

RESEARCH ARTICLE

Integrating SDG13-Climate action into Malaysian school curricula and institutional practices

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ABSTRACT

This research aims to examine the contextual relationships between SDG13 (Climate Action) and four other academic areas: Curriculum Development, Pedagogical Approaches, Student Engagement, and Institutional Practice Policies. It also investigates whether SDG13 awareness programs serve as practical modeling tools to encourage students to become active, eco-conscious participants and, subsequently, ecosystem advocates. Data were obtained through a scoping review process of meticulously selected articles (21) and analyzed using thematic analysis theory and social learning theory. Results showed that SDG13 awareness programmes foster environmental commitment, environmental consciousness, and create youth environmental advocates. This study also underscores the importance of climate action awareness activities, highlighting their impact on students and empowering educators, policymakers, and other relevant stakeholders to foster environmental responsibility and equitable access to knowledge and skills. The primary focus of future empirical studies evaluating the practical impacts of SDG-13 programmes on developing youths as agents of change should be the main focus.

Keywords: SDG-13; climate action in Malaysian schools; SDG-13 education; pro-environmental behaviour; environmental consciousness

1. Introduction

1.1. Background of the study

Integrating climate change awareness programs into Malaysian academic settings, especially in schools, is no longer an optional enhancement strategy but a pivotal requirement for Malaysian society as a whole. With rising temperatures, changing rainfall patterns, sea-level rise, and an increasing frequency of extreme weather events, Malaysia is facing a distinct climate crisis that affects the country's diverse ecosystems (e.g., rainforests, mangroves, and coral reefs). As a developing nation with growing energy needs, Malaysia must strike a balance between development and environmental preservation, particularly in addressing deforestation and plastic pollution. Unfortunately, despite the urgent need for intervention, the incorporation of Sustainable Development Goal 13: Climate Action (SDG13) principles and outreach awareness measures

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for students, the general public, and governance (in all sectors) is still considered structurally inconsistent and inadequate. The fact that Malaysia is a significant consumer of microplastics in food, yet its waste management is still considered in its infancy and inadequate, exposes both human health and ecological equilibrium to severe long-term negative consequences.

The integration of SDG13 principles across existing subjects and the curriculum in the Malaysian education framework as a whole is still considered lacking, as climate change and sustainable development issues are considered contemporary compared to the greater emphasis on (traditional) academic subjects. Despite the crucial need for professional development, educators are still not equipped with relevant teaching tools (updated materials, training sessions, interdisciplinary teaching methods) to successfully conduct activities and transfer information to students. By empowering educators, student-led activities, eco-clubs, and research projects can focus and apply theoretical knowledge to real-life challenges. Hence, fostering a culture of innovation and advocacy. The enhancement of the quality and pertinence of ecosystem education provides a solid grasp of sustainable practices and the elements required to address environmental issues, both in the short term and long term.

1.2. Research questions

1. What is the existing interconnecting context between SDG13 to i) Curriculum Development, ii) Pedagogical Approaches, iii) Student Engagements, and iv) Institutional Practice Policies?
2. How does SDG13's awareness programmes function as a modeling tool (to the student) that is similar to Bandura's Social Learning Theory (SLT)?

Implementing SDG13 activities in Malaysian education systems is of significant importance, as they produce environmentally literate students who understand climate science and how their daily actions and reactions directly and indirectly impact the ecosystem. By developing critical thinking skills around complex environmental problems, youths can empower their younger peers to become environmentally conscious and, subsequently, create a change within their communities. Structured approaches by educators build resilience and adaptive capacity not only in future generations but also within the general public, raising awareness to support climate policies. Pathways for green careers and sustainable economic development, as well as fostering positive community engagement through environmental stewardship, are additional benefits of such programs. Such positive measures and outcomes will position Malaysia amongst serious leaders in climate education worldwide.

2. Literature Review

2.1. Introduction

A systematic search of academic databases, including Scopus, MDPI, ResearchGate, and Semantic Scholar, among others, yielded 21 articles that met the review criteria^[1]. The search included only peer-reviewed English-language publications from 2019 to 2025 that focused on Malaysian primary and secondary education and directly addressed SDG 13 (Climate Action). The review excluded studies that focused exclusively on higher education and lacked evidence-based methods, as well as those that failed to address climate action in educational practice. The 21 selected articles supported each other in exploring four main review themes: curriculum development and pedagogical strategies, student engagement, and institutionalized policy practices. The articles provided both practical evidence and policy information for Malaysian schools, covering all four review domains. The systematic review method maintained both academic rigor and contextual relevance to the study's goals. A PRISMA-like flow diagram (**Figure 1**) shows the complete article identification and selection process for enhanced transparency.

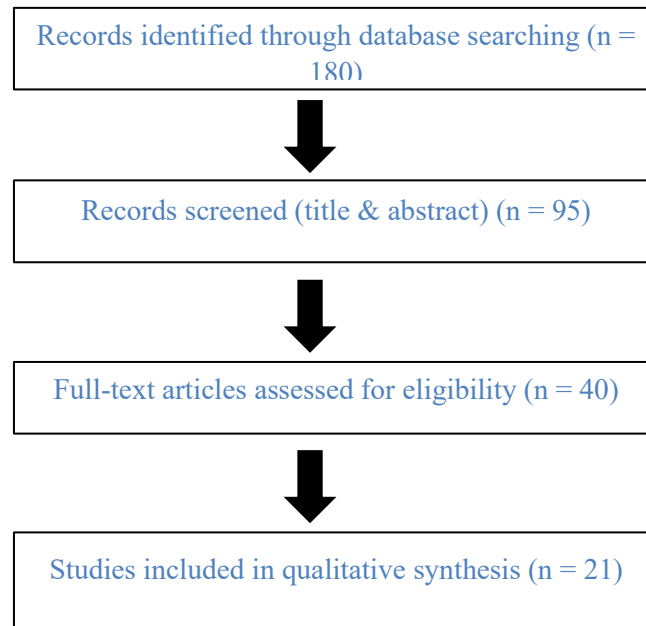


Figure 1. PRISMA flow diagram of study selection process.

The diagram illustrates the systematic identification, screening, eligibility assessment, and final inclusion of 21 studies for this review. Records were retrieved from multiple databases and sources ($n = 180$), screened by title and abstract ($n = 95$), and assessed in full-text form ($n = 40$). After applying inclusion and exclusion criteria, 21 studies were retained for synthesis.

SDG13 (Climate Action)

Since the world adopted sustainable development at the 1987 UN General Assembly, education has been recognized as a critical means to achieve climate action globally. UNESCO (2017); an approach that has been identified as a major framework for enabling learners to understand and address challenges of the climate.

For instance, a five-year learner-centred planetary health project in Bond University's medical program in Australia demonstrated how pedagogy can be more than just awareness-raising; it actually prompts students to act through advocacy, teamwork, and problem-solving on climate change issues^[2]. In Nigeria, Benjamin et al. (2014) noted that education-related climate projects encounter significant societal and infrastructural barriers, yet they continue to be fundamental for advancing SDG13 at the international level^[3].

In schools, barriers are perpetuated by myths and behavioural challenges in students and teachers^[4] a call for climate education to be closely connected to sustainability goals. From a Malaysian perspective, since energy-saving behavior and environmental value are conducive to shaping a more durable attitude towards climate action^[5], fostering the right behavior and values baseline towards a positive perception of organized activities is paramount from a young age. Karim et al. (2022) suggested that it would be beneficial to describe the entire scenario of Climate Change and Environmental Education (CCEE) in terms of school-community interaction, aiming to enhance adaptability and reduce climate vulnerability^[6]. A further factor highlighted is direct teaching, which is strongly supported by Hawa et al. (2023), who argue that disaster risk reduction education is essential for equipping students with the tools they need for climate resilience^[7]. However, at the university level, Malaysian universities are working methodically to integrate sustainability and climate consciousness into educational institutions, from curriculum revisions to policy^[8]. Moreover, Priatna and Khan (2024) consider that education, as a primary function, is to empower citizens, raise their

awareness, and influence policy^[9]. In Malaysia, Thomas et al. (2020) provided examples of how the principles of SDG13 were incorporated into the international school curriculum, achieving surprising success among students who returned to their cities as ambassadors for sustainable consumption patterns^[10]. Kamaruddin et al. (2019) reveal a poor cross-Malaysian school climate among citizens, and a rather fractured state of environmental education. Moreover, knowledge institutions must work diligently to translate knowledge into practical climate engagement among the people^[4,11]. When viewed from a global and a local perspective, the prospects differ, as do the barriers to achieving SDG13 in education.

2.2. Integration of SDG13 Programmes in Malaysia

According to the SDG13 lens, Schools Malaysia have already implemented some successful projects that can be used to promote environmental education and sustainability, aligning with the SDG13 lens. These are among the recipients of the Energy Academy International Green Malaysia Award (annual since 2008 and onwards^[12]). They receive the Sustainable Schools Award (SSA), the Green Schools Campaign Awards, and the Eco Schools Award (ESA)^[12]. The logic behind these programs opening the system and subsequently introducing carbon-free consciousness in the school is executed through co-curricular activities, school policy changes, and relationships with impoverished neighborhoods. SDG 13 will not be applied only to the classroom, but also in the field. The idea and practice of education in Malaysia, with its antecedents, attributes, and commitment to an egalitarian response to social, economic, and environmental concerns. It also ensures that current needs do not lead to a situation in which a good future is left behind in pursuit of what is wanted in the present. One of the emotional elements requires the training of forensic thinking abilities, as well as the elements of being a partner and caring^[13-15]. The applied sub part on climate change of the Secondary School Standards Based Curriculum has been a take-off point of the general condemnation of what amounts to the exam based inclination of the curriculum, an inclination which is a lack of suitable attention to the healthy condition of experience learning policies and learner centered approaches to learning essential to a curricular ethos of environmental custodianship^[6]. Among other things, it was later agreed that Climate Change would be taught in the primary and junior schools, rather than in the third year of junior high. It will be among a set of newly evolving events within Lower Secondary Schools, as a way of introducing climate change education in a manner that fosters enthusiasm and behavioral reform. According to the approach of disaster risk reduction (DRR), climate resilience is defined as characterizing drought and cyclone/tsunami in the current geography curriculum of Malaysia^[7]. Again, because Geography is an elective, many students do not receive this instruction. Syed-Abdullah et al. and subsequent authors discuss how Malaysian universities incorporate sustainability and climate action into their teaching and governance systems, but face continued barriers in institutionalizing this approach throughout the institution^[8].

