

Climate Change and Academic Performance

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Abstract:

Climate change increasingly affects students' school performance, as extreme weather conditions like floods and storms disrupt studies and lead to school closures, causing learning interruptions and affecting student attendance. High temperatures also impact students' concentration in classrooms, leading to fatigue and distraction, which reduces their academic achievement. Additionally, challenging climate conditions increase weather-related illnesses, such as respiratory diseases, resulting in higher absenteeism rates. These challenges require a response from the educational system to ensure continuity of learning, such as improving school infrastructure and adopting remote learning strategies.

Keywords: Disruptions, Attendance, Infrastructure.

Introduction

Scientists face a significant challenge in identifying the mechanisms that govern climate change on our planet. Understanding these processes depends on a set of complex factors that are difficult to predict, especially when it comes to forecasting future climate developments. As efforts continue to collect data on temperature, rainfall, winds, and many other variables, the need for advanced tools to understand the climate history has become more urgent. This data helps predict future changes, but it requires a comprehensive and precise understanding of the available information to reach reliable conclusions.

Climate change has become one of the most pressing global issues today due to its direct impact on various vital sectors, including agriculture, water, energy, and health. This widespread attention from international environmental organizations has reinforced the conviction among climate scientists that these changes are caused by human activity, specifically the release of greenhouse gases into Earth's atmosphere. These gases, which contribute to global warming, come from the burning of fossil fuels for energy production and use, deforestation, and agricultural activities, as well as land-use changes.

Climate change has diverse and significant effects across many areas, especially on the educational system, where it causes several problems that hinder the educational process. Among the most prominent impacts is the damage to educational infrastructure caused by natural disasters such as floods, severe storms, and increasing wildfires due to climate change. Furthermore, these changes affect the performance of both students and teachers, leading to disruptions in education, higher absenteeism rates, and ultimately negatively impacting academic achievement. So, how can the educational system adapt to these increasing challenges and ensure the continuity of education under these changing climatic conditions?

Definition of Climate Change

1. “Changes directly or indirectly attributable to human activities that lead to alterations in the global atmospheric composition, which is observed in addition to natural climatic fluctuations over comparable time periods.” (UNFCCC, 1992, p. 4)
2. “Disruptions and noticeable changes that occur in the weather patterns of a region, including rainfall rates, temperature, and wind conditions. These changes can be attributed to dynamic processes of the Earth, external forces, or the impact of human activities.” (Faris M, 2014, p. 418)

Causes of Global Climate Change

The causes of climate change stem from a combination of natural and human factors:

1. Human Activities:

The burning of fossil fuels like coal, oil, and natural gas is a major contributor to the increase of greenhouse gases like carbon dioxide in the atmosphere, intensifying global warming and raising Earth's temperature. Major sources of emissions include the transportation, industrial, and agricultural sectors.

2. Land Use Changes:

Activities such as deforestation and intensive farming reduce the Earth's ability to absorb carbon and increase methane and nitrous oxide emissions, which further contribute to climate change.

3. Solar Activity:

Changes in solar activity have a limited effect on Earth's climate. While the sun is the main source of energy for Earth, fluctuations in solar radiation are not sufficient to explain the current global warming trend.

4. Volcanic Eruptions:

While volcanic eruptions can temporarily influence the climate by releasing gases like sulfur dioxide, which cool the atmosphere, their long-term impact is minimal compared to human activities (NASA, 2022).

Manifestations of Global Climate Change

When the topic of global climate change is raised, most of us think only of environmental manifestations, such as rising temperatures, the melting of polar ice caps, and the rising levels of seas and oceans. Undoubtedly, these environmental manifestations of global climate change do indeed affect the daily life of humans. However, it is certain that the Earth's temperature is gradually increasing, and the primary cause of this is the greenhouse gas emissions released by human activities. If current patterns of fossil fuel usage, development, and population growth continue, there will be a continuous change in the climate, with serious consequences for the environment and consequently for human life. This impact will extend in the future to encompass all aspects of social life on Earth. (Khaled El-Sayed Hassan, 2021, p. 14)

Economic and Social Impacts of Climate Change

Water-related Impacts:

It is expected that the suffering of regions experiencing drought and water scarcity will increase, and the duration of drought cycles will shorten from about a century to just ten years. It is anticipated that rainfall rates in the Mediterranean Basin and parts of South Africa and South America will decrease by about 30% with a 2°C rise in temperature. This decrease in rainfall will increase to 40-50% with a temperature rise of 4°C. In regions that already suffer from drought cycles, such as Central and East Africa, the number of drought cycles will increase by four times their current rate. Additionally, drought cycles in Southern Europe will occur every 10 years instead of once every 100 years, as they do now. Regions that rely on water from melting snow, such as parts of India, China, Canada, the western United States, and Western Europe, will lose the regularity of their water resources due to the rapid melting of large amounts of snow at once. As a result, they will experience floods at certain times and water shortages at others. However, these risks in Western Europe do not have a significant impact on the sufficiency of water resources. According to some estimates, the number of people who will suffer from severe water scarcity could reach between 1 and 4 billion.

