12th WEEC
CONNECTING PEOPLE
CREATING TOMORROW

PROCEEDINGS OF 12TH WORLD ENVIRONMENTAL EDUCATION CONGRESS

29 JAN – 02 FEB 2024
ABU DHABI, UNITED ARAB EMIRATES

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Congress Organisers

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

World Environmental Education Congress
Network

World Environmental Education Congress
Network

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Foreword

WEEC is a unique event because it brings together a range of specialists and professionals dedicated to environmental education. We all know that instigating change in communities to adopt environmentally friendly behaviour is only possible through rigorous environmental education.

We are fortunate in our day and age that governments have started adopting strategies to place the environment very high up on the national agenda. We are also lucky that more individuals in society are becoming increasingly aware of the importance of saving the planet – especially our children.

But we still have a long way to go, and that is why events like WEEC are critical as a sounding board to ensure that environmental education continues across all countries.

The UAE is a country that values the environment greatly, and our leadership provides us with unconditional support so that all environmentalists and organisations can achieve their goals – especially as a woman. And that is why I am very proud to be an Emirati woman working in the field of environment. There are more women joining the field, and I know that several of them in my team decided to pursue this career path because they were inspired through environmental education. This reflects its importance and the only way we can empower the upcoming generations to become advocates and ambassadors for the environment, is by proving them immense access to more knowledge.

In Abu Dhabi, through EAD we have more than 20 years experience in environmental education. We first started in 1999 with our very first Nature Bus and today, EAD is implementing many pioneering environmental awareness programmes in more than 85% of public and private schools in the Emirate of Abu Dhabi. Throughout the past years, we have received many prestigious awards in recognition and appreciation for our distinguished efforts and innovative programs in the field of environmental awareness.

We aim to continue the legacy of WEEC, which brings together like-minded individuals who play a very significant role when it comes to environmental education.

Thank you

H.E. DR SHAIKHA SALEM AL DHAHERI
Secretary General
Environment Agency - Abu Dhabi

Opening Speech

[Your Highness], Excellencies, Authorities, Institutions, dear colleagues from Abu Dhabi and the United Arab Emirates, friends who have come in large numbers from all over the world, and young people who, for the third time in our history, are participating in the conference that brings us the indispensable and precious voice of the new generations.

First, I would like to thank the local organising committee (the Environment Agency), which, with commitment and conviction, pursued the goal of holding our congress here, providing a dynamic platform for dialogue and collaboration.

I sincerely thank all those in Abu Dhabi, the Emirates and remotely who contributed to the success of our twelfth global meeting.

The 2024 WEEC congress embodies a global commitment to environmental education, which our host country generously demonstrates by also assuming the presidency of the International Union for Conservation of Nature.

The UAE's role as host has been crucial, creating a ripple effect that I hope will extend far beyond the congress, inspiring impactful change worldwide.

Twenty years have passed since the first congress in Portugal, and twelve congresses are an outstanding achievement.

Each time, we present the most appropriate reflections for the moment we are going through in a rapidly accelerating world, the most recent research and the most effective practices.

Each time we meet in a different place on the globe, which is also a different crossroads of history, because the context is constantly changing around us and because each destination bears the mark of various traditions, cultures, economic and social structures as well as holds the mark of events of history and is affected by the events of the present, which is the construction of the story that we will read in the future.

Prof. Mario Salomone,
Secretary-General of WEEC Network

Since the future is a collective invention, the future results from the actions, choices and hopes of the estimated 8.1 billion people who inhabit the Earth or the approximately 8.5 billion who will be on Earth in 2030, the year in which the United Nations Agenda turns.

Environmental education has a great responsibility to contribute to this future invention.

A historical crossroads is also a deadlock: which road or path to take? The crossroads of history is more complex than a fork or a crossroads. It's a tangle of trails that branch off into the forest or tracks out into the desert. Today, the climate, ecological, economic and geopolitical "polycrisis" makes the web of possible paths even more complex and uncertain.

First, I want to emphasise that **environmental education is an education for the future.**

Here in Abu Dhabi, we are at a crucial crossroads.

We are in Asia, but almost at the crossroads of three of the five, or six or seven continents (depending on the criteria) and about the same distance, as the crow flies, from the geographical centres of these three (Asia, Africa, Europe) and the other continents.

I would like to recall that in Abu Dhabi, on 4 February 2019 (so we are on the fifth anniversary), the Grand Imam of Al-Azhar al-Sharif and the Muslims of the East and West, together with the Catholic Church and the Catholics of the East and Wes signed the "Document on human fraternity for world peace and living together".

The document referred to the signals of a "Third World war being fought piecemeal."

Well, World Congresses are also a great opportunity for education leaders worldwide to meet. Thanks to the World Congresses, we are aware of this "closeness between East and West, between North and South" that the Declaration on Human Fraternity called for "among all believers, indeed among believers and non-believers, and among all people of good will".

The declaration identified full citizenship, peace, rights, dialogue and mutual respect among the objectives.

Well, that is to say, when the signs of a "third world war in pieces" are multiplying, **environmental education is also an education in eco-citizenship, multiculturalism and peace.** It is perhaps also an education that, historically born in the countries of the North, must be "decolonised", giving more space to the knowledge, points of view and languages of the countries of the South.

Alongside the challenges of education for the future and the challenge of education for planetary eco-citizenship and peace, I see **a third challenge.**

The forest in which we wander as educators in the formal and non-formal sectors is a forest of disciplines in which the educational pathways of school and university are fragmented. But even outside of school and university, there are hidden separations, watertight compartments, both in our own work and the whole context that surrounds us, made up of structures and people imbued with separations between disciplines and specialised languages.

Interdisciplinarity and transdisciplinarity are subjects of great importance in general and even more so for us. The environment is at the crossroads of perspectives and is the ideal ground to build interdisciplinarity and transdisciplinarity. However, be careful: this is not an abstract question with only academic implications.

This challenge has many implications: it calls into question Western science, the relationship between expert knowledge and traditional and empirical knowledge, raises ethical-political questions and involves a profound reorganisation of knowledge, structures, and laws. It requires considering socio-diversity, biodiversity, and the relationship between humankind and nature.

What better opportunity, in short, to demonstrate the centrality of environmental education?

This question brings us to **an important conclusion** and **announcement.**

To conclude, I would like to quote a phrase suggested to me a few days ago by my colleague Samy Zalat of Egypt's Suez Canal University: **"Mainstreaming of Environmental education on all levels is crucial".**

The World Congresses and the WEEC Global Network were born for this. To promote the quality of environmental education and increase its effectiveness, expand and consolidate the international community of environmental educators, and ensure that each of you returns home after a congress with more ideas and energy.

I invite all of you to strengthen the community and use it to build partnerships, projects, and research initiatives, utilise our website and social media channels, and celebrate the World Day for Environmental Education this October.

Finally, I promised **an announcement.**

Learning processes are essential. Through learning, we acquire the elements to move between the paths of history and the cases of life.

We can learn well or poorly. We can become selfish and individualistic or supportive and cooperative. We can absorb conservative or innovative knowledge.

Unlike material growth, which is impossible on a finite planet, learning has no limits.

Forty-five years ago, the seventh report of the Club of Rome (which we all remember since MIT's first report, "The Limits to Growth") published a report entitled, precisely, **"No Limits to Learning."**

Today, the importance of learning in dealing with "polycrisis" leads us to revisit the crucial relationship of learning to build a desirable future together.

So here is the announcement: **a journey between the Club of Rome and the global WEEC network** begins, with the aim of better understanding the nature of learning today, considering the message that "No Limits to Learning" has sent in the face of the immensity of the task of improving the quality of human beings.

The message is summed up in one sentence by the Italian Aurelio Peccei, founder of the Club of Rome: "What we all need at this point in human evolution is to learn what it takes to learn what we should learn - and learn it."

The work of the Twelfth World Congress, which opens this morning, will also help us on this journey.

Good congress to all of you!

Introduction

The 12th World Environmental Education Congress (WEEC 2024) reaffirms the critical role that Environmental Education (EE) and Education for Sustainable Development (ESD) play in humanity's transformation towards a sustainable world.

WEEC 2024 (29th Jan-02nd Feb, 2024) in Abu Dhabi, United Arab Emirates, offers significant experiences in connecting people from all over the world to discuss, learn and share the latests advances in education programmes surrounding environmental and sustainable development.

The Congress discusses the role and importance of education for environment and sustainability at all levels; within formal, non-formal, and informal education has been presented on more than the two main categories of abstracts that have been submitted : not only academic abstracts and practitioner abstracts , but also other types/formats of abstract, such as novel, short fiction, stage performance, game, and interactive activities regarding and representative of environmental education and sustainability were accepted.

International and Local Socio-scientific Committee

The Socio-scientific committee members provided invaluable support to Congress through their diligent review of over 700 submissions. The committee comprised experts who served as national and international liaisons and established the specific themes of the Congress, persons in charge of thematic niches and those in charge of parallel activities, to develop the content of the various Congress activities to ensure coherence and holistic coverage. It is through their diligence that the 12th WEEC has such depth and quality of content, as illustrated by the abstract contained herein.

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Thematic Clusters

The content of the 12th World Environmental Education Congress, held 29th January to 2nd February, 2024, in Abu Dhabi, United Arab Emirates is categorised into four thematic clusters.

The four thematic clusters follow a deliberate sequence: *'The Challenges', 'The Goals', 'The Dimensions',* and *'The Means'*. In this manner, the environmental challenges that need to be addressed (the *"why"*), such as the triple planetary crises, are at forefront of attention. The goals, such as enviromnental education for a sustainable future are the "what", and the dimensions and means are the "how" these goals will be achieved.

01. THE CHALLENGES

The Challenges facing humanity are many and include emergencies such as natural disasters affecting education, limits in resources or access, and ingrained educational paradigms that may need revision. The focus is on identifying how best to educate about these many and varied challenges to build resilience as well as find solutions.

The Themes most closely associated with this thematic cluster are:

- **Tackling the Triple Planetary Crisis - Climate Change Pollution and Biodiversity Loss**
- **Water Food and Energy Nexus in Environmental Education**

02. THE GOALS

The Goals are actionable plans and objectives aimed at overcoming challenges in environmental education. This section of the programme explores methods for positive transformation in educational approaches, curriculum designs, or systemic changes. The emphasis is on concrete strategies and target outcomes.

The Themes most closely associated with this thematic cluster are:

- **A Worldwide Community for Sustainability as the Goal**
- **Environmental Education for a Sustainable Future**

03. THE DIMENSIONS

The Dimensions are specific domains or subfields within environmental education. Examples include early childhood education, community-based education, indigenous knowledge systems, and the role of art in education. The objective is to explore the multifaceted nature of environmental education and its applications in different settings.

The Themes most closely associated with this thematic cluster are:

- **A Matter of Values and Cultural Diversity - Indigenous Knowledge and Culture**
- **Aesthetics Ethics and Emotional Dimensions - The Role of Art and Design in EE**

04. THE MEANS

The Means comprise tools, methods, and experiences that can be employed in environmental education. This could range from the use of specific teaching aids, software, and technologies to methods for fieldwork and interactive learning. The focus is on practical applications that enhance educational experiences.

The Themes most closely associated with this thematic cluster are:

- **Artificial Intelligence and Smart Technologies**
- **Efforts and Challenges in EE for Early Childhood Education**
- **Outdoor and Place-based Learning in the Decade of Ecosystem Restoration**
- **Promoting Collaboration and Learning Communities to Address Socio-environmental Challenges**

CLUSTER

01

The Challenges

Theme 01:
Tackling the Triple Planetary Crisis -
Climate Change Pollution and Biodiversity Loss

Theme 02:
Water Food and Energy Nexus in
Environmental Education

THE CHALLENGES THEME 01

Tackling the Triple Planetary Crisis - Climate Change Pollution and Biodiversity Loss

Theme Background: The 12th World Environmental Education Congress 2024 aims to foster a discussion around the role of EE and ESD in addressing the urgent global challenges encapsulated in the Triple Planetary Crisis: Climate Change, Pollution, and Biodiversity Loss. These crises, as underscored by the UN Secretary-General's "Code Red" declaration, demand immediate and concerted action from all sectors of society. The common thread that runs through Triple Planetary Crisis driven by decades of unsustainable consumption and production which is also amplifying deep inequalities and threatening our collective future.

Theme Objectives: The thematic track seeks to discuss bold EE and ESD actions that are essential to address the three interconnected planetary crises facing humanity, namely the climate crisis, the nature crisis, and the pollution crisis, that are no more global but planetary in scale.

The aim is also to flag the consequences of inaction, the need for systemic thinking, holistic approaches, and showcase transformative practices in EE and ESD.

Theme Focus:

- The planetary impacts of Climate Change, Pollution and Biodiversity loss due to human actions.
- How critical is it to challenge existing norms related to lifestyles, production, and consumption, by considering equity and inclusivity.
- The need for educational responses that do away with siloed understanding to an interconnected one.
- Ethical considerations in environmental education.
- Innovative curriculum designs that promote systems thinking and holistic problem-solving.
- Fostering responsible citizenship through environmental education.

Theme Outcomes: Giving a clarion call to educators, education systems and governments to integrate interconnected challenges and education and learning responses.

Underscore that EE and ESD have to play a pivotal role in responding to this call, by shaping mindsets, values, and skills needed to address the planetary crises effectively.

The track shines a spotlight on practical insights, innovative approaches, and actionable recommendations that can pinpoint what is missing and what already can for the basis for addressing Triple Planetary Crisis.

Theme Conclusions: The track emphasises the pivotal role of environmental education in fostering critical thinking, values development, and innovative competencies necessary to navigate the complex challenges of our time.

THE CHALLENGES THEME 01

Tackling the Triple Planetary Crisis - Climate Change Pollution and Biodiversity Loss

Proceedings

ID	TITLE	PRESENTER	FORMAT
086	Advanced Baseline Imager (ABI) Algorithm Processing System for Early Forest Fire Detection: Theoretical Basis	Aysha Saif Alkaabi	Oral communication
136	The Impacts of Climate Change and Global Warming Knowledge on Youth Ecologically Sustainable Behavior: A Cross-Country Evidence	Ibrahim Landolo Cheick Oumar Niankara	Oral communication
474	Environmental Responsibility in Architectural Education: Tackling the Planetary Crisis through UNSDGs	Nadia Mounajjed	Oral communication
700	Green Competences: Empowering Future Generation with Socioecological and Educational Tools for Sustainable Jobs	Mariaclaudia Cusumano	Oral communication
901	The Most Serious Threat to the Economy and Environment Comes from Climate	Aurelio Angelini	Workshop

086

Advanced Baseline Imager (ABI) Algorithm Processing System for Early Forest Fire Detection: Theoretical Basis

Aysha Saif Alkaabi[1]

Abstract

Climate change has impacted a wide range of environmental phenomena, but perhaps forests were the most affected. Wildfires represent a global emergency, being one of the major contributors to global greenhouse gas emissions (GHG). They pose a serious threat to the environment and the planet, whether they are caused by natural forces or human activities. The nature of the planet cannot be controlled, but forest fire risk zones can be mapped to minimize the frequency of wildfires. This can be done through a combination of predictive modelling, early warning systems, and improved fire suppression techniques. Technology has brought us to a new age of monitoring and acting on changes more quickly, accurately, and efficiently. The importance of these technologies is more apparent than ever in fire zones. Here, a variety of challenges are present, such as degraded ecosystems, changing environments, increased greenhouse gases and respiratory illnesses affecting children and the elderly. This study aimed at developing a theoretical framework for incorporating early fire detection with an advanced baseline imager (ABI). Two stages can be distinguished in the proposed model: first, the collection and pre-processing of data and second, the identification of novel anomalies. Weather data from the National Oceanic and Atmospheric Administration (NOAA) have been used to track wildfire patterns. This paper may assist meteorologists in understanding fire behaviour and spread. It may also contribute to developing a processing system for incorporating early forest fire detection into advanced baseline imaging systems.

Keywords: climate change, early wildfires warning system, remote sensing, satellite imagery, weather forecasting, wildfires

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1. Introduction

Nearly 4 billion hectares of land are covered by forest, that's about 30% of the planet's surface.

With climate change left unaddressed, our planet's health continues to deteriorate. Wildfires of unprecedented magnitude and duration have successively been taken place in the past few years; and that is due to the increasing intensity and frequency of draught, strong winds, and lightening. Wildfires are predicted to increase in number by about 30% (at 4°C warming in 2100) and in area by 35-50% (at 2°C warming) as a result of climate change (UN Environment, 2022). By the end of this century, it is predicted that wildfires will significantly

Nomenclature

I	=	Heat index
R	=	Daily average relative air humidity %
t	=	Daily average relative air temperature (°C)
NI	=	Nesterov index
w	=	The number of days since the last daily rainfall exceeding 3 mm
T_i	=	Air temperature (°C)
T_i^{dew}	=	Dew point temperature
ROS	=	Rate of spread (m/h)
Tg	=	Teragram

Subscript

dew	=	The temperature at which water vapour condenses into liquid water

Acronyms/Abbreviations

Advanced Baseline Imager (ABI), Advanced very-high-resolution radiometer (AVHRR), Artificial Intelligence (AI), Convolutional Neural Network (CNN), Earth Observation (EO), Early Warning Systems (EWS), Forest Fire Risk (FFR), Greenhouse gas (GHG), Geostationary Operational Environmental Satellite (GOES), Global Disaster Alert and Coordination System (GDACS), Loop Heat Problems (LHP), Machine Learning (ML), Multispectral Scanner System (MSS), Moderate Resolution Imaging Spectroradiometer (MODIS), National Oceanographic and Atmospheric Administration (NOAA), National Environmental Protection Agency (NEPA), Probability of Detection (POD), Remote Sensing (RS), Sustainable Development Goals (SDG's), Coordinated Universal Time (UCT), Visible Infrared Imaging Radiometer (VIIR), Weather Research and Forecasting (WRF).

increase across 74% of the global landmass because of high greenhouse gas emissions (Sun *et al.* 2019). During 2019, wildfires ravaged Australia's southeast coast, covering nearly ten million hectares in less than three months, which resulted in a substantial affect in air quality and global climate, causing a long-lasting and adverse effects to human health due to certain chemicals composition and toxic pollutants of wildfire smoke. (Li *et al.* 2021).

1.1 Advanced Baseline Imager for Geostationary Operational Environmental Satellites

Being the primary instrument in the GOES-R Series, the Advanced Baseline Imager images Earth's weather, oceans, and environment. It has 16 different spectral bands, which cover a wide range of wavelengths, from visible to infrared and near-infrared channels to capture data from the Earth's surface. It can detect and measure temperatures, clouds, snow and ice cover, smoke plumes, and more ("ABI - GOES-R Series," n.d.). The ABI has a resolution of 2 km at nadir and can capture images every 30 seconds. Diurnal ABI fire detection and characterization stands to revolutionize the way we detect, monitor, and understand wildfires and other earth events like volcanic eruptions and landslides (Szpakowski and Jensen, 2019).

1.2 The Advanced Baseline Imager (ABI) Performance and Cooling System Issues

The GOES-17 cooling system issue is an anomaly with the spacecraft's loop heat pipe (LHP), which affects the cooling of the satellite's instruments. This cooling issue can cause imagery from the ABI to become saturated. The loop heat pipe anomaly on GOES-17, degraded imagery may occur in the ABI when the external temperatures are high, and the satellite is in eclipse. The loop heat pipe acts as a heat transfer device, which helps to remove heat from the ABI instruments to the exterior of the satellite. As the satellite moves in and out of eclipse, the external temperatures can change drastically, causing the satellite to enter a "thermal runaway" state. When this occurs, the loop heat pipe is not able to effectively cool the ABI instruments, which can lead to the imagery becoming saturated. Additionally, although the ABI algorithm can detect fires in both clear and cloudy conditions, it is more likely to fail in the presence of opaque clouds. In the ABI fire algorithm, which was originally developed by Matson and Dozier (1981) for NOAA Advanced Very High-Resolution Radiometer (AVHRR) data, a multispectral thresholding contextual process is used for detecting anomalies using band 7, which is capable of detecting anomalies in subpixels caused by high temperatures more easily than band 14. For better fire monitoring, the algorithm was specially tuned for AVHRR data to maximize the accuracy of pinpointing hot spot anomalies.

1.3 Forthcoming Modifications in Advanced Baseline Imager (ABI)

The theoretical basis of this technology is to use advanced imaging techniques to detect and monitor remote sensing and forest fire activity. This can be done by using a variety of sensors and cameras to capture and analyse

data in real time. Advanced imaging techniques allow for the visualization of remote sensing and forest fire activity in a way that has not previously been possible.

Satellite imagery with higher resolution and more spectral bands can capture more detailed information about the Earth's surface. This allows for a better understanding of the location and extent of fires, as well as their effect on the environment. This information can be used to develop more reliable mapping of burned areas (Kurbanov *et al.*, 2022).

2. Materials and Methods

Understanding spatial patterns of wildfire and the identification of areas susceptible to and affected by forest fires was found to be crucial in this study. To better identify areas at risk of future fires, temporal and spatial dynamics of past incidents were analysed. This was done based on the availability of thermal hotspot data and past fire activity records.

2.1 Data Search

Meteorological data from the National Oceanic and Atmospheric Administration (NOAA) have been used to track and understand spatial patterns of wildfires. NOAA's data have been critical in providing insights into the cause and effects of

forest fires. These insights can be combined with supervised and unsupervised approaches for early forest fire anomalies.

2.2 Data Analysis

Temperature can have a significant impact on forest fires. As vegetation becomes drier at higher temperatures, forest fires are more likely to occur (Thapa *et al.*, 2021). The GOES-R ABI fire products can capture small fire events at peak burning even with a spatial resolution of 2 km, providing a complete picture of burning areas across the Western Hemisphere than those derived from higher spatial resolution polar orbiting satellites. The GOES-R ABI fire products represent a major advancement in the ability to detect and monitor fires, as they allow for the capture of even small fire events in near real-time with unprecedented resolution.

3. Forest Fires Across the Globe

Wildfires in tropical areas damage the planet's ability to absorb carbon dioxide and regulate its temperature as a result of forest loss (Center for Climate and Energy Solutions, 2018). Many endangered species in the region are threatened by forest fires, which destroy their habitats and biodiversity. The destruction of these landscapes causes a wide range of environmental effects. These effects include not only reducing the number of animal habitats, but also polluting water supplies for humans and animals alike. Aside from causing burns and deaths, wildfire smoke also has long- and short-term adverse effects on human health due to its hazardous chemical composition (Gao *et al.* 2023). It is especially damaging to the environment when forest fires are uncontrolled. By reducing vegetation, consuming oxygen, and emitting hazardous gases into the air, they leave charred remains of once-thriving ecosystems. Changes in climate can affect the frequency and intensity of forest fires, which can in turn have a direct impact on the amount of carbon released into the atmosphere. Understanding the relationship between climate and fire regimes can help prevent or reduce the amount of damage caused by forest fires. The intensity, spread, and behaviour of fires are affected by air temperature, humidity, and wind levels (Carmel *et al.* 2009). Knowing how these factors influence the fire behaviour can help to predict the likelihood of a fire starting and its potential intensity, as well as to determine the area's most prone to fire risk. This information can be used to create more effective management plans and help protect forests and communities.

3.1 Forest Fires Mapping and Monitoring

Due in part to the extreme megafires that have taken place recently in correlation with the extreme droughts that have been hitting the northwest, fire's potential interaction with climate change has received an increasing amount of attention across the globe. Satellite maps show that peak megafire season occurs in the spring and summer. It can cause significant damage to forest areas, threaten residential areas, kill animals, and seriously pollute the air.

Summer 2022 was an exceptional wildfire season, both in terms of the number of fires observed, and the area burned (figure 3.1), as well as in terms of smoke emissions. Fires increased in Europe between mid-June and mid-August 2022, according to EFFIS (European Forest Fire Information System). The current value exceeds the long-term average from 2006-2021 and the previous peak. Fire events were followed by successive ones till September.

Compared to previous years, summer 2022 was a particularly active wildfire season, though it had the highest number of fires that lasted for a three-month period (June to September).

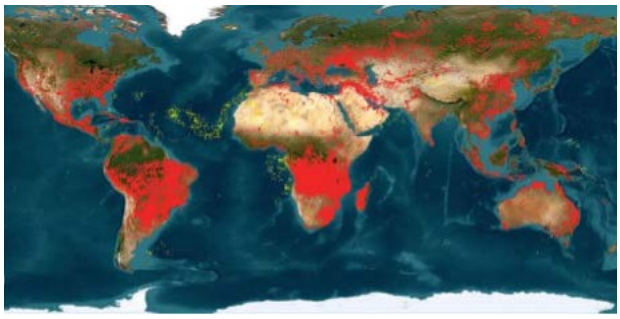

Figure 3.1 Active fires detected by MODIS worldwide in July 2022. Adapted from NASA

Forest fires can cause immense destruction to the environment, especially when they are uncontrolled. They reduce the amount of vegetation, consume oxygen, and emit dangerous

gasses into the air, leaving charred remains of what was once a thriving ecosystem (Volkova *et al.* 2019).

Furthermore, forest fires can spread quickly in areas with dry and dense vegetation. This is because the heat generated by a fire can create its own wind, which helps to carry the fire to distant locations. Additionally, fuel in the form of dry leaves and sticks can easily ignite in such areas, making it difficult to contain the fire (Park *et al.* 2022)

3.2 Forest Fire Risk Indices

To assess fire risks, the Swedish Angstrom index is commonly used (Willis *et al.* 2001). The index is calculated by analysing the statistical relationships between the number of reported fire events and antecedent weather-related information (Lukic *et al.* 2017). Since all inputs are obtained from point measurements at a weather station, weather-based indexes can only predict fire risk for an area-averaged area (Onderka, 2009). The Angstrom index indicate how likely it is that there will be fires on a particular day based on air temperature and relative humidity.

The index, I, is calculated as follows (Skvarenina *et al.* 2003)

$$I = \frac{R}{20} + \left(\frac{27 - t}{10}\right) \quad \text{.....(1)}$$

Where t represents the daily average temperature (°C), and R represents the daily average relative humidity (%). From equation (3), it can be seen that the index, I, decrease as the relative humidity increases and increases as the temperature decreases. There is a heightened risk of fire in an area with a reduced index. An explanation of how the index is used to categorize risks is given in Table 1.

A categorical scale for assessing and rating fire risk was first proposed by Nesterov (Shetinsky 1994). The Nesterov Index is calculated as follows:

$$NI = \sum_{i=1}^{w} (Ti - T^{dew}) Ti \quad \text{.....(2)}$$

Where, *NI* stands for the Nesterov index, w stands for the number of days since the last rainfall exceeded three mm per day, *T* stands for the daily temperature in degrees Celsius, and *T dew* stands for the dew point temperature in degrees Celsius. Nesterov index is intrinsically designed to reset to "zero" whenever daily rainfall exceeds 3mm per day (Shetinsky 1994). Table 1 illustrates Nesterov's original risk levels.

The risk levels of forest fires can range from low to extreme, depending on the area and severity of the fire. This table can help decision makers determine the risk level of an area, and prioritize forest management activities accordingly.To ensure effective fire prevention, fire risk rankings for each district should be considered when preparing for controlling and mitigating any fires. This data can be used to allocate resources and efforts in a way that yields the maximum benefit in terms of risk reduction.

The following chart shows how the temperature of the focal plane in the ABI changes throughout the course of the year. The differences between Northern Hemisphere Vernal and Autumnal Equinoxes occur because the Earth is closer to the Sun at the Northern Hemisphere Vernal Equinox. The chart also shows the effects of 'Eclipse' — when the satellite moves through the Earth's shadow. When the ABI is in the Earth's shadow, it is not being heated by the Sun (and that's why the GOES-R Series carries batteries to power the satellite at

Table 3.2 The output values of Nesterov index (NI) classified into fire risk probability (Shetinsky 1994)

Index values	Interpretation	Probability of fire
NI < 300	Fire occurrence unlikely	No risk
301 < NI < 1000	Fire occurrence unfavourable	Low risk
1001 < NI < 4000	Fire conditions favourable	Medium risk
4001 < NI < 10000	Fire conditions more favourable	High risk
NI > 10000	Fire occurrence very likely	Extremely high risk

that time). The reduced heating occurs between 26 February and 14 April in the Spring, and between 30 August and 16 October in the Fall.

