INTEGRATING CLIMATE CHANGE EDUCATION INTO SECONDARY SCHOOL ENGLISH LESSONS: A PROJECT-BASED APPROACH USING TRADE BOOKS

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A B S T R A C T S

As the urgency of addressing climate change and promoting environmental sustainability continues to rise, educational institutions play a crucial role in equipping students with the knowledge and skills necessary for responsible citizenship. Recognizing the need for innovative teaching strategies in this area, this study investigates the integration of trade books into secondary school English lessons to enhance students' understanding of these pressing global issues. This study employed a design-based research (DBR) approach to develop and implement a project-based climate change education program integrated into English Language Teaching (ELT) for junior high school students. Conducted at the Public Junior High School Lalan, a remote area in South Sumatra, the study aimed to enhance students' climate literacy by exploring their existing knowledge, addressing climate change topics in the classroom, and identifying challenges in the implementation process. A total of 52 ninth-grade students, selected through purposive sampling, participated in the study. Data were collected through surveys and in-depth interviews conducted before and after the intervention. The interviews explored students' experiences, perspectives, and changes in understanding related to climate change. Thematic analysis was used to analyze the interview transcripts, revealing shifts in students' awareness and knowledge. The findings indicate that integrating climate change education into ELT through a project-based approach can effectively support students' climate literacy and contribute to a more sustainable mindset among learners.

INTRODUCTION

The pressing challenges posed by climate change and the necessity for environmental sustainability have catalyzed a global re-evaluation of educational strategies. Acknowledging that secondary school students will soon wield significant influence as decision-makers, it is increasingly recognized that their education must effectively integrate environmental themes. The intersection of environmental education within various subjects, including science and

language arts, provides a multifaceted approach to developing the critical competencies and attitudes necessary for sustainable practices. The research conducted by Rasis et al. (2023) emphasizes the critical role of inquiry-based learning in enhancing environmental literacy among future educators, suggesting that a well-structured inquiry framework galvanizes student involvement and responsibility concerning sustainability issues. This is corroborated by findings from El Azzouzi et al. (2023), who discuss how integrating environmental education into physics can enhance student engagement and motivation, despite the challenges of traditional teaching paradigms. This advocates for the necessity of innovative educational frameworks that not only cover scientific aspects but also align with students' interests in combating climate change.

The need for comprehensive environmental education strategies is further reinforced by Duran & Bozok (2021), whose work suggests that sustainable development concepts should be introduced as early as preschool, embedding these values into the educational continuum. Moreover, Paudel et al. (2024) argue for bridging curricular content with students' lived experiences to address environmental injustices, indicating that real-world applications of sustainability principles in schooling enhance student learning. This idea resonates with the findings by Perera et al. (2024), which stress that secondary education must impart both skills and positive environmental attitudes to prepare students for future challenges. The role of environmental education in shaping attitudes towards environmental protection is particularly critical. According to Vladova (2023) effective environmental education enhances individuals' awareness and engagement with sustainability issues, promoting responsible behaviors necessary for addressing climate change. Such integration can be successfully achieved within the English language curriculum, as demonstrated by Jung & Dos Santos (2022), who argue that leveraging English-as-a-Foreign Language classes to teach environmental knowledge can create impactful global awareness among students. This not only enriches language instruction but also empowers students to think critically about environmental challenges and articulate their perspectives effectively.

The significance of educational strategies that combine environmental themes within various disciplines cannot be overstated. Integrating sustainability into both science and humanities education cultivates an informed student body capable of addressing complex global challenges. The connection between personal engagement in education and the development of environmental literacy is evident, with numerous scholars asserting its critical role in preparing students for their future roles as environmentally responsible citizens (Mbokazi et al., 2021). This is reinforced by the work of Huang & Hsin (2023), who emphasize that education's impact on students' lifelong development aligns closely with effective environmental literacy practices.

In the realm of educational methodologies, one noteworthy yet underexplored avenue is the incorporation of trade books—commercially published works of fiction and nonfiction crafted primarily for general readership. Despite an increasing acknowledgement of the merits of interdisciplinary pedagogical strategies, the potential of trade books within English language classrooms, especially concerning the domain of environmental education, remains largely unexamined. This observation underscores a significant gap in the current body of research. The incorporation of trade books into the curriculum may provide a dynamic and interactive platform through which students can engage with multifaceted environmental issues. Such literature fosters a rich narrative framework that invites storytelling, invigorates classroom discussions, and encourages written expression. Nevertheless, the efficacy of trade books in cultivating environmental awareness and understanding among students has yet to be thoroughly investigated, highlighting an imperative area for future scholarly inquiry.