Impacts Related to Food Production:

The effects of climate change on agriculture will reduce crop yields, especially in regions that are already vulnerable to extreme weather events such as droughts, floods,

and temperature fluctuations. This can lead to food insecurity, price increases, and disruptions in food supply chains. Agricultural areas that depend on specific temperature ranges and water availability will face challenges in sustaining production levels.

Impacts Related to Health:

Climate change will exacerbate public health issues, leading to an increase in heat-related illnesses and deaths. Rising temperatures will also expand the range of many infectious diseases, as warmer climates create better conditions for disease-carrying vectors like mosquitoes. There will also be more frequent occurrences of extreme weather events, such as floods and hurricanes, which can disrupt communities and healthcare systems, further complicating health management.

Impacts Related to Land Resources:

Soil degradation, desertification, and the loss of arable land will become more prominent with climate change. As temperatures rise and weather patterns become more unpredictable, the ability to grow crops and sustain ecosystems will be hindered. Droughts, floods, and changing precipitation patterns will further reduce the fertility of land, leading to reduced agricultural productivity.

Impacts Related to Infrastructure:

Extreme weather events, such as storms, floods, and heatwaves, will damage infrastructure, including roads, bridges, power grids, and water systems. Increased costs for repairs, adaptation, and rebuilding will strain economies. Coastal cities, in particular, are at risk due to rising sea levels, which could submerge critical infrastructure. The long-term effects will require substantial investments in climate-resilient infrastructure to mitigate the damage.

Environmental Impacts:

The most evident environmental impact will be the loss of biodiversity. As climate change accelerates, many species will face extinction due to changing habitats, altered migration patterns, and temperature increases. Coral reefs, forests, and wetlands are particularly vulnerable. Ecosystems will be disrupted, affecting everything from plant life to animal populations, and potentially leading to irreversible ecological damage.

Impact of Climate Change on School Infrastructure

Climate change significantly affects the infrastructure of schools, as educational buildings face major challenges due to changing climatic conditions, such as rising temperatures, heavy rainfall, storms, and rising sea levels. Below is an analysis of the main potential impacts:

1) Impact on School Buildings (UNICEF, 2021)

- **Heavy Rainfall and Flooding:** These can lead to erosion of foundations, weakening of structures, and water seepage into buildings. This can cause deterioration of walls, roofs, and damage to furniture and equipment, requiring repairs and incurring additional costs.

- **Cracks and Material Degradation:** Increased humidity resulting from frequent rains and floods causes wear and tear of building materials, which affects the structural integrity of the buildings, potentially exposing them to partial or complete collapse in severe cases.

2) Rising Temperatures (Journal of School Environment and Health, 2020, p. 49)

- **Increased Pressure on Air Conditioning Systems:** Rising temperatures affect the comfort of students and necessitate the presence of effective cooling and ventilation systems, which increases operational and maintenance costs.

- **Impact on Educational Performance:** High temperatures negatively affect students' concentration and performance inside classrooms, leading to an increased need for additional resources to maintain a conducive learning environment.

3) Impacts from Storms and Strong Winds (WMO, 2020, p. 127)

- **Damage to Roofs and Windows:** Storms and high winds can cause damage to roofs, glass, and windows in schools, requiring emergency repairs to maintain a safe educational environment.

- **Increased Likelihood of School Evacuations:** Schools located in areas prone to storms or hurricanes may face emergency evacuations, which disrupt the continuity of education.

4) Impact on School Transportation

- **Delays in School Arrival:** Damaged or flooded roads can delay school transportation, affecting the regular attendance of students.

- **Increased Operational Costs:** School buses may require additional maintenance or replacement due to damage caused by severe weather conditions.