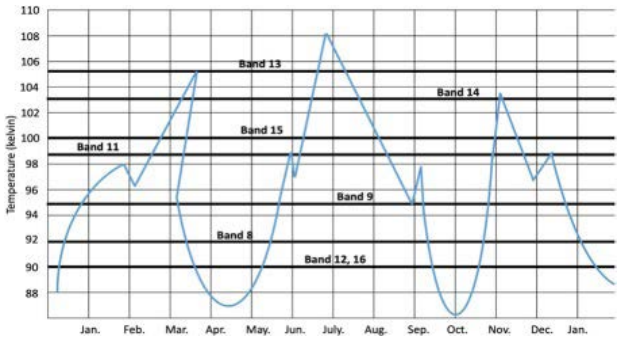

Figure 2. Sunlight penetration to ABI system. Source ABI-18-518, Rev-D, 2019-01,11

The chart also contains for the longwave infrared bands the temperature at which the heat from the satellite increases the likelihood of inaccurate data. At these times, the ABI does not receive any direct sunlight, so its batteries need to provide power for the satellite to continue working. The long-wave infrared bands are susceptible to heat from the satellite itself. Therefore, the temperatures reflect the threshold at which the heat from the satellite can start to interfere with the data and the accuracy of the readings. Marginal saturation may be observed when temperatures rise above the black lines for each band. As temperature curves exceed the black line, the imagery provided becomes unusable.

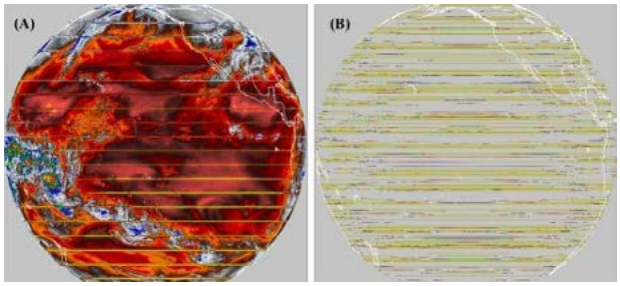

Figure 3. Images provided by GOES-17, marginal data (A) and unusable data (B). Source GOES-R

The image above illustrates what degraded imagery looks like (figure 3). As a result of the penetration of sunlight into the ABI system, high noise is introduced into the imagery. This makes interpretation of the data much more challenging, and sometimes even impossible. As data quality is a major factor in the effectiveness of any space mission, it is imperative that any disturbances, including but not limited to extreme heat, noise interference, and instrument problems, are prevented in order to preserve data quality and prevent the instrument from malfunctioning and producing poor imagery. To prevent this, it is necessary to take measures such as using advanced shielding materials, incorporating instrument redundancy, and enacting proper calibration. This will minimize any undesirable side effects on the data.

A total of five modules make up the system (figure 4). They are based on historical anomaly detection methods as well as on an array of advanced models. These models, together, give the system the ability to accurately detect subtle anomalies in GOES image sequences and estimate expected temperatures for landscapes that do not burn. It is designed to provide an advanced early fire detection system that locates anomalous heat sources in GOES image sequences with high accuracy.

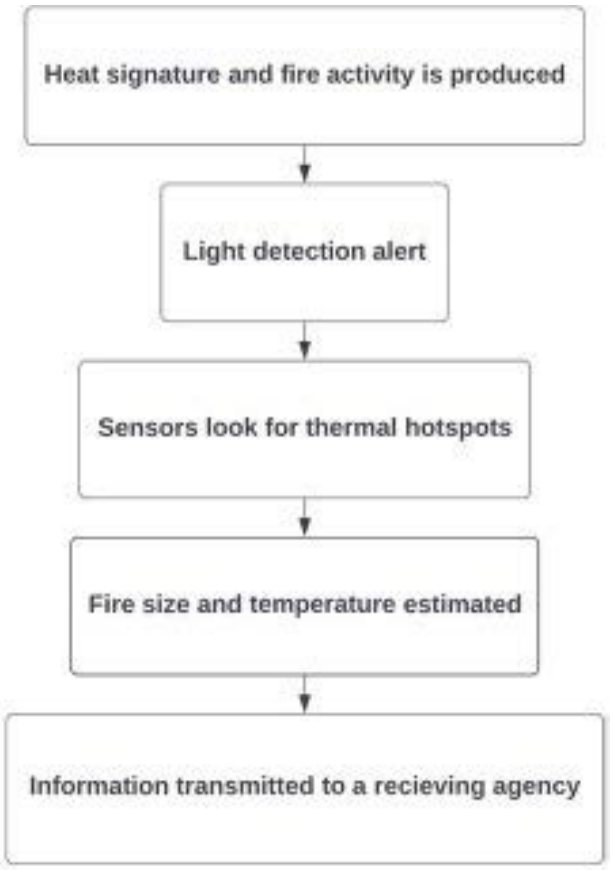

Figure 4. Overview of the workflow proposed for advanced early fire detection

Wildfires can be predicted beforehand with the system. By detecting and analyzing changes in temperatures, humidity, wind speed, and other environmental conditions, the workflow provides an early wildfire detection system that is reliable and advanced. The presence of these changes may be indicative of a wildfire. Using the system, personnel will be alerted to potential fire hazards and heat maps will be generated of areas affected by the fire.

Climate change is causing temperatures to rise in many parts of the world, which leads to drier conditions that can help fuel more intense wildfires. The countries listed in the table below already had a history of wildfires, so they will be particularly at risk of more frequent and more intense fires due to the changing climate (table 2).

Additionally, regions that were previously not in danger of wildfires may become increasingly vulnerable due to the deteriorating climate.

Table 2. Countries with most burned land by wildfires (2022) Source Statista

Country	Hectares
Ukraine	453,972
Spain	299,669
Romania	149,440
Portugal	104,450
Bosnia and Herzegovina	71,867
France	65,660
Italy	58,273

Wildfires are increasing while countries outside the Mediterranean high zone are experiencing extreme suffering, causing drastic changes in the local climate, air quality, and water availability, leading to respiratory issues, heat- related illnesses, and water shortages. They can also reduce biodiversity, leave toxic residues in the soil, and increase the risk of soil erosion.

4. Results

As remote-sensing technology in EO satellites continues to improve, satellite sensors can monitor the Earth's surface with higher resolution and accuracy than traditional methods. They can provide a more nuanced view of various environmental changes, including those associated with forest fires (Wooster *et al.*, 2021). By the end of this century, it is predicted that wildfires will significantly increase across 74% of the global landmass as a result of high greenhouse gas emissions (Sun *et al.*, 2019b).

4.1 Climate Applications

Researchers have used EO data and RS techniques to map and monitor forest areas, which is essential for a successful forest management strategy. Researchers have also been able to identify small-scale changes in forest health by analyzing high-resolution satellite imagery (Matin *et al.* 2017). Additionally, (MODIS) sensors can detect and monitor forest fires very accurately because of their high temporal resolution. This enables them to capture pictures of the same area over a short timeframe. For active forest fire detection, these sensors can capture changes in the landscape in real-time.

5. Discussion

Recent advancements in earth science makes it possible to anticipate, model, and prepare for natural disasters and thereby reducing the number of fire fatalities. This study found that the technological advances in remote sensing sensors and software, such as the Advanced Weather Interactive Processing System (AWIPS) and high-resolution satellite imagers facilitate the availability of fine-grained earth observation data. These technologies allow scientists to observe and track minute changes on the Earth's surface, such as changes in vegetation, soil moisture, and air temperature. This data can be used to better understand and predict changes in global climate and weather patterns.

This is enabling a revolution in the way we monitor, map, and analyse our world, with the potential to improve natural resource management, disaster response, and climate change adaptation. Such data reveal the vegetation canopy in high spatial detail. Efficient methods are needed to fully harness this unprecedented source of information for vegetation mapping. Machine learning (ML) and Deep learning (DL) algorithms such as Convolutional Neural Networks (CNN) are currently paving brand-new avenues in the field of image analysis and computer vision.

Minimizing damage to global environmental disasters caused by wildfires by ensuring accuracy and speed in Early wildfire detection.

5.1 Key Findings

The initial data and existing literature suggested that satellite viewing angles are limited to 80° when processing fire data. For optimal accuracy, fire processing should focus on data within 65° of the satellite viewing angle, avoiding certain biomes and sun-glint regions. Moreover, the ABI algorithm is more likely to fail when there are opaque clouds present, even though it can detect fires in both clear and cloudy conditions. As a result, to further enhance the accuracy of the identification of areas at risk, the combination of thermal hotspot data and past fire activity records can be used to create predictive models and identify future fire-prone area.

6. Conclusions

This paper has taken the first steps in gathering the necessary data to employ a theoretical framework for early forest fire detection in geostationary operational environmental satellites (GOES). The potential impact of these advancements on the field of Earth Sciences is profound and stands to revolutionize the way we observe and understand our planet. The findings of this paper propose imperative climate implications, including the capability of early wildfire detection in remote sensing and earth observatory satellites. Unless addressed, the impact of forest fires on the planet's health will continue to be a challenge as climate change contributes to the increase in frequency and magnitude of wildfires around the world.

Acknowledgements

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The Impacts of Climate Change and Global Warming Knowledge on Youth Ecologically Sustainable Behaviour: A Cross-Country Evidence

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Abstract

This research examines the impact of climate change and global warming knowledge (CCGW_K) on youth Ecologically Sustainable Behavior (ESB) in a cross-country setting. To that end, a conceptual framework based on Random Utility Theory (RUT) was used to collect stated preferences data from a bootstrap sample of 55713 youth respondents distributed across 14 economies. The econometric findings reasonably support the three core principles of ecologically sustainable development (ESD); namely the equity principle [$\hat{\theta}_{ES}$=0.352 (0.350, 0.354)], the efficiency principle [$\hat{\theta}_{EN}$=0.368 (0.366, 0.369)], and the precautionary principle of ESD [$\hat{\theta}_{SN}$= 0.289 (0.288, 0.292)]. They further reveal a mixed influence of CCGW_K on youth ESB; with each knowledge level increase strengthening youth environmental sustainability preferences by 3.02%, while conjointly weakening their social sustainability preferences by 1.83%, but having no significant effect on their economic sustainability preferences. Hence, suggesting that communications that increase youth CCGW_K are necessary but not sufficient for ESB uptake globally.

Introduction

Ecologically Sustainable Development (ESD) is a long standing internationally recognized concept in environmental law, which has seen a worldwide adoption since the 1992 Earth Summit in Rio de Janeiro, and the 2002 World Summit on Sustainable Development (Wapner, 2003). Defined as "Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased", ESD has been incorporated in numerous pieces of legislations including the 1991 "Protection of the Environment Administration Act" (NSW, 1991), the 1992 Australian National Strategy for Ecologically Sustainable Development (Howes, 2021), and the 1999 "Environment Protection and Biodiversity Conservation Act (Cth)" (McGrath, 2005). As a legal concept, ESD involves a cluster of elements (Diesendorf, 2020), which can be summarized into four core principles:

(i) The efficiency principle: which covers the economic dimension of decision making, addressing the question of how "viable" are various choice alternatives?

(ii) The equity principle: which covers the social dimension of decision-making, addressing the question of how "Equitable" are various choice alternatives?

(iii) The precautionary principle: which covers the environmental dimension of decision making, addressing the question of how "bearable" are various choice alternatives?

(iv) The principle of integration: which addresses the inter-dependence and mutual re-enforcement of the first three core principles of ESD.

Keywords: climate change, ecological behavior, ecologically sustainable development, global warming, multi-country, pro-environmental behavior

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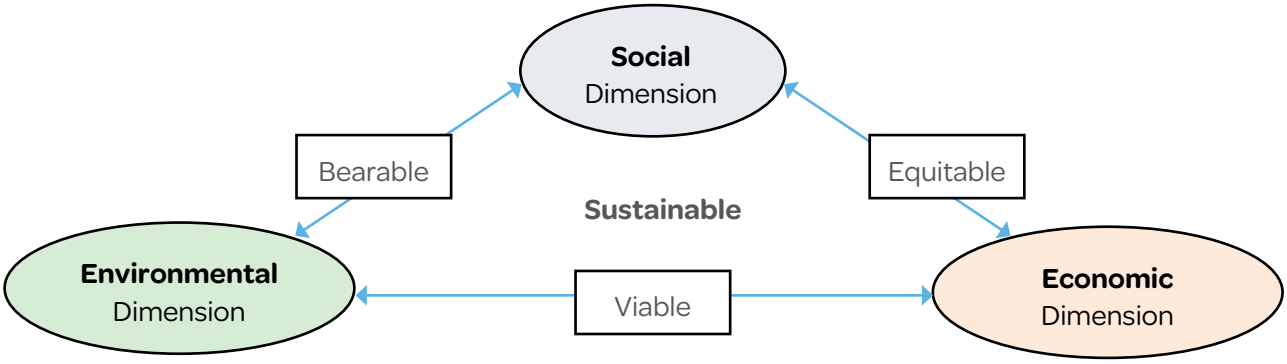

Figure 1: The three pillars model of sustainability

When properly implemented, these core principles aim to extend the culture of sustainability to all institutional dimensions, by "providing for the needs of the present generations, without compromising the ability of future generations to meet their own needs" (Borowy, 2013). Figure (1) provides a graphical depicting of these core principles, and is adapted from the interlocking circles model of sustainability by the world conservation Union (IUCN) (Heselink and Goldstein, 2000).

Despite the global conceptual recognition of the need to balance environmental sustainability, economic sustainability, and social sustainability in order to achieve true sustainability within a circular economy framework (Waltner *et al.*, 2019), the scientific literature to date is still void of its mathematical operationalization in a decision analytic context, to guide evidence-based policymaking. As a result, individual and collective actions are often not matching the many challenges of sustainable development, including the issue of climate change and global warming. Therefore, drawing on the formal definition of "Ecological Behavior-EB" as "actions which contribute towards environmental preservation and/or conservation" (Axelrod and Lehman, 1993), the current research aims to bridge this methodological gap in the scientific discourse, by proposing a model of ecologically sustainable behavior (ESB), which is grounded in rational choice theory (i.e. Random Utility Maximization), with altruistic considerations (both social and environmental).

As an initial attempt, the paper specifically looks at the drivers of ESB in the global youth population, with emphasis on the role of environmental knowledge in general, and climate change & global warming knowledge in particular (Lee *et al.*, 2020). In so doing, the article focuses on answering the following question:

What is the relative influence (marginal contribution) of climate change and global warming knowledge on youth ecologically sustainable behavior?

In addition to its methodological contribution, the question raised by the paper also provides a basis for evaluating the effectiveness of the United Nations (UN) Decade of Education for Sustainable Development (DESD) (Pauw *et al.*, 2015), in terms of its significance in shaping the sustainability preferences and behaviors of the global youth population today (Yamane and Kaneko, 2021). Indeed, leading up to 2015, the DESD has seen the introduction of sustainable development (SD) concepts into formal educational systems worldwide, aiming to provide young people with the knowledge and competence to take actions for a sustainable future (Balundė *et al.*, 2020; Huckle and Wals, 2015). This global commitment by UN country members to sustainable development education (SDE) was subsequently renewed post-2015, through goal 4.7 of the 2030 Agenda for sustainable development, which aims at empowering everyone to make informed decisions in favor of economic viability, social equity, and environmental integrity (i.e. ensuring sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity) for present and future generations (Hak *et al.*, 2016).

Therefore in the remaining, the paper addresses the research question using the following structuring: Section (2) describes the adopted research methodology: including the conceptual framework, sampling design, and data modeling procedure; section (3) presents the results, which are then discussed in section (4), before concluding in section (5).

Methodology

Basic Assumptions of the Model and Conceptual Framework

To better address ecologically sustainable development (ESD), the proposed framework is based on a systemic-view of the global environment (Capra and Jakobsen, 2017), which ecologically speaking can be viewed as the sum of the economic environment, the social environment, and the natural environment. As an evolving system, the sustainability of the global environment requires the sustainability of each of its three sub-system counterparts. Hence, for the concept of "growth" as perceived by human consciousness to be sustainable at the global scale, it must necessarily satisfy each of the three conditions of: (i) economic sustainability, (ii) social sustainability, and (iii) natural/environmental sustainability.

In an anthropogenic reality with the human being at its core (Hornsey *et al.*, 2016), it is the responsibility of each "individual being" to safeguard the above reality, by developing not only its needed consciousness, but also adopting the appropriate actions and behaviors. As such, the proposed model, which is grounded on rational choice theory (i.e. Random Utility Maximization), with joint altruistic considerations assumes that the objective of the individual decision maker is to maximize the total utility from the global environment. That is, jointly maximizing the utility derived from the economic environment, with the utilities derived from the social and natural environments.

Thus, an individual's behavior is assumed to be "ecologically sustainable" if and only if it satisfies the three conditions of economic sustainability, social sustainability, and environmental sustainability. Hence, in line with Farrer (2016) that reported instrumental utility as an important part of how individuals choose between several types of pro-

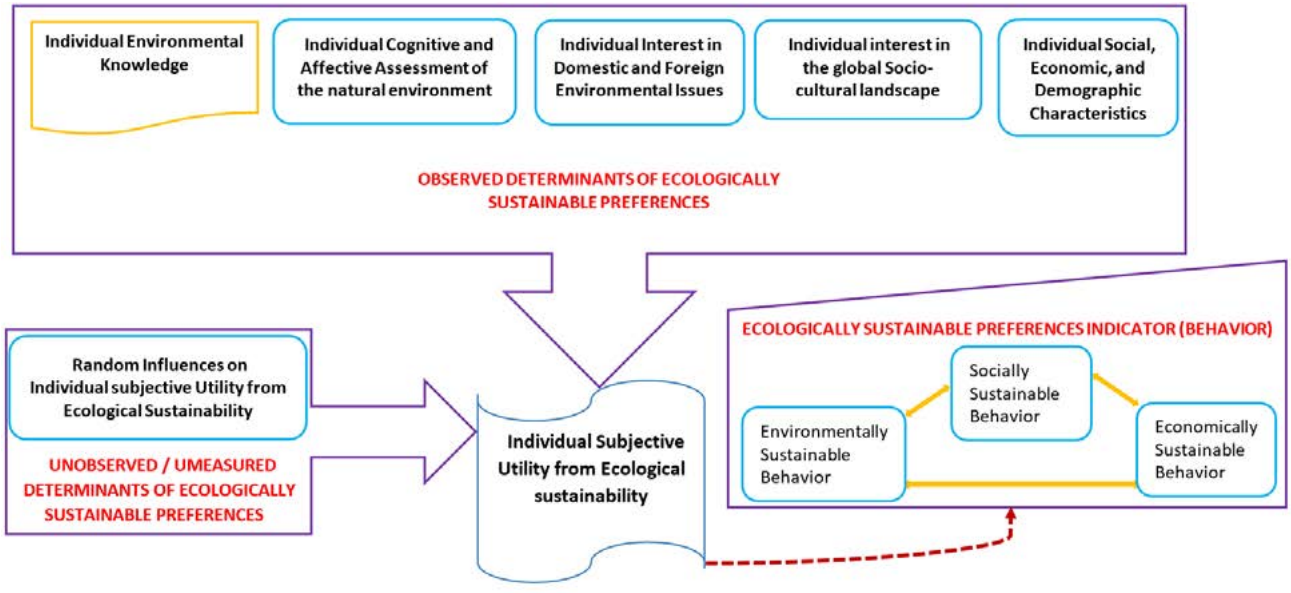

Figure2: Random Utility Based Conceptual Framework of Individual Ecologically Sustainable Behavior (ESB)

Note: *at the "individual level", sustainability consciousness is a three dimensional latent construct underlined by the three psychometric components of knowingness/(cognitive), attitude/(affective), and behavior/(actions), which combine to shape each person's "sustainability preferences" (Gericke et al., 2019). The operational specification of the above (individual level) General Framework to the global youth population in the empirical analysis (see table 3), is consistent with (Waltner et al., 2019).*

environmental behaviors; our proposed Random Utility based model of Ecologically sustainable behavior (ESB) stipulates that an individual's preference (whether revealed or stated) for ecological sustainability, is a reflection of the joint utilities(s) he derives from the economic environment, the social environment, and the natural environment. So that the total subjective utility derived from ESB is an indirect functional of observed and unobserved determinants factors.

Consistent with prior studies addressing the drivers of youth environmental behaviors (Boeve-de Pauw and Van Petegem, 2013; Collado and Corraliza, 2015; Miller *et al.*, 2022; Pisano and Lubell, 2017; Xia and Li, 2022; Žukauskienė *et al.*, 2021), the determinant factors of youth subjective utility from ESB are illustrated in the Random Utility based conceptual framework represented in figure (2). The framework assumes observed ESB determinants to include: (i) the individual's environmental knowledge more broadly, and climate change & global warming knowledge more specifically; (ii) the individual's cognitive and affective assessment of the natural environment; (iii) the individual's interest in domestic and foreign environmental issues; (iv) the individual's interest in the global socio-cultural landscape; (v) the individual's social, economic and demographic characteristics. On the other hand, the unobserved drivers of ESB are assumed to include: (i) the individual's innate propensity to engage in ecologically sustainable actions; and (ii) other unmeasured ESB determinants.

Sampling design and collected data

In order to study the drivers of youth ESB, this paper relies on the above conceptual framework, to collect the required operational data through bootstrap sampling of the raw student questionnaire data file of the 2018 Programme for International Students Assessment (PISA) survey (OECD, 2019). The survey is a comprehensive triennial effort by the Organization for Economic Co-operation and Development (OECD), to collect evidence for assessing the degree of youth social, economic and environmental preparedness. Since the breath of the PISA survey covers the data required for operationalizing the conceptual framework in figure (2), its latest wave is used to reduce the significant time and financial resource requirements of the current research project.

As a result, the study is based on a retrospective cross-sectional design, with the target population defined as "the set of all youth respondents from all participating countries in the 2018 PISA survey". The size of this target population consisted of 612004 youth respondents from 80 countries worldwide. This target population was conceptually partitioned into 80 clusters based on each respondent's country of residence. Within each cluster nation, each respondent had a known chance of being selected, represented by a unique probability weight.

Given that each wave of the PISA survey runs a core component, along with national level component variations aiming to address specific issues in select economies, the first stage of the bootstrap sampling procedure consisted of selecting all cluster nations, reporting collection of the required data operationalizing the defined conceptual framework in figure (2), which is consistent with (Waltner *et al.*, 2019). This consisted of 14 cluster nations out of the initial 80 in the target population, thus yielding an intermediate sample of 92734 youth respondents, distributed across 14 economies. The second stage of the bootstrap

Table (1): The Summary characteristics of the sampling design

Description	# of Countries (Primary Sampling Units)	# of Cases (Secondary Sampling Units)	Retention Rates (%)	
			Countries	Cases
Target population	80	612004	---	---
First stage cluster sampling	14	92734	17.5%	15.15%
Second stage case sampling	14	55713	100%	60.08%
Final Sample	14	55713	17.5%	9.10 %

sampling consisted of selecting all valid cases, defined here as "the set of all youth respondents from the intermediate first stage sample, with full information on all the laid out factors in figure (2). This led to the exclusion of all individual cases with missing/incomplete information in the first stage sample, thus resulting in a final sample of 55713 youth respondents, distributed across 14 cluster nations. The characteristics of the full sampling design are summarized in Table (1) above, while table (A2) shows the cross-country distribution of the collected data.

Econometric Specification and Estimation of the Model

The adopted framework for modeling ecologically sustainable behavior (ESB) relies on the Economic Theory of Random Utility Maximization (Ben-Akiva *et al.*, 2019). Its derivation is consistent with the random utility-based model of individual's behavioral optimizations presented in (Niankara, 2022). In line with the objective to evaluate the impact of climate change and global warming knowledge on ESB, the following additive representations are explicitly adopted for the utility functions:

$$\begin{cases} U^{*}_{E} = V_{E} + \varepsilon_{E} \\ U^{*}_{\overline{E}} = V_{\overline{E}} + \varepsilon_{\overline{E}} \end{cases}$$

$$\begin{cases} U^{*}_{S} = V_{S} + \varepsilon_{S} \\ U^{*}_{\overline{S}} = V_{\overline{S}} + \varepsilon_{\overline{S}} \end{cases} \qquad (1)$$

$$\begin{cases} U^{*}_{N} = V_{N} + \varepsilon_{N} \\ U^{*}_{\overline{N}} = V_{\overline{N}} + \varepsilon_{\overline{N}} \end{cases}$$

Where:
The adopted definition of "Ecological Behavior-EB" follows (Axelrod and Lehman, 1993), as "actions which contribute towards environmental preservation and/or conservation", such that

E: represents the individual's choice to take actions that "contribute to economic sustainability (characterized here with home energy saving behavior), and $\overline{E}$ is its complement event;

S: represents the individual's choice to take actions that "contribute to social sustainability (characterized here with ethical and fair trade consumption behavior); while $\overline{S}$ is its complement;

N: represents the individual's choice to take actions that "contribute to the sustainability of the natural environment (characterized here with participation in activities favoring environmental protection); while $\overline{N}$ is its complement event.

