located in a coastal area. The informant is aware of the impacts of climate change because the area where she lives and where she teaches is faced with rising sea levels. In Kaimana, everyone is also competing to build a higher sea wall because the rising sea water has passed the built sea wall. The occurrence made the informant better understand the impact of climate change.

Coastal areas are vulnerable to climate change. It is projected that sea levels in coastal regions could rise between 0.28 and 0.98 meters by the year 2100, and an increase in storm intensity is forecasted for the future. These changes are expected to have severe impacts on coastal environments, including urban and coastal flooding, loss of life and property, population displacement, degradation of wetlands and mangrove ecosystems, coastal erosion, and the intrusion of seawater into both groundwater and surface water sources. Furthermore, economic and social losses due to coastal flooding have risen since the previous century, partly due to the growing extent of vulnerable areas (Hadipour et al., 2020). Dike construction, a type of gray infrastructure, is one of the most commonly adopted measures for coastal protection. This approach, which includes structures like embankments, seawalls, and storm surge barriers, is widely implemented and offers reliable protection levels in many coastal regions and delta areas. Moreover, green infrastructure or ecosystem-based adaptation, such as utilizing mangrove forests, is also employed in certain areas to safeguard coastlines (Kumano et al., 2021). Additionally, recent studies on coastal management highlight that promoting community involvement and participatory methods is essential for advancing discussions around the values, perceptions, and decision-making processes that form the basis of climate adaptation strategies. basis of climate adaptation strategies (Wolff et al., 2025).

Informants have never received special training on the importance of climate change education for students. Informants feel that climate change education is very important because the impact can already be felt, and in the future, it will be more severe for students. For the integration of climate change education in the independent curriculum, it has been implemented for grade 11, where there will be material in a special chapter that discusses the negative effects of global warming. For grade 10 itself, there is a P5 content on Sustainable Living, which will discuss climate change and the actions that can be done to make adjustments and utilize the resources that have been provided.

Based on the CCE Guidebook, grade 10 students who are in phase E can learn about climate change through science lessons as a mitigation effort, for example, by conducting an energy audit at school by calculating energy (Sekarwulan et al., 2024). The achievement in physics learning is when students can describe natural phenomena in the context of measurement process skills, climate change and global warming, environmental pollution, alternative energy, and its utilization. Thus, in physics lessons, climate change education can be integrated to improve students' abilities regarding environmental phenomena. The

lesson can be implemented with the project-based learning method (Lestari et al., 2023). Project-based learning and Climate Change Education are grounded in constructivist learning theory. A constructivist approach is effective for teaching climate change topics. Project-based learning encourages students to engage with real-world problems or practical projects, allowing them to develop and apply scientific knowledge and skills that are directly relevant to their chosen solutions. This learning approach is inquiry-driven, student-centered, and embedded in real-life environmental contexts (Kundariati et al., 2025).

Informants have not found it difficult to teach climate change material due to adequate media and internet access, but informants have not taught in the context of climate change conditions in the school area and local knowledge. However, there are activities outside of school lessons related to climate challenges in the local area, such as mangrove planting on the beach to prevent abrasion. Informants said that students have been actively involved in environmental initiative discussions or activities. Examples of environmental projects that have been carried out are activities for classroom cleanliness, as well as the utilization of leaves to make ecoprints. Informants said that some students can understand the impacts of climate change, but some are still passive. Students who are active in many activities tend to understand this issue better than students who are not very active. Informants also said that students who are still indifferent may be because they do not fully understand the climate impacts that will be felt. This may be due to the condition of the school environment and students' homes, where natural disasters such as floods or droughts have never occurred, so they have not imagined the events that might occur in the future.

The informant did not know about the CCE Guidebook. The informant stated that educators at the school are still occupied with matters related to the changing curriculum. Informants hope that climate change education can be implemented in schools because students will inherit the Earth in the future. However, the implementation of such education is still lacking, indicating that it needs to be improved, particularly to raise awareness about students' futures. Moreover, the informant mentioned that the character of students is still negligent in maintaining environmental cleanliness, making climate change education a long-term task that must be addressed. Based on the interview results, the main findings of the interview can be seen in Table 2.

