

# Climate Change Education: Bridging the Gap Between Knowledge and Mitigation Actions for Achieving Sustainable Development Goal (SDG)13

Nur Atiqah Farzana Zaini and Kamisah Osman

Faculty of Education, National University of Malaysia, Bangi, Malaysia

Email: atiqahfarzana940@gmail.com, kamisah@ukm.edu.my

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## Abstract

To raise students' awareness of climate change and foster their development of sustainable literacy, this systematic review article focuses on the value of pedagogical approaches in the field of climate change education. It also discusses initiatives that have been taken to support students' global competencies on climate change. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) format was modified for the review of the recent study, which used Scopus and Science Direct as its primary databases. The results show that 12 articles were properly chosen, and they were then critically and methodically examined. To raise schoolchildren's understanding of climate change, the review has effectively identified six main educational approaches: Transformative approach, Interdisciplinary approach, Participatory approach, Problem-based learning, System-thinking approach, and Community-based approach. Apart from that, there are three key factors that influence willingness to adopt climate change mitigation action including sociodemographic factor, environmental factor, and internal factor. In fact, the results of this systematic review will provide meaningful information, especially to educators in developing more effective, efficient, and sustainable strategies that will shape future globally competent citizens in mitigating and adapting to climate change issues and problems to enhance their willingness to act.

**Keywords:** Climate Change Education, Mitigation, Knowledge, Educational Approach, Sustainable Development Goal (SDG).

## Introduction

Climate change is a critical global challenge that affects every aspect of our lives, with children being the most vulnerable to its impacts. Due to their unique physiological, psychological, and developmental characteristics, children are at a higher risk from the adverse effects of climate change and disasters. This vulnerability is compounded by a lack of awareness and education regarding their safety in the face of these challenges (Dr. Abdul Rashid Abdul Azizi, 2021). A 2021 study conducted in collaboration with the National University of Malaysia (UKM), the

University of Science Malaysia (USM), and UNICEF highlights the significant threats posed by climate change and environmental degradation to children's health. The study reveals that while 64% of the 1,101 Malaysian youngsters surveyed expressed concern about climate change, only 5% believed that Malaysia is adequately prepared to handle future climate-related disasters. This gap in perception and preparedness underscores the urgent need for enhanced climate education. Research has shown that awareness of climate change among school students, such as those in SMK Bintulu, is primarily developed through classroom education and environmental activities. However, this awareness does not always translate into proactive behaviors due to limited exposure to information about human contributions to climate change (Izzah and Wan Asrina, 2021). Therefore, there is a pressing need for comprehensive efforts and actions to improve awareness, attitudes, and skills related to disaster risk mitigation among students. In response to this need, today's Science curriculum increasingly integrates climate change education to align with the primary objective of Sustainable Development Goal 13, which calls for urgent action to combat climate change and its impacts. By educating students about the science behind climate change, its causes, and its far-reaching impacts, the curriculum aims to foster a deeper understanding among students of the urgency and complexity of climate-related challenges. This approach not only prepares future generations to address these issues but also encourages critical thinking and innovative solutions to mitigate and adapt to the effects of climate change on a local, national, and global scale.

### **Significance of the Study**

The study aims to fill the existing gaps in climate education by providing comprehensive information on the causes and effects of climate change. Current educational programs often lack depth in this area, resulting in students being aware of climate change but not fully understanding their role in mitigating its effects. By integrating climate change education into the curriculum, the study seeks to provide students with a robust understanding of the issue, thereby fostering a generation that is better equipped to tackle climate challenges. Educating them about climate change equips them with the knowledge and skills necessary to make informed decisions and take effective actions in the future. This empowerment is crucial for fostering a sense of responsibility and urgency in addressing climate-related issues, ensuring that future leaders are prepared to implement sustainable practices and policies. Awareness alone is insufficient; it must translate into action. This study emphasizes the importance of not just educating students about climate change but also instilling behaviors that contribute to environmental conservation. By involving students in practical environmental activities and providing them with strategies to reduce their carbon footprint, the study promotes a proactive approach to climate change mitigation. Besides, the findings of this study have the potential to influence public policy and educational curriculum development at a national level. By demonstrating the effectiveness of integrated climate education, the study can serve as a model for other regions and countries facing similar educational challenges. Policymakers can use the insights gained to implement nationwide programs that prioritize climate education, ensuring that it becomes a fundamental part of the school curriculum. Besides, environmental stewardship involves taking responsibility for the conservation and sustainable use of the environment. By educating students about climate change and its impacts, the study fosters a sense of stewardship among young individuals. This sense of responsibility extends beyond the classroom, encouraging students to engage in community initiatives and advocate for environmental protection. In fact, educating children about climate change has

a ripple effect on the wider community. As students share their knowledge and engage in environmental activities, they raise awareness among their families and peers. This increased awareness contributes to building more resilient communities that are better prepared to respond to climate-related disasters. By aligning the curriculum with Sustainable Development Goal 13, the study contributes to global efforts to combat climate change and its impacts. Educating students about climate change supports other related SDGs, such as SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), and SDG 7 (Affordable and Clean Energy). This integrated approach ensures a holistic contribution to sustainable development. Integrating climate change education into the Science curriculum is crucial for achieving SDG 13, empowering students to become informed global citizens who contribute to sustainable development and environmental stewardship, while addressing educational gaps and providing a foundation for effective nationwide climate education strategies.