The terms V_{E}, $V_{\overline{E}}$, V_{S}, $V_{\overline{S}}$, V_{N}, $V_{\overline{N}}$ represent the observed components of the ESB utility, while ε_{E}, $\varepsilon_{\overline{E}}$, ε_{S}, $\varepsilon_{\overline{S}}$, ε_{N}, $\varepsilon_{\overline{N}}$ represent their unobserved components. Given the latency of individual's ESB utilities, only the indicators of economic sustainability, social sustainability, and environmental sustainability are observable and linked to the derived utilities as:

$$D_{1} = \begin{cases} E & \text{if } U^{*}_{E} = U^{*}_{\overline{E}} > 0 \\ \overline{E} & \text{otherwise} \end{cases}$$

$$D_{2} = \begin{cases} S & \text{if } U^{*}_{S} = U^{*}_{\overline{S}} > 0 \\ \overline{S} & \text{otherwise} \end{cases} \qquad (2)$$

$$D_{3} = \begin{cases} N & \text{if } U^{*}_{N} = U^{*}_{\overline{N}} > 0 \\ \overline{N} & \text{otherwise} \end{cases}$$

Because of the binary nature of each decision context, the choice situations can be redefined as 1 if sustainable, and 0 if non-sustainable, such that the behavioral processes in equation (2) could be equivalently restated as:

$$D_{1} = \begin{cases} 1 & \text{if } U^{*}_{E} = U^{*}_{\overline{E}} > 0 \\ 0 & \text{otherwise} \end{cases}$$

$$D_{2} = \begin{cases} 1 & \text{if } U^{*}_{S} = U^{*}_{\overline{S}} > 0 \\ 0 & \text{otherwise} \end{cases} \qquad (3)$$

$$D_{3} = \begin{cases} 1 & \text{if } U^{*}_{N} = U^{*}_{\overline{N}} > 0 \\ 0 & \text{otherwise} \end{cases}$$

The respective marginal probabilities of engaging in economic sustainability, social sustainability, or environmental sustainability are expressed as:

$$P[D_{1} = 1] = P[U^{*}_{E} - U^{*}_{\overline{E}} > 0]$$

$$P[D_{2} = 1] = P[U^{*}_{S} - U^{*}_{\overline{S}} > 0] \qquad (4)$$

$$P[D_{3} = 1] = P[U^{*}_{N} - U^{*}_{\overline{N}} > 0]$$

Considering first the equation that characterizes the choice process to contribute to economic sustainability, developing further its marginal probability yields:

$$P[U^{*}_{\bar{E}} - U^{*}_{\bar{\bar{E}}} > 0] = P[(V_{E} + \varepsilon_{E}) - (V_{\bar{E}} - \varepsilon_{\bar{E}}) > 0$$

$$= P[(\varepsilon_{E} + \varepsilon_{\bar{E}}) > (V_{\bar{E}} - V_{E})] \quad (5)$$

$$= P[(\varepsilon_{\bar{E}} + \varepsilon_{E}) < (V_{\bar{E}} - V_{E})]$$

Using the same derivation approach, the equations characterizing the respondent's choice to contribute to social and environmental sustainability are obtained as:

$$P[U^{*}_{\bar{S}} - U^{*}_{\bar{\bar{S}}} > 0] = P[(\varepsilon_{\bar{S}} + \varepsilon_{S}) < -(V_{\bar{S}} - V_{S})] \quad (6)$$

$$P[U^{*}_{\bar{N}} - U^{*}_{\bar{\bar{N}}} > 0] = P[(\varepsilon_{\bar{N}} + \varepsilon_{N}) < -(V_{\bar{N}} - V_{N})] \quad (7)$$

Simplifying further the expressions for the subjectively perceived differences in ESB utility with:

$$V_{\bar{E}} - V_{E} = \tilde{V}_{E} \quad \text{and} \quad \varepsilon_{\bar{E}} - \varepsilon_{E} = \tilde{\varepsilon}_{E}$$
$$V_{\bar{S}} - V_{S} = \tilde{V}_{S} \quad \text{and} \quad \varepsilon_{\bar{S}} - \varepsilon_{S} = \tilde{\varepsilon}_{S} \quad (8)$$
$$V_{\bar{N}} - V_{N} = \tilde{V}_{N} \quad \text{and} \quad \varepsilon_{\bar{N}} - \varepsilon_{N} = \tilde{\varepsilon}_{N}$$

We obtain $\tilde{V}_{E}$ as the change in respondent's total utility resulting from the choice to contribute to economic sustainability, or in other words the respondent's derived marginal utility (MU) from economic sustainability. Similarly, $\tilde{V}_{S}$ is the respondent's derived MU from social sustainability; while $\tilde{V}_{N}$ is the respondent's derived MU from environmental sustainability. Therefore, the marginal probabilities of contributing to economic sustainability, social sustainability, and environmental sustainability, in equations (5), (6) and (7) become respectively:

$$P[D_{1} = 1] = P[\tilde{\varepsilon}_{E} < -\tilde{V}_{E}] = \int_{-\infty}^{-\tilde{V}_{E}} f(\tilde{\varepsilon}_{E})\, d\,\tilde{\varepsilon}_{E} \quad (9)$$

$$P[D_{2} = 1] = P[\tilde{\varepsilon}_{S} < -\tilde{V}_{S}] = \int_{-\infty}^{-\tilde{V}_{S}} f(\tilde{\varepsilon}_{S})\, d\,\tilde{\varepsilon}_{S} \quad (10)$$

$$P[D_{3} = 1] = P[\tilde{\varepsilon}_{N} < -\tilde{V}_{N}] = \int_{-\infty}^{-\tilde{V}_{N}} f(\tilde{\varepsilon}_{N})\, d\,\tilde{\varepsilon}_{N} \quad (11)$$

Such that taking into account the 4th core principle of ESD (see the principle of integration in introduction section), the inter-dependence and mutual re-enforcement of the first three core processes of ESD, is achieved through their joint probability distribution:

$$P[D_{1} = 1, D_{2} = 1, D_{3} = 1] =$$

$$\int_{-\infty}^{-\tilde{V}_{E}} \int_{-\infty}^{-\tilde{V}_{S}} \int_{-\infty}^{-\tilde{V}_{N}} f(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N})\, d\,\tilde{\varepsilon}_{N}\, d\,\tilde{\varepsilon}_{S}\, d\,\tilde{\varepsilon}_{E} \quad (12)$$

Where $f(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N})$ represents the joint trivariate probability density of the error differences. Further distributional assumptions about this general function, yield various behavioral models. For example, assuming a multivariate extreme value (logistic) distribution yields the trivariate logistic model (TLM), with $f(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N}) = \Lambda_{3}(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N})$. On the other hand, assuming a multivariate standard normal distribution yields the trivariate probit model (TPM), with $f(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N}) = \phi_{3}(\tilde{\varepsilon}_{E}, \tilde{\varepsilon}_{S}, \tilde{\varepsilon}_{N})$. Under both specifications, the variance-covariance matrix of the joint model is of the form:

$$\sum = \begin{bmatrix} \theta_{EE} & \theta_{ES} & \theta_{EN} \\ \cdot & \theta_{SS} & \theta_{SN} \\ \cdot & \cdot & \theta_{NN} \end{bmatrix} \quad (13)$$

Where θ_{EE}, θ_{SS}, and θ_{NN} represent the variances of the three sub-processes (economic, social, and environmental) of ESB. On the other hand, θ_{ES}, θ_{EN}, θ_{SN} represent the respective covariance parameters between pairs of the three ESD sub-processes. Following the generally accepted identification restrictions for the covariance matrix of discrete probability models, the diagonal variance parameters are set to unitary (i.e. $\theta_{EE} = \theta_{SS} = \theta_{NN} = 1$), while the covariance parameters are estimated along with the unknown regression parameters β_{ij} in equations (14-16). In this random utility based formulation of respondent's ESB, the explicit forms of the observed utility differences are given by:

$$\begin{aligned} \tilde{V}_{E} = {} & \beta_{10} + \beta_{11}\ \text{CCGW_k} + \\ & \beta_{12}\ \text{CogAsCCGW_ImpDifr} + \\ & \beta_{13}\ \text{CogAsEcDeEnv_K} + \\ & \beta_{14}\ \text{AffAsGlobEnvVal} + \\ & \beta_{15}\ \text{IntDNEnv} + \beta_{16}\ \text{IntFNEnv} + \\ & \beta_{17}\ \text{AWACOM} + \beta_{18}\ \text{GLOBMIND} + \\ & \beta_{19}\ \text{AGE} + \beta_{110}\ \text{Gender} + \\ & \beta_{111}\ \text{GradeLev} + \beta_{112}\ \text{WEALTH} + \\ & \beta_{113}\ \text{IMMIG2} + \beta_{114}\ \text{CNT} \end{aligned} \quad (14)$$

$$\begin{aligned}\tilde{V}_S = {} & \beta_{20} + \beta_{21}\ CCGW_k + \\ & \beta_{22}\ CogAsCCGW_ImpDifr\ + \\ & \beta_{23}\ CogAsEcDeEnv_K + \\ & \beta_{24}\ AffAsGlobEnvVal + \\ & \beta_{25}\ IntDNEnv + \beta_{25}\ IntFNEnv + \\ & \beta_{27}\ AWACOM + \\ & \beta_{28}\ GLOBMIND + \\ & \beta_{29}\ AGE + \beta_{210}\ Gender + \\ & \beta_{211}\ GradeLev + \beta_{212}\ WEALTH + \\ & \beta_{213}\ IMMIG2 + \beta_{214}\ CNT\end{aligned} \quad (15)$$

$$\begin{aligned}\tilde{V}_N = {} & \beta_{30} + \beta_{31}\ CCGW_k + \\ & \beta_{32}\ CogAsCCGW_ImpDifer + \\ & \beta_{33}\ CogAsEcDeEnv_K + \\ & \beta_{34}\ AffAsGlobEnvVal + \\ & \beta_{35}\ IntDNEnv + \beta_{36}\ IntFNEnv + \\ & \beta_{37}\ AWACOM + \\ & \beta_{38}\ GLOBMIND + \\ & \beta_{39}\ AGE + \beta_{310}\ Gender + \\ & \beta_{311}\ GradeLev + \beta_{312}\ WEALTH + \\ & \beta_{313}\ IMMIG2 + \beta_{314}\ CNT\end{aligned} \quad (16)$$

Where the β_{ij} represent the parameter coefficients capturing the conditional effects of the explanatory variables on the joint likelihood of engaging in ecologically sustainable behavior (ESB). These coefficients are more precisely interpreted within the RUM framework as the contribution of each explanatory factor to the marginal utility (MU) derived from Economic sustainability ($\tilde{V}_E$); the MU derived from social sustainability ($\tilde{V}_S$); and the MU derived from the sustainability of the natural environment ($\tilde{V}_N$). Of main interests in this study, based on the research objective, is the Marginal Ecological Utility of climate change and global warming knowledge, which has the three components of Marginal Economic Utility (β_{11}), Marginal Social Utility (β_{21}), and Marginal Environmental Utility (β_{31}); as the estimated impacts of climate change and global warming knowledge (CCGW_k) on ecologically sustainable behavior (ESB).

Moreover, national level variations in respondent's ESB, due to country specific differences are absorbed by β_{114}, β_{214} and β_{314} respectively. These effects are assumed to encapsulate variations in ESB, linked to potential differences in primary climate concerns between countries, and differences in socio-political contexts across countries.

All estimations are carried out within the R statistical software. More specifically, the joint conditional model is estimated using the trust region iteration algorithm provided through the R library "GJRM", as described in (Wojtys *et al.*, 2018).

Validation of the Econometric Model

In the formulated econometric model, the statistical significance of the estimated covariance parameters (θ_{ES}, θ_{EN}, and θ_{SN}) are used, along with chi-squared testing to empirically assess the theoretical inter-dependence and mutual re-enforcement of the first three core principles of ESD, as stipulated by the fourth core ESD principle in the introduction. More specifically, the empirical validity of the "equitable" link of sustainability in figure (1), which corresponds to the "equity principle of ESD" is provided by the significance test of θ_{ES}. Similarly, the statistical significance of θ_{EN} provides the empirical validity test for the "viable" link of sustainability, which corresponds to "efficiency principle of ESD"; while θ_{SN} is used to assess the strength of the "bearable" link of sustainability, which corresponds to "precautionary principle of ESD".

Furthermore, for sensitivity analysis in the empirical implementation, four specifications of the Econometric model are considered, including the fully parametric and semi-parametric estimations of both, the logit and probit model representations. This practice is intended to reduce the risks of miss-specification biases, and thus to ensure that the explicitly included explanatory factors do reflect their true (unbiased) influences on the joint likelihood of the three interdependent sub-processes of ESB.

Results

Descriptive Findings from the Study Sample

The descriptive findings are organized in two sub-sections as presented below.

Univariate Descriptive Summaries

Summarized in table (A3), the univariate descriptive statistics show that most study participants are native of their country of response, with an average age of 15.78 years (s.d. 0.293), with female participants making up 51.49% of the study sample. Regarding respondent's schooling level, table (A3) shows that the majority are 10th graders (59.99%), followed by 9th graders (24.38%), then by 11th graders (11.07%), 8th graders (3.66%), 7th graders (0.57%), and finally by 12th graders (0.34%).

With regards to ecological sustainability, 41% of respondents reports participating in activities favoring environmental protection, 74.58% reports reducing home energy use in order to protect the environment, while 45.57% reports choosing certain products for ethical or environmental reasons, even if a bit more expensive.

Given the ordinal nature of the independent variable of primary interest (CCGW_K), which has three increasing levels ranging from 1 to 3, it is treated as a numerical measurement with mean value 1.92 (s.d. 0.637). Table (A3) also shows that the mean value of the three-level ordinal measurement capturing respondent's self-reported cognitive ability to assess the differential impact of climate change and global warming on countries (CogAsCCGW_impDifr) is 1.99 (s.d. 0.728). Similarly, the mean value of the three-level ordinal measurement capturing respondent's self-reported cognitive ability to assess the environmental consequences of economic development (CogAsEcDeEnv_K) is 1.91 (s.d. 0.735). Regarding respondent's affective valuation of the natural environment (AffAsGlobaEnvVal), which is also measured on the ordinal scale with three increasing levels, table (A3) shows a mean value of 2.09 (s.d. 0.648). The three-level ordinal indicators of respondent's self-reported interests in domestic (IntDNEnv) and foreign environmental issues (IntFNEnv) show respectively the mean values of 2.31 (s.d. 0.670) and 1.88 (s.d. 0.715) in table (A3).

Furthermore, table (A3) also summarizes indexes that are standard normalized, based on their OECD level averages and standard deviations. These include respondent's index of intercultural communication awareness (AWACOM), respondent's index of global mindedness (GLOBMIND), and respondent's index of family wealth (WEALTH). It can be noted that the mean index value of AWACOM is recorded at 0.11 (s.d. 0.976), that of GLOBMIND is recorded at 0.12 (s.d. 0.953), and that of WEALTH at -0.45 (s.d. 1.001).

Bivariate Descriptive Summaries

Summarized in table (A4) in the form of conditional frequency distributions, the bivariate descriptive statistics show in the fourth row, the conditional distribution of climate change and global warming knowledge (CCGW_k), across the three outcome indicators of ESB.

Among those reporting to not know much, and therefore unable to explain climate change and global warming, 41.92% reports to also participate in activities that preserve the natural environment, 74.45% reports to engage in home energy conservation; while 44.61% reports to conjointly engage in ethical and fair trade consumption (i.e. choosing to buy products for environmental or social reasons, even if more expensive).

In addition, among those reporting to know something and thus could provide general explanations about climate change and global warming, only 40.74% reports to also participate in activities preserving the natural environment; with 45.36% reporting to also engage in ethical and fair trade consumption; while a much greater portion 74.75% reports to conjointly engage in home energy conservation.

Moreover, among those reporting to be very familiar, and thus comfortable providing detail explanations about climate change and global warming, only 40.45% reports to conjointly participate in activities that preserve the natural environment, while 47.71% reports to also partake in ethical and fair trade consumption, and 74.21% reports to engage in home energy conservation.

Furthermore, with regards to the inter-dependence between the three sub-dimensions of ESB, the first row of table (A4) shows that among those reporting to participate in activities that preserve the natural environment, only 47.4% reports to conjointly engage in home energy conservation, while 51.4% reports to also engage in ethical and fair trade consumption. The second row of table (A4) however shows that among those reporting to engage in home energy conservation, the majority (83.5%) also report to engage in ethical and fair trade consumption.

Finally, the comparative distribution of the three indicators of ESB (ProEnvActiv, HoEnrgConserv, EthiFairTradeCons) across the 14 economies in the study are summarized in figures (3-5) below:

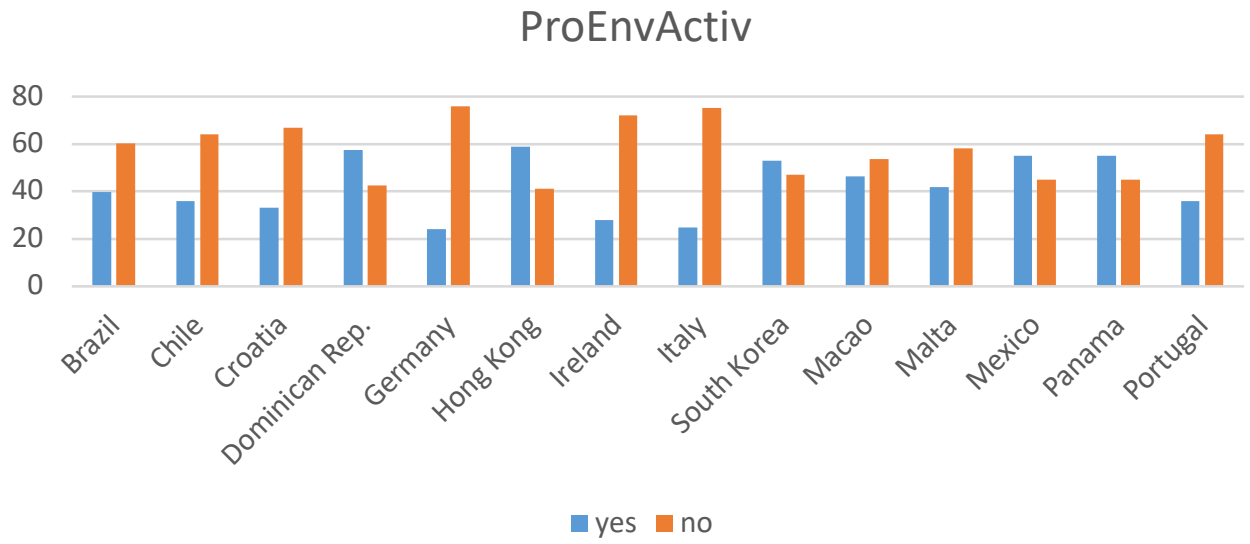

Figure (3): cross-national distribution of environmentally sustainable behavior (ProEnvActiv)

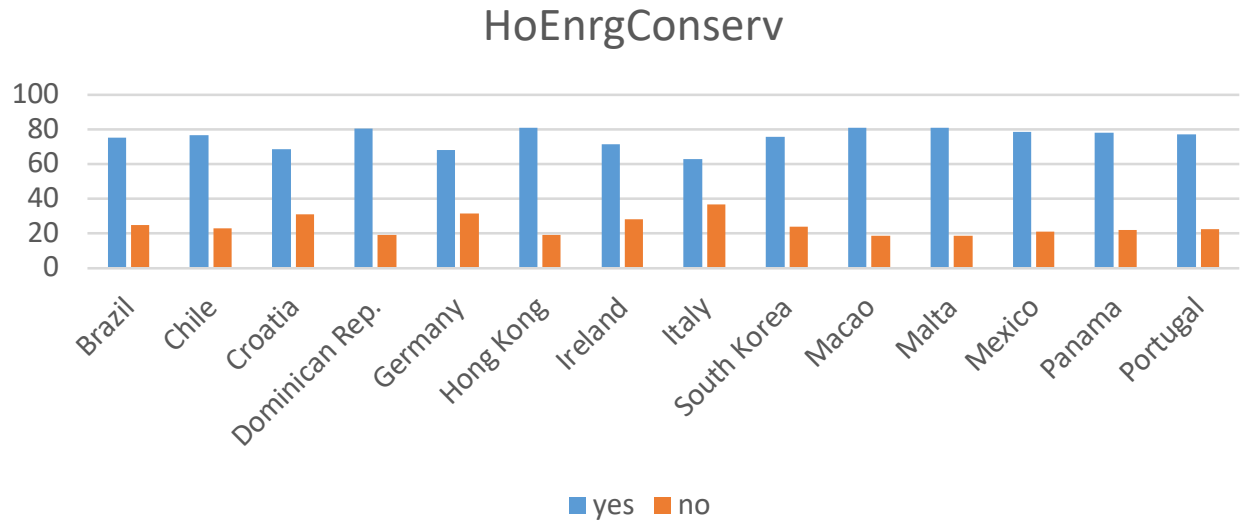

Figure (4): cross-national distribution of economically sustainable behavior (HoEnrgConserv)

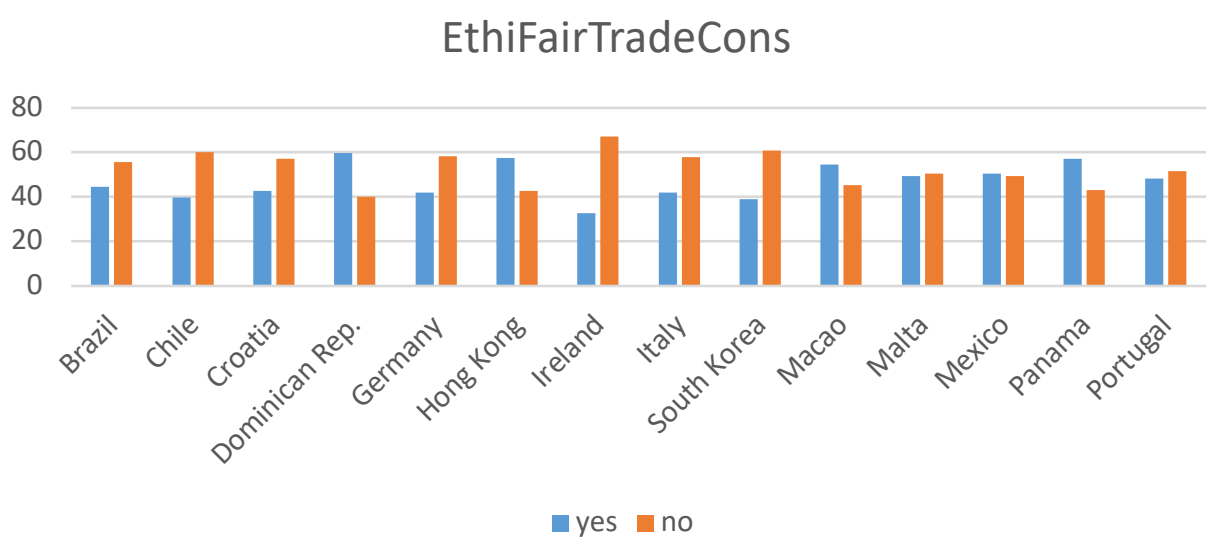

Figure (5): cross-national distribution of socially sustainable behavior (EthiFairTradeCons)

Specification Testing and Sensitivity Analysis Results

To ensure our results are free from misspecification and omitted variable biases, we assessed the association of the three dependent indicators of ESB with the included explanatory factors using the chi-squared dependence test (for qualitative predictors) and welch t-test of group mean difference (for the quantitative predictors). As shown in the last column of table (A4), the p-values of the chi-square tests are mostly below the 5% level, suggesting the significant dependence of the qualitative explanatory factors with the three indicators of ecologically sustainable behavior (ESB). Similarly in table (A5), except for the quantitative variable "age" that only achieves significance at the 10% level, the welch t-test results support the strong dependence of all included quantitative predictors at the <5% significance level, corroborating the graphical boxplot results in figure (A6).

For additional sensitivity checks, we also proceeded with the fully parametric and semi-parametric estimations of both, probit (TPM), and Logit (TPM) representations of the joint probability model of ecologically sustainable behavior, described in Equations (12-14). The outcome of this latter exercise is summarized in table (A6), for all resulting four-model specifications. The convergence diagnostics criteria suggest fully satisfactory convergence of the implemented trust region iteration algorithm in all four cases. In addition, it can be noted from table (A6), that the signs and magnitudes of the estimated covariance parameters ($\hat{\theta}_{ES}$, $\hat{\theta}_{EN}$, $\hat{\theta}_{SN}$), and the estimated impacts of climate change and global warming knowledge ($\hat{\beta}_{11}$, $\hat{\beta}_{21}$, $\hat{\beta}_{31}$), are consistent across all four model specifications. Furthermore, given the statistical significances of the covariance parameters $\hat{\theta}_{ES}$=0.352 (0.350, 0.354); $\hat{\theta}_{EN}$=0.368 (0.366, 0.369); and $\hat{\theta}_{SN}$= 0.289 (0.288, 0.292); we have the empirical evidence of the theoretical inter-dependence and mutual re-enforcement of the first three core principles of ESD, as stipulated by the fourth core ESD principle. The above findings suggest the absence of misspecification issues in our econometric analysis.

Relying however on the model performance criteria of AIC and BIC, it can be noted that the last model (M4), with its lowest values of both AIC and BIC, fits relatively better the data. Hence, this "Semi-parametric trivariate logit with fixed country effects" model is chosen as our base specification, with its full results summarized in table (A7), and is also presented in the subsequent section.

Predictive Findings from the Econometric Model

In the adopted semi-parametric trivariate logit specification, the partially linear status is achieved through the quantitative "age" variable, which enters non-linearly the regression equation. The estimated coefficients are interpreted as "marginal utility contributions" within our adopted context of random utility maximization. This implies that positive coefficient values raise the likelihood of ecologically sustainable behavior uptake, by increasing the marginal utility that respondents derive from such behavior; conversely, negative coefficient values reduce the likelihood of ecologically sustainable behavior uptake, due to lowering the marginal utility derived from such behavior.

Influences of Climate Change & Global Warming Knowledge on ESB

As our primary interest in this study, the impacts that climate change and global warming knowledge (CCGW_K) have on youth ecologically sustainable behavior, are shown on table (A7). It can be noted from the first column, under "ProEnvActiv", that each level increase in CCGW_K increases by 3.02% the marginal utility that youth derive from participating in activities that favor environmental preservation. This finding suggests a positive and significant effect of increased climate change and global warming knowledge on youth "environmentally sustainable behavior". Conversely, from the third column of table (A7), under "EthiFairTradeCons", it can be noted that each level increase in CCGW_K reduces by 1.83% the marginal utility that youth derive from choosing certain products for ethical or environmental reasons, when relatively expensive. This latter finding suggest a significantly adverse effect of increased climate change and global warming knowledge on youth "socially sustainable behavior". Most importantly, this finding validates the altruistic nature of ethical and fair trade behavior, which is typically undertaken at the expense of oneself, and thus source of potential disutility. Finally, the second column of table (A7) shows under "HoEnrgConserv" that each level increase in CCGW_K has no statistically significant impact on the marginal utility that youth derive from home energy conservation. This last finding suggests that increased climate change and global warming knowledge has no real bearing on youth "economically sustainable behavior".

Together, the above findings seem to imply that in the quest for ecologically sustainable development (ESD), simply increasing the knowledge of youth as future decision/policy makers and stewards of humanity, is a "necessary" but not "sufficient" condition for achieving ESD at the international level. Other factors would have to also be considered, as subsequently discussed.

Influences of Cognititve and Affective Factors on ESB

The results from the cognitive and affective drivers of ESB are also shown in table (A7). It can be noted that each level increase in youth's self-reported cognitive ability to assess the differential impact of climate change and global warming on countries (CogAsCCGW_impDifr), while reducing by 3.16% youth marginal utility from ethical and fair trade consumption, increases however by 4.56% and 4.41% respectively youth marginal utilities from participating in environmental preservation activities; and engaging in home energy conservation. Table (A7) also highlights that each level increase in youth's self-reported cognitive ability to assess the environmental consequences of economic development (CogAsEcDeEnv_K) significantly raises by 24.90%, 9.36%, and 15.73% the marginal utilities that youth derive respectively from environmental sustainability, economic sustainability, and social sustainability, and thereby positively affect their environmental preservation, home energy conservation, and ethical/fair trade consumption behaviors. With regards to affective drivers of ESB, table (A7) shows that each level increase in youth's affective valuation of the natural environment (AffAsGlobaEnvVal) significantly raises by 37.34%, 47.45%, and 14.94% respectively, the marginal utilities they derive from environmental preservation, home energy conservation, and ethical/fair trade consumption.

Influences of Environmentl Interests on ESB

From table (A7), it can also be noted that each level increase in youth's self-reported interests in domestic environmental issues (IntDNEnv), raises consistently by 11.26%, 4.36%, and 11.91% the respective marginal utilities youth derive from environmental sustainability, economic sustainability, and social sustainability. In addition, table (A7) also shows that each level increase in youth's self-reported interests in foreign environmental issues (IntDNEnv), while significantly raising by 2.8% and 2.79% the marginal utilities youth derive from home energy conservation, and ethical/fair trade consumption respectively; significantly reduces however by 0.74% the marginal utility they derive from participating in activities that preserve the natural environment.

Influences of Socio-economic and Demographic Factors on ESB

The estimated impacts of socio-economic control factors are also shown in table (A7). It can be noted that each standard deviation increase in youth's index of intercultural communication awareness (AWACOM) above its OECD level average value, while significantly reducing by 6% youth derived marginal utility from environmental preservation activities; conjointly raises by 6.11% and 1.88% respectively their marginal utilities from home energy conservation, and ethical/fair trade consumption. On the other hand, table (A7) also highlights that each standard deviation increase in youth's global mindedness index, above its OECD level average value, consistently raises by 17.49%, 8.30%, and 20.70% the respective marginal utilities they derive from environmental sustainability, economic sustainability, and social sustainability. The wealth effects on table (A7) shows that each standard deviation increase in youth family wealth index, above its OECD level average value, while raising by 7.93% youth marginal utility from ethical/fair trade consumption; appears to consistently reduce by 8.43% and 9.73% respectively the marginal utility youth derive from environmental preservation activities, and home energy conservation.

The estimated effects of the demographic control factors in table (A7) also show that gender has no significant bearing on the marginal utility that youth derive from environmental preservation activities. However, compared to their female counterparts, males appear to derive 23.98% lower marginal utility from home energy conservation, while conjointly deriving 6.74% higher marginal utility from ethical/fair trade consumption. The impact of immigration status shows that, relative to their native counterparts, youth that are non-native of their responding country derive 3.97% lower marginal utility from environmental preservation activities, while conjointly deriving 2.33% and 7.89% higher marginal utilities from home energy conservation, and ethical/fair trade consumption, respectively.

Moreover, the estimated effects of grade level, highlights a consistently non-linear and decreasing impact on Ecologically sustainable behavior, for each increasing grade level in school, between grades 7 and 12. These findings seem to suggest that, as students' advance in grade levels between 7th and 12th grades, the marginal utility they derive from environmental sustainability, economic sustainability, and social sustainability decreases; such that they are less and less likely to engage in environmental preservation activities, home energy conservation, and ethical/fair trade consumption.

Furthermore, the estimated fixed country effects, with Brazil as reference category/country, highlight significant heterogeneity in youth subjective utilities from environmental preservation activities, home energy conservation, and ethical/fair trade consumption, and thus suggest heterogeneous preferences for environmental sustainability, economic sustainability, and social sustainability, across the 14 economies in the study.

Finally, the numerical summaries of the estimated non-linear effects of "age" on ESB are presented in the middle portion of table (A7), with its corresponding smooth function plots given in figure (A7). Since the estimated p-values are well below the 5% significance level for all three sub-dimensions of ESB, we can conclude that age does have a significant nonlinear impact on youth marginal utilities from environmental preservation

activities, home energy conservation, and ethical/fair trade consumption. Thus, as they grow older, youth preferences for environmental sustainability, economic sustainability, and social sustainability, changes significantly at the international level.

Discussions

In the seminal paper titled "toward a neoclassical theory of sustainable consumption: Eight golden age proposition", Saunders (2014) examined the role of neo-classical economics in providing keys to deeper understanding of sustainable consumption, and concluded with eight "golden age" propositions that strongly echoed Edmund Phelps' "golden rule' discoveries (Phelps, 1965).

Despite these propositions, much of the extent literature on youth sustainable consumption behavior has relied on alternative frameworks including the theory of planned behavior (Vermeir and Verbeke, 2008), and the transactional theory of coping and socialization theories (Ojala and Bengtsson, 2019). Similarly for much of the cross-national research on environmental behavior (Boeve-de Pauw and Van Petegem, 2013; Miller *et al.*, 2022; Pisano and Lubell, 2017; Wang, 2017). Therefore, in complement to these streams of literature, and following McFadden's subjective utility interpretation from neo-classical microeconomics (McFadden, 2001), the present study analyzed the impact of climate change and global warming knowledge on youth "Ecological Behavior (EB)" in a cross-country setting. To gain better insight into global sustainability, the paper proposed a model of EB that is grounded on rational choice theory (i.e. Random Utility Maximization), with joint altruistic considerations (i.e. social and environmental).