Table 2. Main findings of the interview

Interview focus	Main finding
Knowledge and awareness about climate change	The informants only know about the impacts of climate change and do not yet understand the issue in depth
A training for climate change education	The informants had never received any special training for climate change education implementation
Climate change education integration into learning activities	The informants have done the integration, even though not in the context of the local vulnerability of each region
Knowledge about the CCE guidebook	The informants did not know about the CCE guidebook
Challenges faced by the educators	Limited resources, lack of understanding of the material, and regional disparities
Student participation in learning activities	Students have been involved in project activities

3.2 Challenges in climate change education

Educators' understanding of climate change is crucial. Interview results indicate that while each educator recognizes the issue's impact, they lack a comprehensive understanding of the overall concept, including its causes and the necessary mitigation and adaptation measures. This gap is related to the insufficient knowledge among educators about teaching climate change education, particularly in the context of regional vulnerabilities and local wisdom. Enhancing the knowledge, attitudes, values, behaviors, and competencies of prospective educators is essential for better preparation in delivering climate change education. There tends to be a lack of preparedness among educators in

addressing climate change topics, often leading to the transmission of misconceptions due to their limited confidence and knowledge (Johnson et al., 2025). Figure 3 presents an example of climate change education that is adapted to regional contexts. Nevertheless, the implementation of climate change education continues to face challenges, particularly due to disparities in educators' access to professional development and the necessary competencies to consistently apply these approaches (Kusumawati & Umam, 2025).

Fig. 3. Coral reef monitoring is conducted by students at SMK Cahaya Anak Papua, Raja Ampat, as an integral part of their science lessons (Sekarwulan et al., 2024)

These challenges are intensified by the absence of specialized training in climate change education for the educators interviewed in this study, which can pose a considerable obstacle in the teaching and learning process. When pedagogical content and practices fall short, educators can receive short-term support through quality curriculum examples and supplemental information to boost their confidence. Ongoing competency development, including coaching and resource provision, is vital to ensure students in Indonesia are educated by capable educators (Teixeira & Crawford, 2022). Unfortunately, despite the publication of the CCE guidebook in 2024, none of the informants were aware of it. While the guidebook is available for direct access and download via kurikulum.kemdikbud.go.id, a lack of information has hindered its optimal utilization. This lack of awareness is unfortunate, as climate change is emphasized as a priority in the national curriculum. According to the Head of the Education Standards, Curriculum, and Assessment Agency, the guidebook serves as a tool for implementing climate change education, allowing flexibility for schools to integrate climate change education using existing resources (Ministry of Primary and Secondary Education, 2024). This statement suggests that the guidebook is meant to complement, not mandate, its adoption. However, interviews reveal that informants still face significant challenges in finding inspiration for integrating climate change education.

The CCE guidebook offers principles, guidelines, and practical tips for schools to implement climate change education effectively. Additionally, it includes information, learning resources, and accessible partnership networks to ensure implementation aligns with quality education principles. The guide also outlines climate change education

competencies according to various phases, describes how to build a climate-resilient culture through the Education Unit Curriculum, and details the assessment process (Sekarwulan et al., 2024). Climate change education is typically delivered and understood within a scientific framework; however, teaching it in an interdisciplinary context offers several advantages. This approach is beneficial because the causes and effects of climate change are extremely complex, encompassing both scientific and socio-political dimensions (Beasy et al., 2023). The CCE guidebook, as a complement to the independent curriculum, presents numerous options for incorporating interdisciplinary integration into various subjects, including math, Indonesian language, art, religion, natural science, social science, and physical education, tailored to different student phases. Interview findings suggest that making the CCE guidebook optional would be a missed opportunity, as educators encounter diverse challenges in teaching climate change education, many of which the CCE guidebook addresses.