5) Rising Sea Levels and Impact on Coastal Schools

- **Schools near Coastal Areas:** Schools located near beaches face the risk of permanent flooding or coastal erosion, which may require relocating these schools or enhancing their protection, resulting in significant costs. (Infrastructure and Sustainability Journal, 2018, p. 217)

Impact of Climate Change on Student Attendance and Academic Performance

Climate change directly and indirectly affects student attendance and academic performance through various environmental, health, and psychological factors. These impacts can be summarized as follows:

1) Impact on School Attendance (World Bank, 2018, p. 246)

- **Severe Weather Conditions:** Storms, heavy rainfall, or floods can disrupt roads and transportation, making it difficult for students to reach their schools. This is particularly evident in rural areas that may lack the infrastructure to withstand extreme weather conditions.

- **School Closures in Emergencies:** With increasing storms and unprecedented high temperatures, schools may be forced to temporarily close to ensure student safety, leading to interruptions in the educational process and inconsistent student attendance.

- **Climate-Related Illnesses:** Higher temperatures and the spread of seasonal diseases, such as fevers and respiratory conditions associated with climate fluctuations, lead to higher absenteeism due to illness.

2) Impact on Academic Performance: (Educational Sciences Journal, 2020, p. 169)

- **Heat and Concentration:** Several studies indicate that high temperatures negatively affect students' concentration and productivity, leading to poor academic performance, especially in classrooms that lack adequate ventilation and cooling systems.

- **Psychological Stress and Learning:** Unstable climatic conditions can cause psychological stress on students, especially when climate change affects their families' economic or social conditions. This stress can reduce motivation to learn and negatively impact academic performance.

- **Gaps in Academic Achievement:** Frequent school closures due to extreme weather conditions create gaps in academic progress, where students struggle to catch up on missed content, which reflects negatively on their overall performance.

3) Impact on Student Health and Well-being

- **Respiratory Diseases and Allergies:** Climate change, such as rising temperatures and increased humidity levels, contributes to higher rates of respiratory diseases and allergies, affecting student health and their ability to concentrate (UNDP, 2019, p. 203).

- **Heat-Related Fatigue:** High temperatures increase physical exhaustion and fatigue, which impacts students' ability to continue studying effectively (International Journal of Public Health, 2019, p. 256).

Educational Policy Responses to Climate Change

Educational policy responses to climate change have become crucial to ensure the continuation of education in the face of growing environmental challenges and to protect students, teachers, and school infrastructure. These responses reflect efforts to adapt to climate impacts and mitigate their negative effects on education. Below are some prominent examples of policy responses at national and international levels (World Bank, 2020, p. 149):

1) Improving School Infrastructure

- **Building Climate-Resilient Schools:** In countries vulnerable to natural disasters, such as floods and hurricanes, educational policies focus on constructing schools with strong structures capable of withstanding such events. For example, the Philippines and Japan emphasize designing schools that can endure severe weather conditions, including earthquakes and storms.

- **Renovating Existing Schools:** Countries like Bangladesh have programs to renovate existing schools to make them more resilient to floods and high winds, which helps ensure safety and reduce the need for frequent school closures (OECD, 2019, p. 221).

2) Climate Education and Environmental Awareness in Curricula

- **Integrating Environmental and Climate-Related Subjects:** Educational policies aim to raise awareness of climate change by incorporating subjects that educate students about the causes and effects of climate change and its impacts on the environment and society. This approach, adopted by many European Union countries and Australia, helps create a generation that is more conscious of environmental challenges (UNICEF, 2021, p. 257).

- **Hands-On Sustainability Education:** Some schools offer environmental gardens and outdoor educational projects to enhance students' practical skills in sustainable environmental practices, as seen in educational programs in the United States and Germany (Brookings Institution, 2021).

3) Emergency and Disaster Management Programs in Schools

- **Rapid Response Disaster Plans:** Some countries have developed emergency plans to evacuate students during natural disasters, focusing on training teachers and students on how to act in emergencies, as implemented in Japan and Canada.

- **Early Warning Systems and Emergency Closure Procedures:** Some policies implement early warning systems in schools located in disaster-prone areas to quickly decide on evacuation when necessary (JEPS, 2019, p. 378).

4) Promoting the Use of Technology for Remote Learning

- **Remote Learning as an Alternative in Emergencies:** Some policies rely on remote learning as an alternative to ensure continuity of education during severe weather or natural disasters. For example, during the COVID-19 pandemic, several countries used technology for remote education, a strategy now permanently integrated into educational systems to respond to climate emergencies.

- **Strengthening Digital Infrastructure:** Some educational policies support investments in enhancing digital infrastructure and providing electronic devices to students, ensuring learning continues even when accessing schools is not possible due to weather conditions (JEPS, 2019, p. 312).