As characterized, the model aligns with the core principles of "Ecological Economics (EC)", which was originally envisioned as a transdisciplinary field of scientific inquiry, with the following core characteristics and goals: "(1) a focus on the primary goal of sustainable well-being of both humans and the rest of nature; (2) three broad sub-goals of sustainable scale, fair distribution, and efficient allocation. (3) intelligent pluralism and integration across disciplines, rather than territorial disciplinary differentiation; (4) concern with the functioning of the interdependent system of humans embedded in the rest of nature from an evolutionary, whole systems perspective; (5) an emphasis on the development of valuation techniques that build on a broad understanding of the interaction of built human, social and natural capital to produce sustainable wellbeing" (Costanza, 2020). In so doing, the paper sought to contribute to the new basic structure of foundational economic knowledge for a sustainability transition, as advocated in (Ropke, 2020).

The findings revealed a mixed influence of climate change and global warming knowledge (CCGW_K) on youth ecologically sustainable behavior (ESB); with a significantly positive impact observed on their likelihood to engage in environmentally sustainable behavior (i.e. participate in activities that preserve the natural environment); while conjointly having a negative impact on their likelihood to engage in socially sustainable behavior (i.e. ethical and fair trade consumption); but conversely having no significant bearing on their likelihood to engage in economically sustainable behavior (i.e. home energy conservation). These findings based on random utility theory are consistent with prior reports based on the theory of planned behavior (Vermeir and Verbeke, 2008), and the transactional theory of coping and socialization theories (Ojala and Bengtsson, 2019). They also corroborate (Stevenson *et al.*, 2018), which using a behavioral change model based on 1041 youth respondents from North Carolina, found support for a causal relationship between climate education treatment and gains in knowledge, but not between the former treatment and behavior.

Overall, our results highlight the "necessity" but not "sufficiency" of climate change and global warming knowledge acquisition for ecologically sustainable development (ESD) at the international level, and thus provide additional insights for moving the international community closer to reaching goal 4.7 of the UN 2030 agenda for sustainable development. In addition to its value for sustainable development education (Pauw *et al.*, 2015), the study and its findings also have important implications for several other sustainable development goals (SDGs), namely goals 7, 11, 12 and 13.

Indeed, as our findings suggest, goal 13-"taking urgent actions to combat climate change and its impacts" is achievable at the grassroots level, by properly raising youth knowledge of the issue (Parant *et al.*, 2017). Doing so would move them to participate more in activities that preserve the natural environment (Korsunova *et al.*, 2021). In addition, achieving goal 7-"making affordable and clean energy accessible for all", would require short, medium and long term investments and efficient use of scarce energy resources at all levels starting from individuals within households (Jakučionytė-Skodienė *et al.*, 2020; Wallis and Klöckner, 2020; Zeiske *et al.*, 2021; Žukauskienė *et al.*, 2021).

Unlike (Keller *et al.*, 2022), which relied on the Austrian Education Energy Initiative (ETSIT), to study the energy literacy of 6000 youth participants, and reported a significant increase in students' energy literacy on a cognitive, affective and behavioral level, with participants also claiming to change their future energy consumption behavior, due to their acquired knowledge; our current findings show that climate change and global warming knowledge did not significantly impact youth home energy conservation behavior. Our finding aligns with Pooley and O'Connor (2000), which suggested that environmental educators should rely on emotions and beliefs, rather than environmental knowledge when designing programs aimed at changing youth environmental attitudes. It also corroborates Parant *et al.* (2017), which recommended the pairing of persuasive message with preparatory acts allowing participants to propose solutions, when seeking to effectively address youth climate change and global warming behaviors through communication campaigns. Suggesting therefore that prospective youth targeted climate change teachings and communications, may effectively benefit from the strategies presented in Beach *et al.* (2017).

This view is consistent with Buenstorf and Gordes (2008), which shows sustainable consumption patterns to spread via processes of social learning, even when individual learning biases may favor environmentally harmful consumptions. It is also consistent with (Stevenson *et al.*, 2018), which using a sample of 950 agriculture students in North Carolina, found agriculture and environment based framing of climate change, together with community frames to elicit concerns and hope, while producing more emotive responses and support for action measures from females and those receptive of the idea of climate change.

This reported affective response from their study aligns fully with those found in our current study, namely that each level increase in youth's affective valuation of the natural environment (AffAsGlobaEnvVal) significantly raises the marginal utilities they derive from environmental preservation, home energy conservation, and ethical/fair trade consumption, and thereby contributing to youth likelihood of ecologically sustainable behavior uptake. Their reported finding on gender however contrasts with ours, which show that gender has no significant bearing on the marginal utility that youth derive from environmental preservation activities; although females do appear significantly more likely to engage in home energy conservation, but relatively less likely to engage in ethical/fair trade consumption, than their male counterparts.

Furthermore, our findings that increased inter-cultural communication awareness (AWACOM), and global mindedness (GLOBMIND) raise the likelihood of youth's ecologically sustainable behavior uptake, are in line with the reported importance of the social context on the transmission of adolescent pro-environmental behavior in general (Collado *et al.*, 2019), and energy saving behavior in particular (Wallis and Klöckner, 2020). They are also consistent with Lacroix and Gifford (2018), which tested a conceptual model of the relationships between cultural cognition world views, climate change risk perception, and psychological barriers to energy conservation behavior, and reported egalitarian and communitarian worldviews to significantly correlate with heightened climate risk perceptions; with the latter being associated with less perceived barriers to energy conservation, and more reported energy conservation behaviors. These latter findings also corroborate Corner *et al.* (2015), which showed among other factors, that worldviews, psychological distance of climate change and its message framing, as well as information-based

interventions' efficacy, are all key drivers of climate change communication effectiveness among youth.

Moreover, both SDGs goal 12-"ensuring sustainable consumption and production patterns" and goal 11-"ensuring sustainable cities and communities" find relevance and key supporting insights, in our current study of ecologically sustainable behavior; due to its focus on ethical/fair trade consumption, as well as efficient home energy usage (Wang, 2017; Zeiske *et al.*, 2021).

Conclusion

This study contributed to the ecological economics literature by pioneering a framework for analyzing ecologically sustainable behavior, based on the neo-classical economic theory of Random Utility Maximization, with joint altruistic (i.e. social and environmental) considerations. Its findings provide important insights for ecologically sustainable development policy making, in addition to assisting the international community move closer to several of it targets set under the UN 2030 agenda for sustainable development. The secondary and pre-COVID-19 nature of our research sample, as well as the retrospective design of the study, contribute to its current limitations. Therefore, a potential future avenue would be to revisit our research question within a prospective study, based on primary post-COVID-19 era stated preferences data. This will be the subject of our next focus on the topic.

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Appendix

Table (A2): Characteristics of the data sample across the 14 covered economies

The select clusters from the 80 cluster nations in the target population	The within target Population data distribution (612004)		After first stage cluster sampling (92734)		After second stage case sampling (55713)	
Cluster ID / Country Name	Abs. Freq.	Rel. Freq.	Abs. Freq.	Rel. Freq.	Abs. Freq.	Rel. Freq.
Brazil	10691	1.75%	10691	11.53%	5037	9.04%
Chile	7621	1.25%	7621	8.22%	4646	8.34%
Croatia	6609	1.08%	6609	7.13%	4710	8.45%
Dominican Republic	5674	0.93%	5674	6.12%	1552	2.79%
Germany	5451	0.89%	5451	5.88%	1499	2.69%
Hong Kong	6037	0.99%	6037	6.51%	4953	8.89%
Ireland	5577	0.91%	5577	6.01%	4116	7.39%
Italy	11785	1.93%	11785	12.71%	7312	13.12%
South Korea	6650	1.09%	6650	7.17%	6257	11.23%
Macao	3775	0.62%	3775	4.07%	3535	6.35%
Malta	3363	0.55%	3363	3.63%	2186	3.92%
Mexico	7299	1.19%	7299	7.87%	4052	7.27%
Panama	6270	1.02%	6270	6.76%	1416	2.54%
Portugal	5932	0.97%	7299	6.40%	4442	7.97%

Note: with the target population partitioned into 80 cluster nations, in the first stage of the bootstrapping, consisted of selecting all cluster nations that conducted the subset of the survey covering the data requirement expressed in the conceptual framework (see figure (2)). This resulted in only 14 cluster nations qualifying, out of the 80 initially in the defined target population. In the second stage of the bootstrap sampling, all valid cases (respondents with full information), from all initially sampled 14 clusters nations were selected to form the final sample. The last two columns of the table show the absolute frequency count (Abs. Freq.), and percent relative frequency count (Rel. Freq.) of respondents across the 14 cluster nations in the data.

Table (A3): Descriptive statistics for the quantitative measurements in conceptual framework in figure (2)

Quantitative variables	Description	Mean	s.d.
Independent indicator of youth climate change & global warming knowledge			
CCGW_K	Ordinal with 3 knowledge levels (1-3). [1- I don't know much and can't explain; 2- I know something and could provide general explanations; 3- I am very familiar and could explain well]	1.92	0.637
Independent indicators of youth Cognitive and Affective Assessment of the Environment			
CogAsCCGW_ImpDifr	Youth cognitive ability to assess the differential impacts of climate change and global warming on countries (1-3). [1- I couldn't or would struggle to, on my own; 2- I could with a bit of effort; 3- I could easily]	1.99	0.728
CogAsEcDeEnv_K	Youth cognitive ability to assess the environmental consequences of economic development (1-3). [1- I couldn't or would struggle to, on my own; 2- I could with a bit of effort; 3- I could easily]	1.91	0.735
AffAsGlobEnvVal	Youth affective valuation of the environment (1-3). Looking after the global environment is important for me [1-Disagree; 2-Agree; 3-Strongly Agree]	2.09	0.648
Independent indicators youth Environmental Interests			
IntDNEnv	Youth interest in domestic environmental issues (1-3). [1-Not-to-not much interested; 2- somewhat interested; 3-very much interested]	2.31	0.670
IntFNEnv	Youth interest in foreign environmental issues (1-3). [1-Not-to-not much interested; 2- somewhat interested; 3-very much interested]	1.88	0.715
Independent indicators youth Interest in the Global Socio-Cultural Landscape			
AWACOM	Standard Normalized Index of intercultural communication awareness	0.11	0.976
GLOBMIND	Standard Normalized Index of global mindedness	0.12	0.953
Socio-economic and demographic characteristics			
AGE	Youth age in years	15.78	0.293
WEALTH	Standard Normalized Index of family wealth	-0.45	1.001
Respondents weighting for national sample representativeness and valid Inferences			
W_FSTUWT	Youth final probability weight in the data	54.44	76.400

...Continued

Qualitative variables	Levels	Abs. Freq.	Rel. Freq.
Dependent Indicators of youth Ecologically sustainable Behavior			
ProEnvActiv (environment)	1- Yes, I participate in activities favoring environmental protection	22840	41.00 %
	2- No, I don't participate in activities protecting the environment	32873	59.00 %
HoEnrgConserv (economic)	1- Yes I reduce home energy use to protect the environment	41553	74.58 %
	2- No, I don't engage in energy conservation	14160	25.42 %
EthiFairTradeCons (Social)	1- Yes, I choose certain products for ethical or environmental reasons, even if a bit more expensive	25387	45.57 %
	2- No, I don't engage in Ethical or Fair trade consumption	30326	54.43 %
Socio-economic and demographic characteristics			
Gender	Youth standardized gender 1- Female 2- Male	 28687 27026	 51.49 % 48.51 %
IMMIG	Youth immigration status 1- Native 2- Non native	 49062 6651	 88.06 % 11.94 %
GradeLev	Youth grade level in School 1- 7th grade 2- 8th grade 3- 9th grade 4- 10th grade 5- 11th grade 6- 12th grade	 320 2037 13581 33423 6165 187	 0.57 % 3.66 % 24.38 % 59.99 % 11.07 % 0.34 %

Note: This operational specification to the youth population, of the General individual level conceptual Framework in Figure (2), is consistent with (Waltner *et al.*, 2019). In the above, Abs. Freq. and Rel. Freq. represent respectively the absolute frequency and relative frequency distributions of the qualitative variables; (N =55713).

Table (A4): Chi-squared dependence test results with conditional frequency distributions in %

				HoEnrg-Conser		EthiFair-TradeCon				
		ProEnvActiv		v		s		Chi2 Test		
		yes	no	yes	no	yes	no	Stat	df	p-Value
ProEnvActiv	yes	---	---	47.4	52.6	54.1	45.9	2802.1***	1	$<2.2\times10^{-16}$
	no	---	---	22.1	77.9	30.0	70.0	3309.2***	1	$<2.2\times10^{-16}$
HoEnrgConserv	yes	---	---	---	---	83.5	16.5			
	no	---	---	---	---	67.1	32.9	1973.8***	1	$<2.2\times10^{-16}$
EthiFairTrade-Cons	yes	---	---	---	---	---	---	---	---	---
	no	---	---	---	---	---	---	---	---	---
CCGW_K	1	41.92	58.08	74.45	25.55	44.61	55.39	6.4889*	2	=0.0390
	2	40.74	59.26	74.75	25.25	45.36	54.64	1.2644	2	=0.5314
	3	40.45	59.45	74.21	25.79	47.71	52.29	22.874***	2	$=1.08\times10^{-16}$
CogAsCCGW_ImpDifr	1	35.13	64.87	69.80	30.20	41.57	58.43	486.37***	2	$<2.2\times10^{-16}$
	2	40.61	59.39	75.85	24.15	45.30	54.70	256.64***	2	$<2.2\times10^{-16}$
	3	47.71	52.29	77.23	22.77	50.14	49.86	219.92***	2	$<2.2\times10^{-16}$
CogAsEcDeEnv_K	1	33.94	66.06	70.23	29.77	40.23	59.77	838.24***	2	$<2.2\times10^{-16}$
	2	41.24	58.76	76.03	23.97	46.29	53.71	277.49***	2	$<2.2\times10^{-16}$
	3	50.45	49.55	77.85	22.15	51.64	48.36	399.73***	2	$<2.2\times10^{-16}$
AffAsGlobEnv-Val	1	26.20	73.80	57.30	42.70	33.46	66.54	2317***	2	$<2.2\times10^{-16}$
	2	38.56	61.44	75.38	24.62	44.49	55.51	2221.5***	2	$<2.2\times10^{-16}$
	3	56.26	43.74	84.30	15.70	56.01	43.99	1206.7***	2	$<2.2\times10^{-16}$
IntDNEnv	1	40.15	59.85	73.18	26.82	43.59	56.41	7.2088*	2	=0.0272
	2	40.63	59.37	74.06	25.94	44.09	55.91	21.579***	2	$=2.06\times10^{-05}$
	3	41.62	58.38	75.53	24.47	47.69	52.31	75.544***	2	$<2.2\times10^{-16}$
IntFNEnv	1	39.77	60.23	73.36	26.64	42.45	57.55	18.338***	2	=0.000104
	2	41.38	58.62	74.95	25.05	46.25	53.75	23.767***	2	$=6.9\times10^{-06}$

				HoEnrg-Conser		EthiFair-TradeCon				
		ProEnvActiv		v		s		Chi2 Test		
	3	42.07	57.93	75.71	24.29	48.99	51.01	129.05***	2	$<2.2\times10^{-16}$
	F	41.20	58.80	76.90	23.10	44.92	55.08	1.0004	1	=0.3172
Gender	M	40.78	59.22	72.13	27.87	46.25	53.75	166.42***	1	$<2.2\times10^{-16}$
								9.8554*	1	=0.0017
	7	76.56	23.44	76.56	23.44	59.06	40.94			
	8	77.71	22.29	77.71	22.29	50.81	49.19	131.4***	5	$<2.2\times10^{-16}$
GradeLev	9	72.40	27.60	72.40	27.60	44.76	55.24	58.888***	5	$=2.06\times10^{-11}$
	10	74.92	25.08	74.92	25.08	45.63	54.37	52.205***	5	$<4.90\times10^{-10}$
	11	76.30	23.70	76.30	23.70	44.64	55.36			
	12	79.14	20.86	79.14	20.86	43.32	56.68			
	Native	40.50	59.50	73.99	26.01	44.91	55.09	41.291***	1	$=1.31\times10^{-10}$
IMMIG	Non-Native	44.64	55.36	78.95	21.05	50.38	49.62	75.704***	1	$<2.2\times10^{-16}$
								70.403***	1	$<2.2\times10^{-16}$
	Brazil	39.59	60.41	75.18	24.82	44.51	55.49			
	Chile	36.01	63.99	76.78	23.22	39.84	60.16	3147.9***	13	$<2.2\times10^{-16}$
CNT	...	...	...	...	...	...	...	991.72***	13	$<2.2\times10^{-16}$
	Panama	55.16	44.84	78.11	21.89	56.99	43.01	1173.5***	13	$<2.2\times10^{-16}$
	Portugal	36.06	63.94	77.26	22.74	48.36	51.64			

Note: This test is implemented to assess the dependence between all the qualitative explanatory factors in figure (2), and the indicators of ecologically sustainable behavior (ProEnvActiv, HoEnrgConserv, and EthiFairTradeCons). "Stat": represents the chi-square test statistic value, while "df" captures the degrees of freedom of the test.
In the above, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Source: Authors' construction using the bootstrap sample described in the data section.

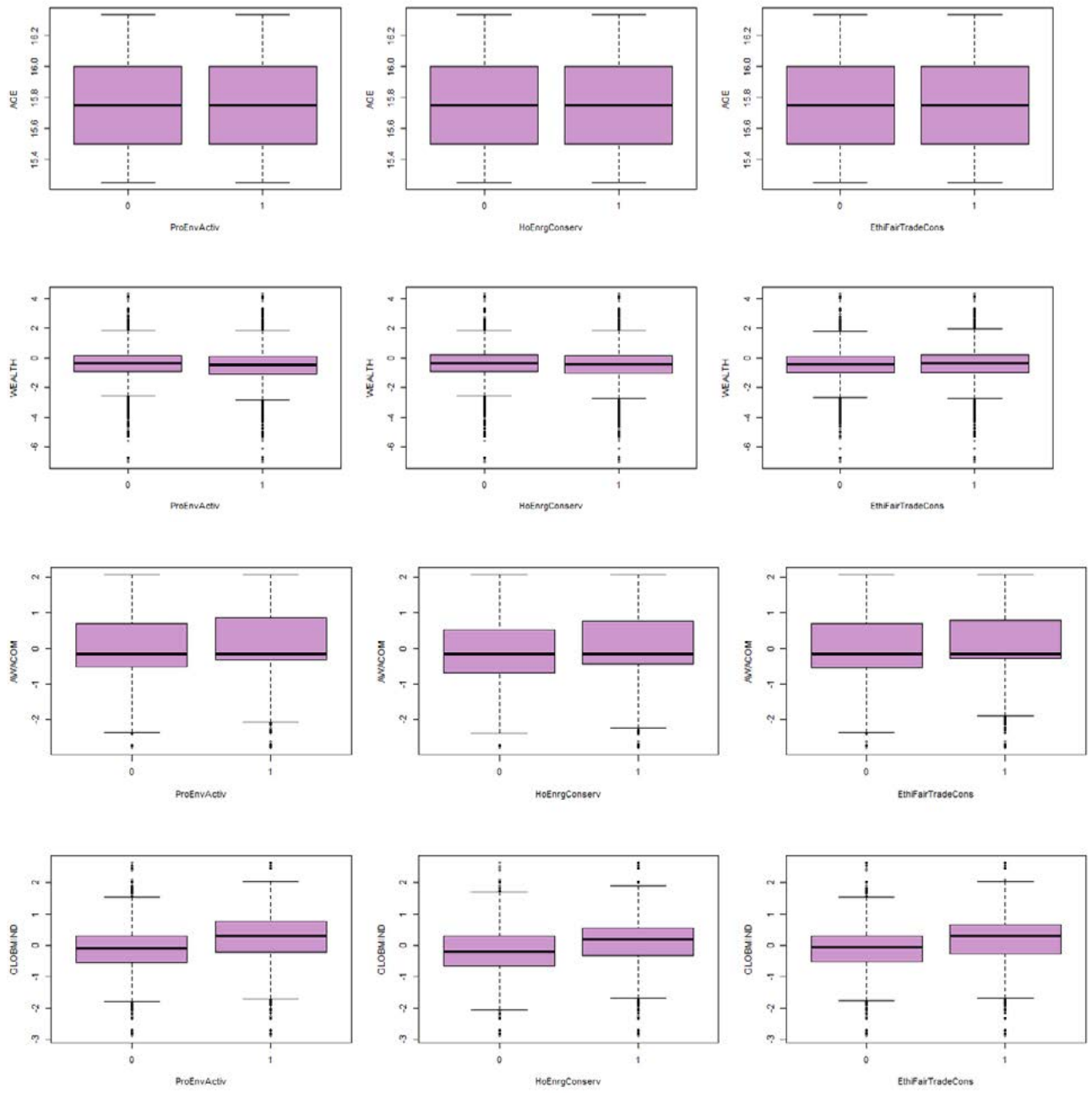

Figure (A6): Boxplots of the quantitative control factors, against the three outcome indicators of ecologically sustainable behavior (ProEnvActiv, HoEnrgConserv, and EthiFairTradeCons).

Table (A5): T-test results for the dependence of the outcome variables with the quantitative control factors

Quantitative control factors	ProEnvActiv	HoEnrgConserv	EthiFairTradeCons
	Group means difference 95% C.I. on mean diff. P-val.	Group means difference 95% C.I. on mean diff. P-val.	Group means difference 95% C.I. on mean diff. P-val.
AGE	0.00018 (-0.0051; 0.0048) =0.944	0.00506 (-0.0106; 0.0005) =0.07603	0.00162 (-0.0065; 0.0033) =0.5162
WEALTH	0.12565*** (0.1085; 0.1428) <2.2×10^{-16}	0.09653*** (0.0777; 0.1154) <2.2×10^{-16}	-0.05156*** (-0.0683; -0.0348) =1.68×10^{-09})
AWACOM	-0.10097*** (-0.1177; 0.08425) <2.2×10^{-16}	-0.19008*** (-0.2085; -0.1716) <2.2×10^{-16}	-0.11614*** (-0.1325; -0.0998) <2.2×10^{-16}
GLOBMIND	-0.37562*** (-0.3919; -0.3593) <2.2×10^{-16}	-0.3255*** (-0.3432; -0.3079) <2.2×10^{-16}	-0.2883*** (-0.3042; -0.2724) <2.2×10^{-16}

Note: Means variations in the values of the quantitative control factors, between the groups of individuals engaging in ecologically sustainable behavior, and those not engaging in such behavior. Used to assess the degree of dependence between the three outcome indicators of ecologically sustainable behavior, and the quantitative control factors.
In the above, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Source: Authors' construction using the bootstrap sample described in the data section.

Table (A6): Summary Performance of the four Model specifications

Model Specification	Algorithm Convergence Diagnostics			AIC	BIC	Estimated Impact of Climate Change and Global Warming |Knowledge on Ecologically Sustainable Behavior			Estimated Correlation coefficients, with 95% C. I.	Sample size (n)
	Largest Absolute Gradient value	Observed Information Matrix is Positive Definite	Eigenvalue Range			ProEnvActiv	HoEnrgConserv	EthiFairTradeCons		
(M1): Fully-Parametric Probit with fixed Country effects	2.01×10^{-06}	yes	[347.025 ; 662321241]	10852644	10853501	0.0176*** (0.0013)	-0.0026 (0.0014)	-0.011*** (0.0013)	$\hat{\theta}_{ES}$=0.351 (0.349 , 0.353)	55713
									$\hat{\theta}_{EN}$=0.367 (0.366 , 0.369)	
									$\hat{\theta}_{SN}$= 0.290 (0.288 , 0.291)	
(M2): Fully-Parametric Logit with fixed Country effects	8.48×10^{-07}	yes	[125.762 ; 251485056]	10851019	10851876	0.0294*** (0.0021)	-0.0045 (0.0023)	-0.0187*** (0.0020)	$\hat{\theta}_{ES}$=0.351 (0.349 , 0.353)	55713
									$\hat{\theta}_{EN}$=0.367 (0.366 , 0.369)	
									$\hat{\theta}_{SN}$= 0.290 (0.288 , 0.291)	
(M3): Semi-Parametric Probit with fixed Country effects	1.32×10^{-08}	yes	[213.451 ; 66085125]	10848128	10849199	0.0180*** (0.0013)	-0.0023 (0.0014)	-0.0109*** (0.0013)	$\hat{\theta}_{ES}$=0.351 (0.350 , 0.353)	55713
									$\hat{\theta}_{EN}$=0.368 (0.366 , 0.370)	
									$\hat{\theta}_{SN}$= 0.289 (0.288 , 0.292)	
(M4): Semi-Parametric Logit with fixed Country effects	2.55×10^{-08}	yes	[77.718 ; 25168457]	10846540	10847611	0.0302*** (0.0021)	-0.0043 (0.0023)	-0.0183*** (0.0020)	$\hat{\theta}_{ES}$=0.352 (0.350 , 0.354)	55713
									$\hat{\theta}_{EN}$=0.368 (0.366 , 0.369)	
									$\hat{\theta}_{SN}$= 0.289 (0.288 , 0.292)	

Note: Numbers in parenthesis are respectively: the 95% Confidence Intervals (C.I.) on the correlation coefficients; and standard errors (s.e.) of the estimated coefficients.
* indicates significance at alpha of 0.05; ** significance at 0.01; and *** significance at 0.001.

Source: Authors' construction using the bootstrap sample described in the data section.

Table (A7): Semi-parametric estimates of the drivers of youth Ecologically Sustainable Behavior.