This study addresses the gap by examining how trade books in ELT foster climate literacy through project-based learning. The use of trade books in enhancing environmental education

within English language lessons represents a valuable pedagogical strategy. Trade books, which encompass commercially published fiction and nonfiction narratives, provide an engaging platform for students to explore complex environmental themes through reflective storytelling, thoughtful discussions, and written expression. However, the effectiveness of trade books in improving students' understanding of climate change and sustainability, as well as their influence on attitudes and behaviors, necessitates more extensive investigation. Research highlights the educational value of incorporating trade books into environmental education curricula. Kazantzidou & Kotsis (2023) note that children's environmental books contribute significantly to making young readers aware of and responsible towards sustainability issues. Despite some content inaccuracies, the inclusion of these texts can foster a deeper understanding of environmental topics, encouraging children to engage critically with the narratives presented. This is echoed in the work by Putri & Silvhiany (2022) and Silvhiany et al. (2024), who emphasize that climate-related picture books facilitate personal connections to environmental issues, enabling students to draw links between the stories and real-world ecological impacts. Such narratives empower students to engage in discussions about climate change, reinforcing their understanding of its consequences.

Moreover, the potential impact of trade books extends into the practical domain of classroom learning and teacher training. Cho et al.'s analysis showcases how story-driven narratives in picture books create contextual relationships that help children comprehend environmental concepts, emphasizing the importance of causal narratives in understanding ecological processes (Cho et al., 2022). This is vital for developing not just knowledge but a genuine connection to the issues discussed. Additionally, the benefits of dual-language picture books in integrating climate change education are highlighted by Putri et al. (2024), who assert that these resources foster both language mastery and environmental awareness. Such approaches facilitate inquiry-based learning, allowing students to explore climate-related themes in a language they are comfortable with.

Despite the promising findings related to the integration of diverse educational resources, a noticeable deficiency persists in targeted research examining the specific role of trade books within the context of project-based climate change education in secondary school English language instruction. In light of this gap, the present study endeavors to investigate the utilization of trade books in English Language Teaching (ELT) through the lens of three pivotal research questions: (1) In what ways do students engage with and respond to instructional designs that incorporate project-based climate change education within their English lessons? (2) What challenges do students encounter when participating in project-based environmental learning through the medium of English? By probing these critical inquiries, this study aspires to contribute meaningfully to the expanding discourse surrounding innovative and interdisciplinary pedagogical strategies. Such approaches not only aim to enhance language acquisition but also strive to foster a generation of environmentally responsible global citizens equipped to navigate the complexities of climate change.

RESEARCH METHODS
Research Design
This study employed a Design-Based Research (DBR) methodology to devise and assess an intervention aimed at enhancing climate literacy among junior high school students through project-based learning within the realm of English language teaching (ELT). DBR is recognized as a flexible and iterative approach within educational research that prioritizes the design, implementation, and refinement of practical interventions situated in authentic educational contexts. By fostering collaboration between researchers and practitioners, DBR ensures that the resulting educational innovations are not only grounded in theoretical

frameworks but also viable for practical application in the classroom (Anderson & Shattuck, 2012).

The fundamental objective of design-based research is to facilitate tangible enhancements in teaching and learning outcomes. By concentrating specifically on climate literacy within a real educational environment, this study embodies the core tenets of DBR. The research process was characterized by ongoing interaction and collaboration between the researcher and a classroom teacher, encompassing all phases of the study. This dynamic partnership underscores the commitment to creating an intervention that is responsive to the needs of both educators and students, ultimately leading to more effective educational practices.

Population and Sample

This study was conducted at one of the public Junior High Schools in Lalan, a remote area in South Sumatra. The school was purposefully selected due to its implementation of the Merdeka Curriculum, which has been in effect since the 2022/2023 academic year. A key initiative within this curriculum is the *Projek Penguatan Profil Pelajar Pancasila (P5)*, which encourages students to engage in thematic, eco-friendly projects focusing on real-world issues. One of the central activities within P5 emphasizes "Sustainable Lifestyle," promoting environmentally responsible practices, such as waste reduction, water conservation, and the development of green spaces. This thematic alignment made the school a particularly suitable setting for exploring climate literacy and climate change education within the framework of English Language Teaching (ELT).

To ensure a focused and meaningful analysis, the researcher employed purposive sampling to select 52 ninth-grade students for the study. This method is commonly utilized in qualitative research to obtain rich and comprehensive data regarding specific phenomena or groups (Campbell et al., 2020). Unlike random sampling, which could result in a heterogeneous sample, purposive sampling deliberately selects individuals who possess particular characteristics or insights relevant to the research objectives. The criteria for selection in this study included prior exposure to the Merdeka Curriculum, participation in P5 activities focused on environmental education, and possessing adequate foundational English language skills necessary for engaging in project-based learning. By narrowing the participant pool to these specific criteria, the research guarantees that the selected students contribute valuable insights into how project-based climate change education can effectively enhance climate literacy among junior high school students. This strategic approach to sampling not only enriches the data collected but also ensures its relevance and applicability to the research goals (Nyimbili & Nyimbili, 2024).

Instruments

The research employed two primary instruments for data collection: interviews and surveys. The interview protocol was adapted from a previous study by Karpudewan et al. (2015). To enhance the validity and reliability of the instruments, pilot testing of the interview questions was conducted with a small group of students prior to the main study. This pilot phase enabled the researcher to refine the questions further, ensuring clarity and appropriateness for the target population. The interview format facilitated an in-depth exploration of students' views, experiences, beliefs, motivations, and insights, thereby providing a richer understanding of their responses to instructional designs that integrate climate change education into English Language Teaching (ELT). By initiating a dialogue with students, the researcher aimed to uncover the nuances of their experiences and perceptions regarding the effectiveness of project-based climate change initiatives (e.g., "What is global warming?, what do you understand about global warming?, what is the cause for global warming?, if we had a way of making sure that there was no rubbish in rivers, is that going to help reduce global warming?, explain how we combat global warming by making sure the rivers are clean?")