Indonesia is among the countries highly vulnerable to the impacts of climate change, including an increased risk of climate-induced disasters. However, the nation's overall readiness to respond to climate change remains at a lower-middle level. The historical development of climate change education in Indonesia has been characterized by a lack of clarity and institutional accountability, resulting in ineffective implementation. Although environmental education was previously incorporated into the previous curriculum (Curriculum 2013), its application remained minimal and non-compulsory. In addition, the National Action Plan for Climate Change Adaptation recommended the integration of climate change education into the national curriculum, which was realized in 2011 when the Ministry of Education and Culture incorporated climate change education into all subjects at the primary and secondary school levels. Similarly, the Meteorology, Climatology, and Geophysics Agency claimed to have developed climate change-related textbooks, although their implementation has yet to be formally evaluated or reported. Given this fragmented trajectory, climate change education in Indonesia remains disjointed and lacks strategic direction. Therefore, a collaborative and coherent policy framework is essential to ensure meaningful integration (Tang, 2024).

The independent curriculum presents a potential opportunity to advance climate change education initiatives in Indonesia. This curriculum aligns with the principles of Education for Sustainable Development, particularly its emphasis on learner-centered and action-oriented pedagogies (Tang, 2024). The development of climate change education in Indonesia is still in its early stages, and the launch of the CCE guidebook with a holistic approach provides hope. However, the potential of this CCE guidebook should not end up like previous initiatives. The continuous and ambiguous changes in climate change education-related policies present additional challenges for educators, particularly in terms of curriculum planning and instructional consistency. Educators play a pivotal role in the successful implementation of climate change education. However, economic priorities continue to hold a dominant position within both climate change and education policies in Indonesia. The emphasis on economic growth and national development frequently results in the deprioritization of environmental goals, which in turn may contribute to the marginalization of climate change education within these policy spheres (Tang, 2024). Moreover, shifts in the political landscape in Indonesia significantly influence the education system, highlighting the need for the government to establish and reinforce climate change education through formal legal frameworks to ensure consistency and prevent disruptions in its implementation.

Although not all informants have accessed the CCE guidebook, the P5 and Adiwiyata programs have offered significant exposure for students to environmental-themed activities. Implementing P5 in schools can enhance the co-curricular aspect of climate change education. Feedback from interviews shows that the P5 program engages students in environmental projects, indirectly fostering their understanding of environmental issues and encouraging participation in project work. However, it is essential to ensure that every student understands the implications of climate change through each environmental activity undertaken. The educators' role is crucial in this regard.

According to Satria et al. (2022), at the outset of profile project activities, educators can blend strategies involving trigger questions and authentic problems. Trigger questions are designed to spark student curiosity and should be open-ended, with answers not found in books or online. Authentic problems should reflect real-life situations experienced by students. Together, these strategies can create more engaging learning stimuli for students. The optimization of the P5 program across profile project activities can be achieved in several ways, including fostering student engagement, providing development opportunities, nurturing positive work values, and ensuring the sustainability of activity effectiveness through regular evaluation and adaptation of profile projects as necessary.

Interview results indicate that schools participating in the Adiwiyata program offer richer experiences and exposure for students regarding environmental issues. According to Megawati et al. (2022), the Adiwiyata school program in Indonesia plays an important role in fostering students' environmental awareness and sense of responsibility. Integrating the Adiwiyata curriculum into environmental education has been shown to effectively raise students' understanding of environmental issues. The program also contributes to creating a clean, attractive, and supportive school environment for teaching and learning. Additionally, various climate-related initiatives such as student projects, sanitation efforts, recycling programs, waste banks, and the conservation of water and energy are incorporated into the school's operational activities.