### Research Problem

In Malaysia, the main challenge in promoting climate action is the low public awareness of how climate change and environmental damage affect families and children, coupled with limited knowledge about effective adaptation and mitigation strategies to protect them. Rapid population growth and economic development have intensified greenhouse gas emissions, waste generation, and environmental degradation, placing additional stress on the environment. As a result, Malaysia faces increasingly unpredictable weather patterns, irregular rainfall, rising temperatures, and hazardous weather events due to human-induced climate change. In fact, UNICEF's Children Climate Risk Index highlights Malaysia's ranking at 61st globally in terms of inadequate attention to children's vulnerability to climate risks and environmental impacts. In the next 20 years, more severe climate change effects have been Apart from that, Azmi et al., (2022), found significant gaps in disaster preparedness among NATECH agencies in Malaysia due to insufficient training and infrequent disaster occurrences. Climate change and environmental degradation adversely affect children's health through floods, waterborne diseases, vector-borne illnesses, air pollution-related issues, and exposure to hazardous materials. Despite this, a joint study by UKM, UNICEF, and UMS revealed that existing laws and policies addressing these issues were established before global concerns about climate change emerged. Children were not specifically targeted in these policies, and national plans lacked explicit measures to protect children's rights according to UNCRC guidelines amidst environmental and climate-related risks. In 2021-2022, Malaysia faced one of its worst flood disasters, causing losses of around 6.1 billion Malaysian Ringgit and impacting about 70,000 people (Adawiyah et al., 2023). Previous studies highlighted a gap between students' environmental knowledge and their pro-environmental behaviors, revealing their limited readiness to address climate change risks in Malaysia (Kolenatý et al., 2022).

Thus, the education sector plays a pivotal role as a vital channel for spreading awareness about environmental health and climate change through various educational initiatives within the school system, conducted by both public and private institutions, government agencies, and community organizations. Therefore, educators must employ effective pedagogical approaches to increase students' readiness for climate-related behaviors and to promote What type of pedagogical approach in climate change education can stimulate students' readiness for climate-related behaviors from a holistic learning perspective?

### Research Question

1. What type of pedagogical approach in climate change education can stimulate students' readiness for climate-related behaviours from a holistic learning perspective?
2. What are the factors influencing students' readiness to take mitigation actions against the climate change crisis?

### Methodology

Systematic Literature Review (SLR) is a method used to identify, assess, and synthesize existing works recorded and produced by researchers (Moher et al., 2009). In the context of this study, the researchers also utilized the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart in the selection of articles related to the research question as stated. To obtain information regarding the research question, the researchers went through four stages in the PRISMA flowchart, which include identification, screening, eligibility, and inclusion stages for articles in the SLR study conducted (Liberati et al., 2009). Thus, this SLR study encompasses search strategies, selection criteria, the selection process, data collection, and data analysis for the obtained articles. Two search engines in the database were used to search for articles and journals, namely SCOPUS and Science Direct.

### Identification

Prominent databases including Science Direct and SCOPUS were used to find publications that addressed the research topic in the SLR that was conducted). This process began by creating a series of keyword search strings, using the guidelines and search capabilities available as specified in the Scopus and Science Direct databases and were assisted by the Boolean Operator function in both databases. The keywords and search strings used can be reused to obtain the latest materials and upcoming research. To find papers pertaining to the research issue, the keywords "Disaster Risk Reduction," "Climate Change Education," "teacher," and "students" were used. One of the main criteria used in the analysis of this study is the level of awareness regarding disaster education at the school level.

Table 1

*Database Keyword*

| Database       | Search String                                                                                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCOPUS         | TITTLE-ABS-KEY ((“disaster risk reduction” OR “ climate change education”) AND (“students” OR “teachers” OR “climate change pedagogical content knowledge” OR “school”)) |
| Science Direct | (“disaster risk reduction” OR “climate change education” AND “students” OR “teachers” OR “climate change pedagogical content knowledge” OR “ school”)                    |

### Screening

To obtain articles that meet the study criteria, several aspects of article selection have been specified, including publication year, language, type of reference material, and the field of study involved, as indicated in Table 2. This stage involves the authors conducting a screening based on specific criteria to make the article selection more detailed and aligned with both research questions. The first stage of article selection involves excluding any articles from book chapters, seminar articles and proceedings, as well as literature review articles. The second

step is for the authors to select only articles in English and related to the fields of Education, Science, Technology, and SDGs. The third step is the publication time frame of articles, which is from 2015 to 2023. After the screening process, only a total of 12 articles were chosen. Although the excluded articles are not included in the study analysis, they may be used as additional references.

Table 2

*Criteria for Inclusion and Exclusion of Articles*

| Criteria                          | Inclusion                                | Exclusion                                                             |
|-----------------------------------|------------------------------------------|-----------------------------------------------------------------------|
| <b>Publication Year</b>           | Publication from 2015-2023               | Publication before 2015                                               |
| <b>Language</b>                   | English                                  | Apart from English                                                    |
| <b>Type Of Reference Material</b> | Article Journal                          | Proceedings, Conferences and chapter in a book, review, meta-analysis |
| <b>Field of Study</b>             | Education, Sciences, Technology and SDGs | Apart from Education, Sciences, Technology and SDGs.                  |

**Eligibility**

At this stage, the authors focused only on articles that discussed the factors influencing readiness to take mitigation actions in response to the climate change crisis and articles related to pedagogical approaches in climate change education. All 34 articles were analyzed by conducting a thorough reading, starting with the abstract and followed by the entire article. Through reading and examination, only 12 articles were selected because their content was relevant to the research question. The entire article selection process for the purpose of this Systematic Literature Review (SLR) is shown and explained using the PRISMA flowchart in Figure 1.