One concern is the fragmented nature of environmental education, which is distributed across various subjects with no clear emphasis on any one of them^[11]. Poor training for teachers and inadequate policy enforcement also undermine the efficacy of climate education. Therefore, despite the groundwork provided by national programmes and curricular frameworks, more consistent and sustained integration of SDG13 is only possible when attention is given to these structural limitations.

2.3. Curriculum Development

The development of climate education curricula is crucial to the improvement and relevance of such education programmes. Contextualised interventions, such as Kamaludin et al. s (2021) conservation education workshop in Setiu, highlight how focused, gender-sensitive, and locally appropriate approaches to learning can raise students' consciousness and advance pro-environmental attitudes^[11].

Yet, Franco, Tapia, and Tracey (2020) report that continuing educational and cultural issues persist, including unsustainable student lifestyles, peer pressure, limited teacher knowledge of climate, and socio-cultural norms^[4]. These realities prohibit climate education from realizing its transformative potential; a need for culturally responsive curricula and innovative pedagogical approaches emerges.

Karim et al. (2022) condemn the Malaysian curriculum for being exam-based and promote better experiential forms of learning where learners can be actively involved^[6]. Meanwhile, Hawa et al. (2023) suggest that realistic disaster readiness training, such as drills and community simulations, would enhance students' preparedness and understanding; however, such methods remain underutilized^[7].

Teacher education is equally vital. Importantly, as Kalsoom and Qureshi (2021) emphasize, teachers must receive sustainability-based training to be a vital source of effective climate education^[16]. Without restructuring their teacher creation structure, curriculum reform will languish as mere lip service. Ethical guidelines for climate education research, as called for by the United Nations Development Programme (2019), include informed consent, confidentiality, and protections for participants. These guidelines are especially critical when children and marginalized populations are included^[17].

Environmental education in Malaysia, such as that commonly experienced through Nature Clubs and recycling efforts, is often disjointed and not integrated into a coherent programme^[11]. This disunity restricts students' ability to develop a holistic environmental literacy and engagement that extends beyond the short term. The authors advocate for strong policy changes that center on environmental education across the curriculum, in addition to supporting teacher and community partnerships.

2.4. Pedagogical Approaches

Mahat et al. (2020) look at how the LCS community program influences ESD, describing the three phases of the research and showing pre- and post-test findings from SMK Kalumpang, Kerling, Selangor's 635 students^[18]. The initiative evaluates low-carbon behaviours and student environmental knowledge. Inspired by ES, the execution method involves establishing a low-carbon club, conducting field research, developing an action plan, tracking progress, re-evaluating it, incorporating it into the curriculum, engaging the school community, and enforcing a low-carbon code. McLean et al. (2022) investigate Bond University's five-year learner-centred planetary health project in its medical curriculum^[2]. Students worked on climate-related health solutions under SDG13. The approach taught planetary health in medical school according to worldwide guidelines, therefore enhancing students' teamwork, advocacy, and problem-solving abilities^[19]. This approach emphasizes the importance of future healthcare professionals addressing climate change by integrating clinical responsibilities with environmental activism^[20]. Future studies should investigate how continuous educational initiatives influence students' lifetime environmental behaviour, advocacy, and professional practice^[2,20].

The most pervasive hurdle to effective CCE is a significant implementation gap. Prabawani et al. (2020) noted that many Malaysian secondary schools struggle to effectively implement sustainable development education, including SDG 13, due to implementation gaps and undertrained teachers^[21]. This lack of national policy support and the continuous need for better professional training for educators stand out as a major contradiction: we have identified the gold-standard pedagogy (e.g., experiential, arts-based), yet the fundamental educational system has not been sufficiently re-prioritized to empower its teachers to deliver it effectively. Collaborative models and community involvement are proposed as solutions to boost teacher confidence and student engagement; however, the foundational issue of systemic support and professional preparation remains. A crucial conceptual bias is highlighted in a recent scoping review: a prevalent tendency for educational approaches to emphasize individual behaviors (such as cycling or consumption)

over systemic change and political engagement^[22-24]. While the literature explicitly aims to turn students into "change agents," the curriculum often implicitly restricts the scope of action to small, personal choices. This disconnect risks politically disarming students, failing to adequately prepare them to address the underlying corporate and governmental drivers of the crisis. This is a serious gap between CCE's aspirational goals and its practical, narrow execution.

Finally, a persistent methodological weakness is the overreliance on short-term assessment. Ramos et al. (2024) explicitly acknowledged the limitations of their study's small sample size and short-term evaluation period^[25]. This widespread practice means the evidence is compelling for immediate learning outcomes, but our understanding of long-term impact remains frustratingly thin. Future research is consistently called upon to investigate how continuous educational initiatives truly influence students' lifetime environmental behaviours, professional practice, and sustained advocacy^[2,20]. Without robust longitudinal studies, the comprehensive effectiveness of transformative pedagogies remains unproven, hindering our ability to justify the scale of systemic educational reform required. Furthermore, Muccione et al. (2025) note the need to close existing geographical research gaps, develop creative pedagogies, and, critically, examine CCE's influence on actual policy outcomes^[22].

Using human coding and NLP in "A Scoping Review on Climate Change Education," Muccione et al. (2025) chart climate change education literature from 2008 to 2023^[22]. The study's primary topics include efficient learning strategies, sustainable development education, and the role of education in promoting resilience and adaptation. It emphasizes the importance of experiential, gamified, and project-based learning (PBL) in climate literacy, as well as transforming practices that enable young people to become change agents^[22,26,27]. Most educational methods stress personal actions over policy involvement, suggesting a disconnect between education and actual climate action^[22-24]. Research should emphasise closing geographical gaps, creating creative pedagogical strategies, and examining how climate education influences policy outcomes^[22].

2.5. Student Engagements

Yusliza et al. (2020) examined how student pro-environmental behaviours are influenced by environmental commitment, consciousness, lifestyle, and self-efficacy^[28]. Data from 72 Malaysian training centre students was analysed using Partial Least Squares (PLS). These elements enhanced pro-environmental behavior and provided fresh perspectives on environmental sustainability research. These results can help private companies, governments, and educational institutions strengthen their environmental education knowledge and support for their students. Results from the study may not be applicable outside one training centre, as it only included students from that centre. Peng Gaspari and Marchi (2024) stated that numerous energy-saving initiatives exist outside regular schoolwork, thus requiring sustainability education to become a mandatory part of official academic curricula^[5]. The educational system faces a fundamental contradiction, as experts agree that climate action requires immediate attention, yet sustainability education is often limited to an optional addition to standard school curricula.

Because energy-saving projects are mostly extracurricular, the study underlines the importance of including sustainability education in the official curriculum. Participation tactics should highlight practical uses to enable students to apply their knowledge. Mncube, Ajani, Ngema, & Mkhasebe (2023) reveal an alarming resource deficiency in their research, which shows that rural schools lack sufficient resources to implement climate education programs properly^[29]. Educational resource inequality between urban and rural areas generates substantial fairness issues that undermine the success of any educational approach no matter how well-designed. There is an urgent need for future research to study the differences in rural-urban

resources, as this will help create an education system that provides equal opportunities for all students. Curriculum creators ought to think about localised material that speaks to students' actual experiences. The study also reveals that rural schools' resource inequality impedes execution. Future research should investigate long-term climate education impacts on student behaviour as well as rural-urban resource disparities to guarantee equitable education.

Ahmed et al. (2022) looked at Bangladeshi public and private college and schoolteachers' perceptions of climate change^[30]. The study found that while most teachers are aware of climate change, their opinions differ by institution, academic background, and extreme weather. Scientific professors and private colleges observed more rain variations and higher temperatures. Logistic regression and chi-square studies revealed that public school teachers observed less temperature rise than private school teachers. This corroborates earlier studies showing that academic background and local environmental experiences have a significant impact on opinions on climate change. This finding introduces a critical subjectivity bias: the local environmental reality of the teacher and their professional training directly shape their perception of climate change, which inevitably influences how they teach the topic. If a teacher's academic background or local context limits their recognition of climate shifts, it creates a formidable obstacle to delivering CCE with the necessary urgency and scientific rigor.

This recurrent limitation on generalizability, coupled with the prevailing short-term nature of most evaluations, represents a major knowledge gap. The field is still struggling to demonstrate the long-term impact of CCE initiatives on a student's behavior, advocacy, and professional life^[22]. The repeated call for future studies to track these long-term behavioral effects underscores that while we are adept at measuring immediate cognitive changes, our understanding of whether these programs produce sustained, lifelong environmental engagement remains fundamentally weak.