N = 55713	Trivariate Logit with Fixed Country Effects Model's Results		
	ProEnvActiv	HoEnrgConserv	EthiFairTradeCons
(INTERCEPT)	-1.2044*** (0.0154)	0.4425*** (0.0188)	-0.2269*** (0.0149)
CCGW_K	0.0302*** (0.0021)	-0.0044 (0.0023)	-0.0183*** (0.0020)
CogAsCCGW_ImpDifr	0.0456*** (0.0020)	0.0441*** (0.0022)	-0.0316*** (0.0020)
CogAsEcDeEnv_K	0.2490*** (0.0020)	0.0936*** (0.0022)	0.1573*** (0.0019)
AffAsGlobEnvVal	0.3734*** (0.0027)	0.4745*** (0.0029)	0.1494*** (0.0025)
IntDNEnv	0.1126*** (0.0023)	0.0436*** (0.0025)	0.1191*** (0.0022)
IntFNEnv	-0.0074*** (0.0022)	0.0280*** (0.0024)	0.0279*** (0.0021)
AWACOM	-0.060*** (0.0014)	0.0611*** (0.0015)	0.0188*** (0.0013)
GLOBMIND	0.1749*** (0.0018)	0.0830*** (0.0020)	0.2070*** (0.0017)
Gender_M	-0.0040 (0.0025)	-0.2398*** (0.0027)	0.0674*** (0.0024)
GradeLev_8	-0.2019*** (0.0150)	-0.4944*** (0.0185)	-0.2457*** (0.0146)
GradeLev_9	-0.6675*** (0.0138)	-0.7510*** (0.0172)	-0.4951*** (0.0134)
GradeLev_10	-0.9156*** (0.0135)	-0.6511*** (0.0169)	-0.7100*** (0.0131)
GradeLev_11	-1.1173*** (0.0137)	-0.7551*** (0.0171)	-0.8898*** (0.0133)
GradeLev_12	-0.9803*** (0.0192)	-0.3971*** (0.0241)	-0.8152*** (0.0188)
WEALTH	-0.0843*** (0.0013)	-0.0973*** (0.0015)	0.0793*** (0.0012)
IMMIG_NonNat	-0.0397*** (0.0077)	0.0233** (0.0077)	0.0789*** (0.0070)
CNT_Chile	-0.2751*** (0.0067)	0.0792*** (0.0076)	-0.4581*** (0.0066)
CNT_Croatia	-0.4357*** (0.0142)	-0.1381*** (0.0145)	-0.3602*** (0.0134)
CNT_Dominican Republic	0.5109*** (0.0113)	0.2398*** (0.0138)	0.4510*** (0.0112)
CNT_Germany	-0.8242*** (0.0067)	-0.1664*** (0.0066)	-0.4189*** (0.0060)
CNT_Hong Kong	0.7574*** (0.0110)	0.3817*** (0.0134)	0.3191*** (0.0108)
CNT_Ireland	-0.5409*** (0.0116)	0.0921*** (0.0117)	-0.7824*** (0.0111)
CNT_Italy	-0.5256*** (0.0053)	-0.3753*** (0.0053)	-0.2767*** (0.0049)
CNT_South Korea	0.3662*** (0.0047)	-0.0434*** (0.0054)	-0.5560*** (0.0047)

N = 55713	Trivariate Logit with Fixed Country Effects Model's Results		
	ProEnvActiv	HoEnrgConserv	EthiFairTradeCons
CNT_Macao	0.1979*** (0.0347)	0.3571*** (0.0436)	0.1681*** (0.0344)
CNT_Malta	0.3178*** (0.0415)	0.5091*** (0.0512)	0.1074** (0.0405)
CNT_Mexico	0.4483*** (0.0039)	0.1112*** (0.0045)	0.0913*** (0.0038)
CNT_Panama	0.3581*** (0.0221)	0.0446* (0.0263)	0.2538*** (0.0220)
CNT_Portugal	-0.5073*** (0.0087)	0.0184* (0.0098)	-0.3135*** (0.0083)
AGE	Edf = 8.971 Ref.df = 9 Chi.Sq = 2237 p-value < 2e-16***	Edf = 8.972 Ref.df = 9 Chi.Sq = 1529 p-value < 2e-16***	Edf = 8.986 Ref.df = 9 Chi.Sq = 1304 p-value < 2e-16***
$\hat{\theta}_{ES}$		0.352* (0.350, 0.354)	
$\hat{\theta}_{EN}$		0.368* (0.366, 0.369)	
$\hat{\theta}_{SN}$		0.289* (0.288, 0.292)	
AIC		10846540	
BIC		10847611	

Numbers in parenthesis are respectively: the standard error (s.e.) of the estimated coefficients, and the 95% Confidence Intervals;
Edf: empirical density function, Ref.df: the corresponding degrees of freedom, Chi.Sq: the corresponding chi-square statistic value; (C.I.) on the Correlation coefficients. In the above, *** p < 0.001, ** p < 0.01, * p< 0.05

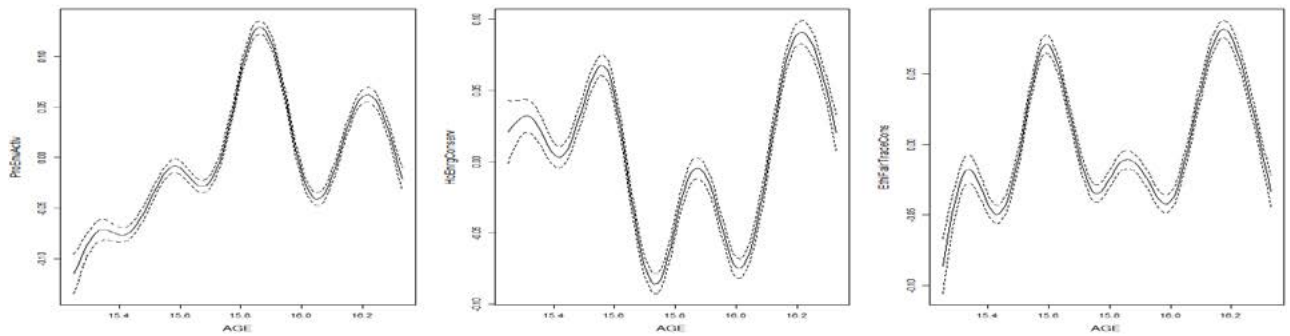

Figure (A7): Smooth function plots of the impact of age, on the three outcome indicators of ecologically sustainable behavior. From left to right are the effects of age on environmentally sustainable behavior, economically sustainable behavior, and socially sustainable behavior, respectively. These are generated from the output of the fitted semi-parametric trivariate logistic model with fixed country effects, presented in table (A7).

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Environmental Responsibility in Architectural Education: Tackling the Planetary Crisis through UNSDGs

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Abstract

As a member of the University Climate Network, Abu Dhabi University supports education's role in addressing the climate problem through teaching and research that align with the United Nations Sustainable Development Goals (UNSDGs). This article examines a research-based teaching initiative for the architecture graduation design project course. Student projects adopt various UNSDGs to complement, consolidate, and support their design agenda while also nurturing their role in the profession and the society at large. Through the use of circular and regenerative design, and modularity, students examine global problems, make ethical decisions regarding the environment, and take an ethical stance toward production and consumption.

Introduction: Architecture, Education and Environmental Responsibility

What if humans designed products and systems that celebrate an abundance of human creativity, culture and productivity? That are so intelligent and safe, our species leave an ecological footprint to delight in, not lament? (McDonough & Braungart, 2002).

The building and construction sectors contribute 39% of global energy-related emissions. In this context, buildings (and their construction) are perceived as offenders to the environment. They are unavoidably linked to the triple planetary crisis, which is causing climate change, natural degradation, and pollution. Many unsustainable production and consumption strategies have been deeply rooted in the construction industry for decades, especially in the Gulf region. While architects may not be held responsible, their position in this industry is inevitable and can become a key to advancing or reversing this crisis. In fact, architects can have a key role in reversing the cycle to mitigate climate change and help in recovery and regeneration. It is never too early to start this in the life of an architect. In fact, this change must start in the early years of education. Providing the tools and mindset to think differently, make informed environmental decisions, and be ready to have a positive impact on the environment. By aligning this mindset with Agenda 2030 and the United Nations Development Goals, architects may find a roadmap to make an impact through their practice.

Adopted by states and organizations, the United Nations Development Goals (SDGs) consist of seventeen high-level targets offering guidance and a framework that can be used by the public and private sectors to drive change towards a better future for all. In 2015, by adopting these goals and supporting the 2030 Agenda, the UAE proclaimed its commitment to sustainability in different areas, both in the educational and professional domains, including the education and practice of architecture. In fact, a number of white papers, guideline books, and reports were published by leading institutions examining how the built environment interacts with the SDGs and seeking ways to inspire architects and stakeholders involved in the built environment to engage with the challenges. For example, in 2018, the Union of International Architects started issuing its Architecture Guide to the UN 17 Sustainable Development Goals. Supported by examples of realized projects, the guide presented how each goal is defined by the UN and demonstrated how it interacts with the built environment (Mossin *et al.* (Ed.), 2018; UAI, 2022).

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Another set of reports by the Royal Institute of British Architects (RIBA) explored the UN Sustainable Development Goals in practice by looking broadly at sustainable and ethical practice within the architectural profession and the built environment. The report discussed the role of the architect as follows:

"Architects can influence the sustainability of project outcomes by integrating traditional creative and technical skills with an up-to-date understanding of environmental, social, and economic impacts. They are uniquely placed to raise awareness of these issues and influence clients and other construction industry professionals, from setting aspirations at the initial strategic project stage through to delivery, post-occupancy, and the full lifecycle of the building. They should therefore be prepared with knowledge of the various more ethical options open to their clients." (2019, RIBA)

Also, in her RIBA Climate Guide book, Mina Hasman (2023) discussed the pressing need for architects to acquire the requisite skills and knowledge to design buildings that deliver sustainable outcomes, meet the RIBA 2030 Climate Challenge, and have mandatory competence in climate literacy. Other books call on design students and environmental professionals to encourage them to design for climate emergencies, urging them to use new materials and avoid excess waste in resources from the beginning of the design process in order to avoid a climate catastrophe and achieve a regenerative built environment (Pelsmakers *et al.*, 2022).

If the UN Sustainable Goals represent an aspiration for architects, then it is a shared commitment to sustainability and professionalism in both higher education and practice as well as through collaborative projects. As they help define the challenges that they need to address to turn the profession into a positive contributor to the environment and to achieve a better and more sustainable future for all, this is particularly true in the case of the UAE.

According to the Ecological Footprint Initiative (n.d.), "We live on a massively overused planet. We are guided by economic accounts, such as GDP, that are insensitive to ecological imbalances." (Ecological Footprint Network, n.d.). IN 2006, The Living Planet Report by the World Wildlife Fund (WWF, 2006) highlighted that "Humanity's Ecological Footprint was growing faster than the planet's ability to regenerate". The report defined the footprint of a country to consist of "all the cropland, grazing land, forest and fishing grounds required to produce the food, fiber and timber it consumes, to absorb the wastes emitted in generating the energy it uses, and to provide space for its infrastructure." The report also drew attention to the high ecological footprint of the UAE. The was ranked with one of the highest per capita Ecological Footprints in the world, which led to massive criticism about its production and consumption patterns. Since then, ecological responsibility started to take priority and the government took major steps to resolve the issue of sustainability in the development of the country. In 2007, Abu Dhabi hosted the World Energy Summit, where they revealed the plan to build the first city with zero carbon and waste, called Masdar City. In 2008. the Estidama Pearl Rating System (PRS) was formed as a framework for sustainable design, construction and operation of communities, buildings and villas. The PRS is intended to be unique in the world and is specifically tailored to the hot climate and arid environment of Abu Dhabi. (Department of Municipalities and Transport, n.d.).

This paper reflects on a teaching strategy that invests in the lucrative interaction between the sustainable goals of the United Nations of the United Nations and the professional trends in higher education in the UAE. It examines case studies developed in the design graduation course at Abu Dhabi University. The course requires a fully developed architecture project, from the schematic concept to design development, and provides a comprehensive experience closely related to the professional practice of architecture after graduation. It also invites students to use different experiences acquired during their education for the suitable development of a design project, including functional, environmental, social, aesthetic, and structural considerations.

Two cases are examined in depth. The first one focuses on the design of an innovation center

that accommodates circular design and relates to the circular economy. The second case is for an agriculture center that focuses on food production and urban farming. The analysis focuses on the simultaneous application of architectural concepts to design goals and their relevance and application to the UNSDGs. This study explores the rich areas for innovation at this confluence of processes, leading to a design framework that enables architecture students to reflect on and analyze their existing socioeconomic, urban, and natural environments and to propose context-sensitive scenarios for the built environment.

The Upcycle Lab: Circular Design, Dematerialization and Modularity (SDG 9, 11, 12, 13)

The first case study is designed by Rufa Goltay and presents a project that seeks to take immediate action to combat climate change through adaptive reuse and responsible consumption and production patterns. The Upcycle Lab is an innovation center housed in a rehabilitated warehouse. The Lab intends to move society towards a more circular lifestyle. Dedicated to the community of Abu Dhabi, the center provides a place for innovation and entrepreneurship, encouraging the community to consume sustainable products.

The project is in Al Mina district of Abu Dhabi, near the port industrial zone. The site is surrounded by abandoned warehouses to be integrated into the project. The project aims to revive the warehouse graveyard, regenerate abandoned structures, adopt principles of circular design, and reuse local materials. By choosing to work in brownfield site, the project confirms a conscious sustainable approach to the site. This rehabilitation can potentially increase public movement into the non-residential Mina area, turning it into a lively area that is considered an important part of Abu Dhabi city.

The elevated zones of the project create a shaded public space below it that preserves the existing local vegetation and provides the users with an outdoor sea viewing deck. All these elements provide an architecture that can contribute to UNSDG 11 on sustainable cities and communities. Not only does it help make the city resilient and sustainable, but the workshops and labs also offer safe and inclusive spaces for experimentation and innovation. They help build resilient infrastructure by promoting inclusive and sustainable industrialization and fostering innovation, therefore being consistent with UNSDG 9, which calls for industry innovation and infrastructure. (Figure 1).

Inspired by circular economy, the main parts of the program relate to each other to create a space of flow. Figure 2 show the process: Waste is brought in by people, then it is sorted, stored, crafted into something new, developed into a business, and sold back to the people who brought in the waste materials. An educational and exhibition component is added to keep the community involved, as are activities to create a sense of healing with the environment while enjoying the scenic views of the site. Having several uses as part of the program invites users of all ages to visit the center and makes recycling a community activity.

The concept behind the project draws on the Japanese art of 'Kintsugi'—a form of art where broken pottery is put back together using gold; this 400-year-old technique is built on the idea of embracing imperfections and flaws to create something more beautiful and stronger where the 'scars' are highlighted. It encourages the reconstruction of broken pieces rather than their disposal. This method also serves as a metaphor for the art of healing, which can also be applied to the current state of the planet, which needs healing, leading us back to the research problem of this project: the rapid loss of resources.

A Cradle to Cradle approach, as discussed by McDonough & Braungart (2002), replaces long-established practices of cradle to grave and helps people reflect, act, and upcycle the trash they produce, giving them a chance to have a second life and maximizing the life cycle of resources.

The relevance of this proposal comes from research study on the reality of waste production and management in the UAE. In 2021, Abu Dhabi alone produced trash weighing more than 11 million tons from residents, governments, and companies, of which only 36% was recycled or

Figure 1: Aerial view of the Upcycle Lab Project in Abu Dhabi Port Industrial Area. Highlighting the four key UNSDGs that the project focused on. Image credit: Rufa Goltay, 2023.

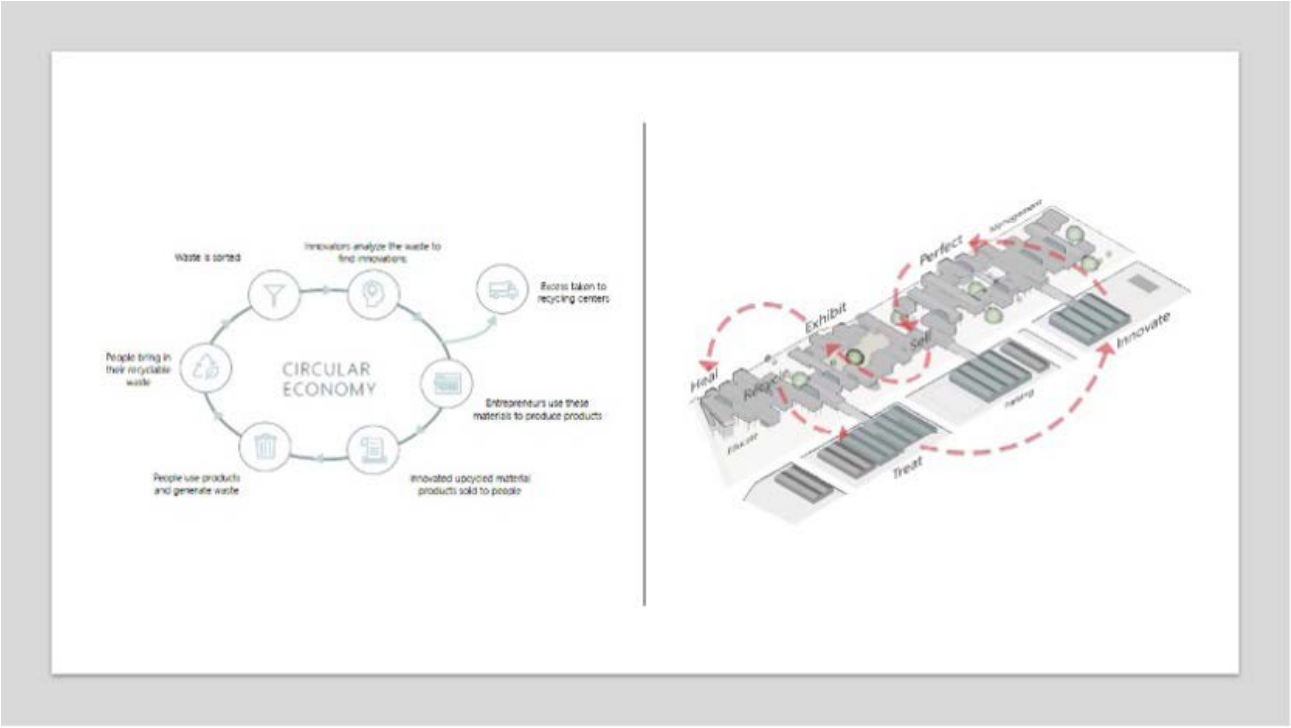

Figure 2: Diagrams showing circular economy approach to Upcycle Lab. Image credit: Rufa Goltay, 2023.

treated sustainably. To address this problem, the government and private sector work towards a more circular economy and more recycling initiatives. Abu Dhabi's Waste Management Centre, Tadweer, provides recycling stations around the city where paper, cans, wood, cardboard, plastics, metal, cotton, wool, mobile phones, batteries, and glass can be segregated and sorted (Tadweer.ae, n.d.). RECAPP is another societal incentive program that rewards the recycling efforts of its users by offering a range of sustainable discounts and vouchers. It deploys recycling boxes on private premises and manages your collections with an effortless digital solution (gorecapp.com, n.d.). Many programs over the past few years emerged trying to provide incentives for recycling materials and products around the UAE, from degrade machines on local public buses to cycled smart bins to recycling mobile apps. All these initiatives reflect a growing local trend to adopt the UNSDG 12, which calls for responsible consumption and production. When it comes to industry and construction waste, the push to reuse and recycle is also growing.

Despite all these efforts, the majority of the materials end up in dumpsites or landfills, becoming pollutants that are not part of nature or human civilization. The Upcycle Lab intends to engage grassroots by offering a dedicated facility for the community to participate in recycling. In this way, it contributes directly to the concept of the circular economy and circular design. The concept of "designing out waste and pollution," circular design prioritizes inner economic loops like repair or remanufacture. And modularity ensures customization, easy and affordable repair and upgrading, as well as remanufacturing.

As part of the circular process, project materials were selected accordingly, including repurposed marine ropes for facade elements. Locally reclaimed metal panels from other warehouses serve as facade panels (see Figure 3). Doors and windows from demolished structures are used in the building to create a mix of restored elements. Oil drums from the port station may be recycled to envelope columns, creating a protective layer. Crushed glass may be filled between panels, creating a facade that allows diffused light, allowing visual comfort. The modular nature of the façade allows for easy repair and replacement of any damaged parts while also making the building

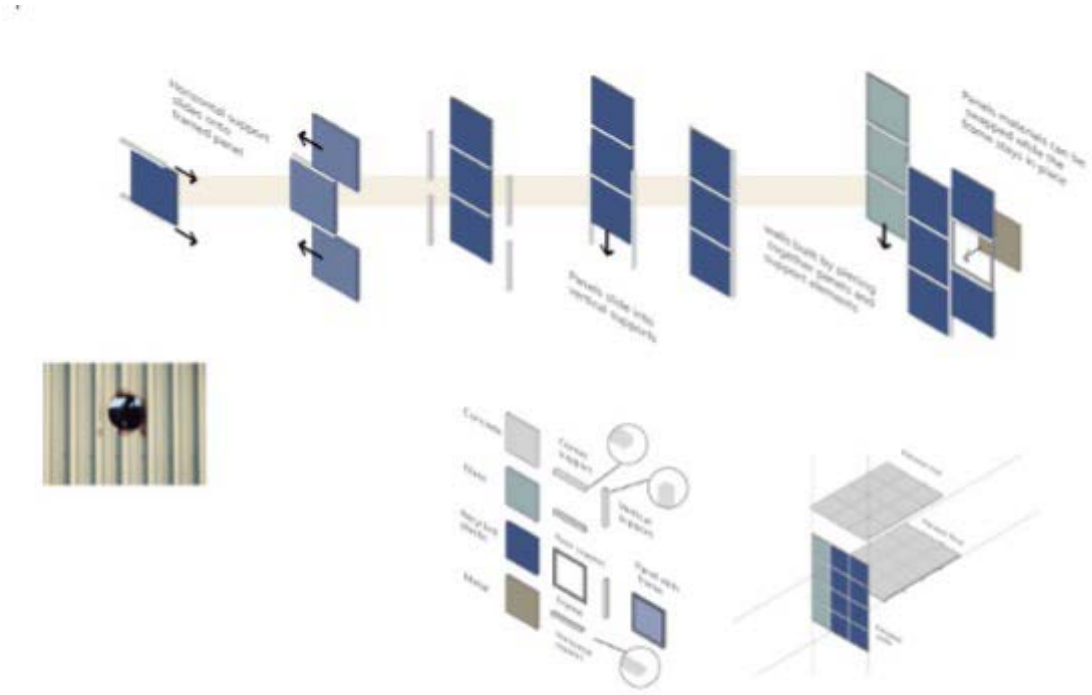

Figure 3: Diagrams illustrating the panelization and recycling approach to building facade in order to minimize waste in the construction process and connect the building to its surroundings. Image credit: Rufa Goltay, 2023.

adaptable to transform and accommodate changes.

A Harvest Hub: Addressing Food Security through Architecture

(SDGs 2, 7, 11, 12, 13)

The second case study by Haya Al Baiti focuses on the design of a new Harvest Hub – an agricultural Institute for Abu Dhabi City. Located in Masdar City, the design process of the building employs regenerative design principles such as water and energy efficiency as well as passive design strategies. In order to restore the gap in ecological literacy, the project aims to join the city's sustainability initiatives. It teaches the public about sustainability and sustainable agriculture. The building program is conceived in consideration of the UN Sustainable Development Goals. The project promotes urban farming; greenhouses offer spaces for growing local produce to be sold to the local community. The community is invited to plant and produce their own food. And a food bank serves the community. The project also houses markets for local produce for the community of Abu Dhabi, attracting people from around the emirate to Masdar City. The Harvest Hub also includes a center focusing on sustainable agriculture and supporting research to achieve food security.

Aware of the fact that the UAE remains dependent on importing the majority of its food products, the project seeks to complement local initiatives to achieve food security, improve nutrition, and promote sustainable agriculture (UNSDG 2). Covered mostly by desert landscapes, the UAE relied primarily on maritime sources of food in the past. Agriculture was very limited for a long time. However, in the past 50 years, there has been a slow change in land developments; more attention has been given to agriculture, starting in Ras Al Khaimah, Fujairah, and Al Ain, yet not without challenges. Since 1971, lands have started to be grown despite the lack of water and arable land, the high production costs, and the difficult environmental conditions. These challenges required advanced technologies to conserve water resources and adopt modern irrigation systems. Despite the increased efforts in production, the majority of food remain imported from outside the

Figure 4: The Harvest Hub project focuses on addressing food security through architecture. Image credit: Haya Al-Bayti, 2023.

Figure 5: Diagram showing some of the sustainable design features included in the project. Image credit: Haya Al-Bayti, 2023.

country. With the strain put on the underground water supplies, Today, agricultural production, landscaping, and food security remain important goals in the UAE. The project joins efforts in this regard by adopting water-efficient systems and considering food waste. Food is considered the source of life and growth. The population of Abu Dhabi, as a community, should grow and embrace the life and growth that agriculture is providing for society.

The Harvest Hub provides a center for inclusion and social interaction in the neighborhood of Masdar and in Abu Dhabi as a whole. By aligning with the UNSDG 11, the project aims to build a community that is inclusive, safe, resilient, and sustainable. Users are connected as a community to advocate for sustainable urban farming and a food-secure future. The building's program is divided into different zones, including the public educational zone, local market, workshops, recreational spaces, research institute, administration, and a food bank. These spaces are distributed in a way that can be easily accessed from different locations and include easy circulation patterns, allowing users to reach their destinations easily and without confusion. The design also encourages walkability throughout the project. The building is located in an area with good public transportation. This helps users use and take advantage of the public transportation and the spaces provided, such as the park, open markets, plazas, and courtyard. Existing crosswalks and pedestrian pathways allow people to walk instead of using the car. They connect the project to the city and provide spatial continuity (UNSDG 13).

The food bank offers a space for collaboration and celebration of local traditions and values, especially in the holy month of Ramadhan, when the community comes together to prepare donation boxes or Iftar meals for people. People from different ages and backgrounds learn from each other and use fresh local produce in the community kitchen. Specific spaces are designated for the public to learn and engage with their community. The roof garden serves as an educational space for the public, as they can learn about planting and socialize as a community, raising awareness amongst them. Two production zones, with a farm for growing local produce and a solar farm, ensure sustainable consumption and production patterns as indicated in UNSDG#12. Additionally, classrooms, workshops, and lecture halls, as well as spaces that teach about gardening and planting for people to implement what they learn into their day-to-day lives. These facilities are intended to educate the public on sustainability and take urgent action to combat climate change and its impacts.

Figure 6: The Harvest Hub provides spaces for inclusion and collaboration as well as food banks and urban farms. Image credit: Haya Al-Bayti, 2023.

As a regenerative building, the hub implements measures of sustainability in the design process such as energy efficiency, water efficiency, waste management, using green materials, as well as passive design strategies and the use of solar panels. By opening up to the North Western wind, the building takes advantage of the incoming air and invites natural ventilation into the courtyard, which provides cooling in the hot climate. In addition, the southern side of the building is designed to control the harsh sunlight, and outdoor spaces are populated with shading devices. Moreover, the building generates its own solar energy from the solar panels covering its roof. This is consistent with UNDSG 7, which calls for the use of affordable and clean energy. The use of sustainable material is also considered through the integration of ETFE (ethylene tetrafluoroethylene) and perforated aluminum sheets in the south façade to reduce the excess penetration of sunlight into the building.

Discussion and Conclusion

Being part of the University Climate Network (UCN), ADU seeks to advocate for education's central role in tackling the climate crisis, including building sustainable cities and communities. This vision is aligned with government programs such as Estidama and with the United Nations Sustainable Development Goals (UNSDGs). The UNSDGs promote sustainability on all levels, one of which promotes action to ensure that we design cities and human settlements to be inclusive, safe, resilient, and sustainable (UNSDG 11). While this goal is evidently associated with sustainable architectural design. The study shows many examples where architecture can relate and align with various goals from food security (UNSDG2) to responsible consumption and production (UNSDG12).

The two case studies that were previously covered show how ecologically ethical design decisions can be made during the design process, such as when working on sustainable sites or encouraging responsible consumption and production through the application of modularity, regenerative design, and circular design. The incorporation of renewable energy guarantees that everyone has access to contemporary, affordable, dependable, sustainable, and sustainable energy (UNSDG 7). (While there are multiple goals addressed in each of the cases, the focus here is on understanding the goals in relation to architecture rather than on exploring sustainable solutions in all of their

complexity). With this educational framework, we intend to lay the groundwork for a discussion on how the built environment may support each of the Goals. All cases remain unbuilt architectural projects and design initiatives. Yet regardless of their approaches and focus, students' intentions confirm the need for serious action to combat climate change and its impact – a viewpoint that is required for the future generation to be ready to tackle the triple planetary crisis.

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Green Competences: Empowering Future Generation with Socioecological and Educational tools for Sustainable Jobs

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Abstract

The European Union has undertaken a significant initiative through its Green Deal Plan to confront the pressing issues of Climate change and Environmental degradation, recognizing their implications for Europe and the global community. This endeavor necessitates a fundamental shift in the prevailing economic paradigm and a heightened focus on fostering a culture of environmental Sustainability within the European Union. As part of this endeavor, the EU has identified a set of Sustainability competencies that are integral to developing educational and training programs. This multifaceted approach seeks to cultivate knowledge, skills, and attitudes over a lifetime, fostering a critical perspective on prevailing economic models, which are inherently tied to the depletion of natural resources and lifestyle choices.

The concept of Green Competence, emerging from these competencies, underscores the dual responsibilities of prioritizing Earth's well-being and addressing global population concerns. This study aims to investigate the notion of green competence and its potential integration into university programs by bridging the domains of human and social sciences with STEM disciplines.

This research commences with a review of the literature on competencies and skills within sustainability education, lifelong learning, and climate education. Subsequently, the study constructs a robust framework comprising intersectional, interdisciplinary, and trans-disciplinary tools applicable within any university context.

Within this framework, four key fields of interest emerge:

a) Sustainable values and awareness: This dimension emphasizes the cultivation of values and heightened awareness of sustainability principles.

b) Complexity in Sustainability: Acknowledging the intricate nature of sustainability challenges, this facet seeks to equip individuals with the tools to navigate and address complex sustainability issues.

c) Critical Thinking: Developing critical thinking skills is fundamental in assessing and responding to sustainability-related problems.

d) Responsibility and Action for Sustainability: This component underscores the imperative of taking responsibility for Sustainability and translating this awareness into meaningful actions.

This research underscores the need for socio-ecological and educational tools that empower universities to play a pivotal role in ushering in a sustainable future. By integrating Human and Social Sciences into STEM disciplines, we can comprehensively address the multifaceted challenges of climate change and environmental degradation across all facets of society. Furthermore, it calls for additional research to facilitate the transition toward Sustainability across all scientific disciplines.

Introduction

The European Union has undertaken a significant initiative through its Green Deal Plan to confront the pressing issues of Climate change and Environmental degradation, recognizing their implications for Europe and the global community. This endeavor necessitates a fundamental shift in the prevailing economic paradigm and a heightened focus on fostering a culture of environmental Sustainability within the European Union.

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The European Green Deal, launched in 2019 by the European Commission (EC), is a step forward to a fair and prosperous sustainable society and Climate zero-impact by transforming economies in the European Region.