**Inclusion**

Based on the search results from these keywords, the authors found 803 articles through Scopus and 305 articles from Science Direct. Eight articles overlapped in both databases with the assistance of Endnotes software. After screening, 12 articles that met the required criteria were chosen. An expert conducted a secondary review to prevent bias. Articles were reassessed based on established criteria to ensure they met the standards for inclusion in the final selection. The selected articles are listed in Table 3. Figure 1 is the illustration of the flowchart of the article selection process, adapted from the PRISMA flowchart (Tawfik et al., 2019).

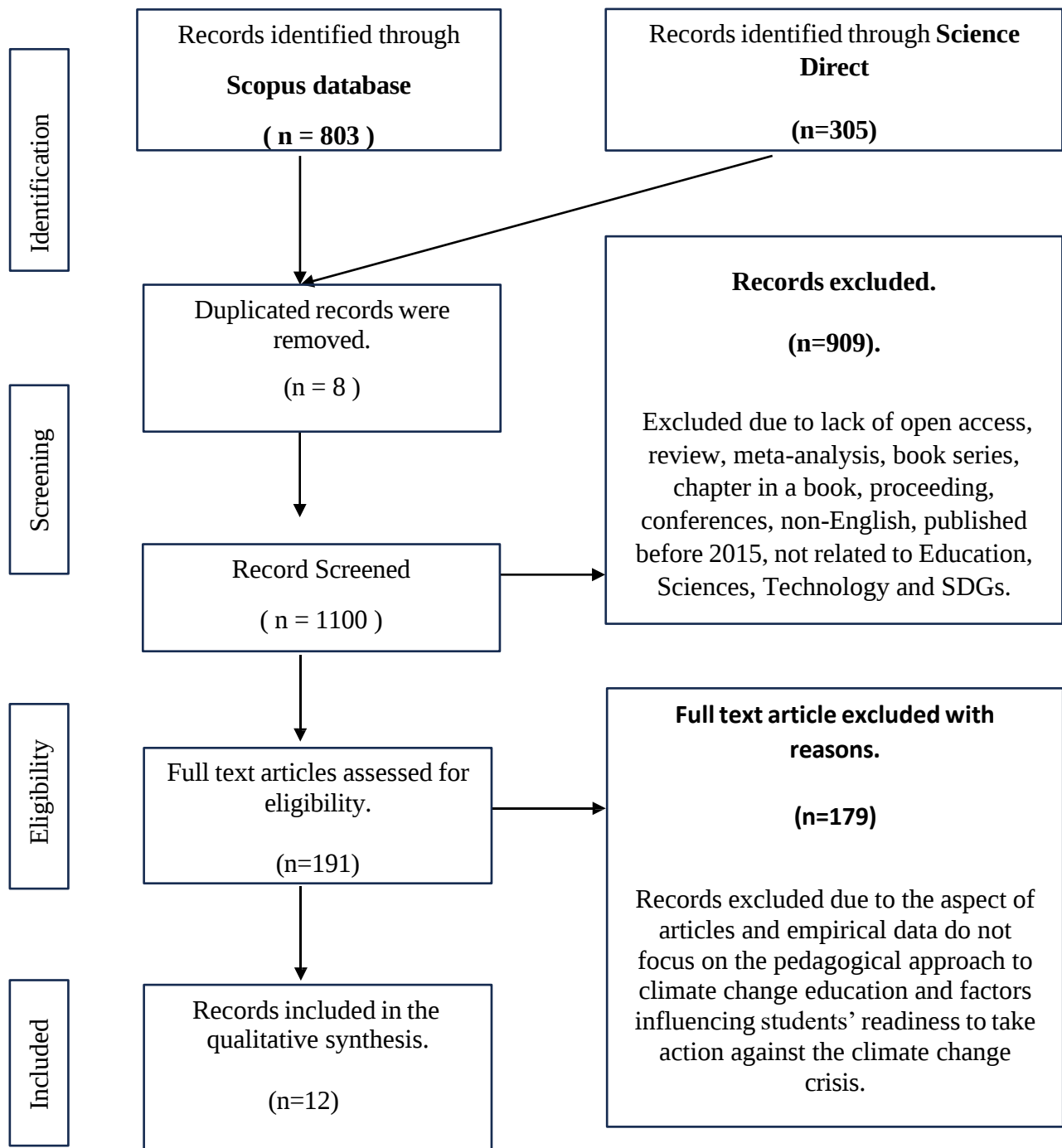


Figure 1. PRISMA flowchart

Table 3

*Data Abstraction and Analysis*

| Vol. | Author (Year)                   | Research Title                                                                                                                                                     |
|------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.   | Kroufek et al., (2023)          | The impact of educational strategies on primary school students' attitudes toward climate change: A comparison of three European Countries.                        |
| 2.   | Feldbacher et al., (2023)       | Identifying gaps in climate change education : A case study in Austrian School.                                                                                    |
| 3.   | Nuryazmin et al., (2022)        | Measuring pro-environmental behaviour triggered by environmental value.                                                                                            |
| 4.   | Barlett et al., (2022)          | Environmental justice pedagogies and self-efficacy for climate change.                                                                                             |
| 5.   | Kolenaty et al., (2022)         | What triggers climate action: The impact of a climate change education programs on students' climate literacy and their willingness to act.                        |
| 6.   | Tolppanen & Karkkainen (2021)   | The Blame-Game: Pre services teachers' view on who is responsible and what needs to be done to mitigate climate change.                                            |
| 7.   | Favier et al., (2021)           | Learning to teach climate change: Students in teachers' training and their progression in pedagogical content knowledge.                                           |
| 8.   | Trott (2019)                    | Children constructive climate change engagement: Empowering awareness, agency and action.                                                                          |
| 9.   | Sakari Tolppanen et al., (2022) | Changes in students' knowledge, worldviews, value and willingness to take mitigative climate action after attending a course on holistic climate change education. |
| 10.  | Mageswary Karpudewan (2019)     | The relationship between values, beliefs, personal norms and climate conserving behaviour of Malaysian primary school students.                                    |
| 11.  | Anna Lehtonen et al., (2018)    | A pedagogy of interconnectedness for encountering climate change as a wicked sustainability problem.                                                               |
| 12.  | Perkins,K. (2017)               | International perspectives on the pedagogy of climate change.                                                                                                      |