5) International Collaboration to Strengthen Climate Policies in Education

- **International Financial and Support Programs:** International organizations like UNICEF and the World Bank offer programs to help developing countries adopt educational policies that align with climate challenges. These programs include funding for building climate-resilient schools and training teachers on integrating climate education into curricula.

- **Participation in International Conferences and Agreements:** International collaboration helps spread successful experiences and ideas globally. Countries participate in conferences like the United Nations Climate Summit to emphasize the role of education in addressing climate change (UNDP, 2021).

Mitigation Policies

Climate change is an environmental crisis that has caused over 525,000 deaths worldwide due to 15,000 extreme weather events between 1995 and 2004, resulting in losses close to \$3 trillion. Climate change presents a fundamental threat to livelihoods, directly contributing to global temperature rise and the increasing frequency and intensity of extreme weather events and natural disasters like droughts, floods, desertification, biodiversity loss, and more. These impacts have a direct effect on global food security, human health, well-being, security, economic growth, job opportunities, and educational systems, necessitating strategies for adaptation.

Recommendations for Improving Educational Responses to Environmental Challenges

1) Enhance Climate-Resilient Infrastructure

- **Building Disaster-Resistant Schools:** Schools should be designed to withstand disasters such as floods, storms, and earthquakes. This includes improving drainage systems in flood-prone areas and ensuring classrooms are equipped with adequate cooling and ventilation systems to handle rising temperatures.

- **Renovating Old Schools:** Update older school buildings to be more climate-resilient by strengthening foundations, improving insulation, and installing wind- and storm-resistant windows and doors.

- **Integrating Renewable Energy:** Installing solar or wind energy systems to power schools, reducing reliance on conventional energy sources and increasing the sustainability of educational facilities.

2) Integrate Environmental and Climate Education into Curricula

- **Incorporating Environmental Issues in Curricula:** Curricula should focus on educating students about climate change, its causes, effects, and importance of environmental sustainability.

- **Teaching Adaptation and Positive Contributions:** Schools should encourage students to adopt environmentally friendly behaviors, such as recycling, reducing resource consumption, and participating in tree planting activities.

- **Teaching Disaster Preparedness:** Training students and teachers on how to respond during natural disasters through evacuation plans and safety drills.

3) Develop Remote Learning Technologies for Emergencies

- **Strengthen Digital Infrastructure:** Provide the necessary resources and technologies for remote learning, including high-speed internet and mobile devices, especially in rural or disaster-prone areas.

- **Create Flexible Learning Plans:** Develop flexible study plans to meet student needs during disasters, such as recorded lessons or an electronic resource library that students can access anytime.

- **Train Teachers in Digital Education:** Provide training for teachers on managing online lessons and offering effective remote education, ensuring students can continue learning during disruptions.

4) Collaborate with International and Environmental Organizations

- **Leverage International Support Programs:** Strengthen partnerships with international organizations like UNICEF and the World Bank for funding and technical support to build climate-resilient schools and develop environmental curricula.

- **Engage Local Environmental Organizations:** Organize educational programs with local environmental groups to increase students' awareness of regional environmental challenges and how to address them.

- **Involve Students in Community Environmental Activities:** Encourage schools to organize community events like tree planting and beach clean-ups to foster environmental responsibility among students.

5) Establish Comprehensive and Sustainable Education Policies for Climate Change

- **Develop Rapid Response Disaster Plans in Schools:** Education systems should develop emergency plans to ensure the safety of students and staff during natural disasters, with regular training on their implementation.

- **Encourage Scientific Research on Climate Impact on Education:** Allocate resources to support research on how climate change affects education and to develop scientific and technological solutions to mitigate these impacts.

- **Promote Innovation in Environmental Education:** Encourage schools and educational institutions to adopt innovative approaches in environmental education, such as establishing educational gardens or using digital learning tools for climate and environmental topics.

6) Raise Awareness among Teachers, Students, and Parents

- **Teacher Training on Climate Change:** Train teachers on the importance of climate change and its impacts and how to incorporate it into the learning process.

- **Parent Workshops on Climate Change:** Conduct awareness workshops for parents on the significance of climate change and its effects on their children's education, encouraging their involvement in school efforts.

- **Launch Continuous Awareness Campaigns:** Organize awareness campaigns through social media and within schools to spread environmental awareness among students and the wider community.

7) Encourage Use of Eco-Friendly Materials in Schools

- **Using Recycled Materials in School Supplies:** Reduce the use of environmentally harmful materials and replace them with

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