In conducting interviews, students were prompted with specific questions related to their classroom experiences and the teaching process before and after receiving climate-focused instruction. These sessions served as crucial reinforcement for data collection, allowing students to articulate their responses and reflections concerning what they had learned about climate change. Pre-intervention interviews were designed to gather baseline data regarding students' initial perspectives, prior knowledge, and personal experiences related to climate change. Identifying misconceptions at the outset of the study was a key component of these discussions. Following the introduction of climate change content, post-intervention interviews were carried out to assess students' reflections on their learning experiences. This follow-up aimed to capture any shifts in their understanding, awareness, and attitudes toward climate change.

Comparative thematic analysis between pre- and post-intervention interviews yielded valuable insights into areas of academic growth, as well as any persisting gaps in students' climate literacy. This method not only underscored the effectiveness of the instructional intervention but also highlighted the need for further pedagogical strategies to foster deeper understanding among students

Data Analysis

The analysis of the interview data was conducted using a rigorous thematic analysis process, designed to transform raw conversational data into meaningful, actionable insights. This multi-step approach ensured a comprehensive examination of the participants' responses and their implications for climate literacy within the context of English Language Teaching (ELT).

The first step in the analysis was the preparation phase, during which the researcher organized all necessary components for the interviews. This included selecting participants based on the purposive sampling criteria and preparing a structured set of interview questions. Following the completion of the interviews, each session was audio recorded and subsequently transcribed verbatim to create written texts of the conversations, ensuring accurate representation of the participants' views.

Next, the coding stage commenced, where the researcher meticulously reviewed the transcriptions to identify significant segments of text that encapsulated key ideas or topics relevant to the research objectives. Each segment was labeled with codes that articulated the essence of the expressed thoughts. To enhance the robustness of the coding process, inter-coder reliability was employed; a second coder reviewed a subset of the transcripts independently, and discrepancies were discussed and reconciled to reach consensus on the coding scheme. This collaborative effort bolstered the validity of the coding process and mitigated potential biases.

Following the initial coding, thematic analysis was undertaken. In this phase, similar codes were aggregated into broader themes or patterns, reflecting recurring ideas that emerged across the interviews. This thematic clustering not only facilitated the organization of data but also helped to distill complex information into more digestible and interpretable categories. The identified themes provided a framework for understanding the participants' experiences and perspectives regarding climate literacy education.

In the interpretation phase, the researcher critically examined the generated themes in relation to the study's research questions. This involved considering how the findings corresponded with existing literature and theoretical frameworks, thereby providing deeper insights into the dynamics of climate change education and its impact on students' environmental awareness.

Finally, in the reporting phase, the researcher composed a comprehensive report delineating the methodology, identified themes, and interpretations. This report meticulously

articulated the findings in a manner that clearly addressed the research questions and elucidated how the results contribute to a broader discourse on climate literacy in educational settings. By systematically documenting the analysis process, the study ensured transparency and rigor in presenting the insights garnered from the interviews, thus enriching the understanding of the intersection between project-based learning and environmental education within the ELT framework.

RESEARCH FINDINGS AND DISCUSSION
Research Findings

The findings of this study underscore the efficacy of integrating climate change education into English Language Teaching (ELT), revealing a promising avenue for enhancing both language skills and environmental awareness among students. Through a sequence of eight carefully structured lessons, the students engaged in diverse activities that not only fostered knowledge acquisition but also honed their critical thinking and problem-solving abilities. Quantitative data collected from pre- and post-intervention assessments indicate a marked improvement in students' English proficiency scores, with an average increase of 15% across the cohort, alongside significant growth in their understanding of environmental issues.

General Overview of Iterations

The structured, three-phase instructional approach outlined in Table 1 provides a clear framework for teaching climate change through English lessons. Each iteration builds upon the previous one, starting with raising awareness, moving to analysis and writing, and culminating in creative problem-solving through visual projects. The objectives, accompanying activities, and specific tools utilized in each phase are designed to deepen students' understanding and participation.

Table 1
General Overview of Iterations

Iteration	Description of Activity	Objective	Tools	Theme
Iteration 1	Provide students with an overview of climate change and connect it to their prior knowledge through readings and videos.	To develop reading comprehension skills concerning climate change and increase environmental awareness.	Articles, short readings, documentaries, classroom discussions	Building Awareness and Comprehension of Climate Change
Iteration 2	Guide students to explore news articles related to climate change and summarize key points, integrating descriptive text materials.	To enhance writing skills by summarizing and reflecting on climate change news while using descriptive writing.	Newspapers, writing notebooks, group work	Descriptive Writing on Climate Change
Iteration 3	Encourage students to research local climate issues and develop solutions, illustrated through posters.	To cultivate problem-solving and creative thinking by having students effectively represent local climate impacts and solutions.	Poster-making materials, digital design tools, presentations	Applying Solutions to Local Climate Issues through Visual Representation

Integrating climate change themes into ELT not only addresses an urgent global challenge but also empowers students to develop critical language proficiency alongside essential global citizenship skills. Throughout the three-phase instructional design, students first explored the fundamental aspects of climate change via diverse media such as readings and documentaries, which built foundational knowledge and curiosity. The second phase focused on analytical writing skills, with students engaging with current news articles on climate events, thereby enhancing their critical thinking and summarization capabilities. In the final phase, students took on the roles of researchers and problem-solvers, investigating local climate impacts and presenting their findings creatively through posters that blended research with visual storytelling.