This study utilized an integrative review approach, which synthesized diverse research designs including qualitative, quantitative, and mixed methods. Thematic analysis was then employed to develop themes and sub-themes from the compiled data. Initially, the researchers analyzed 18 selected articles to extract relevant statements or data addressing the research questions. Through coding methods, they organized the raw data into usable information, identifying themes, concepts, or ideas essential to the study.

## Results

By using descriptive analysis and thematic analysis drawn from the systematic literature review of the chosen articles, the author presents information on the factors influencing readiness to take mitigation actions in response to the climate change crisis as well as articles related to pedagogical approaches in climate change education.

Five (5) articles were quantitative, and five (5) articles were qualitative, according to the analysis results. There were just two (2) mixed-method research articles among the remainder. Eight (8) significant nations, including Malaysia, the Czech Republic, Austria,

Switzerland, Finland, Norway, the United States, and Germany, were participating in climate change research, according to the study of the chosen papers.

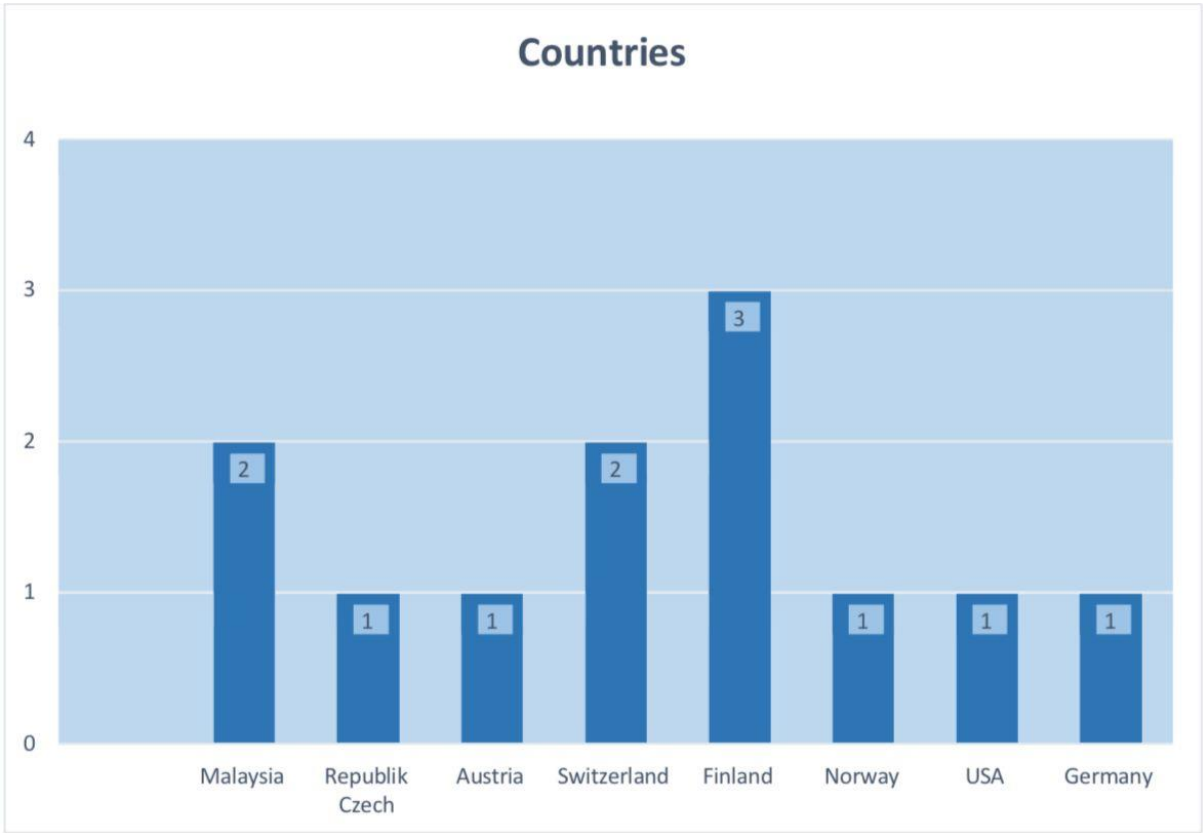


Figure 2. Countries Involved in Article Selection

Table 4

*Summary of Country, Experimental Design, Instrument and Sample Size of 12 Selected Articles*