The need for Sustainability, both in the Global North and South, has been justified by the need to stay within the limitary Planet Boundary, reverse the impact of human activity on the Planet, and deal with a holistic crisis through holistic strategies (Rockström *et al.*, 2009). According to Vandana Shiva, globally, we are living in an existential crisis (climate, sanitarian, economic, social, and democratic) that requires a boldness of gaze to step up toward the future (2004). According to Orr, we are living in "The perfect storm" that lies ahead is caused by the collision of changing climate, spreading ecological disorder (including deforestation, soil loss, water shortages, species loss, and ocean acidification) (2013). Although this topic has become more pervasive in the last decades, there is evidence that already, if the business as usual had continued, the Planet would have achieved the Limits to Growth (Meadows *et al.*, 1972). Still, after 50 years, our societies are talking about to mitigate Climate change and how to reduce the social impact, also considering that most vulnerable people are living in the global south region. Therefore, the climate crisis is the cause of rising global injustice (Davidson, 2022).

The Green Deal aims to address those multiple challenges. Moreover, it represents a milestone in the framework of ecological and social transition in Europe, a strategy to transform economies by decoupling the economy from the exploitation of natural resources. The Green Deal as a multifaced strategy aims to transform policies in terms of climate, energy, transportation, and food systems, restore ecosystems and biodiversity, fiscal and investment, Research, innovation, and Education as pillars for reducing greenhouse gas emissions by at least 55% by 2030 to face Climate Change and environmental degradation (EC, 2019).

The complexity of our time makes implementing a linear policy complicated and inefficient. This complexity requires a strategic perspective for effective implementation on behalf of all. In the context of the Green Deal in which a prominent swift is wished in all economic sections of the economy, studies should be focused on how to transform "talking" into "walking", in other words, how to transform Sustainability values, avoiding Greenwashing (Österblom et. al., 2023) into the effective process of learning that can facilitate job opportunity for youth generation by Respecting the Limits of the Planet (Meadowon, 1972). This work will also contribute to "responding to the citizens' desire to contribute to a better future, enabling students to appreciate the complexity of our world, empowering people of any age to be 'global citizens', or driving Europe's competitiveness and innovation" (EC, 2019, p.9). This study aims to highlight the role of universities as key agents in the green transition by empowering students through Green Competencies.

Education for Sustainability

The lack of effective public engagement worldwide in living in harmony with the environment is passing responsibility from the governance to the individuals who contribute to the climate crisis with their own ecological footprint (Rees & Wackernagel, 1994). In this view, people should be educated, trained with properly education to be aware of the consequences of practices and behavior in the Planet as in the global community.

The term Education for Sustainability (ES) appeared for the first time in 1990. However, a frame of synonyms or similar terms previously used to refer to ES is still discussed (Angelini & Pizzuto, 2021). For instance, environmental education and education for sustainable development (Scalabrino, 2022). Moreover, since 2010, a new branch of education has been named Climate Education, which focuses on putting evidence and increasing awareness on how fossil fuels cause climate change. This brunch is particularly relevant as a strategic tool for decarbonization. All those educational frames belong to the Education for Sustainability. In this work, we focus on ES as a shared framework in which green competencies are hinging, as a shared space where sustainability practices can be spread.

Although difference emerges, the need to build up a set of competencies for imagining the

future Together (UNESCO, 2021). "Education for Sustainability promotes the understanding of the complexity of the World in which we live, to collaborate, speak up and act for a Positive change (UNESCO, 2015). In this sense, the science of complexity Morin (1999) contribute to exploring how single elements in the Planet are intertwined each other's, indeed, each element belongs to the whole and it is not separate (Shiva, 2022). More recently, another prominent researcher Haraway introduced the tentacular thinking, focusing on relationship between humans and nonhumans by highlighting how "Nothing is connected to everything; everything is connected to something" (2016). Those theories are fundamental to taking the distance from the traditional model of understanding, which is simply related to cause-effect. Moreover, this opens a new space for the learning process.

In the last two decades, Education has been recognized as a critical agent in transforming society along more sustainable, equitable, and socially just lines (UNESCO, 2005). Education is a strategic tool for facing global challenges and supporting the green transition in building sustainable communities independent of age and social class. Learning is seen as a never-ending process (lifelong learning) that occurs in all spheres of daily life (food consumption, housing, transportation, Education, etc.). In this context, Education for Sustainability covers a broad range of knowledge as competencies and skills for navigating our times World.

Sociology has a prominent role in responding to climate change as a mirror for citizens, politics, and power. Indeed, sociology, by providing evidence, can have an impact on changing perspectives and make a significant change (Davidson, 2022). There are several aspects that sociology can address, such as fighting fake news and disinformation to contribute to raising awareness in our societies (Cusumano, 2023).

For instance, there is evidence that climate change denial is correlated with the fossil fuel industry. This unveils how socio-economic dynamics developed into globalization, neoliberalism, and capitalism are intertwined with environmental and Climate issues (Davidson DJ, 2022). Climate denial is the most dangerous version of science denial; for this reason, Climate denial can be considered as the antithesis of Climate Education (Kutney, 2024). Facing Climate denial represents a step forward toward better information and for being well-informed. Moreover, denialism is also known as the "climate change countermovement" by sociologists.

Education is a lifelong process that never stops; in this work, we would focus on the University level as centers of knowledge. Indeed, universities are essential to preparing students for roles in a green economy and sustainable future, it is a crucial step to jump into the labor market and, therefore, as a transformation of society toward the green economy. Facing Education for Sustainability in Higher Education means combining green knowledge and training opportunities as a complementary education system.

Thanks to the 2030 Agenda (United Nations; 2015), sustainable development goals have become a daily life approach to looking up the future, including the University system. Despite this prominent change, the "Institutionalization of the SDGs needs more steps forward to step up towards a sustainable future. This is crucial to drive the transition toward Sustainability. In this sense, it is necessary to investigate which competencies are essential for reversing the current global paradigm, in other words, to reverse the "business as usual", in other words, the model based on economic growth as on the depletion of natural resources.

To make a significant change, sustainable competencies are identified as strategic tools that should be developed in all learning environments, but surely at the University level. In recent years, European countries have started to include Sustainability in curricula (European Commission, 2024). If, on the one hand, this is a crucial step, a prominent lack of capacity to read the single goals in an intertwined way still emerges, as was auspiced by the UN with the introduction of the 17 SDGs (2015). The critical issue is adopting interdisciplinary and transdisciplinary approaches, which are other concepts that are still discussed but not implemented in our universities. On

the other hand, there is a need to identify skills, competition, and knowledge to facilitate the learning process in the Anthropocene era to shift toward sustainable practice to pursue and achieve a future for Humanity (Bianchi *et al.*, 2022). Clark correctly discusses whether sustainability can have room for itself (2007) as a method for improving society's capacity to use the earth, in other words, by recognizing the independence of sustainability as a science. This could be both an advantage and a disadvantage. It can be considered an advantage as mandatory science in all majors, but it is also a disadvantage in this discipline, separated from STEM and Humanitas. In synthesis, Sustainability should be a method for understanding the complex dynamics that arise from interactions between human and environmental systems (Clark, 2007).

Sustainability Competences

In Europe, in recent years, the interest in encompassing SD in Higher education has increased, so thanks to the idea of making sustainable universities, this progress has been made thanks to research and competencies for SD (Lozano *et al.*, 2019). Sustainability education aims to enforce competencies to make a change in the current socioeconomic processes.

The question that would arise here is how to get a professional–scientific foundation related to sustainability for jobs. University studies provide skills and knowledge for developing a career. Moreover, universities can play a crucial role in shaping Sustainable development, as they can produce competence for sustainability awareness (Rieckmann, 2011).

We will investigate sustainability competencies and how to frame them in high-level education through interdisciplinary courses.First, it is necessary to clarify what Sustainability Competencies (SC) are. Here, we will refer to the Council Recommendation on Key Competencies for Lifelong Learning definition, which refers to a combination of knowledge, skills, and attitude (Scalabrino, 2022).

According to Brundiers and colleagues (2020), SC "Comprises the entirety of individual dispositions comprising knowledge, skills, motives, and attitudes necessary to solve sustainability-related problems and advance sustainable development in a range of different contexts, including private, social, and institutional."

Bianchi and colleagues have been building up a framework for Green Competences (GC) to support people in achieving SC; according to them, SC "empowers learners to embody sustainability values, and embrace complex systems, in order to take or request action that restores and maintains eco- system health and enhances justice, generating visions for sustainable futures" (p. 15, 2022). In other words, SC competencies are crucial for a mindset switch in all inhabitants of the Planet by shifting from the Anthropocentric perspective to the ecocentric one. Consequently, this means refusing the idea that humans have the power to dominate nature; on the contrary, adopting the ecocentric perspective means recognizing that Humans are part and dependent on nature.In this sense, SC is identified as an agent to make a change toward a more sustainable future. Developing sustainability skills contributes to enforcing knowledge and increasing individual and social awareness and responsibility toward others and the Planet.

The European Commission classifies SC as a transversal critical competence framework or as a cross-cutting or cross-curricular learning area in a separate part of the curriculum or can be integrated into several subject areas separately (2024). Indeed, the way of dealing with SC has a different impact. Considering the framework in which SC is perceived makes the difference itself. In this sense, considering the ecological approach, which includes taking Planetary Boundaries and Climate Change, should be the only approach to drive an effective swift, more than considering the Green Growth Degrowth or Circular Economy. The urgency of this issue cannot be overstated. As asserted by prominent researchers, planetary habitability conditions have primacy over economic production conditions.

The European sustainability competence framework has identified four areas for GC: values, complexity, Envisaged futures, and action.

SC encompasses a wide range of moral and ethical values. For instance, SC competence cannot be separated from the human rights approach or a decolonized perspective; in other words, to build a better future, we must start from here and from the present, considering our humanity. At the same time, the green vision considers, as already anticipated, the acknowledgment that other humans and non-species are not just part but interconnected parts of the Planet, with the awareness that using a species for human utility can damage all inhabitants, both human and nonhumans. This interconnectedness should serve as a reminder of our shared responsibility. In summary, ES encompasses a wide range of values, such as justice, equity, tolerance, sufficiency, and responsibility (Bianchi *et al.*, 2022).

As already anticipated, the SD approach requires systemic thinking, critical thinking, and problem-solving. These are not just aspects, but crucial tools that aim to enforce the capacity to understand worldwide interaction, assume a critical perspective about economic and cultural direction, and finally activate transformative change starting from the people (bottom-up). The need for systemic thinking cannot be overstated in addressing sustainability issues.

The third area regards envisioning a sustainable future. The current global trend regarding Climate Change (IPCC, 2022) suggests that if we do not make a rapid swift, the gas emissions will continue to grow by causing irreversible Climate change, causing the abrupt environmental change that is already occurring as three of the planetary boundaries (Climate change, Rate of biodiversity loss and interference with the Nitrogen cycle) has been already transgressed their boundaries (RockstrÖm *et al.*, 2009).

This evidence can impact present and future generations. The dramatic situation could affect future generations, creating interferences such as climate anxiety and immobility. For this reason, it is necessary to empower future generations by providing adequate knowledge to enforce the ability to imagine a better future and a sustainable scenario (Bianchi *et al.*, 2022). Indeed, as the other boundaries are not crossed, there are several reasons to continue pursuing that humanity has the freedom to pursue long-term social and economic development (RockstrÖm *et al.*, 2009).

The fourth and fifth areas, more practical, consist of making the change by encouraging people to act and implementing responsibility through awareness with the intent to adopt environmental practices. This means taking part in the political, social, and academic debate. This specific point directly addresses the audience by impacting the socioecological issue.

Other research made a different classification; for instance, Rieckmann has identified 12 competencies: systemic thinking and handling of complexity, anticipatory thinking, critical thinking, acting fairly and ecologically, cooperation in (heterogeneous) groups, participation, empathy and change of perspective, interdisciplinary work, communication and use of media, planning and realizing innovative projects, evaluation, and ambiguity and frustration tolerance (2011).

In this context, interdisciplinary courses can be characterized as placing the student at the core of learning activities to construct knowledge that can be applied in various contexts (Lakkala *et al.*, 2023). This method will also offer a creative space where elaborating ideas and thoughts cultivate criticism and enforce values to encompass their jobs.

Secondly, implementing SC throughout a non-mandatory subject causes a gap in curricula; similarity, avoiding going deep into the issue and focusing on the ground of the issue may not provide the broad perspective that Sustainability requires to face the problem. Finally, the challenge is how to integrate Sustainability into the teaching activity to activate the transforming process.

The EU proposes seven sustainability competencies (Bianchi, 2022). Sustainability is the value of 'embracing complexity in sustainability', which refers to the understanding that sustainability issues are multifaceted and interconnected, as well as 'envisioning sustainable futures' and 'acting for sustainability.'

The Higher education system must enforce institutionalized activities that mainly characterize

our time, among other climate change, as the ecological and social transition providing tools to implement knowledge, raising awareness of the risk for the threat of Global Peace arising wars in the European and Mediterranean area.

Conclusion

Comparing other regions, the EU is making some effort to incorporate SD into the curriculum, although this enhancement is needed a system change. The Higher education system must enforce institutionalized activities that mainly characterize our time, among other climate change, as the ecological and social transition providing tools to implement knowledge, raising awareness of the risk for the threat of Global Peace arising wars in the European and Mediterranean area, in other words, it must prioritize sustainable competencies within their curricula to prepare students, as future workers for the complex environmental, social, and economic challenges of the Anthropocene.

Empowering future generations through these competencies ensures that universities are not only responsive to but are proactive in addressing the multifaceted crises of our time, driving the ecological and social transitions needed to foster a resilient, sustainable future.

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901 The Most Serious Threat to the Economy and Environment Comes from Climate

Aurelio Angelini[1], *Massimo Scalia*

The Most Serious Threat to the Economy and Environment Comes from Climate

The current global economic model, based on intensive resource extraction, is unsustainable in the long run. The continued use of fossil fuels is accelerating the climate crisis, and the damage from this dependence will be increasingly difficult to manage without a rapid transition to a green economy.

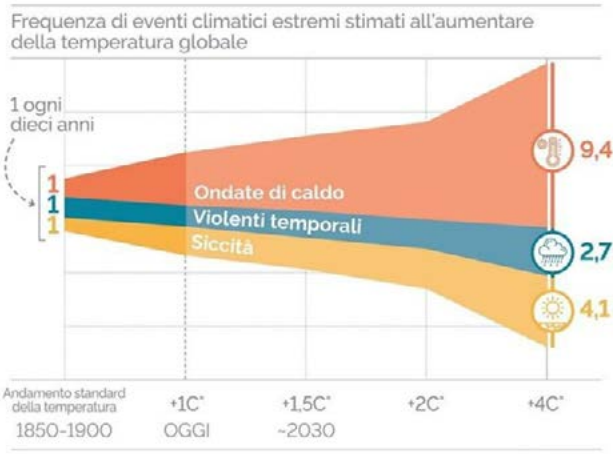
The poorest countries, which are least responsible for greenhouse gas emissions, are also the most vulnerable to the impacts of climate change. This amplifies existing inequalities, both nationally and internationally.

Climate change poses an unprecedented threat, not only to the environment but also to the global economy. The combined effects of extreme weather events, biodiversity loss, forced migration and economic instability require urgent and internationally coordinated action. The challenge is to turn these threats into opportunities by promoting innovations and policies that can ensure a sustainable future.

The most serious threat to the economy and environment from climate change is now a consensus issue among scientists, economists and international institutions. But at the same time, international accurses and national policies are not keeping up with the serious climate crisis that continues to worsen.

Climate change is causing variations in rainfall, more frequent and intense droughts, and extreme temperatures, all co nditions that can compromise agricultural production. This puts global food security at risk, particularly in poorer countries where resources to adapt to these changes are limited.

Estimated Frequency of Extreme Weather Events as Global Temperature Increases



Source: IPCC

Rising global temperatures are linked to extreme weather events such as hurricanes, floods, and wildfires. These events can cause enormous damage to infrastructure, reduce the GDP of entire countries, and put pressure on health and social systems.

Global warming is altering natural ecosystems, leading to the loss of biodiversity. This harms not only the environment, but also the economy, as many sectors depend on healthy ecosystems, such as agriculture, fisheries and tourism.

Regions that become unlivable due to sea level rise or desertification are forcing millions of people to migrate. These climate migrations put pressure on the economies and infrastructure of countries near and far, generating social and geopolitical tensions.

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Nations are increasingly forced to invest heavily in adaptation infrastructure and climate change mitigation policies. The necessary interventions, such as energy transition to renewable sources, adaptation of cities, and coastal protection, entail significant costs.

Exceeding the CO_2 and CH_4 levels recorded in such distant epochs is a clear signal of the impact of human activities on the climate. This reinforces the urgency of adopting global policies to reduce greenhouse gas emissions, invest in green technologies and promote sustainability in all economic sectors.

Levels of CO_2 and methane unseen in the past 15 million years indicate a dramatic shift in the planet's climate balance, driven primarily by human activities, and represents a tipping point for Earth's climate. Without decisive and global action, continued warming will lead to severe and potentially irreversible climatic and environmental impacts, with devastating consequences for humanity and planetary ecosystems, putting economies and human life at risk.

Levels of carbon dioxide (CO_2) and methane (CH_4) in the atmosphere are the highest ever recorded in the past 15 million years. This figure is alarming because it underscores the magnitude and rapidity of the climate change, we are experiencing.

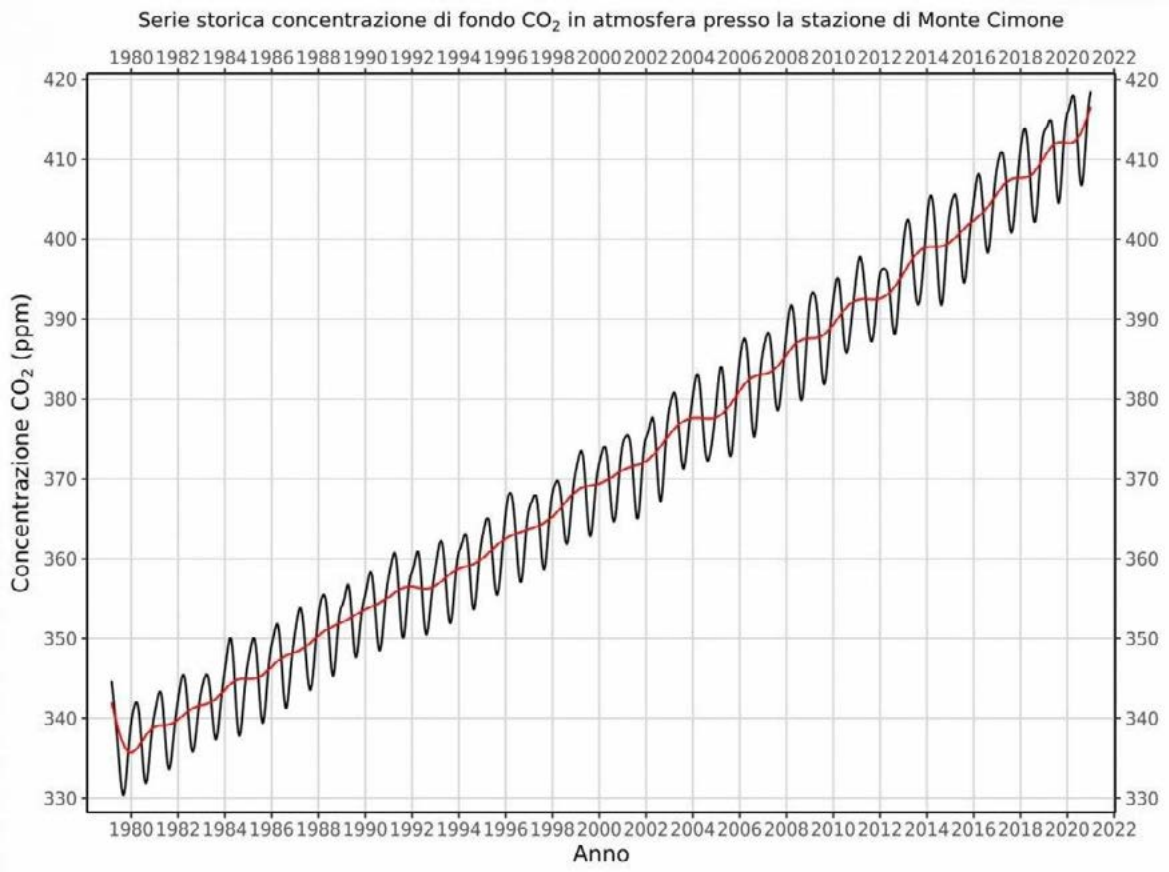
Carbon dioxide is the main greenhouse gas produced by human activities, through the burning of fossil fuels (coal, oil and natural gas) and deforestation. Today, the concentration of CO_2 has exceeded 420 parts per million (ppm), a level not seen for millions of years. During the Pliocene (about 3-5 million years ago), CO_2 concentrations were similar, but temperatures were much higher, and sea levels were significantly higher.

Disasters Ranked According to Reported (a) Deaths (1970 - 2012)

(a)	Disaster Type	Year	Country	Number of deaths
1	Extreme temperature	2010	Russian Federation	55 736
2	Extreme temperature	2003	Italy	20 089
3	Extreme temperature	2003	France	19 490
4	Extreme temperature	2003	Spain	15 090
5	Extreme temperature	2003	Germany	9 355
6	Extreme temperature	2003	Portugal	2 696
7	Extreme temperature	2006	France	1 388
8	Extreme temperature	2003	Belgium	1 175
9	Extreme temperature	2003	Switzerland	1 039
10	Extreme temperature	1987	Greece	1 000

Source: Climatemonitor

Historical Series of Atmospheric CO_2 Concentration at the Monte Cimone Station (IT)



Source: Mount Cimone survey station

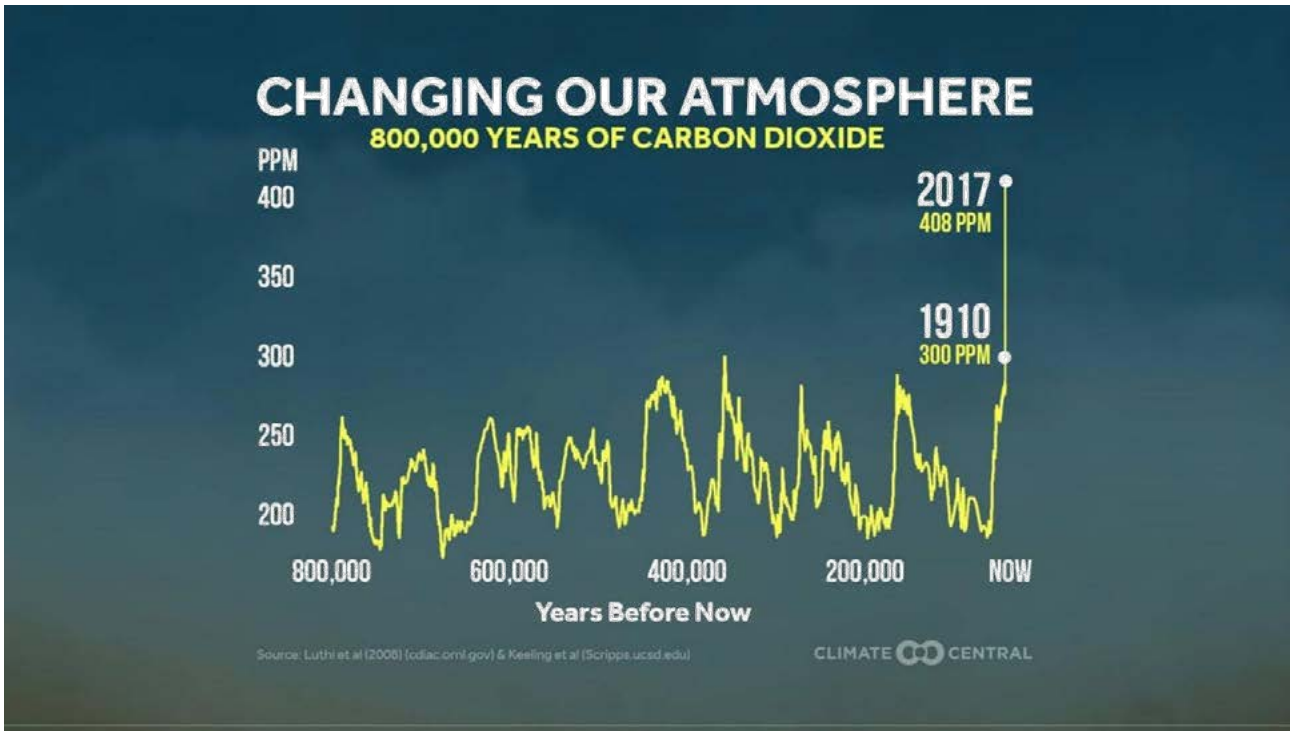
Methane is a much more potent greenhouse gas than CO_2 in the short term, with about 80 times more global warming potential over a 20-year period. Its concentrations have increased dramatically in recent decades, reaching levels not seen in millennia, exceeding 1900 parts per billion (ppb). Major sources of methane include agricultural activities (especially livestock farming), leaks during fossil fuel extraction, and landfill degradation.

The increase in these greenhouse gases is already causing global average temperatures to rise by about 1.2°C compared to pre-industrial times. This increase is causing more frequent and intense extreme weather events.

Glaciers in Greenland and Antarctica are melting rapidly, contributing to sea level rise and threatening coastal communities.

Rising temperatures alter rainfall and storm patterns, intensifying droughts in some regions and floods in others. About 25 percent of the CO_2 emitted is absorbed by the oceans, leading to water acidification and harming marine life, particularly corals and other sensitive species. Fifteen million years ago, during the Miocene, the planet was very different. Temperatures were significantly higher and sea levels much higher. Current concentrations of greenhouse gases are thus returning the Earth to climatic conditions that have nothing to do with those under which human civilization evolved.

Paleoclimatic studies show that during the last period when CO_2 and methane concentrations were so high, the Earth had a very different climate. At that time, global temperatures were much higher, polar ice caps were much smaller or nonexistent, and sea levels were up to 20-40 meters higher than today.



Source: Climate Central, 2019.

What is particularly troubling is not only the absolute level of these greenhouse gases, but the rate at which they are increasing. The current growth rates of CO_2 and CH_4 concentrations are unprecedented in the history of the planet. This rapid increase leaves little time for ecosystems and human societies to adapt to climate change.

If levels of these greenhouse gases continue to rise, we will see even more extreme climate changes, such as global temperatures rising by more than 3-4°C by the end of the century, if effective measures to reduce emissions are not taken. This would have devastating impacts on the availability of water and agricultural resources and the survival of many species. Sea level rise, which could submerge many coastal cities.

The only way to prevent the situation from getting worse is to drastically reduce CO2 and methane emissions. Energy consumption must be reduced through more efficient technologies and the adoption of sustainable practices. Shifting from fossil fuels to renewables such as solar, wind, geothermal and hydropower has become a compulsory ethical and political choice, stipulating globally to stop deforestation and promote reforestation to increase CO2 absorption. As well as adopting policies to abate methane emissions by improving agricultural practices and waste management.

Disasters such as hurricanes, floods, fires and droughts, which are becoming more frequent and intense due to climate change, cause significant damage to public and private infrastructure. Reconstruction comes at a huge cost to governments and businesses. In 2022 alone, damage from extreme weather events exceeded $300 billion globally.

Damage to roads, bridges, power plants, factories and homes, as well as loss of productivity related to infrastructure destruction. Climate variations alter growing seasons, leading to poor or failed harvests in many parts of the world. Rising temperatures and erratic rainfall patterns worsen soil quality and water resources, putting entire agricultural sectors in crisis. This leads to a decrease in the supply of agricultural products, resulting in higher food prices, inflation and food crises.

Drought in some regions can lead to shortages of essential crops such as wheat and corn, directly impacting prices of necessities.

Rising temperatures, particularly in tropical and subtropical countries, affect labor productivity, particularly in sectors that require outdoor work, such as agriculture, construction, and tourism. Heat waves reduce work capacity and increase health and safety costs.