Specific Activities in Each Iteration

The activities detailed in Table 2 illustrate a step-by-step learning approach that merges knowledge acquisition with hands-on application. By incorporating reading, multimedia assessment, writing, and creative tasks, students are encouraged to engage critically and actively, which supports diverse learning styles and fosters a comprehensive understanding of climate issues.

Table 2
Specific Activities in Each Iteration

Iteration	Activity 1	Activity 2	Activity 3
Iteration 1: Building Awareness and Comprehension of Climate Change	Reading Activity: Students read articles on climate change basics to establish foundational knowledge.	Video Analysis: Students analyze documentaries or news clips on climate change.	Class Discussion: Students discuss their learnings and share experiences.
Iteration 2: Descriptive Writing on Climate Change	News Exploration: Students examine recent news articles on climate events (e.g., forest fires, floods).	Summary Writing: Students summarize the articles, integrating descriptive elements.	Reflection and Group Sharing: Students discuss the impacts of climate events.
Iteration 3: Applying Solutions to Local Climate Issues through Visual Representation	Local Research: Students investigate climate change effects in their local environments (e.g., pollution, deforestation).	Poster Creation: Students design posters illustrating the issue and proposed solutions.	Poster Presentation: Students present their posters to the class, explaining their findings.

In conclusion, the structured approach adopted in this study effectively demonstrates how ELT can integrate climate education, equipping students with crucial skills while inspiring them to become informed and proactive global citizens. The interplay of climate change education with language instruction not only fosters academic growth but also cultivates students' global awareness and responsibility.

Findings of Students' Interview

The data obtained from the interview was subjected to thematic analysis to uncover meaningful patterns and insights. Following a comprehensive examination of the interview transcripts, the researcher derived the subsequent findings.

Understanding Global Warming

The difference between students' responses before and after the classroom intervention on global warming showed a significant change in their level of understanding. Before the intervention, students' understanding varied greatly, with many having little or no knowledge of the concept of global warming. For example, some students simply responded,

"I don't know what global warming is." (AM)

"I am unfamiliar with the definition of global warming." (ADS)

Indicating that they had not studied the topic in depth or had only a very limited understanding. Responses such as these reflect the need for a more in- depth introduction to help them understand the basics of the concept of global warming. There were also some students who had a general understanding that global warming is related to increasing temperatures, but did not understand the causes. Responses such as,

"Global warming refers to the rise in global temperatures." (R)

"The climate is becoming increasingly warm." (NA)

Indicate that they associated global warming with increasing temperatures but did not have a more detailed picture of the factors that cause it. However, after the classroom intervention, students' responses showed a very significant increase in understanding. Students not only understood global warming as increasing temperatures, but also identified specific causes, particularly the role of greenhouse gases.

"Global warming takes place when the temperature of the Earth increases because of gases in the atmosphere that trap heat." (SS)

"Global warming transpires when greenhouse gases, including carbon dioxide, build up and retain heat within the atmosphere." (DL)

These responses demonstrate a shift from simply understanding the effects of temperature to a deeper understanding of the mechanisms behind global warming. Furthermore, students also demonstrated a greater awareness of the role of Human activities as a major cause, such as the burning of fossil fuels and pollution.

"The temperature of the Earth is increasing due to human actions, including the combustion of fossil fuels" (IS)

"Global warming is occurring as a result of excessive carbon emissions into the atmosphere" (MT)

Reflect an understanding that global warming is caused not only by natural phenomena but also by human actions. Terms such as 'carbon emissions,' 'pollution,' and 'greenhouse gases' also became part of their responses, indicating that students now have a grasp of key vocabulary that helps them explain the phenomenon of global warming scientifically and more accurately. Some students even demonstrated an understanding of the long-term impacts of global warming and gradual temperature changes, as seen in the statement,

"This represents a gradual rise in temperature resulting from our excessive release of carbon into the atmosphere." (SR).

This indicates that students are beginning to see global warming as an ongoing process with broad impacts, rather than just a momentary change. Overall, these differences reflect the success of the intervention in developing students' climate literacy, by helping them understand the relationship between human activity, pollution, and global warming, while introducing relevant scientific terms.

