



Sustainable Education and Student Action: Understanding Student Contributions to Addressing Climate Change

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Abstract: This study aimed to identify new factors in sustainable education that are able to motivate students for action related to climate change, and to evaluate the influence of the student movement for climate change on student actions. This research was conducted through a literature review research method. This research provides an explanation of existing findings and data. The results show that formal education in schools and social activities, such as interactions between students, can form a culture that supports sustainable collective action. An evaluation of the student movement in climate change mitigation, including activities such as recycling and waste collection, provides insight into its positive impact. This research contributes to designing educational approaches that motivate and evaluate student action on climate.

Keywords: Climate Change; Social Interaction; Sustainable Education; Student Contribution

Introduction

The level of change that occurs in the current climate has become a very serious matter when the era of global warming produces changes to the climate, called climate change (Koranteng et al., 2019). Climate change certainly has an impact on all forms of life on earth where the climate becomes unpredictable, which raises various problems such as prolonged drought and extreme flooding due to extreme changes in the world's climate (Olalere, 2020). In addition, the term global warming results in climate change, and although the world's climate has always changed, this climate change leads to the destruction of the earth little by little due to human activities.

Global warming refers to an increase in the average temperature in the atmosphere near the Earth's surface and in the troposphere that can result in changes in global climate patterns. This increase in global temperature is caused by an increase in greenhouse gas (GHG) emissions in the atmosphere (Chairunnisa et al., 2022). This occurs due to an increase in the intensity of

the greenhouse effect caused by the presence of gases in the atmosphere that absorb heat rays, especially infrared rays emitted by the earth. Global warming as a result of increasing concentrations of greenhouse gases, which trigger climate change, has become a global concern in recent decades (Safitri et al., 2022). This phenomenon has gained considerable attention due to the potential negative impacts of climate change on various economic sectors, which can threaten human life. In addition, many diseases once thought to be extinct are now re-emerging in areas with changing climatic conditions that favor their reemergence (Putri et al., 2023).

It is important to understand that climate change is caused by greenhouse gases known as the greenhouse effect, and the greenhouse effect is a natural process, and most greenhouse gases actually support life because, without them, heat would escape into space and the Earth's average temperature would be much cooler (Bauer & Menrad, 2019). Climate change has direct impacts, so the urgency of mitigation to reduce the impact or inhibit the increase in earth temperature that

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can exacerbate climate change needs to be addressed, and one of them is sustainable education.

Education plays a key role in climate change mitigation efforts. By raising public awareness about the causes and impacts of climate change, education prepares individuals to take more sustainable actions. In addition, education has the ability to stimulate changes in people's attitudes and behaviors, as well as assist them in making wise decisions (Setiawan et al., 2023). In classrooms, young people can be educated about the impacts of global warming and learn how to deal with climate change. Education empowers everyone, but especially inspires the younger generation to take action. This knowledge of the facts helps to overcome the fear that often arises when facing issues that are often characterized by uncertainty and fear in the general public.

To implement this strategy, education needs to serve as a strong foundation for individuals. Education should act as a guide that teaches concepts related to climate change, adaptation, and mitigation. Climate change is often treated as an additional element in various learning topics contained in the curriculum (Gahbauer et al., 2021). The important role of education in the context of the three main dimensions of climate change. Education can be an access point for children to understand the situation and associated risks (von STORCH et al., 2019). Research has shown that quality environmental education can raise awareness about climate change, and its influence not only applies to children but also spreads to include their parents and families. In addition to being a tool for individual behavior change in mitigation efforts, education centers and schools can also play a role in mitigation by achieving carbon neutral status, improving energy efficiency, and reducing the ecological impacts they produce (Larashati et al., 2022).

Apart from the strategic role of the education system that is serious about discussing climate change, which will produce a movement of lessons in supporting and socializing the movement to reduce the impact and factors that exacerbate climate change in the world (Sitanggang & Lumbanraja, 2023). The younger generation, especially school-age students, have a high interest in learning about and participating in climate change action. The importance of climate change education is higher today than ever before, as an in-depth understanding of the root causes and impacts of climate change is a crucial first step in changing people's mindsets, establishing new strategies to mitigate its impacts, and developing adaptation skills to unavoidable impacts (Bello Benavides et al., 2021). By using high-quality subject matter, applying innovative learning methods, and building networks with relevant stakeholders, our ultimate goal is to create conditions

that support the improvement and development of climate change education in schools, with the hope that this will spur the real changes in the environmental, social, and economic fabric that are now urgently needed (Tahta et al., 2023).

The importance of understanding and perspective on climate change, its causes, and its impacts must be formed from the beginning through learning related to the environment that has previously been formed and integrated with the national curriculum at school; therefore, students' cognitive and socio-emotional understanding of climate change will produce workable solution (Riyansyah & Masturi, 2023). In addition, sustainable education can also enhance students' creativity, encourage active engagement, and increase awareness of the environment to address global challenges and climate change (Fauziah et al., 2021).