| Vol. | Author                        | Title                                                                                                                                       | Countries      | Research Design | Research Instruments                          | Research sample |
|------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|-----------------------------------------------|-----------------|
| 1.   | Kroufek et al., (2023)        | The impact of educational strategies on primary school students' attitudes toward climate change: A comparison of three European Countries. | Republic Czech | Quantitative    | Questionnaire                                 | 473             |
| 2.   | Feldbacher et al., (2023)     | Identifying gaps in climate change education : A case study in Austrian School.                                                             | Austria        | Quantitative    | Questionnaire                                 | 113             |
| 3.   | Nuryazmin et al., (2022)      | Measuring pro-environmental behaviour triggered by environmental value.                                                                     | Malaysia       | Quantitative    | Questionnaire                                 | 152             |
| 4.   | Barlett et al., (2022)        | Environmental justice pedagogies and self-efficacy for climate change.                                                                      | Switzerland    | Qualitative     | Content Analysis                              | 69              |
| 5.   | Kolenaty et al., (2022)       | What triggers climate action: The impact of a climate change education programs on students' climate literacy and their willingness to act. | Switzerland    | Mixed-Method    | Quasi experiment, Questionnaire and Interview | 123             |
| 6.   | Tolppanen & Karkkainen (2021) | The Blame-Game: Pre services teachers' view on who is responsible and what needs to be done to mitigate climate change.                     | Finland        | Qualitative     | Open-Ended Survey                             | 230             |
| 7.   | Favier et al., (2021)         | Learning to teach climate change: Students in teachers' training and their progression in pedagogical content knowledge.                    | Norway         | Qualitative     | Survey, Interview and Observation             | 145             |
| 8.   | Trott (2019)                  | Children constructive climate change engagement: Empowering awareness, agency and action.                                                   | USA            | Mixed-Method    | Interview                                     | 55              |

|     |                                 |                                                                                                                                                                    |          |              |                      |     |
|-----|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------|----------------------|-----|
| 9.  | Sakari Tolppanen et al., (2022) | Changes in students' knowledge, worldviews, value and willingness to take mitigative climate action after attending a course on holistic climate change education. | Finland  | Quantitative | Questionnaire        | 245 |
| 10. | Mageswary Karpudewan (2019)     | The relationship between values, beliefs, personal norms and climate conserving behaviour of Malaysian primary school students.                                    | Malaysia | Quantitative | Questionnaire        | 300 |
| 11. | Anna Lehtonen et al., (2018)    | A pedagogy of interconnectedness for encountering climate change as a wicked sustainability problem.                                                               | Finland  | Qualitative  | Document Analysis    | 124 |
| 12. | Perkins,K. (2017)               | International perspectives on the pedagogy of climate change.                                                                                                      | Germany  | Qualitative  | Survey and Interview | 6   |

Based on the research findings regarding the publication years of the 12 selected articles, two articles were published in 2023, 2021, and 2019. Additionally, one article was published in each of 2017 and 2018, followed by four articles published in 2022.

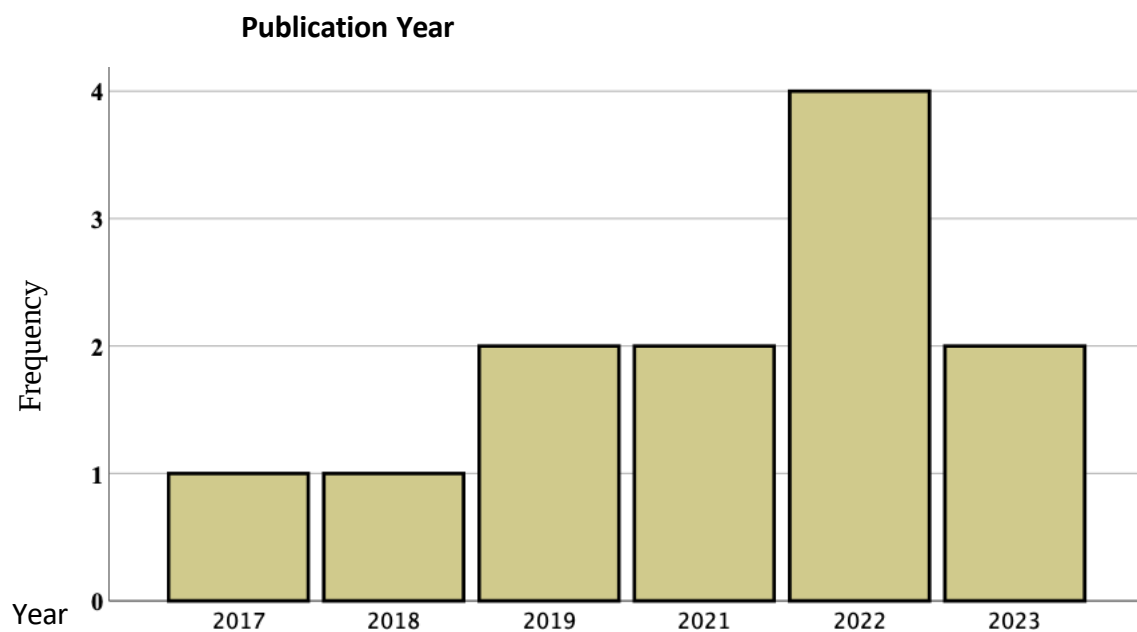


Figure 3. Publication Years of Analyzed Articles

To address the research question, two elements related to climate change education aimed at stimulating preparedness for climate change mitigation were elucidated in this study. The themes that emerged from the findings of the 12 articles are related to the types of pedagogy and strategies in the field of climate change education, as well as the factors influencing students' preparedness for climate change mitigation actions. Each of these two themes has specific sub-themes.

There are three (3) key factors influencing students' preparedness to take climate change mitigation actions, namely (i) sociodemographic factors, (ii) environmental factors, and (iii) internal factors.