2.6. Institutional Practice Policies

Benjamin et al. (2024) analyse the progress and difficulties Nigeria faces in achieving SDG13. The study emphasizes how limited knowledge among government officials, inadequate political commitment, reliance on fossil fuels, and insufficient coordination among agencies limit effective climate action^[3]. The authors demonstrate that SDG13 success requires better institutional coordination together with public-private partnerships and strategic funding systems and community-based adaptation initiatives. Future research needs to study the total effects of climate change adaptation initiatives that use local conditions and evaluate partnership success rates in various Nigerian regions^[3].

Developing Climate Change Literacy Through Place-Based Education: A Case Study in Malaysia provides a valuable insight into the effectiveness of Place-Based Education (PBE) in fostering climate change literacy within a Malaysian school setting^[31]. The research shows that student engagement with their current surroundings leads to better climate change impact comprehension and environmental awareness. According to Aboramadan, M. (2022) by emphasizing experiential learning and local context, the research highlights the potential of PBE to cultivate critical thinking and problem-solving skills among students^[32]. Study proves that hands-on community-based learning produces better results than traditional classroom teaching according to research^[33]. Finally, it would be beneficial to conduct a comparative study between traditional and PBE approaches to climate change education^[31].

The review article uses various research findings to show educational institutions their path toward achieving SDG13. The authors Priatna and Monk (2023) highlight three essential elements for climate change education which include curriculum integration and active learning methods and student participation in climate action initiatives^[34]. Tripathy, A.B., Swain, B., & Mishra, M. (2024) pointed out the concerns,

including teacher training and resource limitations, while advocating for institutional policy changes to support sustainability^[35]. The need for holistic approaches, are beyond mere knowledge dissemination to empower students as agents of change^[36]. Future research direction should best focus on more empirical studies on effectiveness evaluations of various pedagogical approaches and curriculum designs in different educational contexts. Investigations into the impact of institutional policies on climate action within schools are also needed. A major systemic contradiction is the lack of coherence within government policy. Kelvin Tang's (2024) critical study on CCE in Indonesia exposed significant policy coherence gaps through an analysis of dozens of policy texts and expert interviews^[37]. Tang (2024) critically found that while dedicated climate change policies emphasize "capacity building," education policies often prioritize moral and character development, leading to a fragmentation of CCE efforts^[37]. This internal policy schism means that CCE is pulled in competing directions, diluting its strategic impact. Despite attempts to embed CCE through innovative structures like the Merdeka Curriculum's project-based CCE and the commendable Adiwiyata Green Schools Award Programme, persistent institutional coordination problems remain.

Tang's (2024) Indonesian analysis also revealed that economic priorities typically dominate CCE. This consistent finding across diverse geographies uncovers a fundamental bias: CCE is often politically subordinated to short-term economic goals, limiting its transformative scope and resulting in efforts that are more about environmental awareness than about challenging systemic, unsustainable economic practices^[37]. The study identified several critical barriers at the governmental level: limited knowledge among officials, inadequate political commitment, heavy reliance on fossil fuels, and insufficient coordination among agencies. This governmental and institutional inertia poses a major gap: even if educational institutions successfully produce informed "agents of change," their impact will be severely limited if the existing political and administrative structure lacks the knowledge, commitment, and coordination to implement large-scale climate action. Successful SDG 13 implementation, therefore, necessitates improved institutional coordination, strategic funding, and strong public-private partnerships alongside educational initiatives.

Considering these challenges, future research directions must pivot to directly addressing policy effectiveness. While the call for empirical studies on pedagogical and curricular efficacy is reiterated, there is a distinct and crucial need for investigations into the impact of institutional policies on climate action within schools^[34,35]. We must move past describing policy failures to empirically assessing the effectiveness of collaboration among stakeholders and the long-term impacts of locally adapted climate initiatives, taking regional differences into account^[3]. This focus will help determine where and how policy intervention can best support the innovative work being done in the classroom.

2.7. Critical analysis

Although there are promising interventions and research efforts to promote SDG13 through education, a closer look reveals gaps and challenges. The literature is prone to celebrating success or outcomes without probing the contradictions embedded in the system sufficiently. For instance, there is an operational bias in the curriculum that emphasises knowledge acquisition and examinations preparation more than practical learning focused on students leading climate actions in real-life^[6,7]. Socio-cultural effects such as peer pressure, family values and community standards are acknowledged but little is done about how these hinder or promote climate change education^[4]. Many reports also have a "sunshine" bias (an overly optimistic outlook) that fails to acknowledge issues of equity; e.g., not all may have the same access to essential climate content in science, geography (where it is taught), limited disaster teaching if geography remains electable for qualification purposes in age 14-16 and sustainability and scalability of interventions^[7]. In terms of methodology, the use of self-reported, short-term data limits full comprehension of long-term program

effects. The use of longitudinal approaches, mixed methods, and multiple stakeholder perspectives is required. Future research and praxis will thus need to adopt a more critical, contextualized perspective that focuses on issues of equity, socio-political dynamics, innovative pedagogy, and ethics in order for education to fulfil its potential for climate action and SDG13.

2.8. Theoretical framework

Scoping Reviews (Arksey & O'Malley, 2005)^[1]

The five-stage scoping review methodology of Arksey & O'Malley (2005) provided a systematic approach that enables researchers to comprehensively map existing literature, synthesize research findings and identify knowledge gaps coherently.

Stage 1: Research Question Development

This process begins with formulating a focused and clear research question that guides the review. This question must balance both specificity and breadth, which allows for comprehensive coverage while maintaining relevance to this study's objectives.

Stage 2: Literature Identification

This stage involves conducting exhaustive literature searches across various sources, including a) academic databases, b) grey literature repositories, c) policy documentations, d) conference proceedings, and e) professional publications.

Stage 3: Selection Process

The research team employs specific criteria for study selection, which involves three screening levels: title assessment, abstract evaluation, and full-text assessment. The research requirements are fulfilled by the structured participant selection method.

Stage 4: Data Organization

The selected studies undergo systematic data extraction, which enables researchers to organize vital information into uniform formats. The research process produces five core elements, which consist of research methodologies and key findings and ethical considerations and policy implications, and contextual factors.

Stage 5: Synthesis and Reporting

The final stage involves synthesizing and analysing the collected data to a) identify emerging themes, b) highlighting research gaps, c) recognizing patterns in existing literature and d) presenting comprehensive findings.

The main methodological drawback of the Arksey and O'Malley framework is that it does not explicitly require a quality assessment of the included studies, even though it is perfect for mapping the CCE terrain^[1]. The absence of quality assessment creates a major threat to a field which relies on limited case studies and policy recommendations and high-quality randomized control trials. The practice of treating all evidence equally results in biased identification of effective practices because it includes untested or unrelated evidence during assessment. The synthesis process needs researchers to evaluate study strength through contextual discussions, which enables them to interpret the mapped literature responsibly.

2.9. Data analysis

Thematic Analysis theory (Braun & Clarke, 2006): Thematic analysis theory refers to a form of *qualitative* research method that requires identifying and subsequently, processing the collected data before

announcing any form of recurring trends (called "themes") within a coded dataset, that would allow researchers to uncover in-depth context and perform interpretations by grouping related concepts and ideas [38].

Key points about thematic analysis theory:

Focus on patterns

The central idea is to find repeating patterns/themes instead of merely summarizing the information.

Flexibility in approach

While there are structured steps, thematic analysis can be applied more flexibly compared to other qualitative methods, allowing researchers to adapt their coding and theme development based on the data.

Inductive vs. Deductive

Inductive: Themes are developed directly from the data without pre-defined categories, allowing for new insights to emerge.

Deductive: Researchers use pre-existing theoretical concepts to guide the coding process and identify relevant themes.

Applications of thematic analysis:

- a) Understanding people's experiences and perspectives on a topic
- b) Exploring social phenomena and trends
- c) Analysing qualitative data from interviews, focus groups, documents, or online discussions

Important considerations:

Researcher bias:

Since thematic analysis involves interpretation, researchers need to be aware of their own biases and actively work to mitigate them.

Reliability and validity:

Ensuring the findings are consistent and can be replicated by other researchers through rigorous coding procedures and clear documentation.

Researcher bias is the main methodological flaw in thematic analysis. Given that the method is essentially interpretive, the themes chosen, ranked, and labeled may unintentionally be influenced by researchers' prior academic knowledge, presumptions about educational policy, or personal views on climate change. The situation demands both urgent academic and ethical intervention. The researchers need to document their entire coding process, from beginning to end, and confirm that their synthesis results have sufficient backing from specific textual evidence in the original studies. The research needs to assess both validity and reliability in its concluding stages. For another researcher to theoretically follow the same path to the same conclusions, the results must be consistent and the interpretation process sufficiently transparent. The research achieves this through its use of strict coding methods and its detailed documentation of code organization and theme development from initial coding to final theme identification. The objective is to generate results that both align with the real data and pass the standards of academic evaluation.

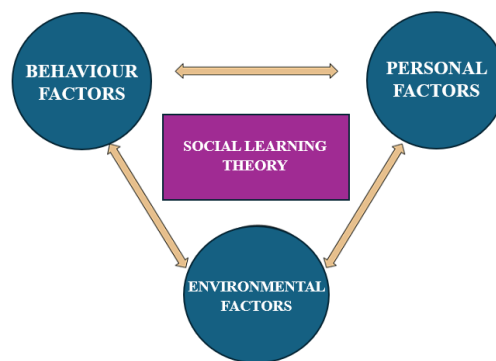
Data Analysis: Social Learning Theory (Bandura, 1977a)^[39]

According to Bandura's SLT, we learn from interacting with others in a social context. We observe, assimilate, and imitate others' behaviour when witnessing positive or rewarding experiences. Although Bandura (1977a) agreed with the behaviourist learning theories of classical conditioning and operant conditioning, he added that i) between stimuli and response, mediating processes exist, and ii) by observing the environment, a particular behaviour is being developed.