The important role of students and young people in climate change mitigation is a great hope that the earth can still be said to be habitable in the future (Syukur et al., 2018). In addition, the role of students is very significant and influential on all policies governing mitigation efforts for climate change. The younger generation has the potential to act as active actors who make a positive contribution to efforts to reduce greenhouse gas (GHG) emissions (Bentz, 2020). Through active involvement in various climate change mitigation initiatives, such as encouraging the transition to renewable and environmentally friendly energy sources, reducing the use of fossil fuel vehicles, and participating in large-scale tree planting programs, they have an important role in determining the success of keeping the earth's temperature rise below 1.5 degrees Celsius.

To raise the awareness of the younger generation about climate change and its impact on human survival, constructive efforts are needed to convey knowledge about environmental issues, particularly those related to climate change. In addition, the organizations in which they are involved can be used as a tool to raise awareness and encourage youth participation in addressing environmental issues related to climate change (Bugaj et al., 2021). In addition, young people need to be encouraged to be active in various efforts to address the impacts of climate change with a cultural approach (Ide et al., 2019). With holistic environmental improvement efforts, we hope to change the views of young people and inspire them to play a role in efforts to deal with climate change. Moreover, in the coming years, the number of young people around the world, including in Indonesia, will be huge. Today, young people have a significant opportunity and an important role to play in determining the direction of global change. Through a cultural approach that provides a foundation and honors the important role of people, we can mobilize together in this effort.

To support the movement to save the earth from extreme climate change, it certainly requires an education system that normally organizes education and teaching and learning processes about climate change into a subject that can be taught as early as possible through the curriculum (Tahta et al., 2023). Indonesia is one of the countries that is vulnerable to the impact of the climate crisis because it is an archipelago, maritime, and agrarian country (Simanjuntak, 2016). However, many people do not yet understand the dangers of the climate crisis and the importance of climate change mitigation and adaptation. Research conducted by Eugene Cordero, Diana Centeno, and Anne Marie Todd from San José State University in the United States (US) found a close relationship between the experience of climate education and changes in individual behavior related to emissions in daily life. According to the study, an intensive one-year course that teaches climate change mitigation has a lasting impact on a person's carbon emissions.

The use of the curriculum currently in effect in Indonesia is the use of the 2013 Curriculum and the Merdeka Curriculum. In the 2013 curriculum, material on climate change is included in a separate chapter. This shows the characteristics of a curriculum that focuses on developing students' ideas on each subject matter. Presenting material per chapter on each subject matter with more allocated time can help improve student competence. While the independent curriculum focuses on strengthening the Pancasila student profile by encouraging students to apply their science knowledge to solving science problems that are ultimately related to social, economic, and human rights, it is more suitable for integrating material with presentations such as case studies or special projects. In addition, in terms of competency development, research shows that the 2013 curriculum emphasizes more on students' understanding of concepts through analysis activities and application of simple concepts.

In addition, the consistency of curriculum use should also be unified between all islands in Indonesia so that the implementation of the curriculum and environmental education in climate change mitigation is truly integrated by all islands in Indonesia, but of course, at this time, there are still differences between the implementation carried out by educators in urban and rural areas (Nurhayati, 2022). One of the important factors influencing the climate change mitigation process is education. In fact, there is a big difference between urban and rural communities that have better access to education and information. The curriculum is provided by the government through the Ministry of Education and Culture and already has some materials related to disasters, climate change, and the environment. However, problems found in practice

include insufficiently skilled teachers, a lack of practical guidelines, and a lack of financial support. The current curriculum content should take a more predominantly practical approach, provide practical guidance to ease use, and improve teachers' ability to provide appropriate teaching (Ridwan et al., 2023). In addition, collaborate on each material studied and be guided by the question of how it contributes to the reduction of climate change problems. Climate change mitigation education and campaigns are getting closer to education projects.

In the context of understanding the theory of climate change, another thing that needs to be the focus and goal after the learning process on climate change is a change in attitude that can be expressed by students through a movement that can have a positive impact in the form of an invitation to reduce all activities that can contribute to climate change.

Although sociological research on global climate impacts has been growing, its connection with other natural and social sciences has been limited. In addition, other results also found that the social relationship between society and the level of education in developed and developing countries is very different in terms of social awareness of climate change. Through the above review, some information has not been summarized in the form of a report or a result of studies and research, so this research has the aim of revealing new things that can contribute to the research topic, namely regarding sustainable education and student actions in understanding their contribution as students in addressing climate change. In addition, this study also has novel information about the social relationship between the process of education and action in scientific activities to reduce the impact of climate change in the form of mitigation. Therefore, the objectives of this study are (1) to identify new factors in sustainable education that are able to motivate students for action related to climate change. And the second objective is to evaluate the influence of the student movement for climate change on student actions. Therefore, through this study, that will provide solutions to sustainable education and student actions that are in accordance with the culture of Indonesia to carry out a student-initiated movement to have a positive impact on the environment so that it can reduce more serious and extreme climate change.