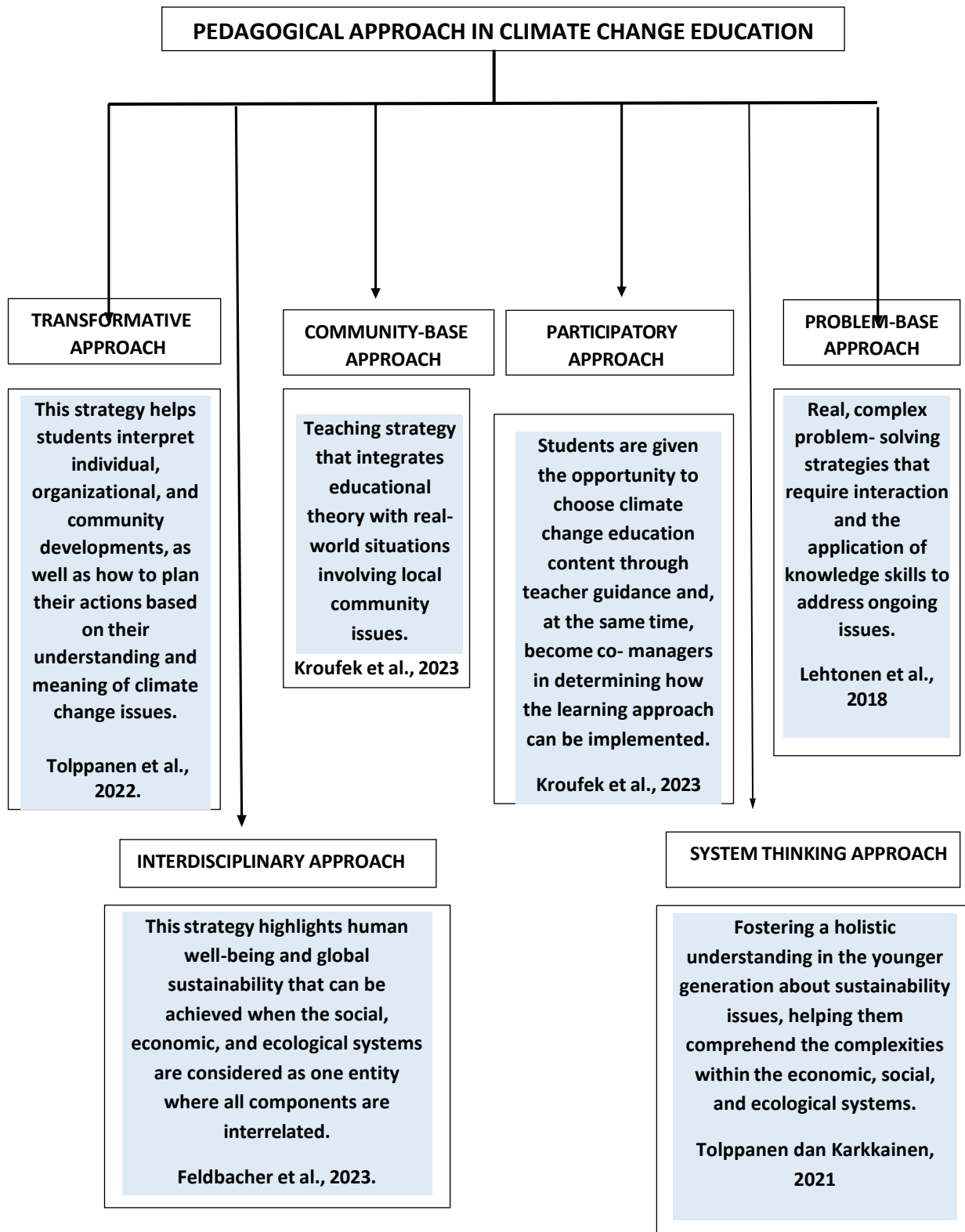


Figure 4. Summary of Pedagogical Approach in Climate Change Education

Table 5

*Summary of Approaches and Educational Practices to Stimulate Pro-Environmental Behaviors*

| Holistic Approach in Climate Change Education |                         |                            |                          |                        |                        |                          |
|-----------------------------------------------|-------------------------|----------------------------|--------------------------|------------------------|------------------------|--------------------------|
| Author                                        | Transformative Approach | Interdisciplinary Approach | Community-Based Approach | Participatory Approach | Problem-Based Approach | System Thinking Approach |
| Kroufek et al., (2023)                        |                         |                            | X                        | X                      |                        |                          |
| Feldbacher et al., (2023)                     |                         | X                          |                          | X                      | X                      |                          |
| Nuryazmin et al., (2022)                      |                         |                            |                          |                        |                        |                          |
| Barlett et al., (2022)                        |                         |                            |                          |                        |                        |                          |
| Kolenaty et al., (2022)                       | X                       | X                          | X                        |                        |                        |                          |
| Tolppanen & Karkkainen (2021)                 |                         |                            |                          | X                      |                        | X                        |
| Favier et al., (2021)                         |                         | X                          | X                        |                        |                        | X                        |
| Trott (2019)                                  |                         |                            | X                        |                        |                        |                          |
| Tolppanen et al., (2022)                      | X                       | X                          |                          |                        |                        |                          |
| Karpudewan (2019)                             | XX                      |                            |                          |                        |                        |                          |
| Lehtonen et al., (2018)                       |                         |                            |                          | X                      | X                      | X                        |
| Perkins (2017)                                |                         | X                          |                          |                        |                        |                          |