Schools within the Adiwiyata program considerably benefit from their integration of climate change education. The involvement of educators and school leadership is critical to the program's success. Educators and school officials must recognize the implications of their activities concerning climate change to foster deeper student understanding. Nonetheless, schools lacking this program can still implement climate change education through collaboration among educators. Schools can embed environmental education in their vision, mission, and curriculum by organizing extracurricular activities centered on environmental sustainability (Husin et al., 2025). Ideas for strengthening climate competency through extracurricular activities can be found in the CCE guidebook, such as scouts by implementing Saka Kalpataru, the Youth Red Cross, which focuses on knowledge and the development of standard operating procedures for managing climate change-related diseases, such as Acute Respiratory Infection and heatstroke. Additionally, initiatives like Youth Scientific Paper and journalism can involve reporting on the impact of climate change in the surrounding area. Arts, culture, and theater can also be used to campaign for climate change issues through fine arts, music, dance, or theatre (Sekarwulan et al., 2024). Educators can foster collaboration to incorporate environmental education across various subjects (Husin et al., 2025).

The suggested solutions are valid, yet educational inequality continues to be a major issue in Indonesia. Interviews indicate that the first informant sees a skills gap between educators in Java and those in other areas. The third informant pointed out that frequent curriculum changes require educators to adapt quickly, which is challenging due to the lengthy implementation times needed for new curricula. Educational inequality remains a growing concern worldwide, including in Indonesia, where Java Island still enjoys a greater availability of educational facilities and infrastructure compared to other regions, particularly in Eastern Indonesia (Wirandana & Khoirunurrofik, 2024). Additionally, educators in remote areas face restricted opportunities for professional growth and collaboration with peers, hindering their ability to keep up with modern teaching practices (Baharuddin & Burhan, 2025). Equal access to education is a fundamental right for all citizens. Thus, the education system must guarantee adequate facilities and resources that empower schools to fulfill their roles and help students gain essential knowledge, irrespective of regional disparities (Wirandana & Khoirunurrofik, 2024).

Rural students frequently experience less motivation to learn due to restricted access to higher education and fewer successful role models compared to their urban counterparts. They also lack both tangible resources, such as educational materials and facilities, and intangible resources, like effective teaching techniques and educators' expertise (Chang et al., 2023). Such challenges complicate the integration of climate change education. Interview

results indicate that the third informant has witnessed these challenges, albeit not specifically within the climate change education context. Nonetheless, low student motivation may surface universally. In the realm of climate change education, motivation largely hinges on knowledge and responsibility. Active involvement in climate change learning and actions can cultivate expectations. Students' motivations to act often arise from their awareness of possibilities within their social contexts, enabling them to understand and explore climate change and its local and global implications (Johnson et al., 2025).

4. Conclusions

Climate change education has started to be implemented in the teaching locations of the informants, but it still needs significant attention. Climate change education is integrated through P5 activities and the Adiwiyata program, but it would be beneficial if the CCE guidebook by Ministry of Education, Culture, Research, and Technology were disseminated more extensively and adopted by educational units. Given the vulnerability of each region to climate change, there is no substantial difference in the content of the education. Special training must be prioritized, as the topic of climate change is vast, with specific explanations for each regional condition, and is not fully mastered by all educators.

Students have been actively involved in the learning process, however, considerable improvement is needed for climate change education. Additionally, the commitment of educators to collaborate on integrating climate change education into the school environment is essential, as this education must be implemented collectively. Schools can play a role in fostering a culture of love for the environment to create a climate-resilient mindset in students. The weaknesses of the education system in Indonesia present challenges to the success of implementing climate change education. Therefore, the government needs to strive for equal distribution of quality educators and education. In addition, it is essential to establish a legal framework for climate change education to ensure its effective execution and long-term implementation. The writing of this article is based solely on in-depth interviews and literature studies without direct observation; thus, it may introduce bias. For this reason, further observations and studies are necessary to evaluate the implementation of climate change education in Indonesia, especially from the perspective of educators and policymakers.

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Author Contribution

The author was responsible for the conceptualization and design of the study, including the formulation of the research objectives and framework. The author also carried out the methodology, conducted in-depth interviews with the informants, and managed the data collection and curation. Furthermore, the author performed the analysis, interpretation, and discussion of the findings, as well as prepared the original draft of the manuscript. The review, editing, and finalization of the article were also undertaken solely by the author.

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