Method

Research Design

This research was conducted through the literature review research method. This method is used to search and collect several journals and draw some conclusions.

Data Collection Method

The data collection method is carried out by reviewing various related literature to obtain various information related to the object of research, including sustainable education in mitigating climate change, the role of lessons in carrying out movements to reduce the impact and take mitigation actions for climate change, curriculum implementation centered on the discussion of climate change and social factors, and community interactions in addressing and mitigating climate change. This research uses secondary data collected from various journals, proceedings, reports, and news articles related to the object of the research being studied above (Rodewald, 2022).

Data Analysis

The analysis used in this study is the type of qualitative analysis used in this study because it aims to explore information so that the objectives in this study can be presented with an accurate discussion. Qualitative analysis is used to classify data based on research problems and their collection (Chen et al., 2023). Qualitative analysis assesses data collected from secondary data, namely through literature studies, and whether its implementation is in accordance with current theories and rules, so as to measure how effective the implementation process.

Result and Discussion

Sustainable Education for Students to Support Climate Change Mitigation

Sustainable Education is key to protecting the Earth from the damage caused by climate change. This is because sustainable education teaches people sustainable skills, helps them understand and act according to climate change, encourages innovation, and makes them people who care about climate issues (Žalėnienė & Pereira, 2021). In addition, sustainable education makes people responsible for the environment and future generations. The findings of the above opinions are also supported by the United Nations (2023) in that education can help people make better decisions and change their attitudes and behaviors. In the classroom, young people can be educated about the impacts of global warming and how to adapt to climate change. Education motivates people, especially children, to act. Knowing the facts helps dispel fears of the problem, which is often characterized by chaos and turmoil in the public arena. UNICEF has used the thoughts and fantasies of children around the world to understand what it means to be a child in an era of rapid climate change.

The international organization under the United Nations, UNESCO, also pays special attention to the innovation and displacement of the current learning process to be more directed towards activities that are able to reduce the impact of climate change and also mitigate climate change with learning activities in schools and can be practiced after students have a lot of interaction with various learning resources that discuss climate change. The UNESCO report (2023) states that at COP27 in 2022, the UN Secretary-General underlined that we are heading into an increasingly severe climate crisis, while we still continue to contribute to this problem. In an increasingly complex and interconnected world with real existential threats such as climate change, there is a growing call for education to enable individuals as agents of change to acquire the knowledge, skills, values, and attitudes that lead to the green transition of our societies, in accordance with Target 4.7 of the SDGs and the entire 2030 Agenda. To accelerate urgent action on climate sustainability, the Green Education Partnership was launched during the Transforming Education Summit as a global initiative to provide strong, coordinated, and comprehensive action to advance and improve the implementation of education on climate change. The partnership encourages countries and stakeholders to focus attention on four action areas: (1) greening school environments, (2) integrating climate change education in curricula, (3) building the capacity of teachers and education systems, and (4) mobilizing communities to participate in climate sustainability efforts.

In the above review, the latest information has been obtained, which will be further explained, namely the transformation of green education and green policies in the field of education to address climate change from now on. One of the possible solutions related to sustainable education is greening the school environment (Green School). According to Nurdin, N. et al. (2017), (Rahman et al., 2019) that One way to improve knowledge and understanding of disaster risk is to incorporate disaster risk reduction (DRR) and/or disaster risk reduction (DRR) programs, including climate change impacts, into formal education and curricula. In Indonesia, there has been some progress in incorporating DRR into the school curriculum, mostly limited to national-level policies. Several studies have tried to see how disaster knowledge and education have been integrated into the school curriculum as a whole, from the national policy level to local implementation. However, this implementation is still limited to teacher creativity and teacher improvisation, as well as the national policy level.

In addition, the implementation of Green School in research results (Rahman et al., 2019) revealed that the concept in the Green-Based School Management Model

that has been proposed is a strong model that can be an effective solution to overcome the negative impacts of global warming. In addition, schools are the smallest environment that best understands how to educate students to have a sustainable character. Students' activities in schools can also be controlled, both by fellow students and by teachers and school employees. Thus, if one member of the school community does something that does not support sustainable character, others will immediately remind him to act in accordance with the goals of a sustainable school. If this becomes a habit, over time, all members of the school community will have habits that eventually form a sustainable character. Therefore, schools need to be authorized to manage and develop a sustainable school-based management model.