The Social Learning Theory provides a solid framework to understand how people change their behavior through habit adoption, but it fails to address the core issue of creating change agents according to CCE's stated objective. SLT mainly concentrates on individual agency and the demonstration of observable actions. The framework lacks sufficient theoretical strength to analyze the intricate non-linear processes that occur in large-scale systemic political engagement and institutional change according to policy coherence research. The theory risks reducing the urgent demand for structural advocacy, challenging corporate or governmental policy to a simpler, manageable problem of individual role-modelling. Therefore, SLT is used to explain the efficacy of behavioural pedagogies; researchers must acknowledge its limited capacity to fully conceptualize the macro-level involvement required to address the crisis's root causes.

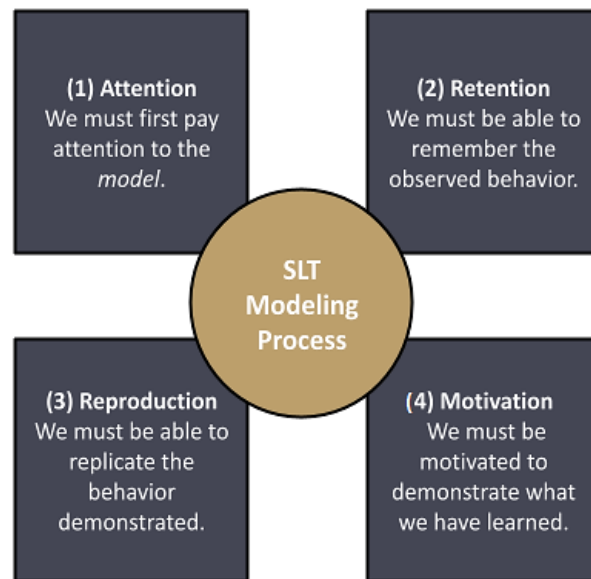
2.10. Stages of the theory: A diagram

The following three processes are interconnected in the development of a person's behaviour (modified from Bandura, 1977b):



- Observation
We observe other people's behaviour.
- Imitation
Following observation, we assimilate and imitate the observed behaviour.
- Modelling
We are more likely to imitate behaviour modelled by people we perceive as similar to ourselves.

“Although behaviourists theorists claim that learning must result in a permanent behaviour-change, social learning theorists demonstrated the importance of cognition and recognizing that learning can occur in the absence of behaviour”, Bandura (1965). Hence, a sample diagram of ‘Behaviour Learned Through Modelling’



3. Methodology

3.1. Research design

Five-stage Scoping Review Methodology (Arksey & O'Malley, 2005)^[1]

Tables for Data (Collection) and Data Charting will be able to synthesize evidence from various research designs (mentioned in the reviewed articles), such as quantitative, qualitative, and mixed-methods studies in order to seek the type of relationship between SDG13 and four specifically focused areas in relation to how SDG13 programmes are being integrated into school curricula and institutional practices in Malaysia. Based on the title, theme, inclusion, and exclusion criteria, a total of 21 articles were selected for the literature review.

3.2. Research framework

Stage 1: Research Question Development

The materialization of the two Research Questions was developed by referring to the list of RQs mentioned in the (21) literature reviewed.

Stage 2: Literature Identification

Type of Literature:

- Peer-reviewed Journal Articles
- Dissertations and Theses

Conference Proceedings

- Chapters from Published Books
- Government Reports and Policy Documents
- Published Books

Academic Databases:

- ResearchGate

- SCOPUS
- MDPI
- Semantic Scholar
- Other Journal Sources
- Books
- Conference

In order to optimize 'search' results and ensure comprehensive coverage, 'Boolean operators (AND, OR)' were applied.

Stage 3: Selection Process

Inclusion Criteria:

- Period: Publications between 2019 and 2025
- Sample Scope: Malaysian Primary and Secondary Schools as Educational Context
- Language: Literature Published in English only

Exclusion Criteria:

- Studies unrelated to SDG13
- Studies related to higher education institutions/teacher training institutions
- Articles without empirical data
- Blog posts and informal publications
- Studies without specific application to the Malaysian context.
- Primary focus on Malaysia's Primary and Secondary Schools as an Educational Context
- Literature published in English only

Stage 4: Data Organization / Data Charting

Key information from selected studies was systematically extracted and organized into dedicated tables (as below) for analysis purposes. Please refer to Appendix A

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
	Research Objectives: Research Questions:	•	•
	Full APA Citation		
Curriculum Development (how climate action is being integrated into different subjects ...)			
Pedagogical Approaches (how project-based learning is addressed ...)			
Student Engagements (strategies to actively involve students ...)			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...)			
Challenges (within Educational Context)			
Ethical Considerations (with regards to Educational Research)			

Stage 5: Synthesizing and Reporting

Consolidating, Analyzing and Presenting the Results

The review-synthesized findings were made through:

- 1) Thematic Analysis Theory (Braun & Clarke, 2006), was applied to seek relationships between SDG13 and 4 other academic areas, namely Curriculum Development, Pedagogical Approaches, Student Engagements and Institutional Practice Policies^[38].
- 2) Social Learning Theory (Bandura, 1977a) was applied to explore if different types of SDG13 awareness programmes had created an effective model in motivating the students into becoming active eco-participants and subsequently, becoming youth advocates and agents of change^[39].

4. Findings and discussion

The intersection of SDG13 and EE organization creates a rich tapestry of considerations that require thorough analysis. This chapter presents the findings in relation to the applied theories and subsequently addresses the research questions posed.

Five-stage Scoping Review Methodology (Arksey & O'Malley, 2005)^[1]

The literature selection process went through the first three stages, and data collected (fourth stage) from the following multiple sources (appended below) were charted accordingly.

Type of Literature:

Peer-reviewed Journal Articles	[13]
Dissertations and Theses	[6]
Conference Proceedings	[1]
Chapters from Published Books	[1]

Academic Database:

a. Source: ResearchGate	[6]
b. Source: SCOPUS	[4]
c. Source: MDPI	[3]
d. Source: Semantic Scholar	[3]
e. Other Sources : ERIC, Frontiers, NPJ, SAGE, and PLOS : 1 article each	[5]

Data collected from all 21 articles were systematically evaluated and placed into the relevant tables for analysis purposes. Please refer to Scoping Review - Data Charting Tables in Appendix 'A'

Thematic Analysis Theory (Braun & Clarke, 2006)^[38]

Researchers have identified and explored critical issues that shape contemporary online education through systematic thematic analysis. The analysis reveals several interconnected themes: between SDG 13 and Curriculum Development, Pedagogical Approaches, Students' Engagement, and Institutional Practice Policies. These themes, which have undergone a comprehensive review of existing literature, have been systematically analysed to provide insights into the existing SDG13 programmes that were integrated into school curricula and institutional practices in Malaysia. The findings from the four areas are as follows:

Curriculum Development

The Malaysian academic system was constructed in accordance with rigorous standards and a structured curriculum; hence, embedding climate action education into existing topics would allow a multidisciplinary exploration of ecosystem issues without major changes to the entire curriculum. For example:

i) Interdisciplinary Approach towards Climate Action Integration:

By combining artistic and scientific knowledge, participants are not only able creatively explore climate change adaptation scenarios but bridge gaps between scientific understanding and creative problem-solving to subjects such as Science (covers CCEE), focusing on sustainability, biodiversity, and the impact of human activities, Biology (includes chapters on ecosystems, biodiversity, and environmental sustainability), Chemistry (discusses sustainable production, consumption, and industrial impacts), Geography (highlights environmental conservation and its relationship between human activities and climate change) and Moral Education (promoting environmental ethics and sustainable living).

ii) Experiential Learning

The activities promote experiential learning where participants simulate real-life climate-related problems and collaboratively create adaptive solutions. The framework proposed by the study focuses on creating concrete learning experiences that emphasize empathy, creativity, collaboration, and critical reflection—performing arts using workshops such as image-theatre, improvisation, and forum-theatre to engage participants in constructing and analyzing narratives related to climate change. Such approaches can be integrated into PBL modules across various subjects.

iii) Educational Platforms and Initiatives:

Within the ESD Integration, the KSSM framework may include themes such as Sustainable production and consumption, Global citizenship and environmental responsibility, and Sustainable transportation and energy consumption. Initiative taken by other international platforms such as European Education (EU) and Training sector's Green Education initiative and the Office of Climate Education under UNESCO and the US agencies support programme called *The GLOBE* Program (Global Learning and Observations to Benefit the Environment), are examples that can be referred to as they provide students with opportunities to voice their ideas, suggestions towards the global environmental existing circumstances.

Survey-based studies have been particularly useful in highlighting curriculum-related gaps and opportunities in climate change education. Ahmed et al. (2022), for example, conducted comparative surveys with public and private school teachers in Bangladesh and found differences in teachers' awareness, confidence, and preparedness to teach climate change content^[30]. These findings point to the critical role of curriculum design in equipping teachers with structured guidance and resources to integrate climate change education effectively.

Pedagogical Approaches

The three most preferred approaches in implementing climate action programmes are PBL, *Experiential Learning*, and *Inquiry-Based Learning*. Advocating real-world, community-based adaptation and mitigation projects, allowing students and local communities to engage in climate action directly, and developing critical thinking and problem-solving skills.

Surveys and qualitative interviews provide insight into how pedagogical strategies are applied and adapted by educators. Ahmed et al. (2022) revealed that teachers' perceptions strongly influence their instructional practices, demonstrating how attitudes and confidence can shape pedagogy^[30]. In addition,

Jacobson et al. (2016) examined the integration of science and art as a pedagogical approach to climate change communication, drawing on participant feedback to evaluate its effectiveness^[40]. Their findings highlight how creative pedagogies, when assessed through qualitative data, can foster deeper engagement with complex issues such as climate change. While these studies emphasize the importance of teaching strategies, others have turned to more structured and activity-based formats such as project-based learning.