Table 6

*Factors Influencing Readiness to Take Climate Change Mitigation Actions*

|                             | Sociodemographic |    |   | Environmental |    |    |   |   |    | Internal |    |   |   |
|-----------------------------|------------------|----|---|---------------|----|----|---|---|----|----------|----|---|---|
|                             | HI               | A  | G | EL            | EA | SC | F | K | SE | AT       | PC | M | V |
| Kroufek et al., (2023)      |                  |    | X |               | X  |    |   | X | X  | X        |    |   |   |
| Feldbacher et al., (2023)   |                  |    |   |               | X  |    |   | X | X  | X        | X  | X |   |
| Nuryazmin et al., 2022.     | X                | X  |   | X             | X  | X  |   | X | X  |          |    |   | X |
| Ahmad Zainuri et al., 2022. |                  |    |   |               |    |    |   |   |    |          |    |   |   |
| Barlett                     |                  |    |   |               | X  |    |   | X | X  |          |    |   |   |
| et al., (2022)              |                  | XX |   |               |    |    |   |   |    | XX       |    |   |   |
| Kolenaty et al., (2022)     |                  | X  |   |               | X  |    |   | X | X  |          | X  |   |   |
| Tolppanen & Karkkainen      |                  |    |   |               |    |    | X |   |    |          |    |   | X |
| (2021)                      |                  |    |   |               |    |    |   |   |    |          |    |   |   |
| Favier et al., (2021)       | X                | X  |   |               | XX |    |   | X |    | X        |    |   |   |
| Trott (2019)                |                  |    |   |               |    |    |   |   |    |          |    |   |   |
| Tolppanen et al., (2022)    |                  |    | X |               |    |    |   | X |    | X        |    | X | X |
| Karpudewan (2019)           | X                |    | X |               |    |    |   | X |    | XX       |    | X | X |
| Lehtonen et al., (2018)     |                  |    |   |               | X  |    |   |   |    | X        |    |   |   |
| Perkins (2017)              |                  |    |   |               |    |    |   | X |    |          |    | X |   |

Sociodemographic Factor: (HI=Household Income, A=Age, G=Gender, EL=Education Level)  
 Environmental Factor: (EA=Environmental Awareness, SC=Social Capital, F=Facilities)  
 Internal Factor: K=Knowledge, SE=Self-Efficacy, PC=Personal Concern, AT=Attitudes, M=Motivation, V=Value)

### Findings and Discussion of the Study

The findings and discussion presented in this study aim to explore effective educational approaches in climate change education that can enhance students' readiness for climate-related behaviors from a holistic learning perspective. This research addresses the question of how different pedagogical methods can contribute to preparing students to understand and respond to climate change challenges comprehensively. Additionally, the study investigates various factors influencing students' readiness to actively participate in mitigation efforts against the climate change crisis. This research seeks to provide insights into optimizing

climate change education strategies in schools and educational institutions. This discussion will contribute to advancing our understanding of how education can empower students to become proactive agents in addressing climate-related issues within their communities and beyond.

### **What types of pedagogical approaches in climate change education stimulate climate-related behaviors from a holistic learning perspective?**

Holistic education focuses on the development of universal values and plays a vital role in education. Holistic education also leads students to delve into sustainable knowledge closely related to mitigation behavior. A strong emphasis on holistic education can foster attitudes that ultimately encourage students' readiness to act against climate change. This aspect of holistic education has been proven to enhance knowledge, influence attitudes, and serve as a prerequisite for the ability to solve future problems while improving climate literacy sustainably (Kroufek et al., 2023).

### **Transformative Learning**

Transformative learning in climate change education aims to deeply understand climate issues and foster actions and social change. This approach not only imparts information but also aims to alter students' thought patterns, attitudes, and actions to make them active agents in climate change mitigation. It helps students interpret developments at various levels and plan actions based on their understanding of climate issues (Tolppanen et al., 2022). Reflecting on local extreme events and their personal impacts is encouraged, along with active engagement in group discussions to address climate change. Collaboration between students, educators, and the community is essential for effective solutions. This approach also stimulates critical and creative thinking for innovative climate change solutions (Brodowski, 2023).

### **Problem-Based Learning (PBL)**

Problem-Based Learning (PBL) involves real, complex problem-solving strategies that require interaction and the application of knowledge to address ongoing issues, focusing on understanding and resolving climate change-related problems (Lehtonen et al., 2018). This approach helps students find solutions to environmental issues such as natural disasters and global warming, enhancing their understanding of climate change, raising awareness, and motivating them to act in mitigation. PBL allows students to actively engage in learning by working in groups to explore climate change issues in depth. Through field activities, data analysis, and discussions, students learn to identify critical issues and generate relevant mitigation actions (Aisyah, 2019).

### **Interdisciplinary Learning**

Interdisciplinary learning in climate change education integrates elements from various disciplines to promote pro-environmental behavior and climate change mitigation actions, highlighting the interconnectedness of social, economic, and ecological systems (Feldbacher et al., 2023). This approach incorporates climate change topics into subjects such as science, social sciences, economics, arts, politics, and culture, fostering collaboration among teachers from different disciplines. Utilizing diverse learning resources, such as documentaries, scientific reports, and art pieces, helps students grasp the complexity of climate change. Direct field experiences and open discussions on climate change from multiple perspectives further

enhance this learning strategy, promoting a comprehensive understanding of the issue and effective solutions.

### **System Thinking Approach**

Systems thinking in climate change education deepens holistic thinking about sustainability and the interconnectedness of economic, social, and ecological systems. This approach emphasizes understanding the relationships between climate system elements, such as temperature, precipitation, and carbon dioxide levels, through models and simulations, allowing students to visualize system impacts and comprehend the complexity of climate systems. It highlights the significant influence of human activities like deforestation and greenhouse gas emissions on climate balance, fostering awareness that human actions are crucial to climate change solutions. Additionally, systems thinking incorporates social and economic factors, such as poverty and injustice, in climate education, underscoring that mitigation efforts involve more than just science and technology. This pedagogy emphasizes the importance of individual and community actions in addressing the climate crisis and their contribution to global climate change solutions.