In addition, the application of the green school concept emphasizes the balance between theories related to the environment, global warming, and climate change and the various negative impacts resulting from climate change due to human activities that damage the environment. The concept of green school will try to integrate with sustainable education, which means that all activities related to the environment and handling climate change due to global warming will continue. This is also supported and elaborated by Brian Prasetyawan (2023) on the importance of sustainable education and climate change in his discussion, explaining that climate change education has several main reasons. First, to raise awareness about global issues, especially climate change, which has a serious impact on the environment, economy, and human welfare. Second, to prepare future generations, namely students, who will face the consequences of climate change and need to have the knowledge and skills to reduce its impact. Third, climate change education encourages action, not just knowledge, so students who are educated about climate change are more likely to engage in concrete actions such as reducing carbon emissions and supporting renewable energy. In addition, environmental education for the younger generation is one clear way to address environmental degradation. Schools are the primary place of learning that provides environmental experience, knowledge, and awareness. Through green schools, environmental education can provide a basis for students' environmental actions. Green school development shows that environmental education requires a variety of learning approaches, including character building, participatory learning, green space building, modeling, peer and teamwork, and educational games. The study also highlighted that building green areas in schools is not enough; it is necessary to raise students' awareness in cognitive, emotional, and practical terms (Suryani et al., 2019).

In addition to the green school concept, the education system also develops sustainable education supported by a green curriculum or integration of climate change education into the curriculum because this is very important to support the continuity of the process, implementation, and practice of students in supporting the handling and mitigation of climate change. According to (Chang & Pascua, 2017) that a climate change and global warming education curriculum is critical to building a deep understanding and awareness of the serious threats faced by our planet due to climate change. It not only provides the required knowledge, but also helps students develop the skills and attitudes needed to face these challenges. Social science has a major role to play in addressing environmental issues, as it involves understanding the complex relationship between humans and the environment, as well as the social, economic and political impacts of climate change. In including the topic of climate change in the social science curriculum, we are preparing future generations with a solid understanding of the importance of sustainability, as well as the ability to formulate sustainable policies and actions to protect the environment and human well-being.

Another supporting factor in the sustainability of sustainable education in mitigating and handling climate change due to global warming is also the need for training of human resources in schools, namely training given to each teacher so that the process of implementing sustainable education can run smoothly. According to Mustafa (2023), the role of teachers in shaping students' attitudes and behaviors related to climate change issues is vital. However, not all teachers have an adequate understanding of the issue and how to teach it to students. Therefore, it is important to organize climate change training for teachers. This training can help teachers understand climate change issues more deeply and inspire them to teach them to students in an effective and engaging way. In addition, the training can also improve teachers' ability to integrate climate change issues into the existing curriculum and provide solutions to reduce the impact of climate change. Thus, students can realize the urgency of climate change issues and contribute to efforts to reduce their negative impacts. As part of a society that cares about the environment, we can also play a role in supporting teacher training on climate change and strengthening education on this issue in schools.

The Impact of Social Movements for Student Action on Climate Change

The importance of social movements carried out that are useful for providing positive influences to students or between students and students is very

influential when viewed from a social perspective to produce real movements in overcoming climate change. In essence, the activity of fostering knowledge first is very important, where the activity provides an overview and understanding to students that the situation of the earth, which is the only place where humans can live, has now begun to be threatened due to climate change. One of the reports reported by the Editor (2021) on education and movement carried out in one of the schools in Indramayu explained that preparing young people to deal with the impacts of climate change is an important priority, given that climate change will continue to affect their future. One effective strategy is to integrate climate change issues into the education curriculum. For example, in Indramayu District, they have successfully internalized climate change into their education curriculum and even won an award as a pioneer in the Environmental Education Curriculum with the theme of mangroves.

Furthermore, the Mangrove Thematic Environmental Education (EE) Local Content Curriculum has been adopted for primary-level learners and is accompanied by supporting books such as core and basic competency books, textbooks, LKS books, and teachers' guides. Information on climate change has been integrated into this curriculum to increase awareness and mitigate disasters in coastal areas. In addition, the Environmental Care and Culture Movement in Schools (PBLHS) in Indramayu Regency also aims to integrate environmentally friendly behavior through subjects, extracurricular activities, and habituation, providing knowledge, skills, and environmental values to students.

In addition, the movement that is also able to influence the actions taken by students after gaining an understanding of the climate, its effects on the earth, and the causes of global warming and climate change is the movement carried out by students. In the results of a report conducted by Bello Benavides et al., (2021), which summarizes several movements that are at least able to address climate change, the report explains that realizing one's potential and strengths will help students understand how they can contribute to addressing climate change. For example, students who have skills in campaigning and public speaking can use this ability to voice climate change issues through various platforms. Therefore, understanding one's own capacity is crucial. After recognizing your potential, the next step is to take action. However, in addition to that, the important thing that needs to be done first is to go deep within oneself before influencing others with climate change issues. He encourages individuals to start with themselves, then involve their families, organizations, and so on. The next effort is to do self-development, or "upgrading," such as expanding understanding by studying science related to