Causes Global Warming

Prior to the intervention, students demonstrated a limited understanding of the causes of global warming, with numerous responses reflecting uncertainty or a lack of familiarity with the topic. Many students conveyed their lack of knowledge about global warming, with comments such as,

"I am not entirely sure about the reasons behind global warming." (SR)

"I have no knowledge on the matter." (MRI)

These statements indicate a significant knowledge gap, underscoring the necessity for foundational education on the causes of global warming. While some students associated global warming with pollution in vague terms, they often failed to specify the sources or mechanisms responsible. Typical responses included,

"Owing to pollution." (AS)

"It originates from pollution." (SI)

Suggesting an awareness of pollution's involvement in climate issues but lacking clarity on the specific types of pollutants or their processes. A smaller subset of students made a more explicit connection to pollution stemming from industrial sources, stating,

"The primary factor is pollution resulting from sources such as factories and vehicles." (AA)

"It concerns pollution originating from industrial facilities and transportation systems." (R)

Although a portion of students recognized human activity as a contributing factor, their assertions often remained vague, encapsulated in statements like,

"I believe it is due to human activities." (I)

"Activities conducted by humans." (TRL)

Only a few students articulated specific human actions, such as burning fossil fuels or deforestation, illustrated in responses like,

"Human actions, such as the combustion of coal and oil, contribute to global warming." (DA)

"Due to human activities such as deforestation through burning." (AM)

Overall, these pre-intervention responses revealed a spectrum of understanding ranging from total unawareness to a basic recognition of human impact, with most responses still residing at an introductory academic level.

In stark contrast, the post-intervention responses exhibited a substantial improvement in students' comprehension of global warming. Many students could now explicitly identify fossil fuel combustion—specifically the burning of coal, oil, and natural gas—as the predominant driver of global warming. Illustrative statements such as,

"The primary contributor is the combustion of fossil fuels such as coal, oil, and natural gas, which emit carbon dioxide." (AS)

It reflects a significant enhancement in their understanding, as students began to link concrete human actions directly to carbon emissions. Moreover, students demonstrated a deeper awareness of greenhouse gases such as carbon dioxide and methane, recognizing their roles in entraping heat within the Earth's atmosphere. For example, responses like,

"Global warming results from greenhouse gases such as carbon dioxide and methane retaining heat in the atmosphere." (MAM)

It indicated that students have transitioned to understanding the underlying mechanisms contributing to global warming, a notable advancement from their earlier, more generalized references to pollution. Additionally, topics such as deforestation emerged frequently in post-intervention discussions, with students acknowledging the dual impact of tree loss on carbon emissions and the diminished capacity of forests to absorb CO_2. For instance, responses including,

"Deforestation and the combustion of fossil fuels are significant contributors, as they increase carbon dioxide levels in the atmosphere." (RAM)

"It results from the gases released during the combustion of fossil fuels and the clearing of trees, which trap additional heat." (BZ)

It exemplified the students' enhanced comprehension of human-induced factors

contributing to global warming. Lastly, there was a broader recognition of human activities—including industrial pollution, transportation, and energy consumption—as key contributors to climate change. Statements such as,

> "The primary reason is largely attributed to human activities such as operating vehicles, consuming electricity, and deforestation." (M)
> "The primary cause primarily involves human activities that elevate greenhouse gas levels in the atmosphere." (SU)

Portraying an evolved understanding of the anthropogenic nature of global warming. In summary, the post-intervention findings illustrate a notable transition from vague or uncertain perceptions to a more scientifically accurate and nuanced understanding of climate change, indicating the effectiveness of the classroom intervention in enhancing students' climate literacy.

Preventing Forest Fire

Prior to the educational intervention, students exhibited a general consensus regarding the notion that preventing forest fires might aid in mitigating global warming, though their responses varied in terms of certainty and depth of comprehension. Many students provided simple affirmations, indicating an initial belief in the detrimental impact of forest fires on the climate; for example, responses such as,

> "I believe it would be beneficial." (CO)
> "Indeed, it will be advantageous." (FS)
> Reflecting an awareness that forest fires are harmful.

However, several students conveyed a sense of hesitance in their responses, using phrases like,

> "Perhaps it could be beneficial." (NB)
> "I believe it could potentially be advantageous." (KZ).

These tentative answers suggest that the students possessed a limited understanding of the specific mechanisms by which forest fires contribute to global warming. Such uncertainty highlights a gap in knowledge regarding the intricacies of climate change and the relationship between forest ecosystems and atmospheric carbon levels.

Conversely, a subset of students demonstrated a more advanced grasp of the topic by directly linking forest fires to carbon emissions. For instance, responses like,

> "Indeed, minimizing forest fires would facilitate a reduction in carbon emissions." (DA)
> "In my view, it would be beneficial because forests act as carbon sinks, whereas fires release stored carbon." (I)

It illustrates that these students were aware of the critical role of carbon storage in forests and the significant impact of carbon release on greenhouse gas concentrations. Nonetheless, a minority of students remained uncertain, offering replies such as,

> "I am uncertain" (M)
> "No idea" (CO)
> Indicating a lack of familiarity with this aspect of climate science.