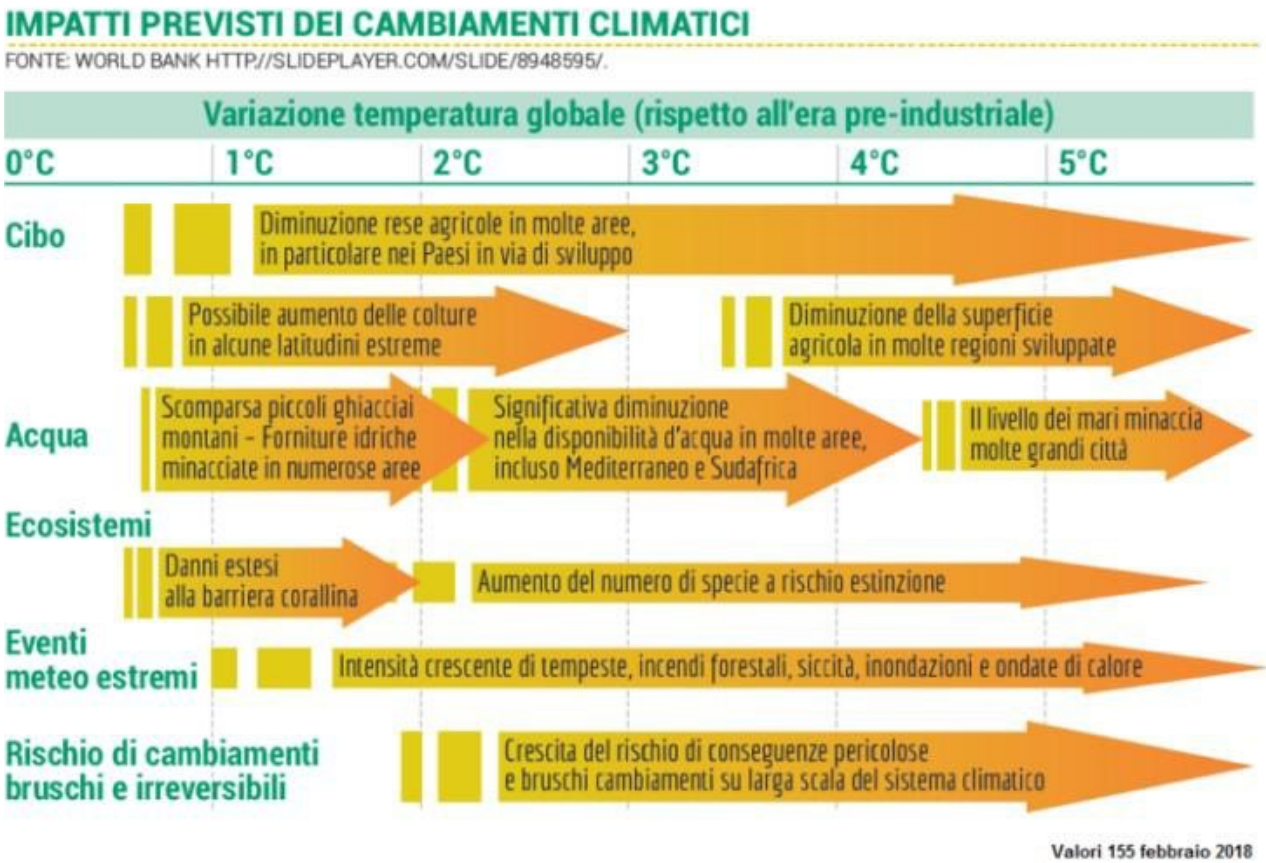
Extreme heat waves in Europe have caused significant reductions in productivity in the agricultural sector, while countries such as India and Pakistan have experienced blackouts due to excessive energy demand for cooling.

Governments will need to allocate increasing resources to deal with the consequences of change climate, including managing natural disasters, building more resilient infrastructure, and funding adaptation and mitigation programs. These costs can drain resources from other essential sectors, such as health, education and social security.

There will be a need to build barriers against sea level rise, upgrade power grids to withstand extreme weather events, and replace fossil fuel power plants with renewable energy plants. In addition, climate change increases risk for many companies and sectors, putting pressure on the financial system. The insurance industry is particularly vulnerable, as the number and severity of natural events are driving up insurance premiums, making some places uninsurable. Insurance companies are raising the cost of policies to protect homes from floods and fires. In some particularly exposed areas, such as the coasts of the United States, it may become impossible to insure properties.

The climate crisis is forcing millions of people to migrate due to extreme weather events, desertification and sea level rise. This causes pressure on the economies of neighboring

Expected Impacts of Climate Change



countries or more stable regions and can lead to social tensions and conflicts related to access to resources such as water and food.

Rising temperatures and water shortages in the Sahel have triggered conflicts between farmers and pastoralists, increasing instability in the region.

Tourism, which depends on stable climatic conditions, is highly vulnerable. Areas such as tropical islands and mountainous regions are already experiencing coastal erosion and reduced snowfall, making these destinations less attractive to tourists.

In the energy sector, climate change threatens electricity generation through traditional sources, such as coal-fired and hydroelectric power plants, due to droughts or declines in water availability.

Tourism in the Maldives islands is threatened by rising sea levels, while drought in California has reduced the capacity of hydroelectric power plants.

Climate change introduces long-term economic uncertainty as companies must adapt to new environmental conditions, stricter regulations, and an increasing demand for sustainable products. This can cause instability in stock markets and increase investment risks.

Oil and coal companies are facing increasing pressure from investors to reduce their emissions and adapt to the energy transition, while emerging sectors such as renewable energy are growing.

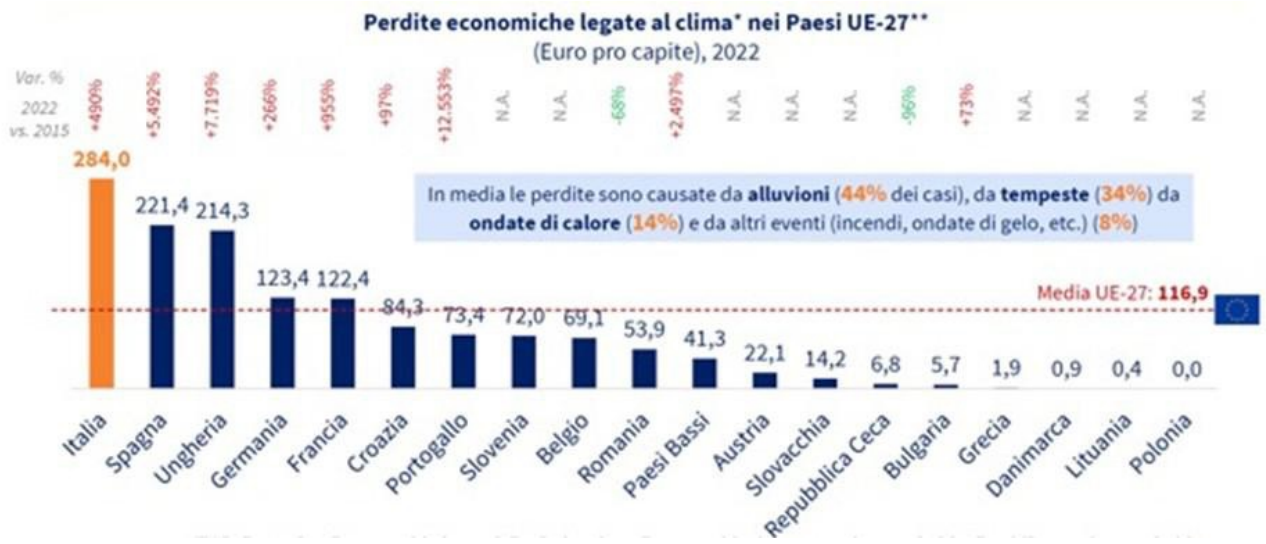
The poorest communities and countries are hardest hit by the climate crisis, as they often lack the resources to adapt or mitigate the damage. This amplifies global and regional economic inequalities, exacerbating social and political tensions.

Small islands in the Pacific, such as Kiribati, are severely threatened by sea level rise, but lack the funds needed to protect themselves.

The climate crisis is not just an environmental problem; it represents one of the greatest economic challenges of our time. The costs associated with damage, adaptation, and mitigation will be high and growing if action is not taken quickly and in a coordinated manner. However, a transition to a low-carbon economy could also create economic opportunities through technological innovation, green jobs, and the adoption of sustainable policies.

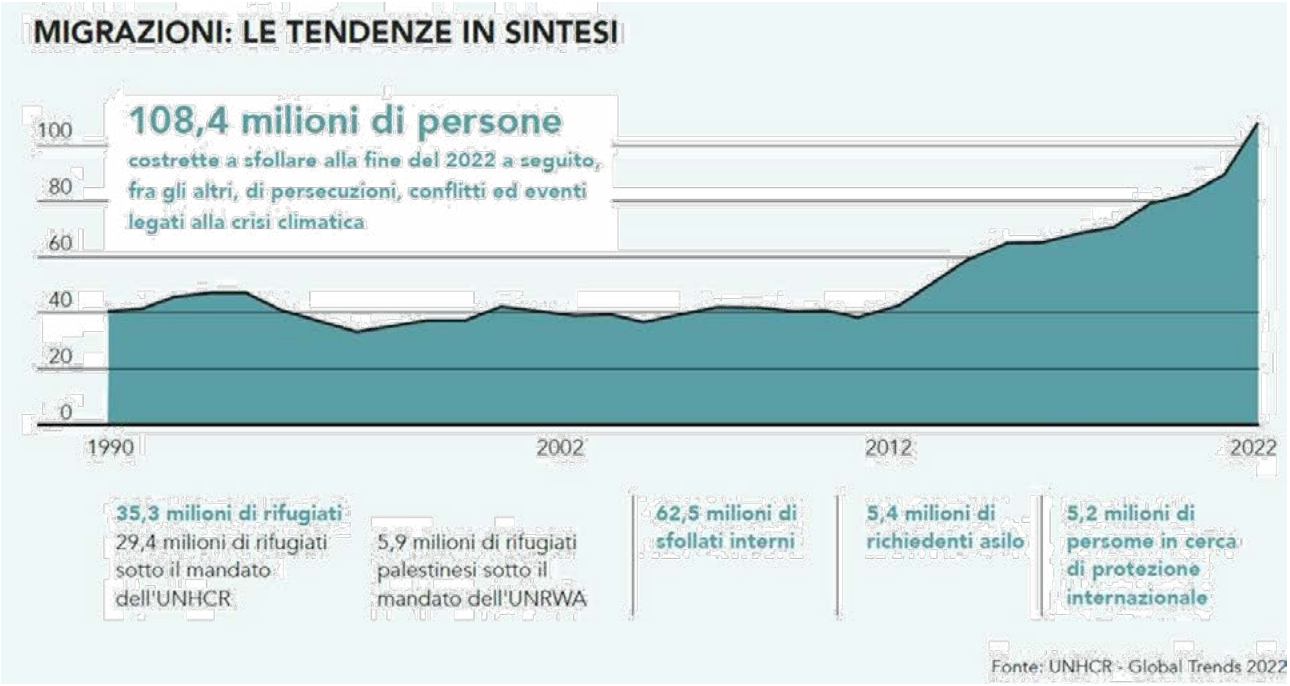
The 2006 Stern Report had a significant impact in highlighting the economic costs produced by fossil energy sources that are primarily responsible for climate change, but it did not fully produce the desired effects. Nicolas Stern anticipated many

Climate-related Economic Losses in EU Countries 27



Source: European Environment Agency AEA, 2024

Migration: Trends in Brief



of the problems we are experiencing today. He helped change the narrative around the climate crisis by pointing out that failing to act would be far more costly than implementing mitigation policies right away. The Stern Report was conducted on behalf of the British government and was one of the first economic studies to comprehensively assess the economic consequences of climate change. The report accurately predicted that the economic damage from climate change would increase significantly if rapid action was not taken to reduce greenhouse gas emissions.

Stern estimated that, in the absence of measures to counter climate change, global economic damages could amount to a loss of 5 percent to 20 percent of global GDP per year. These costs would have come from more frequent and severe natural disasters, negative impacts on agricultural production and food security, public health compromised by heat waves and disease, forced migration and conflicts over resources.

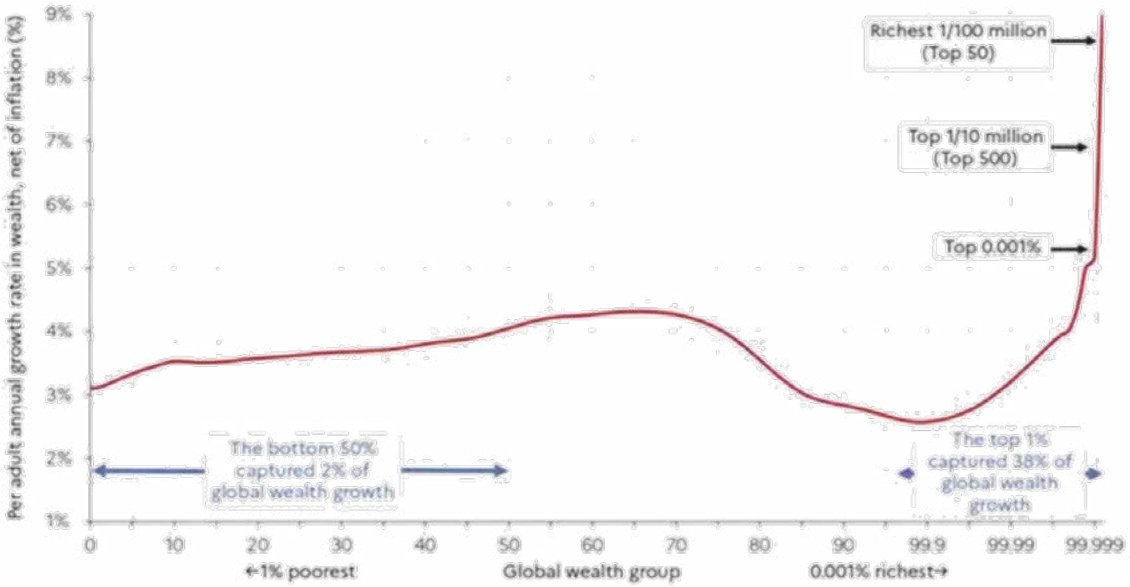
The report emphasized how much it would cost not to address climate change, Stern estimated that investing about 1 percent of annual global GDP to reduce greenhouse gas emissions could prevent much greater economic damage in the future. This figure was later updated to 2 percent in subsequent editions of the report, considering new scientific data. The report highlighted that the poorest countries, despite being the least responsible for greenhouse gas emissions, would be the most affected by climate change. Tropical regions, where agriculture is vulnerable and water resources are scarce, would have been most exposed. This would have widened global inequalities, with destabilizing economic and social consequences.

Stern focused not only on the costs, but also on the economic opportunities of acting against climate change.

After the report was published, new scientific evidence emerged that made Stern's predictions even more relevant. Extreme weather events, such as hurricanes, wildfires, and heat waves, increased, as did the resulting economic damage. The report has become a benchmark for global climate policies and has helped justify many of the international initiatives, such as the 2015 COP25 Paris Agreement.

Global warming has profound consequences for the global economy, intersecting several sectors

Global Inequity



Interpretation: *Growth rates among the poorest half of the population were between 3% and 4% per year, between 1995 and 2021. Since this group started from very low wealth levels, its absolute levels of growth remained very low. The poorest half of the world population has captured only 2.3% of overall wealth growth since 1995. The top 1% benefited from high growth rates (3% to 9% per year). This group captured 38% of total wealth growth between 1995 and 2021. Net household wealth is equal to the sum of financial assets (e.g. equity or bonds) and non-financial assets (e.g. housing or land) owned by individuals, net of their debts* ***Sources and series:*** *wir2022.wid.world/methodology, Bauluz et al. (2021) and updates.*

Source: World Inequality Report 2022

and exacerbating inequalities that have increased over the past 30 years. The repercussions range from increased costs associated with natural disasters to the need for a radical transformation of economic systems.

The human economy and population depend on constant flows of air, water, food, raw materials and fossil fuels from Earth; they constantly send waste and pollution back to Earth. The limits of growth are the limits of the capacity of the Planet's sources to provide those flows of materials and energy, and the limits of the capacity of the Planet's sinks to absorb waste and pollution.

At current regimes, the flows that hold up the human economy cannot be maintained indefinitely, or even for very long, because many crucial springs are degrading and depleting, while many wells are already overflowing. This bad news is followed by good news, however, and that is that the current high regimes are not necessary to ensure a satisfactory standard of living for the entire world population. It is possible to maintain or even increase the production of final goods and services while substantially reducing the burden on the Planet. The choices and avenues for taking this path are many, but first it is necessary to understand the major environmental issues with which humanity is dealing.

Education for sustainable development must contribute to the formation of the citizen of the future: that citizen whom we cannot foresee but can only imagine and help build. The change that is proposed is first and foremost in the way of thinking - and thinking of oneself - in relation to the world: it is necessary to develop in school's skills, knowledge, and attitudes that allow us to rethink our relationship with the world in the direction of "inhabiting the planet lightly. At the root of the ecological crisis there would in fact be a loss of the sense of dwelling, of the meaning that human beings attach to their relationships with both the natural world and the world of humans. Climate change obliges us to rethink the culture of Sustainability by placing environmental education as education for change at the center of the ecological crisis.

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Climate Central (climatecentral.org)

UNHCR, the United Nations Refugee Agency |

IPCC - Intergovernmental Panel on Climate Change Excess mortality rising from too much heat | Science online Home (enea.co.uk)

The Stern Review on the Economics of Climate Change is a 700-page report released for the Government of the United Kingdom on October 30, 2006, by economist Nicholas Stern, UK, 2006.

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THE CHALLENGES THEME 02

Water Food and Energy Nexus in Environmental Education

Theme Background:	Experts and nations have recognised the interconnected relationship between water, food, and energy in a broader context. The nexus underscores that the three essential elements are deeply intertwined, and any changes or challenges in one domain will have significant implications for the others—can we afford to build a siloed understanding? A simplistic understanding impairs abilities to address root causes, deploy synergies, and address trade-offs. The 12th World Environmental Education Congress (WEEC) 2024, to be hosted in Abu Dhabi, provides a unique platform for EE and ESD stakeholders to engage in meaningful discourse on why and how Water-Food-Energy Nexus should be the lens to understand each of them and their interconnectedness.
Theme Objectives:	This thematic track aims to explore innovative approaches to educating and involving people in understanding and addressing the challenges and opportunities presented by this nexus.
Theme Focus:	• How and why nexus approach can contribute to building public attitudes that are not hinged on simplistic understanding of critical issues. • Discuss how EE and ESD can bring in a holistic and interdisciplinary understanding to deal with nexus challenges.
Theme Outcomes:	Embracing competencies and pedagogic approaches that build a more comprehensive understanding of environmental challenges.
Theme Conclusions:	Stakeholders which include educators, researchers, practitioners, and policymakers share insights and best practices that will empower individuals and communities to navigate the complexities of the Water-Food-Energy Nexus and work towards solutions.

THE CHALLENGES THEME 02

Water Food and Energy Nexus in Environmental Education

Proceedings

ID	TITLE	PRESENTER	FORMAT
261	The Contribution of Near-Infrared Waves, Bluetooth Connectivity, and Android Operative System to Good Agricultural Practices in Southern Africa	Quiven Inoque Ebicha	Oral communication
426	Access to Clean Water and Proper Sanitation as a Fundamental Human Right in Africa	Bruno Muyunga	Oral communication

261

The Contribution of Near-Infrared Waves, Bluetooth Connectivity, and Android Operative System to Good Agricultural Practices in Southern Africa

Quiven Inoque Ebicha[1]

Abstract

The existence of near-infrared electromagnetic waves used in soil scanners, and the introduction of the android and iOS operative systems and Bluetooth on various electronic devices brought a huge breakthrough into deep studies concerning the physical, chemical and biological properties of soils. The Agrocares Soil scanner, a modern portable electronic device easy to use, is one of the achievements which brought great, positive and notable changes in the farming sector of two Southern African countries, namely, Zambia and Mozambique, contributing in soil conservation and yield improvement. Ever since Solidaridad Southern Africa introduced the soil scanners, now fully operated by Kvuno Soil Labs, it has become clear that soil testing is a very important good agricultural practice which serves as solution in optimizing crop production, protecting the environment from contamination by runoff and leaching of excess fertilizers which aid in the diagnosis of plant development problems, improving the nutritional balance during crops' growth and serving money and energy conservation by applying only the amounts of fertilizers needed. The results obtained through the soil testing done using the Agrocares Soil scanner provided an indication of essential nutrient deficiencies including pH imbalance and excess soluble salts. This study indicates the positive results that have been achieved ever since the Agrocares soil scanner was introduced in Zambia and Mozambique for soil testing and the detailed explanation of the soil analysis report's main sections.

1. Introduction

During this 21st century, Southern African countries have faced serious crisis concerning soil fertility. Although considered as a great problem to the agricultural sector especially in rural areas where subsistence as well as commercial farming are practiced, no considerable interventions where seriously taken. Many fields which were once productive in the past became almost barren, only permitting less than 50% of the expected yields. According to the observations and results obtained from the researches carried out by soil scientists and agronomists, poor harvests were due to decreasing soil fertility status caused by poor soil management and fertilizer application techniques. This phenomenon was also observed in Zambia and Mozambique, where Solidaridad is currently assisting smallholder farmers to implement good agricultural and environment-friendly practices. It was noted that the majority of the smallholder farmers of the two countries didn't have the opportunities to get the results of the actual status of their soils and were mainly dependent on the agro dealers whose fertilizer application knowledge and advice is mainly based on the type of crop grown during a certain season. In many cases which were also observed during various studies carried out scientifically, there was a mismatch between applied nutrients and required nutrients for productive soils. As far as soil conservation management is concerned, the application of non-limiting nutrients often results in huge economic losses and environmental degradation.

1.2. Soil Testing in the Smallholder Farmer Sector

Being an international civil society organization, Solidaridad's main mission is to facilitate the development of socially responsible, ecologically sound and profitable supply chains. As it is well

Keywords: soil, scanner, solidaridad, Zambia, Mozambique

(1) Solidaridad Southern Africa, Maputo, Mozambique

known, it is impossible to manage what you do not measure, and reliable soil analysis services are often inaccessible to most smallholder farmers and when available, they are often too expensive and the delay between the soil sampling and the delivery of the results and fertilizer recommendations is often too long for the farmers to make good interpretations and to be aligned with the farming seasons.

Facing this challenge a new decision had to be made which involved the introduction of infrastructure for digitally enabled agriculture which would be affordable, quick, easy to use and interpret. Next to this, soil testing scanners would be incorporated in the project sites in order to adjust the soil management practices and showcase that it could be possible for the Mozambican and Zambian smallholder farmers from both urban and rural areas to easily test their soils using modernised simple technology.

The soil fertility problems observed in the various sites where Solidaridad Southern Africa is currently assisting farmers could have been overcome in the past years if smallholder farmers had based their fertilizer options on real-time information. However, according to the information given by Agrocares, only about 5% of the farmers throughout the world have access to reliable soil testing information. It has also been noted that conventional soil analysis laboratories are not in condition to give real time information because the soil samples need to be collected from the field, sent to the laboratory and be analyzed there and this process is often expensive, time-consuming, with results that are often difficult to be interpreted by many smallholder farmers especially in remote rural areas where the levels of illiteracy are often too high. Solidaridad decided to intervene in order to help increase productivity in a sustainable way as it is well known that managing soil fertility is always essential to sustainably improve yields. Solidaridad had to clarify to the farmers, through local good agricultural practice training sessions and awareness campaigns, that the management of soil fertility begins with comprehending the nutrient status of the soil and the nutrient requirements of the crops to be introduced in a certain field. Executing soil tests with potential fertilizer recommendations were almost non-existent in the majority of the rural areas of Mozambique and Zambia, therefore, Solidaridad Network in conjunction with Agrocares committed to work together to help smallholder farmers test their soils by introducing a portable soil scanner with a Near Infrared sensor.

Thanks to Agrocares technology, Solidaridad Southern Africa was able to lay the infrastructure for digitally enabled agriculture in Mozambique and Zambia. As this kind of digital technology was being introduced for the first time in the two countries, a regional calibration process had to be carried so that this technology would be aligned with the Agrocares in-house developed calibration database. In order to introduce the Mozambican and Zambian data for calibration onto the Agrocares database, enough soil samples had to be collected to cover the full spectral range of the soils within the two countries. The soil samples were collected in 2019 and later send to the Agrocares laboratories in the Netherlands. As a mean of easy, more organized and controllable management of the soil analysis done using the scanners, Solidaridad Southern Africa created a social enterprise called Kvuno which is currently the one operating the soil scanners in seven micro-laboratories located in Manica, Maputo, Zambezia and Tete provinces in Mozambique, and in the Eastern, Southern and Lusaka provinces in Zambia. Since 2019 up to the end of first trimester of 2022 Kvuno Soil Labs' staff collected more than 6 000 soil samples and were all analysed successfully using the Agrocares soil scanner. Through the practical fertilizer recommendations contained in the fertiliser and soil management advice reports, many testimonies of yield improvement from the two countries have been presented. With the support of other governmental and non-governmental institutions such as universities, civil society organizations, agricultural companies and other research centres, field experiments have been conducted together with Kvuno Soil Labs field enumerators as well as Solidaridad's field officers in order to demonstrate the importance of soil testing to smallholder farmers. The installation of Kvuno soil labs in Mozambique and Zambia marked the beginning of the era of precision agriculture

Figure 1: Agrocares Soil scanner and the calibration cap

based on soil data. These micro-laboratory services enable the farmers to analyse the nutrients contained in the soil quickly and easily and to make decisions on how to fertilize the same soils.

1.3. Agrocares Soil Scanner

The Agrocares soil scanner is a handheld soil scanner with a near-infrared sensor. It was developed by Soilcares, a branch of Agrocares based in the Netherlands. It was developed for fast and affordable diagnosis of soil fertility status.

During scanning, the spectral image of the soil sample measured with the near-infrared sensor is sent to the application on a smartphone via Bluetooth. The application which is currently used is the Agrocares Scanner Solutions available on google play store. Subsequently this application connects to the Agrocare's Global Calibration Database to convert the spectral images into required soil data and recommendations for the selected crops. As Agrocares database is global. All data from all over the world are stored in one database and the prediction models use all data, but the release is based on a country-by-country quality compliance.

2. Objectives

- Evaluate how Kvuno Soil Labs fulfilled the dream of the smallholder farmers in Zambia and Mozambique through fast, reliable and affordable soil analysis methods;
- Explain the structure of the soil analysis reports;
- Evaluate the statistical data concerning the soil samples collected and analysed by Kvuno soil labs during the first three years.

3. Materials and Methods Used

3.1. Sampling and Data Registration Process in the Field

Sample collection is done using soil probes and small hoes depending on the physical status of the soil at a given place and moment. Kvuno Soil Labs empower producers to make data driven decisions based on soil nutrient and other key parameters and its services are always powered by the most effective technology available to the society.

Kvuno Soil labs' enumerators use mobile android or iOS devices for data collection in the field. Up to the end of the first semester of 2023 all the data collected from the field was registered using the ODK (Open Data Kit) platform which was then replaced by the Kobo Collect app. This method is far off better as it replaces paper forms used in survey-based data gathering and also supports a wide range of questions and answer types, and is designed to work well without network connectivity. As far as soil sample collection and analysis are concerned, Kvuno introduced a total of four forms (see table 1).

Table 1: The four ODK forms currently used by Kvuno Soil Labs for data collection in the field.

Kvuno Soil Labs ODK Forms	Utility	Information Included in the Form
Kvuno Soil Collection Form	Used for data registration during the soil sample collection process in the field.	✓ Employee QR code I.D (e.g. KVA3001, KVA3016, etc.); ✓ Date of soil sample collection; ✓ Payment procedure (Cash, Zwardy or Programme voucher); ✓ Farmer's Details (Solidaridad farmer's I.D card code, full name, gender, date of birth, contact number; ✓ Field's details (name of the producer's association or cooperative, total area in square metres, acres or hectares, crop type, target yield, geographical coordinates and soil sample barcode number).
Kvuno Report Delivery Form	Filled when delivering the soil analysis report/ results to the farmer.	✓ Details of the Kvuno employee delivering the report to the farmer, date of delivery and the sample's barcode number;
Kvuno Chain of Custody Form	Filled when the employee delivering the results is different from the one who would have collected the soil sample in the field before analysis.	✓ Details of the employee delivering the report to the farmer, date of delivery and the samples barcode number
Kvuno Soil Customer Feedback Form	This form is for the farmers'/ customers' comments concerning the services offered by Kvuno Soil Labs.	✓ Farmer's or customer's comments

For the Solidaridad registered farmers there's no need to fill the whole ODK form because all what's needed is to scan their QR code ID cards and their personal details will reflect automatically in the system. After finishing the data registration in the field, the completed and verified forms are send to the server. The details will then reflect in another digital system known as Kvuno Mdosi created by the Solidaridad Southern Africa digital experts. All the data collected during the field work reflects in this technologically and digitally advanced system in a very short period of time depending on the flexibility of the system's processing unit. The Kvuno Mdosi System also allows the lab administrators to carry out the Cash-up and Banking process of the delivered soil sample analysis reports. It also allows the issuing of the invoices and receipts after all the cash payments are done. Chain of custody verification can also be carried out using this system. In order to carry out all these processes the lab administrator only needs three main elements which are:

- Soil sample's barcode contained on the plastic bag containing the sample;
- Report number *(found on the final report);*
- Lab I.D number;
- Employee I.D number *(found on the staff I.D card).*

3.2. Laboratory Analysis

The Solidaridad Soilcares Advisor included in the Agrocares Scanner Solutions App is the one that is used by the Kvuno Soil Labs to test the soil samples collected from the fields. The application connects via Bluetooth to the soil scanner and create nutrient status reports. During training, the Kvuno Soil Lab administrators didn't face many difficulties in getting adapted to the use of application and the scanner because of its user-friendly layout and step-by-step guidance on how to scan the soil samples. The soil scanning procedure can also be done in offline mode and the results become available once a connection to Wi-Fi or network is established. For the application, several languages are available based on the region and/or settings of the individual mobile phone. The nutrient status report is created in less than 10 minutes and can be accessible on the android smart phone, iOS device or on the Agrocares web portal.