climate change. For example, by conducting research on environmentally friendly energy and exploring the economic and social aspects of climate change. The same thing is also explained by Satyanegara (2021) about the influence of social movements on actions for students through social media, where the internet and communication technology are so advanced that they can also be used to carry out environmental campaigns carried out by the community for students and also social interactions between students and other students. The report also explains that through the internet, many ideas, knowledge, and views can reach individuals around the world and help them access education and essential services, while sparking innovation and movements. The internet has evolved from a tool for long-distance communication to a platform for ideas, and the biggest influencers in this regard are influencers and key opinion leaders (KOLs). Influencers refer to individuals or groups that have great influence due to their ability to capture the attention of a large audience with the content they produce. Meanwhile, a KOL is someone who has expertise in a particular field and a preferred channel of communication, usually through social media. In the field of climate change, there are several key influences that have started campaigns against global warming. For example, Mr. Beast's Team Trees campaign, whose main goal is to plant 20 million trees worldwide, started in October 2019, the campaign has already exceeded its initial target. In addition, it has the support of other prominent climate change influencers, such as Destin Sandler of the Smarter Every Day Channel and Elon Musk, CEO of Tesla. Social media also creates an open space for organizations, climate change activists, and scientists to reach more people around the world. One example is how UKCOP26 and Green Peace are using social media platforms to not only share valuable knowledge about the current state of the climate but also to collaborate with artists, activists, politicians, and academic institutions, showing that the world is currently in a continuous state of climate emergency.

In addition, the student movement program at Oxford University has also had a very positive impact. Parker (2023) explains that, as a student, it is important to understand that you have the power to play a role in the fight against climate change. Adopting climate change solutions as a student involves making small conscious choices, which can have a significant impact if done consistently over time. Here are some ways you can reduce your impact on climate change as a college student: Choose to walk, bike, or take public transportation whenever possible, as these choices significantly reduce your carbon footprint. Be wise in your use of energy and water at home and school. Turn off lights when not in use, unplug electronic devices, and

use energy-efficient appliances. Be mindful of water consumption by taking shorter showers, turning off taps when brushing your teeth, and fixing leaks. Encourage your school to adopt water-saving measures and energy-efficient systems. Get involved in environmental clubs or organizations in your school or community that encourage sustainability, recycling, and conservation efforts. Support local green initiatives, such as tree planting, cleanup activities, or single-use plastic ban campaigns. If no such club or organization exists, consider starting one yourself to engage your peers in the fight against climate change. Share your knowledge about climate change and its impacts with friends, family, and classmates. Encourage them to join you in adopting sustainable practices and participating in green initiatives.

Furthermore, students have the ability to educate their peers who may be less informed about environmental issues, particularly the dangers of climate change, and simple changes in their daily lives, such as reducing meat consumption, can have a positive impact. While it is difficult to design policies or change the views of influential adults, educating current and future generations will play an important role in preparing society for the most serious challenges we will all face in the coming years. (Earth Institute, 2019).

In addition to social movements that are widely carried out by foreign communities, Indonesia also has a social movement that has a significant impact on the movement carried out by the Pandawara Group, which is a youth community to overcome waste that directly impacts pollution in the environment, which contributes to global warming and climate change. According to Megasari (2023), Pandawara Group is an initiative that has become a prime mover in efforts to address environmental issues. This group, consisting of the nation's children, aims to preserve the environment and reduce the negative impact of waste on society and nature. They actively share their river cleaning activities through videos on Pandawara Group's TikTok platform. They also prove that cleaning up trash in the gutter or river is not as bad as many people might think. For more than a year of action, Pandawara has managed to collect 27,066 kilograms of trash from 78 waterways in Bandung City and Regency. In addition, Pandawara Group recently organized a beach cleaning activity in Labuan, Teluk Village, Pandeglang Regency, Banten Province. They successfully organized this activity by involving volunteers from various backgrounds, including elementary, junior high, high school students, university students, local communities, as well as authorities such as sub district head, the head of region, navy, neighborhood, and hamlet, to the head of the Banten Provincial Environment Office.

Educational Policy Implications and Use of Climate Change Curriculum

In order to raise public and stakeholder awareness of the phenomenon of climate change and environmental protection, it is important to integrate climate change issues into the education sector. This effort is key given that climate change has become an important factor in decision-making and policy-making. In addition, climate change education also contributes to the preparation of society to face the challenges presented by climate change. To achieve this, the internalization of climate change issues can be realized through improved curricula that include aspects of climate change and the environment in training programs in various state institutions such as LEMHANAS, LAN, and training. Furthermore, to support mitigation and adaptation actions at the local level, climate change issues can be proposed to be included in the education curriculum at the regional level (Admin, 2021).

This was also added by (Cordero et al., 2020) that have identified a number of key design elements that are considered critical to the success of the educational programs we develop, and these elements have maintained student engagement over the years. Some of these elements include relating climate change science to students' lives, giving students experience in creating change in their chosen communities, and creating a culture focused on environmental stewardship and action. We found that these elements of the course help students to understand the subject matter more deeply, which affects their personal and professional lives, and these elements align with some of the predictive factors used in designing the course. The elements are interrelated, do not stand alone, and also connect with other important elements in the program, including a strong focus on climate change science, climate change solutions, and environmental communication.