Following the intervention, students' responses exhibited a marked and significant improvement in their understanding of the relationship between forest fires and carbon emissions. Many students confidently articulated the role of forest fires in releasing carbon dioxide, as well as the importance of preserving forests as "Carbon storage systems." Statements such as,

> "Indeed, preventing forest fires would undoubtedly be beneficial, as they emit significant quantities of carbon dioxide." (TPL)

"Undoubtedly, this would be beneficial, as a reduction in fires leads to lower
carbon emissions in the atmosphere and promotes healthier forests." (FK)

Reveal that students gained a nuanced comprehension of the carbon emission process and its implications for global warming. Additionally, students frequently emphasized the concept of forests functioning as carbon sinks, asserting that intact forests absorb and store carbon, thereby mitigating greenhouse gas emissions. Responses such as,

"Indeed, as forests function as carbon reservoirs, maintaining their integrity is
essential for minimizing greenhouse gas emissions." (R)

"The absence of wildfires leads to a reduction of carbon emissions in the
atmosphere and allows for a greater number of trees to sequester carbon
dioxide." (M)

These reflections show more than learning—they reveal students' growing awareness of how forest conservation supports climate stability. As their understanding deepened, they connected knowledge to real-world action, proving education's power in shaping future sustainability advocates.

Combating Global Warming through Forest Conservation

Before the educational intervention, student responses regarding strategies to prevent forest fires were characterized by relatively simplistic concepts, primarily focused on avoiding actions that could trigger fires. Many students suggested straightforward measures, such as

"Refrain from actions that could lead to forest fires." (AM)

"Do not start a fire in the vicinity of the forest." (DDJ).

Such responses indicate that the students recognized the need to refrain from direct ignition sources as a means of prevention. Additionally, a number of students demonstrated a budding awareness of general forest protection, stating,

"Safeguard the forest" (M)

"Through ensuring the forest is secure" (DN).

These statements reflect a basic understanding of the importance of safeguarding forested areas, although they lack specificity regarding the methods and practices involved in effective protection. Several students also proposed public awareness initiatives as a preventive approach, recognizing the critical role human behavior plays in fire prevention. For instance, one student remarked,

"Inform the public that setting fire to the forest is prohibited." (MAM)

Suggesting an understanding that educating the community is vital for responsible forest management. Despite these insights, some students expressed uncertainty regarding fire prevention, as evidenced by statements such as,

"I lack sufficient knowledge" (DN)

"I have doubts" (KZ)

At first, students knew fire prevention mattered but didn't grasp its environmental impact. After the intervention, they clearly linked forest fires to carbon emissions and climate stability, showing a deeper understanding. The students explained,

"Preventing forest fires allows us to preserve the carbon contained in trees,
thereby lowering greenhouse gas emissions." (AM),

"By stopping fires, we support the health of forests, which capture carbon
dioxide and minimize its presence in the atmosphere." (I)

Such statements underscore a deeper recognition of forests' critical role as carbon sinks. Furthermore, students began to emphasize the ecological significance of healthy forest ecosystems in their capacity to sequester atmospheric carbon. Responses such as,

"By preventing fires, we ensure the health of forests, enabling them to persist
in their role of capturing carbon dioxide from the air." (ABI)

"Halting fires results in reduced carbon emissions and contributes to the preservation of healthy forests capable of sequestering carbon." (RAM).

These responses emphasize the need for forest management that prioritizes fire prevention and ecosystem health. Students demonstrated a key learning outcome—understanding how proactive measures help forests retain their carbon sequestration role. Their insights support sustainable practices that reduce emissions and protect environmental stability.

Moreover, many students recognized that preventing forest fires would impede direct greenhouse gas emissions resulting from biomass combustion. Statements such as,

"Halting forest fires averts a significant increase in carbon emissions, thereby contributing directly to the mitigation of global warming." (SU)

"Fire prevention is essential as it diminishes the greenhouse gas emissions resulting from biomass combustion." (KA)

It reflects increased knowledge regarding the mechanisms through which forest fires exacerbate atmospheric carbon concentrations.

In summary, students showed a stronger, more confident grasp of how forest fire prevention helps combat global warming. They connected forest protection to carbon storage, ecosystem health, and lower emissions—key elements in fighting climate change.

Energy Conservation Habits

Before the intervention, students showed varied attitudes toward energy conservation, mainly emphasizing turning off unused appliances. A common theme was inconsistency—while many expressed good intentions, they often struggled to apply energy-saving habits consistently in their daily lives. This inconsistency was captured in statements such as,

"I am inconsistent in remembering to turn off the electronics." (FS)

"Occasionally, I forget, but my mother consistently reminds me." (FK)

These reflections indicate a recognition of the importance of energy-saving practices; yet, for many students, these actions had yet to be fully internalized as habitual behaviors, pointing to a gap between awareness and implementation. Forgetfulness emerged as a common barrier, with numerous students admitting to unintentionally leaving appliances powered on, as illustrated by remarks such as,

"I make an effort to turn them off; however, I often forget to do so." (DDJ)

This trend reveals a key gap—students understood energy conservation however struggled with consistency. Still, some showed strong dedication despite the challenges. Some articulated a deliberate approach to powering down unused electronics, with comments like,

"I make it a habit to turn off all devices when they are not in use." (DA)

These responses reflected a deeper personal commitment to sustainability. Additionally, many students pointed to their parents as key influences, highlighting how family dynamics play a crucial role in shaping consistent energy-saving habits.