Project-Based Learning (PBL)

PBL engages students in a more meaningful 'climate action' awareness activity through skilful and knowledgeable teachers/trainers as well as proper, structured guidelines. Amongst the programmes are:

i) Integration of PBL in Geography Education:

PBL is used to engage students in disaster preparedness activities by having them participate in simulated disaster response exercises, such as mapping high-risk flood areas in their communities.

ii) Hands-on Learning Experiences:

Students will conduct field studies by visiting areas open to natural disasters (e.g., flood-prone regions, landslide slopes). They will be asked to analyse risk factors and propose mitigation strategies. In addition, group research projects are designed for students to investigate climate adaptation measures in different geographical regions.

iii) Student-Centred Approach:

Students are assigned roles (e.g., emergency responders, urban planners, policymakers) to develop a practical understanding of disaster management. In contrast, classroom discussions are held to focus on real-world disaster case studies, allowing students to evaluate and propose solutions critically.

Survey and interview methods were used to evaluate the effectiveness of project-based learning in climate education. A study conducted by Karpudewan et al. (2015) where climate change activities were implemented in primary schools, and pre- and post-intervention questionnaires were used to measure the impact^[41]. The findings showed that PBL helped to enhance students' conceptual understanding and environmental attitudes. Similarly, Jacobson et al. (2016) collected participants' feedback when applying PBL through an integrated art-science project^[40]. The result proved that PBL, supported by evaluative surveys, can serve as an effective pathway for engaging learners with climate-related challenges. Beyond structured projects, experiential forms of learning have also been used to deepen students' personal and emotional connections to climate change.

Experiential Learning (EL):

The practical, hands-on approach require students to be actively involved in environmental activities rather than just learning passively, through outdoor learning, energy audits, and monitoring school energy consumption as practical approaches. Students are brought to visit nature reserves and mangrove swamps to observe environmental impacts firsthand, where such excursions help students to appreciate biodiversity and understand ecological balance, thus strengthening their environmental awareness. Activities such as climate games, PBL, and online courses are used as innovative tools to promote understanding and enhance climate literacy.

To monitor the impact of experiential learning approaches on learners, we used qualitative feedback and reflective interviews in the activities centralized to student learning ^[42]. This would help to synthesize examples of art-based climate education, where participants' reflections were used as proof of increased awareness and personal connection to climate issues. Similarly, Karpudewan et al. (2015) used surveys to

foster meaningful shifts in knowledge and attitudes among young learners in structured experiential activities^[41]. The result had proven that data from interviews, survey, feedback and students' reflections could strengthen the evaluation of curriculum and pedagogy in climate education.

Inquiry-Based Learning (IBL) and Action-Oriented Learning (AOL)

This approach focuses on the importance of helping students connect their actions with environmental consequences. This measure aligns with PBL, where students could engage in real-world energy-saving projects, such as tracking household electricity usage or implementing school-wide conservation initiatives. It is impertinent that the support system recognizes young people as essential stakeholders in climate education, particularly in advocacy and policy engagement.

Technology-Enhanced Learning

Integrating online platforms and digital tools to support climate education provides a context for broadening access and promoting environmental awareness. The use of climate games (gamification), a creative way to engage learners and encourage knowledge retention, is considered a valuable strategy for making climate education more accessible and enjoyable.

Student Engagement

Besides PBL, experiential learning, and inquiry-based learning, students use their voices and actions to influence climate policies and promote sustainable practice by functioning as 'Change Agents.' In order to empower them to actively participate in advocacy, policy engagement, and community-driven climate change programme, the following initiatives have been taken:

Collaborative and Participatory Learning

By encouraging group discussions, role-play, and collective improvisation, students are able to co-create knowledge and develop solutions together. Small group discussions and debates on environmental policies help students develop critical-thinking and critical analyses as well as decision-making skills of climate issues. By working in groups and through peer discussions, learning becomes more interactive, and participants are able to evaluate their performances and propose improvements. In addition, this approach can assist students to stimulate creativity and emotional engagement through improvisation and exploration. This strategy encourages a sense of community and tightens climate resilience among students.

Creative and Artistic Approaches

Climate change education can be enhanced by making complex, abstract, or emotionally heavy topics more relatable, engaging and transformative through creative and artistic approaches. Art can trigger emotional responses that can drive behavior change, increase concern, and build solidarity. For example, poetry and music portraying loss due to climate disasters while creating empathy across cultures or photography exhibits proving the impact of deforestation or drought on communities.

Technology and Social Media Integration

Interactive learning through technology makes climate change education more engaging, hands on and data driven. For instance, making a video production for short documentaries or explainer videos on climate topics. Furthermore, social media acts as megaphone for climate voices, helping students connect, advocate and act. For example, to raise awareness through platforms like Instagram, Tiktok or Twitter. Thus, integrating technology and social media into climate change education can significantly enhance reach, engagement and effectiveness and assist educators present information dynamically.

Student-Centred Activities

To shift the focus from passive learning to active exploration, collaboration, and problem solving, student-centered activities are essential in climate change education. In such activities, students will be able to develop real-world skills while engaging with one of the most critical issues of our time. For instance, inquiry-based projects can encourage students to conduct research on climate-related topics. As for the outcome, this approach enables real-world application and teamwork.

Surveys, interviews, and classroom evaluations show that student engagement in climate change education is shaped by values, attitudes, and the design of learning activities. While awareness of climate issues is often high, active participation depends on opportunities for interactive learning, authentic tasks, and learner-centered approaches. Evidence from student feedback and reflections also highlights that such strategies not only improve climate knowledge but also foster sustained commitment to sustainable behaviours^[43].

Institutional Practice Policies

Policies and practices showed that while efforts to integrate climate action exist, there are obstacles in implementation due to limited training, fragmented curriculum, and a lack of community involvement. Nonetheless, besides those measures applied within the structured curriculum, the following policies do highlight the efforts and gaps in institutionalizing climate action within the Malaysian education system.

National Education Policies on Climate Action

- The Malaysia Education Blueprint 2013–2025 integrates Sustainable Development Goal 4 (SDG4) to ensure inclusive, equitable, and quality education with a focus on sustainability and environmental issues.
- The Global Sustainability Implementation Guide by the Ministry of Education (MOE) provides a framework for schools to integrate sustainability education^[44].
- The Malaysian Education Blueprint 2013–2025 emphasizes the importance of ESD but mentions existing gaps in the full integration of environmental topics.

Implementation of the 3R Campaign (Reduce, Reuse, Recycle)

Schools have introduced 3R campaigns as an extracurricular activity to promote waste management. The study finds that while some urban schools have successfully implemented 3R initiatives, rural schools face setbacks due to a lack of community engagement and resources.

Integration of Climate Action in Education Policies

- The Malaysia Education Blueprint 2013–2025 emphasizes the integration of ESD into the national curriculum.
- The Ministry of Education (MOE) Malaysia introduced the Global Sustainability Implementation Guide to align school curricula with Sustainable Development Goals (SDGs).

Disaster Risk Reduction (DRR) in Geography Curriculum

Schools are integrating the Sendai Framework for Disaster Risk Reduction (2015–2030) into the geography syllabus, which includes disaster preparedness, risk management, and climate adaptation strategies. The challenges are detailed in **Table 1**.

Table 1. Challenges.

1. Exam-Oriented Teaching Approach	<ul style="list-style-type: none"> Due to the lack of emphasis on CCE topics in major national examinations within the Primary School Standards-based Curriculum (KSSR) and KSSM, students are somewhat restricted from fully participating in climate-related activities, as the majority of the teachers are focused on exam preparation rather than experiential learning.
2. Fragmented Curriculum Implementation	<ul style="list-style-type: none"> CCE's apparent dilemma would be the lack of in-depth exploration and poor execution of climate-related topics compared to other core 3R subjects, where topic transitions (intro > basic > intermediate > high) exist from KSSR to KSSM curricula. Moreover, with Geography not being a core subject, it is no longer accessible to all secondary students. Implementing CCE becomes challenging when trying to address all students from varied background and their learning needs within a single approach.
3. Teacher Training and Pedagogical Methods	<ul style="list-style-type: none"> Many teachers lack proper training and rely heavily on textbooks, failing to interpret climate topics creatively. Novice teachers, in particular, struggle with integrating climate change concepts into their teaching. Subject specialization restricts flexibility, making it difficult for teachers to incorporate interdisciplinary environmental education. Some teachers lack the necessary skills to effectively teach disaster risk education. No standardized training programs exist for educators to enhance DRR instruction. Schools vary in their approach to DRR education, with no uniform strategy for teaching disaster preparedness.
4. Limited Student Engagement and Motivation	<ul style="list-style-type: none"> Students show low interest in reading about climate change and prefer interactive, hands-on learning. Socioeconomic barriers (e.g., lack of access to technology, the internet, and resources) further hinder engagement. Students have low self-efficacy in participating in climate action, struggling to apply knowledge in real-life situations. Many students lack sufficient knowledge and awareness about disasters, despite prior exposure. Some students do not fully understand DRR concepts and need additional training or education.
5. Lack of Hands-on Learning Opportunities	<ul style="list-style-type: none"> The curriculum primarily focuses on theoretical knowledge, with limited fieldwork or practical training. Disaster preparedness activities (e.g., emergency drills) are not consistently implemented in schools.
6. Community and Policy Support Deficiencies	<ul style="list-style-type: none"> Rural schools face resistance in implementing environmental programs due to low parental and community involvement. The 3R (Reduce, Reuse, Recycle) campaign is widely promoted in schools, but its impact remains limited without community support. Logistical limitations in organizing field trips and community projects. Limited resources and funding for place-based education initiatives.
7. Marginalization of Climate Change Education (CCE) : Limited inclusion of CCE in formal policies and curriculum.	<ul style="list-style-type: none"> Poor coordination between climate-change policies and educational policies. Economic Prioritization: Economic growth goals often overshadow environmental education efforts. Bureaucratic Complexity: Inefficient coordination among various agencies due to hierarchical structures.