The commitment to implement education policies that lead to environmental education that discusses more about the environment, climate change, and global warming, as well as curriculum integration, is certainly very possible to implement. Apart from the needs of the times, environmental education and a curriculum that focuses on climate change have also been proposed by students who are aware of the importance of learning climate change through science and biology materials. This is also elaborated by Nurita (2021): the younger generation, who will be the heirs of the future, need to be aware of the negative impacts of climate change that are getting worse and also understand how to deal with it. The coalition has made five demands to the Ministry of Education and Culture, as follows: First, incorporate climate education into the core of the curriculum, requiring students to learn about the scientific, social,

and ethical aspects of climate change. Second, ensure that climate education is inclusive, taking into account the participation of diverse groups, including gender, different generations, people with disabilities, and other vulnerable groups. Third, provide support for the mental well-being of students and education staff in coping with climate-related anxiety by providing appropriate facilities. Fourth, train teachers and provide effective climate education materials and practices. Finally, contribute to creating and supporting measures to reduce carbon emissions in educational settings, with an end target of 2030.

In addition to focusing on adolescents, environmental education and the use of policies in the climate change curriculum should also start at an early age. This is also emphasized by (Yamin & Karmila, 2019) that the importance of introducing the concept of protecting the environment early on in elementary school is very large, considering that elementary school students, as a young generation, have the potential to become a generation that plays an important role in greening efforts and maintaining environmental stability. Therefore, the use of learning media in the form of cartoons in the process of learning science about the environment is expected to attract their attention and help them understand how to protect the environment and apply this knowledge in everyday life. This is also supported by Admin (2018), who says that from a young age, children should be taught environmentally friendly habits, such as the importance of recycling and gardening.

Comparison of Climate Change Education Policies and Curricula Abroad

In addition, the implementation of climate change curriculum was also reported by Preston (2023), who found that climate change education made significant progress six years ago with the introduction of the Next Generation Science Standards. These standards instruct teachers to incorporate material on climate change and its causes through human activities into the high school curriculum. To date, 20 states, along with the District of Columbia, have adopted these standards, and several other states have implemented modified versions. In all, 37 states have recognized human-caused climate change in their science standards, according to the National Center for Science Education.

Finland has also successfully implemented a climate change curriculum. In a report conducted by Verlie & Flynn (2022) that teaching about climate change has become a significant part of the Finnish education system, and currently, a new climate studies program is under development with the vision that climate change should be an essential element in all subjects. Several NGOs have created materials on climate change and the

circular economy that teachers can use as needed. In every Finnish school, this is routine practice, but at Sakarinmäki School, students have the added advantage that their school building is equipped with its own renewable energy source that they can study. The school relies on about 80 percent of its energy consumption from renewable energy sources, such as solar panels, geothermal heating, and bio-oil that is only needed in winter. This energy use can be viewed in real-time through screens in the school corridors in a more understandable way, including as an equivalent number of warm showers, which is then integrated into the school curriculum. The information allows students to understand the concept of climate change, perform percentage calculations, and apply the knowledge in various subjects such as math, physics, and chemistry. Recent survey results also show Finnish children and young people's growing concern about climate change.

From the United Nations data for the use of curricula integrated with climate change education, there are certainly those that have implemented and have not implemented with various obstacles faced. The report explains that the latest data from UNESCO involving 100 countries indicates that only 53% of national education curricula around the world include climate change as a topic, and when the topic appears, the priority given is generally very low. In addition, UNESCO and Education International survey results show that less than 40% of the teachers surveyed felt confident in teaching about the severity of climate change, and only about a third felt able to explain the impact of climate change on their region or area. When asked about barriers to teaching about climate change, about 30% of the 58,000 teachers who participated in the survey reported that they were not familiar with appropriate teaching methods. More than a quarter of the respondents considered that some approaches to teaching climate education were not suitable for online teaching. This is a significant concern, especially given that 737 million students in 66 countries are still affected by partial or full school closures. UNESCO emphasizes the need for cooperation between the education and environmental sectors to successfully integrate climate change education in education systems around the world, at every level of education (UNESCO, 2023)

How Social Interaction Affects Students' Contributions to Climate Change

Students' social interactions within the school or college setting, including the exchange of ideas, information, and collaboration on environmental projects, can significantly contribute to students' efforts in dealing with climate change. Teachers and mentors also play an important role in providing guidance and an in-depth understanding of climate change impacts.

At the family level, these interactions influence daily behaviors, such as food selection and waste management. Meanwhile, involvement in community activities, such as environmental campaigns, can extend positive impacts and strengthen social support, shaping norms that support sustainable practices. Overall, students' social interactions involving multiple levels can be key to shaping their positive contributions to climate change. This is also emphasized by Bello Benavides et al., (2021) that several approaches to creating sustainable social change to address climate change have been explored, but research exploring the long-term effects of interventions is limited. A recent meta-analysis of behavior change interventions for climate change mitigation shows that there is no evidence of sustained positive effects after the intervention ends. In this perspective, three key themes are highlighted, namely deep engagement, common mental models, and social norms, as a strong basis for answering important questions about creating lasting change in climate change-related beliefs, attitudes, and behaviors.