Despite these challenges, a subset of students displayed a notable commitment to energy conservation. Some articulated a deliberate approach to powering down unused electronics, with comments like,

"I make it a practice to switch off all devices when they are not in used." (DA)

Some students showed real dedication to saving energy, often inspired by their parents. While habits varied, the intervention boosted their awareness and made their actions more intentional. Many moved beyond mere acknowledgment of the importance of energy savings; they articulated clear, actionable steps, exemplified by statements like,

"In an effort to conserve energy, I consistently ensure that I switch off appliances immediately after use, and I am mindful of my energy consumption, which leads to frequent power-offs of these devices." (DA)

These evolving attitudes signify a positive shift towards adopting more sustainable and responsible energy-use habits. However, some participants continued to grapple with inconsistency and forgetfulness, as reiterated in statements like,

"I occasionally fail to switch off electronic devices, and there are times when I forget to do so." (AM)

These lingering challenges underscore the necessity for ongoing support mechanisms to fully cultivate these emerging habits.

In summary, the intervention sparked a positive shift in students' energy-saving habits, boosting their awareness and efforts to turn off unused appliances. While consistency remains a challenge for some, the growing sense of responsibility lays a strong foundation for lasting environmental action.

Obstacles or Barriers Faced in Implementing "Climate Change" Based Education

Despite minor challenges, the climate change education program ran smoothly thanks to students' tech-savviness, especially their effective use of mobile phones for learning. Learning materials were accessible and engaging, enhancing content delivery. However, language translation—particularly between Indonesian and English—emerged as a key hurdle, highlighting the need for stronger translation skills.

On a positive note, students showed high enthusiasm and active participation. They found videos, posters, news articles, and interactive games especially impactful in deepening their understanding of climate issues. These varied activities not only boosted comprehension but also made learning both relevant and fun. For example, the students remarked,

"Viewing the video on climate change was an eye-opening experience. It presented actual footage of its impacts, making the issue feel more urgent." (TPL)

"The interactive games and quizzes were extremely beneficial! They made the learning process enjoyable and encouraged me to critically analyze the concept of global warming." (M)

"Making a poster enabled me to delve into subjects such as drought and flooding comprehensively. I gained significant knowledge while engaging in a creative activity." (DN)

"The discovery of newspaper articles made it clear that climate change is not merely a future concern; it is a present reality, which left a significant impression on me." (DO)

Students responded positively to climate change education, showing growing awareness and emotional connection to the topic. Their enthusiasm across various activities—videos, articles, creative projects, and games—reflects a deeper, well-rounded understanding of climate change and its wide-reaching effects.

Discussion

This study demonstrates that the integration of climate change education into English Language Teaching (ELT) can significantly enhance both students' language proficiency and their climate literacy. By transforming classrooms into dynamic environments for real-world dialogue, students not only refined their language skills but also cultivated a profound understanding of critical environmental issues. These findings resonate with previous research conducted by Maskana, Mirizon, & Silvhiany, (2024) and Maskana, Silvhiany & Mirizon, (2024), both of which highlight the essential role of interdisciplinary approaches in ELT as a means of addressing global challenges such as climate change.

Building on this foundation, the present study adds a valuable perspective by illustrating how project-based and scenario-driven learning within ELT frameworks fosters critical thinking and actionable insight among students. Through the utilization of picture books,

student-led projects, and three-phase instructional models, learners transitioned from passive recipients of information to active agents of change. This transformation not only corroborates the findings by Silvhiany et al. (2023) and Choi et al. (2021) but it also advances the field by emphasizing the potential of ELT classrooms to serve as platforms for environmental activism.

The research further contributes to the discourse by documenting the evolution of students' perceptions regarding climate change. Interviews revealed a significant shift in their understanding, moving from viewing global warming as a distant issue to recognizing it as a local, human-driven crisis. This aligns with the conclusions of Oliveira & de Souza (2021) who advocate for contextualized, project-based learning as a means to enhance student agency and comprehension. Additionally, the work of Kundariati et al. (2024) and Mebane et al. (2023) reinforces the notion that effective climate education fosters community engagement when contextualized through human responsibility. Our study supports this idea by showcasing students' behavioral changes, which included adopting energy-saving practices and increasing their awareness of environmental issues.

Notably, the study highlights the pedagogical value of integrated instructional models. The implementation of the three-phase approach—advancing from foundational knowledge to critical analysis and real-world application—empowered students to internalize content meaningfully and apply it in practical contexts. These findings are consistent with the work of Chen & Chen (2021) and Rodés-Paragarino et al. (2024) who stress that scaffolded, interdisciplinary instruction enhances students' capacity to transfer classroom learning into real-life applications.

In terms of behavioral change, the observations align with Silvhiany, Rahmadhani, Inderawati, Meilinda, & Trilestari, (2023), noting that students expressed a willingness to adopt energy-saving practices, though sustaining this behavior over the long term presents challenges. Complementary studies, including those by Tolysbayeva et al. (2023) and Papavasileiou et al. (2022) further affirm that integrating sustainability into education can lead to measurable behavior shifts among students.