### **Participatory approach**

The participatory approach in climate change education is a step that involves the active engagement of all parties in the learning process about climate change issues. This approach encompasses the involvement of teachers, students, the community, and the government, with the aim of creating an inclusive learning situation where all parties collaborate in addressing climate change issues. Inclusive learning means that all parties are involved in efforts to address the climate change crisis, regardless of age, gender, social background, or educational level.

### **Community-Based approach**

Community-Based Learning (CBL) in climate change education emphasizes active community involvement to address this global issue. By engaging local communities, CBL increases awareness, understanding, and responsibility towards climate change. Implementing CBL involves exposing learners to local climate issues like floods, droughts, and temperature increases, encouraging proactive environmental protection. This approach helps students understand the scientific aspects of climate change while promoting effective actions through a holistic perspective that considers social, economic, and ecological dimensions.

### **What Factors Influence Students' Readiness to Take Mitigating Actions Against the Climate Change Crisis?**

The second research question was raised to determine the factors that influence students' readiness to take mitigating actions against the climate change crisis. Referring to the Disaster Behavior Theory and the analysis of all the articles, it was found that there are (3) main factors discussing the factors that drive an individual's behavior towards the environment, involving factors (i) Socio-demographics, (ii) Environment, and (iii) Internal. Internal factors are related to an individual's knowledge, values, attitudes, self-efficacy, motivation, and concerns. While environmental factors involve facilities, environmental awareness, and social capital. Then, socio-demographic factors consist of age, gender, household income, and education level (Nuryazmin et al., 2022).

**Internal Factors**

The highest-listed factor in the research subjects is the internal factor when the findings clearly indicate that eleven (11) out of the twelve (12) selected articles are related to internal factors, which have six (6) main aspects, namely (i) Knowledge, (ii) Self-Efficacy, (iii) Attitude, (iv) Personal Concerns, (v) Motivation, and (vi) Values. The research underscores the pivotal role of internal factors—particularly knowledge and attitude—in shaping responses to climate change. Among the reviewed articles, these factors were prominently discussed in nine out of twelve studies. Knowledge encompasses understanding of disaster types, warning signs, and response strategies, crucial for effective preparedness. Attitudes, influenced by knowledge, significantly impact attitudes towards climate change mitigation efforts. Self-efficacy, the belief in one's ability to contribute to mitigation, enhances motivation. Perceived risk, driven by individual concerns about climate impacts, further motivates action. Additionally, personal values such as environmental consciousness and social justice play integral roles in driving sustained mitigation efforts. Understanding these complex interactions is essential for crafting effective climate change education and mitigation strategies tailored to diverse social and cultural contexts.

**Sociodemographic Factor**

Sociodemographic factors significantly influence attitudes and behaviours towards climate change and environmental issues. According to Masud et al (2017), socioeconomic factor such as gender, age, education, income and ethnicity play a crucial role in shaping an individual's understanding and perception of climate change issues. Lower socioeconomic status and education levels often correlate with reduced environmental awareness and engagement (Moser & Kleinhuickelkotten, 2018). Younger generations generally exhibit more positive attitudes towards environmental literacy but also face heightened vulnerability to climate change impacts. Parental influence, especially among those with higher socioeconomic status, significantly shapes children's attitudes and actions towards sustainability. Gender disparities also affect responses to climate change and disasters. Women and girls often demonstrate higher levels of concern and willingness to take action, yet they may face greater vulnerability due to societal roles, access to resources, and participation in decision-making processes (Jerin et al., 2023). Patriarchal norms and underrepresentation in leadership roles contribute to challenges in women's participation in climate adaptation and disaster management efforts. Recognizing these diverse influences is crucial for developing inclusive policies and educational programs that effectively engage all segments of society in addressing climate change challenges. Empowering women economically, enhancing their participation in decision-making, and reducing gender inequities are essential steps towards more equitable and resilient climate responses.

**Environmental Factor**

Environmental awareness, accessibility to resources, and social capital are critical in climate change education and community adaptation efforts. High environmental awareness fosters community engagement in mitigation and adaptation strategies through understanding climate change causes, effects, and actionable solutions. Accessibility involves ensuring communities have readily available resources like training programs and technology to effectively address climate challenges. Strong social capital, based on trust and collaboration, enhances community resilience by facilitating collective actions and knowledge sharing. Effective climate change education integrates both theoretical knowledge and practical

application, empowering communities to take meaningful steps towards environmental sustainability.

### Conclusion

Efforts to promote proactive responses to the climate change crisis through educational platforms typically begin with the component of climate change education knowledge, which then leads to individuals' concerns and awareness of climate change risks. This, in turn, encourages changes in behavior and engagement with the issue. This statement aligns with the analysis findings made by the researchers, as the analysis successfully demonstrated the correlation between the top three factors contributing to awareness of behavior and mitigation of climate change issues, namely (i) knowledge, (ii) environmental awareness, and (iii) attitudes. In conclusion, bridging the gap between knowledge and mitigation action is a complex challenge, but it is essential to achieve Sustainable Development Goal (SDG) 13, which demands urgent action to address climate change and its consequences. With collective engagement and increasing awareness, all parties can succeed in facing the challenges of climate change and creating a sustainable future for the nation's ecosystem.

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