In addition, research conducted by Leichenko & O'Brien (2020) that interaction through climate change Education has an important role to play in addressing this issue and encouraging the adoption of individual and group practices that reduce pollution and increase pro-environmental behavior. However, climate change education courses that only focus on providing information about the seriousness of the climate change problem can create feelings of helplessness and lead to emotional paralysis. Pro-environmental education courses should consider people's emotional landscape regarding climate change. Understanding climate change-related emotions is important, as the inner dimension influences individual and collective responses to environmental issues. Emotions drive cognitive decision-making processes. Addressing climate change by taking emotional aspects into account is challenging, as traditional climate change education tends to ignore emotional aspects. It is important to explore different educational strategies that take into account emotions arising from climate change and promote environmentally friendly attitudes and behaviors. This research proposes that an integrated approach based on traditional science, ecological education, affective education, and community psychology has the potential to increase students' awareness of environmental issues, understand the psychological dimensions of climate change, encourage climate action, and contribute to the creation of a more sustainable society.

Sustainable Education Concepts in Support of Student Contributions in Addressing Climate Change

The concept of sustainable education plays a crucial role in supporting students' contributions to addressing climate change. Sustainable education focuses not only on transferring knowledge about climate change but also on developing a deep understanding of its impacts and stimulating critical thinking about sustainable solutions. Engaging students in active learning, such as environment-based projects or school carbon footprint reduction programs, can strengthen their commitment to sustainable practices. In addition, creating learning environments that encourage interdisciplinary collaboration and active participation in the community can expand the impact of sustainable education. This is also emphasized by the results of research conducted by Yuan & Sun (2022) that to increase students' understanding and awareness of climate change, warming, and cooling of the Earth and to develop their interest in STEM (Science, Technology, Engineering, and Mathematics) fields, this research successfully created opportunities through a citizen science-based environmental education program. By utilizing instruments such as infrared cameras, this approach proved effective in improving students' knowledge of climate change and environmental issues as a whole. The integrated methods, including pre- and post-session quizzes as well as thermal camera-based activities by elementary and middle school students, provided a comprehensive picture of the impact the activities had on student learning and understanding. Overall, this research provides deep insight into the role of the Heat-Cool initiative in increasing students' awareness and knowledge of climate change drivers and their impacts.

The successful climate change mitigation requires action at all levels of society, from individuals to organizations, local governments, countries, and international institutions, creating a clear obligation and opportunity in the context of education. In terms of climate change, learning from experience is considered an overdue action, given the inertia in human climate and energy systems. Decisions and actions today have consequences that develop over decades, centuries, or even longer. Although we are fortunate to live in a time where science provides rigorous projections based on existing knowledge, providing the opportunity to learn from those projections rather than from direct experience, However, the realization of this privilege depends on the translation of such knowledge through education to produce societal action.

As a form of illustration of the novelty in this research related to student social interaction in supporting the implementation process of sustainable education to support the contribution of lessons for handling climate change.

The involvement of educational institutions, especially schools, in student-led efforts to address climate change has undeniable urgency. As the primary place where young people spend most of their time, schools provide a solid foundation for shaping environment-related attitudes and behaviors. Formal education in schools is a structured channel to convey scientific information on climate change, its consequences, and mitigation strategies. Engaging educational institutions not only provides knowledge but also creates a sustainable environmental culture, promotes sustainable practices, and forms positive habits among students. Schools also have the potential to engage students in practical projects and environment-related activities, enriching their experience and strengthening engagement in relevant environmental issues. More than just a scientific investment, school involvement in addressing climate change shapes positive character and values early on, creating future leaders who care about and engage in environmental and sustainability issues. In addition, the process of social interaction in terms of sociology has been embedded in the aforementioned concept through the school, where the school is the source of such interaction in developing the concept of sustainable education and the contribution made by students in addressing climate change.

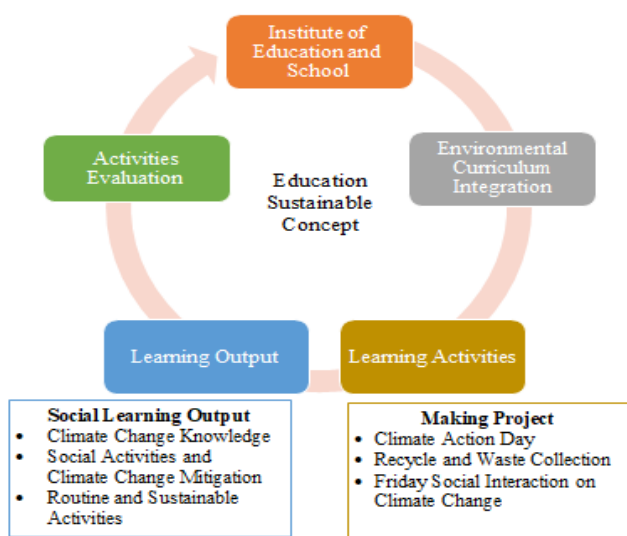


Figure 1. Illustration of Education Sustainable Concept (Autor’s Personal Data)

The integration of environmental curricula becomes particularly important in addressing climate change for students when viewed from a sociological perspective. By integrating environmental issues into the curriculum, education not only provides scientific knowledge about climate change but also creates a deeper understanding of how social factors play a key

role in responses to this issue. An environmentally integrated curriculum can shape positive social perceptions and attitudes towards the environment, motivate learners to participate in collective action, and change social norms regarding sustainable behavior. Thus, a sociological approach to environmental curriculum integration paves the way for creating a society that is more environmentally conscious and committed to addressing climate change. Therefore, curriculum integration in environmental education focuses students on gaining knowledge and working on long-term projects in support of mitigation for climate change that will impact the school and the community.