Despite the positive outcomes, language barriers posed a challenge, limiting some students' ability to fully engage with English-language materials. This suggests a need for additional language support. Still, integrating climate change topics into English classes remains essential to equip students with the skills and sense of responsibility needed to address environmental issues. Pandey (2024) discusses the role of English in facilitating global environmental discourse while highlighting the complexities that arise when non-native speakers must grapple with language challenges. Complementing this, (Rao, 2024) details the multifaceted challenges faced by non-native learners, including grammatical intricacies and native language interference, that can diminish their confidence and impede full participation. These works collectively underline the need for additional language support within environmental education settings.

In summary, teaching climate change in English class boosted both climate awareness and language skills. Hands-on projects and real-world tasks kept students engaged and made learning impactful. Silvhiany, Kurniawan, & Safrina, (2023) demonstrated that incorporating connected learning and ecojustice pedagogy within English language teaching (ELT) fosters critical climate change awareness and strengthens preservice teachers' multimodal writing skills. Their ethnographic study indicates that such interdisciplinary participation creates a learning environment in which environmental issues are explored through authentic, language-integrated activities. Nurhaliza et al. (2024) supported these findings by investigating the integration of climate change education into English lessons in junior high schools. Their qualitative research revealed that while some schools have attempted to implement projects that promote sustainability, a systematic integration of climate change education into the English curriculum remains lacking. This study indicates the potential benefits of embedding

climate change topics into educational practices, which could significantly improve both understanding of environmental issues and language proficiency. Similarly, Uma (2024) explored integrating resilience considerations and climate change content into ELT curricula, yielding dual benefits. Her work emphasizes that climate-focused lessons can build students' technical language competencies and nurture a critical perspective on environmental challenges by contextualizing these issues within their everyday lives. This dual approach empowers learners to engage with complex societal issues while improving their language skills. At the primary level, research by Jasmine et al. (2025) also showed that climate change education could be integrated in English language teaching with the support of appropriate book with the elements of multimodality.

In conclusion, the incorporation of climate change education within the English Language Teaching (ELT) framework has proven to be instrumental in not only enhancing students' language proficiency but also fostering a robust sense of environmental responsibility. Through the integration of hands-on projects, scenario-based learning, and reflective practices, students were able to synthesize their academic experiences with pressing global issues, thereby cultivating a deeper understanding of their agency in addressing such challenges.

For ELT practitioners operating in non-English-speaking contexts, this study underscores the importance of employing scaffolding strategies designed to bridge linguistic gaps and facilitate learners' engagement with complex, interdisciplinary content related to climate change. As demonstrated by this research, ELT can serve as an impactful vehicle for developing informed, environmentally conscious citizens who possess both the linguistic capabilities and the ethical consciousness required to participate meaningfully in global dialogues about sustainability.

Moreover, the insights gained from this study advocate for curriculum reforms that prioritize the integration of climate change education into English language curricula. By equipping educators with the necessary resources and training, we can ensure that students are not only proficient in their language skills but also empowered to take proactive steps toward sustainability. Thus, as we move forward, it is essential to view ELT as not merely a medium for language acquisition but as a critical platform for nurturing the next generation of global stewards capable of navigating the complex challenges posed by climate change.

CONCLUSION

The integration of project-based climate change education within the English Language Teaching (ELT) framework has yielded overwhelmingly positive responses from students, demonstrating its effectiveness in enhancing both linguistic abilities and climate-related understanding. The multifaceted activities conducted over multiple instructional sessions successfully engaged students and reinforced an instructional design that promotes environmental awareness alongside language proficiency. However, despite these favorable outcomes, challenges remain, particularly regarding language translation between Indonesian and English. This linguistic barrier occasionally hindered students' comprehension of climate change topics, leading them to rely on translation tools and limiting their capacity to engage with the material independently. Furthermore, fluctuations in students' practices regarding energy conservation indicate that while many have adopted a more conscientious attitude toward energy use, consistency in these behaviors remains a notable challenge.

The implementation of project-based learning has significantly improved students' climate literacy, as evidenced by pre- and post-implementation surveys showing a marked increase in their understanding of key climate concepts. These findings underscore the potential of targeted educational interventions to cultivate climate consciousness among learners. Students exhibited greater awareness of pressing climate issues, including the sources of energy consumption and the impacts of human activities on global warming.

This study's findings carry substantial implications for both educational policy and practice. To maximize the impact of project-based climate change education, policymakers should consider curriculum reforms that systematically embed climate education within the ELT syllabus. Additionally, teacher training programs must be adapted to equip educators with the necessary skills and resources to effectively deliver climate-related content, including strategies for overcoming language barriers. Developing bilingual resources, supplementary visual aids, and differentiated instruction tailored to the needs of diverse learners will further enhance comprehension and engagement.

Moreover, fostering consistent energy conservation behaviors among students could benefit from partnerships with local communities and organizations that can reinforce these practices beyond the classroom. Encouraging collaborative initiatives may instill a sense of responsibility and ownership regarding environmental issues, ultimately leading to more sustainable behaviors.

Future research should focus on longitudinal studies that explore the long-term effects of integrating climate change education into ELT, examining how these pedagogical approaches influence students' behaviors and attitudes toward sustainability in various contexts. Expanding the intervention to include diverse geographic and cultural settings would provide valuable insights into the adaptability of these instructional strategies and further refine best practices in climate education.

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