Ethical Considerations

The implementation of climate education in Malaysia raises several important ethical considerations that require careful balance between scientific accuracy, cultural respect, and practical implementation in Malaysia's unique context. Amongst the several key CCE ethical considerations are as follows:

Educational Equity and Access

The commitment to ensuring equal access to quality CCE throughout Malaysia's urban-rural socioeconomic diversity will be an arduous task, as it not only accentuates the educational gaps between well-funded and under-resourced schools, but also the geographical landscape and sporadic rural settlements present less developed educational and technological infrastructure.

Cultural Sensitivity and Indigenous Knowledge

The designing of the CCE curriculum needs to be culturally sensitive due to Malaysia's existing multilayered melting pot of diverse religions, beliefs, customs, and urban-rural-traditional lifestyle practices within the Peninsular and East Malaysia states. Furthermore, the stewards must recognise the importance of respecting and incorporating the deep traditional ecological insights practiced by the indigenous communities within the CCE and not merely applying pure scientific measures alone.

Intergenerational Justice

Young Malaysians should not be held accountable for 'solving' existing global issues just because they were born in a world where technology is at its prime. There must be a balance in CCE implementation approaches, especially when revealing the current climate threats and the measures to address the rising issues. The psychological impact (of realization) that they not only inherited a 'world in distress' but are expected to partake in the global environmental healing can be extremely overwhelming to the students. Implementations of CCE in schools must be subtle and empathetic.

Economic Development Tensions

While Malaysia's economic development and livelihood still gravitate heavily toward industrial sectors such as manufacturing, palm oil production, and fossil fuel extraction, etc, these sectors contribute significantly to emissions. Hence, CCE stewards are required to guide students through accepting contradictory circumstances that may arise, potentially sparking conflicts and ethical tensions, as they strive towards an ecologically sound future.

Government Responsibility and Academic Freedom

The government's involvement in shaping CCE curricula and maintaining a balance between delivering scientific objectivity accurately and preserving academic autonomy is being questioned, especially given varying international perspectives on climate policy and Malaysia's position in global negotiations.

5. Implications and future research

Implications of SDG13 programmes

In an era where environmental issues are worsening over the decades, the role of youth advocacy is becoming pivotal in driving meaningful changes. The power of youth-led campaigns must not be underestimated. They are young, energetic, technology-savvy, curious, and always looking for ways to be of assistance to the community. Despite having a shortfall of relevant knowledge, exposure, and guidance, they are not to be stereotyped as a group of ecosystem illiterates. To solve these setbacks, academic and non-academic institutions, private organizations, NGOs, and educators/teachers/trainers/advocators are now

stepping forward and engaging positively with Primary and Secondary students. Through petitions, meetings, discussions, and advocacy campaigns, youth empower their peers and communities with information on climate change, biodiversity loss, and sustainable practices. By emulating their eco-predecessors, they are able to engage with policymakers and put forth fresh ideas towards policy advocacy.

Every awareness programme developed through curriculum innovation and diverse pedagogical approaches can shape young participants both psychologically and academically, making them more aware of how their actions may either protect or harm the environment. Bandura (1977a) explained that people learn by observing, imitating, and modelling the behaviour of others^[39]. When students engage in project-based, experiential, and inquiry-driven activities, they practice behaviours that support conservation and, when empowered, can amplify their voices as catalysts for change. Moving forward, curriculum development for SDG13 should focus on cross-disciplinary integration, embedding climate concepts across subjects such as Science, English, and Mathematics. Lessons can include greenhouse effect experiments, mapping local climate impacts, reading and public speaking on eco-friendly habits, and interpreting data on carbon emissions or rainfall trends. Climate content should also be locally grounded by linking global issues to Malaysian experiences such as floods, haze, and coral bleaching, while drawing on indigenous knowledge like Orang Asli Forest practices and traditional paddy cycles. Finally, assessment should go beyond memorisation to include project-based campaigns, eco-audits of school resources, and reflection journals that connect classroom learning with personal and community practices. Detailed Recommendations are provided in **Table 2**.

Table 2. Recommendations.

1. Curriculum Development	<ul style="list-style-type: none"> Developing a cross-disciplinary approach that embeds climate concepts across subjects. Lesson Plan Template: <ul style="list-style-type: none"> Science (Year 4): Greenhouse effect experiment with plastic bottles. English (Year 6): Reading & public speaking on eco-friendly habits. Mathematics (Year 6): Data interpretation of Malaysian carbon emissions & rainfall trends. Creating locally relevant climate content that connects global issues with Malaysian contexts. <ul style="list-style-type: none"> Modules linked to Malaysian contexts (Kelantan floods, haze, Sabah coral bleaching). Integration of indigenous knowledge (orang Asli forest practices, paddy cycles). Establishing assessment methods that evaluate climate literacy and action competence. <ul style="list-style-type: none"> Project-based tasks (climate awareness campaigns, eco-audits). Reflection journals on personal and family eco-practices. Rubrics assessing action competence, not just memorization.
2. Curriculum Enhancement	<ul style="list-style-type: none"> Advocates for reinstating Geography as a compulsory subject to ensure comprehensive climate education. <ul style="list-style-type: none"> Ensure structured exposure to ecosystems, climate systems, and disaster management. Align curriculum with Malaysian climate issues such as floods, haze, and coastal erosion. Introduce 'Action-Based Learning' outdoor activities, case studies, and community-based projects for experiential learning. <ul style="list-style-type: none"> Field studies such as mangrove planting and river clean-ups. Case studies of Malaysian events (Kelantan floods, Sabah coral bleaching). Community projects including waste segregation and water-saving campaigns. Empower educators with updated disaster risk reduction methodologies to effectively teach climate action subjects. <ul style="list-style-type: none"> Provide updated DRR teaching modules. Integrate preparedness activities into Science and Geography lessons. Seek a partner with local authorities for simulations and drills.
3. Improving Project-Based Learning (PBL)	<ul style="list-style-type: none"> Developing structured guidelines to help teachers integrate PBL into lesson plans. <ul style="list-style-type: none"> Frameworks for lesson planning and assessment. Sample projects such as school energy audits or zero-waste initiatives. Providing teacher training programs focused on experiential learning techniques.

	<ul style="list-style-type: none"> - Workshops on inquiry-based and problem-solving methods. - Sharing of best practices across schools. • Enhancing collaboration with government agencies and NGOs for real-world disaster education projects. <ul style="list-style-type: none"> - Invite experts for talks and project mentoring. - Joint campaigns and disaster preparedness activities. - Organized student visits to environmental centres.
4. Improving Student Engagement	<ul style="list-style-type: none"> • Incorporate more real-world disaster scenarios into the curriculum. <ul style="list-style-type: none"> - Simulations on flood evacuation or haze impacts. - Critical reflection on current Malaysian climate events. • Train teachers in interactive and experiential learning approaches. <ul style="list-style-type: none"> - Role play, debates and public speaking on eco-topics. - Encourage use of digital resources such as AR/VR simulations and eco-apps.
5. Capacity Building	<ul style="list-style-type: none"> • Comprehensive teacher professional development focused on climate-related pedagogy. <ul style="list-style-type: none"> - Continuous training in climate pedagogy and sustainability education. - Access to updated teaching resources and climate data. • Student leadership programs that empower youth as climate champions. <ul style="list-style-type: none"> - Establish Eco-Club leaders or Climate Ambassadors in schools. - Create platforms for youth climate advocacy. • Administrative training for school leaders on sustainability management <ul style="list-style-type: none"> - Modules on sustainable management of energy, water, and waste. - Guidance for implementing and monitoring green initiatives.
6. Institutional Transformation	<ul style="list-style-type: none"> • Implementing a whole-school sustainability approach beyond classroom teaching <ul style="list-style-type: none"> - Embed climate action into the vision, policy, and culture. - Reduce resource consumption through school-wide practices. • Building school-community partnerships for climate action projects <ul style="list-style-type: none"> - Joint projects with parents, councils, and industries. - Community participation in tree planting and recycling drives. • Establishing green certification programs for educational institutions <ul style="list-style-type: none"> - Recognition for schools meeting sustainability standards. - Provide incentives for continuous improvement.
7. Policy Enhancement	<ul style="list-style-type: none"> • Strengthening teacher training on environmental education through specialized workshops. <ul style="list-style-type: none"> - Focus on environmental education, climate resilience, and DRR. - Collaboration with universities and training institutes. • Developing more cohesive guidelines for integrating climate action into teaching. <ul style="list-style-type: none"> - Establish a national framework to embed climate education in all subjects. - Develop monitoring and evaluation tools for implementation. • Encouraging effective waste chain management as part of school sustainability policies to promote the 'Waste to Wealth' approach. <ul style="list-style-type: none"> - Composting and recycling to be integrated into school culture. - Income-generating projects from recycled materials. • Expanding 3R campaigns beyond urban schools to engage rural communities. <ul style="list-style-type: none"> - Resource support for reduce, reuse, and recycle practices. - Culturally appropriate local engagement. • Make geography a core subject to ensure all students learn about climate resilience. <ul style="list-style-type: none"> - Strengthen student understanding of climate resilience. - Ensure equal access in rural and urban contexts. • Expand government and NGO collaboration to provide resources and real-world learning opportunities. <ul style="list-style-type: none"> - Provide schools with resources, workshops and campaign materials. • Engage students in national climate initiatives.