School activities such as Climate Action Day, Recycle and Waste Collection, and Friday Social Interaction on Climate Change have great potential to support students' contributions to climate change mitigation. Climate Action Day can provide a focused platform to raise students' awareness of environmental issues, engage them in collective action, and encourage the formation of sustainable attitudes. Through this activity, students can experience firsthand the impact of positive actions on the environment. Recycling and waste collection help create a school environment that cares about waste management. It provides practical experience on the importance of recycling and waste reduction in students' daily lives. By actively participating in waste and recycling collection, students can respond directly to the positive impact on the environment that can be achieved through their actions. Friday Social Interaction on Climate Change provides a space for discussion and exchange of ideas among students on climate change. This not only deepens their understanding but also builds a supportive community to exchange ideas and strategies for facing the challenges of climate change. This activity motivates students to socially engage in environmental issues, creating a culture of care and responsibility towards the future of the planet. Overall, engaging students in activities such as these not only provides practical knowledge about climate change but also shapes positive attitudes and values that can be the basis for their continued contribution to climate change mitigation in the future.

Learning outcomes that include increased climate change knowledge, participation in climate change social and mitigation activities, and the implementation of routine and sustainable activities can be considered an effective approach to supporting students in mitigating climate change. Enhanced climate change knowledge equips students with an in-depth understanding of fundamental environmental issues, while participation in social and mitigation activities provides hands-on experience in positive collective action towards the environment. Social interaction between students, especially through activities such as Friday Social

Interaction on Climate Change, creates a community that supports the exchange of ideas and support in facing the challenges of climate change. These activities facilitate collaboration and build a social culture that cares about the environment. Meanwhile, the implementation of regular and ongoing activities such as recycling and waste collection creates sustainable practices in students' daily lives, which can form positive habits that contribute to climate change mitigation. Thus, this whole learning approach creates an environment that supports students in translating knowledge into real actions, involving social interactions that strengthen their commitment to environmental issues. This approach is not only effective in providing practical understanding and skills but also shapes character and social values essential to contributing to climate change mitigation.

The evaluation stage is crucial to assessing the success and impact of the activities that have been carried out in the context of climate change mitigation. Evaluation involves a comprehensive assessment of the achievement of the set objectives, the effectiveness of the strategies used, as well as the participation and impact on students and the surrounding environment. Through evaluation, we can measure the improvement of students' knowledge on climate change, assess the extent to which social and mitigation activities have been applied in their daily lives, and evaluate the effectiveness of routine and ongoing activities such as recycling and waste collection. In addition, the evaluation also includes analyzing the social interactions between students established during activities such as Friday Social Interaction on Climate Change. How collaboration is formed, the extent to which ideas are exchanged, and whether a social culture that supports environmental awareness is created can be the focus of the assessment. Evaluation also considers the sustainability aspect of the activity and whether the positive habits implemented, such as recycling practices, can be maintained and applied sustainably by students. Therefore, the evaluation stage becomes a key instrument to identify areas that need to be improved, formulate recommendations for further development, and ensure that the activities carried out not only have a short-term impact but also make a sustainable contribution to climate change mitigation efforts.

Conclusion

In the context of this research, the first objective is to identify new factors in sustainable education that can motivate students to take action on climate change. From the information above, we understand that the integration of environmental curriculum, school activities such as Climate Action Day, and participation

in social activities such as Friday Social Interaction on Climate Change can be important factors that motivate students. Formal education in schools provides a structured foundation to shape deep understanding and positive attitudes regarding climate change. In addition, social activities such as student-to-student interactions can create a culture that supports and motivates learners to engage in sustainable collective action. The second objective of the research, to evaluate the influence of the student movement on climate change on student actions, can be related to the concept of evaluation discussed earlier. Evaluation involves assessing the effectiveness of activities and social interactions between students and the implementation of sustainable actions such as recycling and waste collection. Thus, through this evaluation stage, the research can provide insights into the extent to which the student movement can drive concrete actions in climate change mitigation. Overall, the results of this study can contribute to designing sustainable education approaches that not only increase knowledge but also motivate and evaluate student action on climate change. The factors identified, such as the integration of environmental curricula and sustainable school activities, can form the basis for creating an educational environment that supports students' positive behavior change in the face of climate change challenges.

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