Table 2. (Continued)

6. Conclusion

To successfully integrate SDG13, climate education must be embedded in the national curriculum rather than treated as an optional enhancement. The Ministry of Education must introduce clear guidelines for incorporating sustainability topics into core subjects and equip educators with the skills and confidence to teach them effectively. A focused effort by stakeholders (government ministries, private and semi-

government industrial key players, academic institutions' governance, and the general public) is required to address the different types of naiveté/obliviousness they pose. By empowering stakeholders, developing collaborative annual programmes and implementing SDG13 awareness activities within the schools' curricula, a community may transition from being environmentally illiterate to an active, eco-conscious society with a positive drive to be different. Such a form of transitional journey would ensure that more effective and resilient efforts are taken towards environmental sustainability, benefiting future generations. In a nutshell, incorporating SDG13 into Malaysian educational institutions offers a significant opportunity to tackle climate-related issues and equip future generations with the necessary skills. Only through the systematic integration of climate action awareness programmes into both the curriculum and institutional operations can Malaysian schools play a pivotal role in producing environmentally conscious citizens ready to address the damaging impact of global warming.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A

Climate Action Programmes in Malaysian Education: Integrating SDG13 into School Curricula and Institutional Practices

Scoping review – data collection and data collection for thematic analysis

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
1 / Qualitative	<p>Research Objectives:</p> <ul style="list-style-type: none"> To investigate the effectiveness of place-based education (PBE) in developing climate change literacy among Malaysian students. To explore how PBE influences students' understanding of climate change issues. <p>Research Questions:</p> <ul style="list-style-type: none"> How does place-based education influence students understand of climate change concepts? What are the perceived benefits of using place-based education for developing climate change literacy? 	<ul style="list-style-type: none"> The study offers valuable insights on an innovative teaching approach for climate change education in Malaysia. The findings can guide educators and policymakers in utilizing PBE to improve students' climate change literacy and encourage environmental stewardship. It serves as a practical example of teaching climate change education in Malaysia. 	<ul style="list-style-type: none"> Relying on qualitative data like interviews and observations could lead to subjective interpretations. Context Specific. The research took place in a single school in Malaysia, making it difficult to generalize the results to other schools or regions in Malaysia. There is a possibility of researcher bias in both the collection and analysis of data in qualitative research.
<p>Full APA Citation Syed-Abdullah, S. I. S., Kushnir, I., & Abdrahim, N. A. (2023). Narratives on Education for Sustainable Development in Malaysian universities. <i>Sustainability</i>, 15(17), 13110. https://doi.org/10.3390/su151713110</p>			
<p>Curriculum Development (how climate action is being integrated into different subjects ...) Integration of local environmental issues into science and social studies curricula. Development of place-based learning modules focusing on climate change impacts in the local area.</p>			
<p>Pedagogical Approaches (how project-based learning is addressed ...) Project-based learning through community investigations and environmental monitoring. Experiential learning through field trips and outdoor activities.</p>			
<p>Student Engagements (strategies to actively involve students ...) / Active participation in community-based climate action projects. Collaborative learning through group investigations and discussions. Students are engaged in environmental monitoring and data collection.</p>			
<p>Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Support for field trips and outdoor learning activities. Collaboration with local community organizations and environmental agencies. Teacher training on place-based education and climate change education.</p>			
<p>Challenges (within Educational Context) / Logistical challenges in organizing field trips and community projects. Limited resources and funding for place-based education initiatives. Teacher training and capacity building for implementing PBE.</p>			
<p>Ethical Considerations (with regards to Educational Research) / Ensuring informed consent from students and community members involved in projects. Protecting the privacy of community members and their data. Respecting local cultural and environmental sensitivities.</p>			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
2 / Conceptual	Research Objectives : <ul style="list-style-type: none">To show how institutions can help with curriculum development, research, advocacy, and sustainable practices.To stress the significance of promoting behavioral change, supporting policy advocacy, and building resilience. Research Questions <ul style="list-style-type: none">What is the significance of education in mitigating climate change impacts and achieving SDG 13?How can educational institutions effectively contribute to climate change education and action?	<ul style="list-style-type: none">Underscores the importance of integrating climate change education into curricula to foster climate literacy and promote sustainable behaviors.	<ul style="list-style-type: none">Conceptual and review-based studies may be subject to the biases of the authors in selecting and interpreting the literature.
	Full APA Citation Priatna, D., & Khan, S. M. (2024b). The importance of education and role of educational institutions in climate change mitigation and achieving UN SDG 13 Climate Action. <i>Indonesian Journal of Applied Environmental Studies</i> , 5(1), 1–5. https://doi.org/10.33751/injast.v5i1.10559		
Curriculum Development (how climate action is being integrated into different subjects ...) Advocates for integration of climate change concepts across various subjects, fosters critical thinking and problem-solving skills related to climate issues.			
Pedagogical Approaches (how project-based learning is addressed ...) Promotes the use of pedagogical approaches that encourage active learning, such as project-based learning, experiential learning, and inquiry-based learning. These approaches are seen as essential for developing students' ability to analyze and address climate change challenges.			
Student Engagements (strategies to actively involve students ...) Emphasizes the importance of engaging students in real-world activities related to climate action, such as community projects, environmental monitoring, and advocacy initiatives. These strategies aim to empower students to become active agents of change.			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Highlights the need for educational institutions to adopt policies and practices that support climate action, such as reducing their carbon footprint, promoting sustainable resource use, and integrating sustainability into their operations.			
Challenges (within Educational Context) Identify challenges such as a lack of teacher training, inadequate resources, and the need for greater policy support. It also acknowledges the challenge of integrating climate change education into already crowded curricula.			
Ethical Considerations (with regards to Educational Research) / Ethical responsibility to promote sustainable actions.			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitation
3 / Mixed- Method	Research Objectives : <ul style="list-style-type: none">To evaluate the impact of integrating Sustainable Development Goals (SDGs) into the International School Curriculum.To investigate the factors influencing the adoption and implementation of SDG-integrated curricula in international schools Research Questions <ul style="list-style-type: none">How does the integration of SDGs into the International School Curriculum affect students' knowledge, attitudes, and behaviors related to sustainable development?What are the key factors that influence the successful implementation of SDG-integrated curricula in international schools?	<ul style="list-style-type: none">Provides empirical evidence on the effectiveness of integrating SDGs into international school curricula.Offers insights into best practices for implementing SDG-related education, <u>update</u> curriculum development and teacher training.	<ul style="list-style-type: none">n/a
	Full APA Citation Thomas, N. U. W. P., Devasia, N. D. S. N., Subrmanian, N. D. P., Williams, N. D. M. J., & Baba, N. D. H. N. (2020). Integrating UNSDG in International School's curriculum: Nurturing a Sustainable Society in Malaysia. <i>GIS Business</i> , 15(2), 194–212. https://doi.org/10.26643/gis.v15i2.18906		
	Curriculum Development (how climate action is being integrated into different subjects ..) Advocates for the integration of SDG-related content, including climate action, across various subjects, emphasizing interdisciplinary connections and real-world applications.		
Pedagogical Approaches (how project-based learning is addressed ...) Likely promotes the use of active learning strategies, including project-based learning, inquiry-based learning, and collaborative learning, to engage students in exploring and addressing SDG-related issues.			
Student Engagements (strategies to actively involve students ...) Encourages student participation in community projects, environmental initiatives, and advocacy campaigns to foster a sense of agency and responsibility in addressing climate change.			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Highlights the need for schools to adopt policies and practices that support sustainability, such as reducing energy consumption, promoting waste reduction, and integrating sustainability into school operations.			
Challenges (within Educational Context) Addresses challenges related to curriculum implementation, teacher training, resource availability, and the need for greater institutional support for SDG-related education.			
Ethical Considerations (with regards to Educational Research) Given the mixed-methods nature of the study, ethical considerations likely include obtaining informed consent from participants, ensuring data privacy and confidentiality, and adhering to IRB guidelines, accurate representation of the SDG goals, and the avoidance of any "greenwashing" within the curriculum.			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
4 / Mixed-Method	Research Objectives: <ul style="list-style-type: none">Evaluate the effectiveness of a learner-centered planetary health assignment in developing students' competencies related to Sustainable Development Goal (SDG) 13 (Climate Action) and additional SDGs. Research Questions: <ul style="list-style-type: none">Did the assignment meet its intended outcomes in increasing awareness, responsibility, advocacy, and related skill development among medical students?	<ul style="list-style-type: none">Addressing climate change through authentic student assignments, fostering planetary citizenship.	<ul style="list-style-type: none">Self-reported data (subjective biases), limited generalizability beyond the studied university context.
	Full APA Citation McLean, M., Phelps, C., Smith, J., Maheshwari, N., Veer, V., Bushell, D., Matthews, R., Craig, B., & Moro, C. (2022). An authentic learner-centred planetary health assignment: A five-year evaluation of student choices to address Sustainable Development Goal 13 (Climate Action). <i>Frontiers in Public Health</i> , 10. https://doi.org/10.3389/fpubh.2022.1049932		
	Curriculum Development (how climate action is being integrated into different subjects ...) Integration into medical education curriculum with explicit connections to SDG 13 and additional SDGs (12, 3, 6). Longitudinal embedding of planetary health from the first year through to clinical rotations.		
Pedagogical Approaches (how project-based learning is addressed ...) Emphasis on authentic, student-led project-based learning where students identify climate issues and propose real-world solutions. Inclusion of teamwork, systems thinking, and design thinking methodologies in developing actionable products.			
Student Engagements (strategies to actively involve students ...) Allowing students autonomy in choosing teams, topics, audiences, and formats of their deliverables. Encouraging creative expression through diverse deliverable formats such as policy documents, websites, videos, and apps			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Bond University's explicit commitment to integrating planetary health across its medical curriculum, guided by the SDGs. Supporting student advocacy and outreach by sending student-developed materials to government bodies and healthcare institutions. Commitment to planetary citizenship and global citizenship as graduate attributes.			
Challenges (within Educational Context) Self-report measures may reflect subjective biases in students' perceived skills and attitudes. Ensuring effective integration and consistent evaluation of planetary health education across curriculum phases.			
Ethical Considerations (with regards to Educational Research) / Institutional ethics approval obtained, ensuring ethical handling of student-generated data. Consideration of cultural sensitivity through integration of Indigenous ecological knowledge and perspectives.			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
5 / Qualitative	<p>Research Objectives:</p> <ul style="list-style-type: none"> To critically analyze challenges in current climate education, identify issues preventing climate education from translating into effective action, and suggest improvements to achieve Sustainable Development Goal 13 (Climate Action). <p>Research Questions:</p> <ul style="list-style-type: none"> What factors hinder educators and students from effectively engaging in climate action? How can these challenges be addressed to facilitate climate education to action? 	<ul style="list-style-type: none"> Identifies obstacles for students and educators in climate action. Emphasizes the need for curriculum transformation and practical integration. 	<ul style="list-style-type: none"> Specific challenges in different cultural and educational settings may limit generalizability.
<p>Full APA Citation Franco, I. B., Tapia, R., & Tracey, J. (2019). SDG 13 Climate action. In <i>Science for sustainable societies</i> (pp. 219–228). https://doi.org/10.1007/978-981-32-9927-6_14</p>			
<p>Curriculum Development (how climate action is being integrated into different subjects...) Integrating climate change topics into formal and informal curricula, emphasizing practical actions and sustainable lifestyle education. Linking sustainability issues to real-life student contexts, enhancing relevancy and actionability.</p>			
<p>Pedagogical Approaches (how project-based learning is addressed ...) Promoting student-driven research and real-world problem-solving, encouraging students to develop and apply their own solutions. Employing innovative, context-based methodologies rather than traditional, abstract teaching methods</p>			
<p>Student Engagements (strategies to actively involve students ...) Incentivizing sustainable behaviors through extracurricular initiatives (e.g., sustainable product markets, clothing swaps, leadership campaigns). Using relatable technology platforms (apps) to engage students actively in sustainability actions.</p>			
<p>Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Establishing robust educator training and professional development in climate education. Encouraging partnerships among schools, public authorities, and private sector stakeholders to develop and support climate-focused curriculum and activities.</p>			
<p>Challenges (within Educational Context) Resistance to lifestyle changes among students due to unsustainable cultural norms and peer influence. Educators' limited expertise and capacity to deliver effective, action-oriented climate education. Curriculum overcrowding and insufficient funding/resources dedicated to climate education</p>			
<p>Ethical Considerations (with regards to Educational Research) Ensuring diverse stakeholder voices, especially marginalized groups, are represented ethically and accurately in climate education research. Recognizing cultural sensitivities and avoiding imposing standardized global solutions without contextual relevance.</p>			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
6 / Qualitative	Research Objectives: <ul style="list-style-type: none">Critically examine Nigeria’s progress and challenges in implementing Sustainable Development Goal 13 (Climate Action). Research Questions: <ul style="list-style-type: none">What are the key challenges and progress points in the implementation of SDG 13 within Nigeria?	<ul style="list-style-type: none">Provides in-depth insights into local-level implementation challenges and strategic recommendations, highlighting the importance of inter-agency collaboration and institutional coordination in Nigeria’s context.	<ul style="list-style-type: none">Study is focused exclusively on Nigeria, limiting broader generalization to other developing nations or different political/economic contexts
	Full APA Citation Benjamin, K. T., Osasumwe, O. F., Amuche, E. O., Rebecca, K. K., & Issac, K. S. (2024). Navigating climate action in Nigeria: Assessing Sustainable Development Goal 13 implementation and challenges. <i>Journal of Law and Sustainable Development</i> , 12(1), 1–22. https://doi.org/10.55908/sdgs.v12i1.971		
Curriculum Development (how climate action is being integrated into different subjects ...) / Emphasis on integrating climate action knowledge into community education, improving awareness at the grassroots level. Development of targeted local Edu prog reflecting Nigeria’s specific climate challenges.			
Pedagogical Approaches (how project-based learning is addressed ...) Emphasis on integrating climate action knowledge into community education, improving awareness at the grassroots level. Development of targeted local educational programs reflecting Nigeria’s specific climate challenges.			
Student Engagements (strategies to actively involve students ...) Encouraging practical experiences through community initiatives, local adaptation efforts, and educational campaigns led by NGOs. Involving youth actively as SDG ambassadors to spread awareness and advocate climate-friendly lifestyles			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Establishing comprehensive frameworks, i.e. Lagos Climate Action Plan, including specific climate resilience and mitigation measures. Enhancing coordination among governmental bodies, NGOs, community groups, and other stakeholders through structured collaboration mechanisms.			
Challenges (within Educational Context) Limited government awareness and understanding of climate issues and insufficient training among educators and officials. Persistent dependence on fossil fuels and financial constraints significantly hinder the adoption of sustainable practices. Fragmented and isolated actions by multiple agencies lacking a unified climate strategy.			
Ethical Considerations (with regards to Educational Research) / Importance of ethically representing local communities in research, ensuring their participation in decisions related to climate adaptation strategies. Addressing equitable resource allocation and inclusive involvement of vulnerable and marginalized groups in climate actions.			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
7 / Quantitative	<p>Research Objectives:</p> <ul style="list-style-type: none"> To examine how teachers' institutional affiliations, academic backgrounds, and experiences with climate impacts shape their perceptions of climate change. <p>Research Questions:</p> <ul style="list-style-type: none"> How do teachers perceive climate change? What factors influence these perceptions? <p>Hypothesis</p> <ul style="list-style-type: none"> Teachers' perceptions vary based on type of institution, academic background, and exposure to extreme weather events. 	<ul style="list-style-type: none"> Supports curriculum improvement and teacher training for climate change education. 	<ul style="list-style-type: none"> Limited to three institutions in Sylhet; findings may not generalize to all of Bangladesh.
<p>Full APA Citation</p> <p>Ahmed, M. N., Ahmed, K. J., Chowdhury, M. T., & Atiqul Haq, S. M. (2022). Teachers' Perceptions About Climate Change: A Comparative Study of Public and Private Schools and Colleges in Bangladesh. <i>Frontiers in Climate</i>, 4, 784875. https://doi.org/10.3389/fclim.2022.784875</p>			
<p>Curriculum Development (how climate action is being integrated into different subjects ...) Incorporation of climate change topics into existing environmental science and geography curricula. Recommendation for climate education modules in teacher training programs.</p>			
<p>Pedagogical Approaches (how project-based learning is addressed ...) Encourages problem-solving and project-based learning around local climate issues and extreme weather events. Recommends experiential learning through discussions and seminars.</p>			
<p>Student Engagements (strategies to actively involve students ...) Promotes teacher-student discussions on local environmental challenges. Encourages student projects on climate change adaptation strategies.</p>			
<p>Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Suggests integrating climate risk awareness into school policies. Advocates for school participation in environmental organizations and programs.</p>			
<p>Challenges (within Educational Context) Lack of formal training for teachers on climate-related topics. Variability in perceptions based on school type and teachers' academic backgrounds.</p>			
<p>Ethical Considerations (with regards to Educational Research) Ensures confidentiality and informed consent of participants. Highlights voluntary participation and anonymity of teacher responses.</p>			

Article No / Type of Study	Research Objectives, Research Questions	Significance	Limitations
8 / Qualitative	Research Objectives: <ul style="list-style-type: none">To evaluate the impact of three interactive activities on improving children's climate literacy and motivation for pro-environmental behavior. Research Questions: <ul style="list-style-type: none">How do these activities influence children's understanding of climate change? Do they motivate behavioral change?	<ul style="list-style-type: none">Enhances environmental education using engaging methods.	<ul style="list-style-type: none">Small, region-specific sample; does not measure long-term impact.
	Full APA Citation Ramos, R., Rodrigues, M. J., & Rodrigues, I. (2024). Activity Proposals to Improve Children’s Climate Literacy and Environmental Literacy. <i>Education Sciences</i> , 14(2), 194. https://doi.org/10.3390/educsci14020194		
Curriculum Development (how climate action is being integrated into different subjects ...) Integrated into environmental studies, science, and citizenship education. Focus on ecological footprints, greenhouse effect, and sustainability topics.			
Pedagogical Approaches (how project-based learning is addressed ...) Project-based learning using terrarium construction and board games. Active learning combining play, inquiry-based learning, and storytelling.			
Student Engagements (strategies to actively involve students ...) Group activities (e.g., board games and collaborative projects). Class discussions and role-playing to reflect on real-world environmental issues.			
Institutional Practice Policies (identifying policies/practices within schools that support climate action ...) Teachers' limited preparation in climate-related content. Complexity of translating scientific climate concepts into child-friendly language.			
Challenges (within Educational Context) Lack of formal training for teachers on climate-related topics. Variability in perceptions based on school type and teachers’ academic backgrounds.			
Ethical Considerations (with regards to Educational Research) Obtained informed consent from parents and children. Protected anonymity and allowed voluntary participation with the right to withdraw.			

(Continued)