Figure 2: Illustrates of the main equipment found in the Kvuno Soil Laboratories.

3.3. Solidaridad Soilcares Advisor

This app was specifically developed for Solidaridad Network and allows the analyzer to use the Agrocares soil scanner for analysis of key soil parameters which include total Nitrogen (N), available Phosphorus (P) (Mehlich 3), exchangeable Potassium (K), pH level, organic carbon and cation exchange capacity.

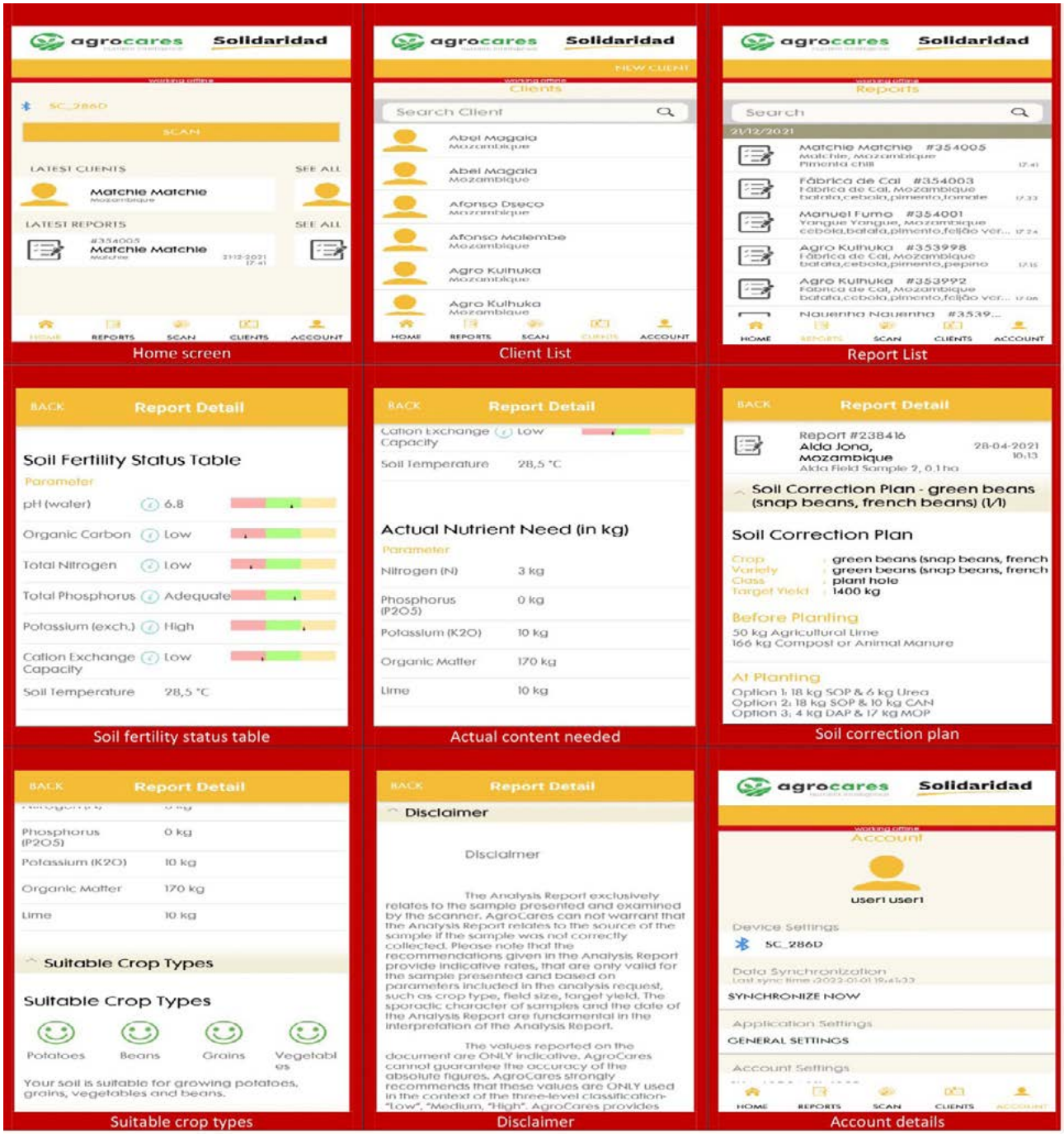

Figura 3: Some of the important information expected to be found in the Solidaridad Soilcares Advisor.

Fertilization and Management Advice

Solidaridad

Alda Jona
Mafuiane
Mozambique
849420529
-25.944845, 32.578987

General Information

Sample Number : 238416 Date : 2021-04-28 Field Name : Alda Field Sample 2 Field Size : 0.1 ha Soil Texture : Sandy Loam
Crop Name : green beans (snap beans, french beans) Target Yield : 1400 kg

Figure 4: General information section (example)

4. Results and Interpretations: Soil Fertilization and Management Advice's Report

The final report contains various reporting options ranging from the standard nutrient status reports to specific and practical management recommendations. The layout of the application and the reports are customized depending on the user's license key. The fertilizer recommendations generated by the scanner app are based on the macronutrients and crop specific needs that are measured. The complete soil fertilization and management report is divided into six sections which characterized by the general information, soil status, actual nutrient need, soil correction plan, suitable crop types and the disclaimer.

4.1. General Information

This section provides the basic information of the report. It includes the sample's number, creation date, field name, field size (in hectares, acres or square metres), measured soil texture, the crop's name and selected target yield.

4.1.1. Target Yield

This is the yield (in kilogrammes) that the farmer intends to achieve after introducing the desired crops in the field. Additionally, the target yield also influences the amount of lime, organic matter and the fertilizers that will be recommended. The target yield is entered by the user and if it's unrealistically low/high, a default target will automatically be calculated by the Soilcares recommendation system.

4.2. Qualitative and Quantitative Soil Fertility Status Table

The scanner measures six parameters on which the fertilizer recommendations are based. These parameters are pH (water method), organic carbon, total Nitrogen, total Phosphorus, exchangeable Potassium and cation exchange capacity. The scanner first determines the specific soil properties of the farmer's field regarding the soil acidity and temperature, organic matter content and the nutrient content of Nitrogen (N), Phosphorus (P_2O_5) and Potassium (K_2O). The parameters' values are provided based on international literature and local experts. The thresholds for NPK are crop specific, hence the measured levels of high, adequate and low may differ between different crops on the same measured soil. The six parameters that are measured are classified into three categories which are high, adequate and low according to figures 10 and 11.

Soil Fertility Status Table

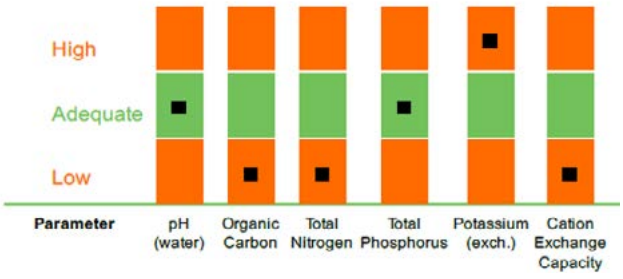

Figure 5: Qualitative Soil fertility status (example)

Tabela do estado de fertilidade do solo

Parâmetro	Unidade	Resultado da análise	Intervalo baixo	Intervalo alto	Baixo	Adequado	Alto
pH (água)	valor do PH	6.8	6.0	7.2		■	
Carbono Orgânico	g/kg		17	50	■		
Nitrogênio total	g/kg		1	2	■		
Fósforo (M3)	mg/kg		20	40	■		
Potássio (exch.)	mmol+/kg		1.5	3			■
Capacidade de troca catiônica	mmol+/kg		75	200		■	

Figure 6: Quantitative soil fertility status (example)

4.3. Actual Nutrient Need

This section shows the entire amount of nutrients needed to maintain sufficient soil fertility and provide nutrients for crop growth. The soil parameters are used to estimate the soil's natural supply of the Nitrogen, Phosphorus and Potassium. The crop's nutrient, lime, compost and manure requirements are estimated using this existing natural nutrient supply and the targeted yield. The higher the target yield the more nutrients are needed. Lime and compost are necessary to correct the soil acidity and organic matter levels of the soil. Adding lime will adjust the soil acidity (pH) of the soil to the optimum level required for a good crop growth.

Actual Nutrient Need (in kg)

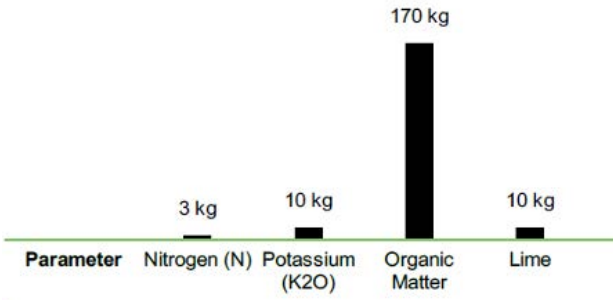

Figure 7: Quantities of the actual nutrient needed for the soil fertility maintenance (example).

Nitrogen (N): Nitrogen crop requirement is estimated based on the crop Nitrogen uptake, soil Nitrogen supply, Nitrogen mineralization *(manure/ compost)* and available Nitrogen. Additionally, the results are corrected according to nutrient losses due to leaching.

Phosphorus (P): The recommendations for this parameter also follows the nutrient balance approach, combining crop nutrient requirements with the actual soil analysis results. For the NPK App, Phosphorus total is used for the assessment of the actual nutrient status and to determine a suitable fertilizer advice.

Potassium (K): K-exchangeable is used to assess the soil nutrient status and associated optimum fertilizer dose.

Lime Requirement: Lime recommendation is based on the pH value of the soil. Its requirement is based on a top soil layer of 20 cm and is expressed in Kg agricultural lime. Liming is only required when the soil pH is lower than the optimum pH required by the crop.

Compost Requirement: Compost is required to balance the decomposition of the soil organic matter in the soil. The recommendations for organic matter are based on the organic carbon measurements made by the soil scanner. If the carbon is below the optimum level of 17% of the recommended compost, the natural decomposition is counter balanced and organic carbon is added to increase the organic matter on the long term.

4.5. Soil Correction Plan (Fertilizer Recommendations)

This section of the report shows a detailed fertilizer management advice that is based on the actual nutrient need. It provides insights on the possible alternatives of fertilizer applications to achieve the desired crop yield and to maintain an adequate soil fertility level. The recommendations are based on the result of the soil sample analysis and the nutrient requirement of the selected crops. Possible recommendations are calculated and presented in three options which are: best option, first alternative and second alternative. The best option consists of a combination of fertilizers that match the macro- and micro-nutrient requirements as good as possible. The first and second alternative advice does not consider the micronutrient requirement but rather advises basic fertilizer products that are available anywhere *(in the current Scanner advice only macronutrients are measured and considered for the recommendation).* The fertilizer combinations are based on the fertilizer products available in the region and the list of fertilizers can be adjusted to region specific availability.

Soil Correction Plan

	Activities	Instructions	Best Option	First Alternative	Second Alternative
1	Before Planting	If Available	50 kg Agricultural Lime		
2	Before Planting	If Available	166 kg Compost or Animal Manure		
3	At Planting	Place the fertiliser at the bottom of the planting holes, put 10 cm of soil on top, add the seed and cover the seed with soil.	18 kg SOP and 5 kg Urea	18 kg SOP and 10 kg CAN	4 kg DAP and 17 kg MOP

Figure 8: Example of the Soil correction plan

4.6. Suitable Crop Type

This section shows the list of the suitable crops which can be grown on the analysed soil based on the pH result.

The green smileys indicate crop suitability and the red smileys indicate difficulty for growing certain crops without any soil correction.

Suitable Crop Types

Figure 9: Suitable crop sections

4.7. Disclaimer

The disclaimer contains the legal rights information on the soil sample collected and analysed.

Disclaimer Scanner

The Analysis Report exclusively relates to the sample presented and examined by the Scanner of AgroCares. AgroCares cannot warrant that the Analysis Report relates to the source of the sample if the sample was not correctly collected. Recommendations and values given in the report provide indicative rates, that are only valid for the sample presented and based on parameters provided by the user. AgroCares strongly recommends that results are only used in the context of classifications; low, adequate, high. Whilst we have taken all reasonable care to ensure that our results are accurate, we have not taken into account other factors that could affect the interpretation of the results. AgroCares accepts no liability for any loss or damage arising directly or indirectly from the use of the report and under no circumstances whatsoever shall be liable for any special, incidental or consequential damages which may arise therefrom. This document cannot be reproduced, except in full, without prior written approval from AgroCares. The recipient of this report agrees to and understands that in the preparation of this report, personal data has been sent to AgroCares in the Netherlands. The recipient further consents to his personal data being collected by AgroCares and by the user of AgroCares technology with whom the recipient entered into an agreement for the preparation of this report, and expressly consents to such personal data being used for research and marketing purposes. The recipient may at all times request access to his personal data or demand that his personal data is removed by contacting AgroCares by email : info@agrocares.com.

Figure 10: Disclaimer and the information that appears in it.

5. Results from the First Three Years of Operation in Mozambique and Zambia

5.1. Number of Soil Samples Collected by Lab ID and Solidaridad Farmer (2019 to end of March 2022)

The following (Figure 17 and table 2) show the number of soil samples collected and analysed since the installation of Kvuno Micro-soil Labs in 2019. Many farmers have since adhered to Kvuno Soil Labs' services and many testimonies of satisfaction have since been heard from the majority of them as they were able to overcome the yield limitations that they had been experiencing for a long time. Since the beginning of the services up to the 31st of March 2022, a total of 6.175 soil samples were collected and analysed successfully. As it can be observed on table 2, out of the total number of soil samples collected and analysed, 1220 of them were collected from the fields belonging to Solidaridad registered farmers. This number corresponds to 19,76% of the overall number. It can also be observed that 4.955 (corresponding to 80, 24%) of the total number of soil samples collected and analysed belonged to other private farmers, university students, agricultural companies and institutions. Figure 18 and table 3 show the same overall results of the soil samples collected and analysed but based on gender distribution and it can be noted that the majority of the land owners are men.

Number of Samples Collected by Lab ID and Solidaridad Farmer ID

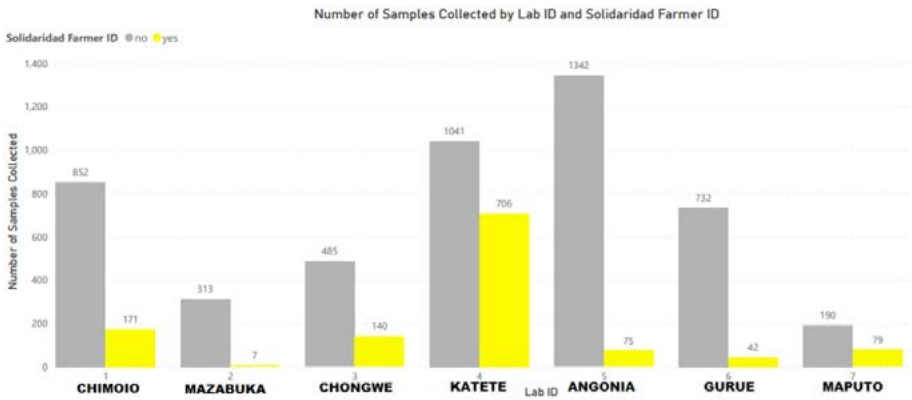

Figure 11: Graph diagram illustrating the overall number of samples collected for Mozambique and Zambia.

Table 2: Number of soil samples collected in the first three years

Soil samples collected and analysed for Solidaridad Registered Farmers	1220	19,76%
Soil samples collected and analysed for Non-Solidaridad Registered Farmers	4955	80,24%
Total Number of Samples Collected and Analysed in Mozambique	**6175**	**100%**

5.5. Number of Soil Samples Collected by Lab ID and Gender

Number of Samples by Lab ID and Gender

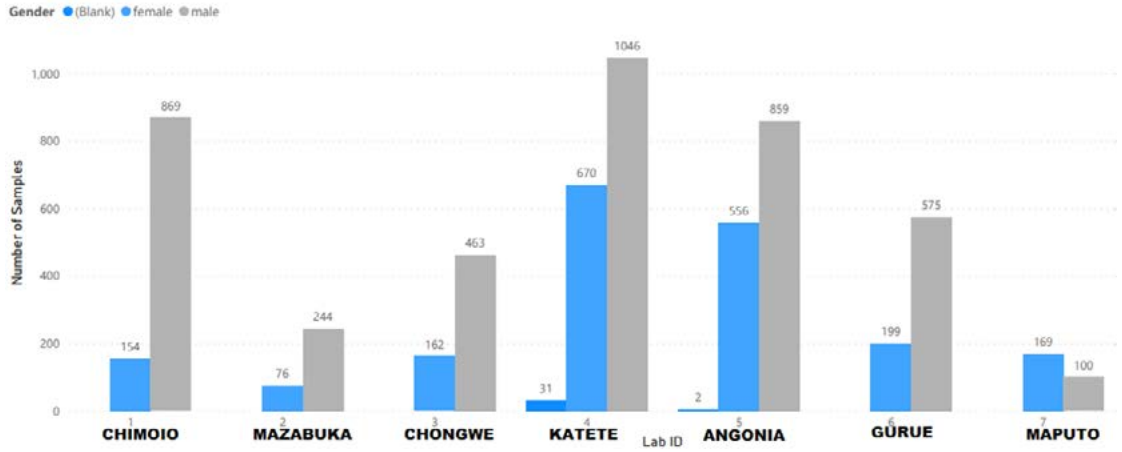

Figure 12: Graph diagram illustrating the overall number of samples collected by gender in Mozambique and Zambia

Table 3: Overall number of samples collected by gender in Mozambique up to the end of 2021

Soil samples analysed (Female farmers)	1986	32,16%
Soil samples analysed (Male farmers)	4156	67,30%
Soil samples analysed (Gender not specified during soil sample collection)	33	0,54%
TOTAL	**6175**	**100%**

6. Conclusion

With the installation of Kvuno Soil Labs in the projects' sites where Solidaridad Southern Africa is implementing its activities in Mozambique and Zambia, local farmers had the opportunity to have their soil analysed enabling them to know the nutrients contained in the soil quickly and easily and to make decisions about how to fertilize the same soils. This marked the beginning of the era of precision agriculture based on soil data to the smallholder farmers fulfilling the dream of the majority of them. The soil analysis report contains various reporting options ranging from the standard nutrient status reports to specific and practical management recommendations which can be easily interpreted. The farmers especially those based in rural areas can now easily know the soil status and actual nutrient need of their fields, including the suitable crop types and also obtain the soil correction plan presenting the fertilizer recommendations. Through the statistical data obtained since 2019 up to the end of the first quarter of 2022 it was clearly noted that the majority of the farmers who adhered to Kvuno Soil Lab services are non-Solidaridad registered farmers and many of the land owners who had their soil analysed were male farmers.

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426 Access to Clean Water and Proper Sanitation as a Fundamental Human Right in Africa

Muyunga Bruno, Uganda

Introduction

While the world is progressing to achieve SDG 6, Africa is unfortunately the only region sliding backwards.

According to research, it is remembered that In 2020, around 387 million people still lacked a basic level of drinking water service, 737 million lacked basic sanitation services (including 197 million who practiced open defecation), and 811 million still lacked or had limited access to basic hygiene services. Around half of schools and health facilities lacked access to proper water and sanitation services (WSS).

Over the past decades, 37 million more Africans were without basic drinking and 247 million more were without basic sanitation, according to research. Significant inequalities also persist between urban and rural regions within countries.

The continent is seeing a fast urbanization trend, with 350 million more Africans living in cities by 2030.

Our water security diagnostics show that by 2050, water scarcity could reduce GDP by 6%. Half of global maternal deaths occur in Africa. Poor water, sanitation, and hygiene (WASH) also lead to increased diarrheal diseases, which is still the leading cause of death in the region, causing more than 8% of child deaths. Having a water source and sanitation facilities at home or close to home is especially beneficial for women and children. Easy access to safe water and sanitation can help safeguard the safety, dignity, and wellbeing of women and girls, who are often at most risk for gender-based violence as they collect water or use sanitation facilities.

Uganda's natural resource base is one of the richest and most diverse in Africa, resulting in the country's economy relying heavily on goods and services so provided. For example, estimates show that gross

returns to the national economy from biodiversity alone can be as high as US$ 63.9 billion per year.

However, water resources are under increasing threat of degradation

as exhibited in reduced quality and quantities in major freshwater bodies. Soil erosion and industrial pollution have reduced surface water quality.

Wetlands are also important for controlling floods, filtering wastes, dry season fishing and livestock grazing, and tourism. They suffer from pollution, conversion to other uses such as agriculture and human settlement. This therefore calls for;

1. Address policy and institutional reforms.
2. Leverage private and partner financing to Build resilience.
3. Prioritize country and regional collaboration platforms.

Looking forward

Sanitation and capacity building training to sensitize people across regions about clean water, and enlighten communities about clean environment.

Establishment of filtered water sources in different communities as a way of improving water and sanitation.

Recommendation

Great outcry for as many partners for future environmental

preservation mostly by the youths who are direct beneficiaries in the now and the near future.

Ensuring campaigns like the "The go green campaign" to motivate and sensitive youths to preserve the environment.

Formation and establishment of an accounting system or team to carryout monitoring and evaluation processes to ensure establishment of these ideas.

CLUSTER

02

The Goals

Theme 01:
A Worldwide Community for Sustainability as the Goal

Theme 02:
Environmental Education for a Sustainable Future

THE GOALS THEME 01

A Worldwide Community for Sustainability as the Goal

Theme Background:

The pursuit of sustainability has transcended the realm of mere environmental concern; it has become a fundamental goal that permeates all aspects of our lives, including education. True sustainability necessitates a holistic approach that not only addresses the environmental aspects but also integrates social, economic, and cultural dimensions. This approach must extend beyond the boundaries of educational institutions to encompass the broader community. Achieving inclusive and holistic sustainability goals requires a paradigm shift—a commitment to 'whole institutional approaches,' global networks, and regional centres of excellence.

EE has evolved into a global movement that began with the objective with diverse interpretations, all rooted in a universal context from a goal to develop a world population that is aware of, and concerned about, the environment and its associated problems..." Belgrade Charter, 1975. Numerous actors, including environmental agencies, educational institutions, teachers, NGOs, and international organisations like the UN, are working towards integrating EE and sustainability perspectives into their activities. Their motivations vary, spanning from individual and organisational change to social learning and global citizenship.

Theme Objectives:

The theme, "A Worldwide Community for Sustainability as the Goal," seeks to discuss and deliberate on:

- How EE and ESD community can integrate sustainability that leaves a lasting impact and minimizes our collective environmental footprint.
- How EE and ESD can contribute to the development of global citizenship through collaborative networks and online learning communities that connect individuals and institutions across borders.

Theme Focus:

Good practices in EE and ESD collaboration among different countries, socioeconomic contexts, and cultures, highlighting the exchange of experiences and the value of diversity in sustainability efforts.

Strategies for building and expanding networks that amplify the efforts of communities to drive effective and sustainable change at local and global levels.

Theme Outcomes:

Highlight the critical role of engaging diverse communities in global sustainability issues.

Theme Conclusions:

Educators, researchers, practitioners, and community leaders contribute to a vital conversation in Abu Dhabi around what it takes to advocate for sustainable and equitable development.

Together, the EE and ESD community will explore innovative approaches, share experiences, and build networks that empower communities worldwide to work towards a sustainable and equitable future for all.

THE GOALS THEME 01

A Worldwide Community for Sustainability as the Goal

Proceedings

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Novice to Normal: Embedding Education for Sustainable Development in Learning and Teaching - the Take 1 Programme as a Whole-School Approach

Valerie Lewis[1]

Abstract

Highlighting the significance of education for sustainable development (ESD) and the importance of its integration into formal and non-formal curricula may appear as another educational hurdle for educators to overcome. This paper presents an overview of the design and implementation of the Take 1 Programme of training, demonstrating a mechanism to embed ESD within the learning and teaching practices of second-level schools in Ireland. The programme showcases a transformative learning approach, empowering educators in recognising ESD as an intrinsic component of learning and teaching, seamlessly interwoven throughout the educational landscape.

The 2030 Agenda for Sustainable Development contained a pledge that "no one will be left behind" (United Nations, 2015, p.1) and while it is seldom disputed in principle, in practice it presents many challenges. Student activism, particularly relating to climate strikes has been evident both in Ireland and globally over the last number of years. Taking to the streets as part of an organised outcry, these young people force us all to reflect on the future of our planet. However, representative does not necessarily mean inclusive, and it is important that all our students in all our classrooms are presented with an opportunity for engagement. This engagement can take many formats and may not necessarily result in strikes or public demonstrations. It is this principle of inclusion and the belief that no one should be left behind, which underpins the basis for the development of the Take 1 Programme.

The Take 1 Programme is a professional learning programme developed from a desire to support senior leaders, middle leaders, and teacher leaders in Irish second-level schools to embed Education for Sustainable Development (ESD) in learning and teaching across the lower second-level school curriculum. The Take 1 Programme was developed on a foundation which acknowledges that the content associated with ESD and Global Citizenship Education (GCE) can be complex and vast. Coupled with the sense of urgency generated around climate anxiety, it can be challenging to know where to begin. While acknowledging the current focus on climate, environmental and biodiversity issues, it promotes the interconnected nature of ESD themes and argues that these current challenges need to be addressed through an integrated and collaborative approach.

The Take 1 Programme uses the Sustainable Development Goals as the conduit for learning and teaching about the many key issues surrounding ESD. The Global Goals were chosen as an appropriate engagement point because of their universality and impact across all facets of society and as a fixed starting point which provides a common framework of reference. This connection between ESD and the SDGs was noted in the UNESCO roadmap (2020) concerning the challenges facing the planet and an exploration of the next steps for response through education –

The criticism that ESD has received for its 'vagueness', which stems in part from its broad and inclusive perspective and the ever-changing nature of sustainability issues, can be addressed more concretely when the field is linked with the SDGs" (UNESCO, 2020, p. 57).

The roadmap considers the merger of ESD, and the SDGs is not only a requirement "but a 'win-win' for both fields" (p.57).

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Policy Landscape in Ireland

Recent developments at educational and national policy level in Ireland have been pivotal not only in informing the development of the Take 1 Programme, but also in highlighting the impactful and integrated nature of ESD. In June of 2022, the collaborative efforts of three government departments with education under their purview, led to the launch of the Second National Strategy on Education for Sustainable Development: ESD to 2030 (Government of Ireland, 2022a). and was accompanied by an Implementation Plan spanning until 2026 (Government of Ireland, 2022b). This comprehensive strategy encompasses all levels of education in Ireland, from early learning and care to tertiary education and research. Moreover, it extends its reach beyond formal education to actively involve local communities and youth groups through lifelong learning endeavours. The strategy notably reflects international standards and approaches, as evidenced by its alignment with UNESCO's Framework for ESD (2019). It delineates five key priority areas: Advancing Policy, Transforming Learning Environments, Building Educator Capacities, Empowering and Mobilising Youth, and Accelerating Local-Level Actions.

Looking at Our School 2022: A Quality Framework for Post-Primary Schools (LAOS) is designed for teachers and school leaders as a framework that provides a shared understanding of what effective and highly effective practices look like in the Irish school system. It provides a unified and coherent set of standards for two dimensions of the work of schools: Learning & Teaching and, Leadership & Management. It is also intended to be used by schools as they participate in the self-evaluation (SSE) process, supporting planning and engagement that is considerate of issues and challenges which have impacted education in recent years. Reflective of greater cohesion across the formal education sector, LAOS highlights the value of students as active agents in their learning who engage purposefully in a wide range of learning activities and respond to learning opportunities. Explicit reference to sustainability has been made in LAOS 2022, and it is reflective of both student capacity as well as values and policies at management level. The lived experience of sustainability is supported by asking that "the school values and promotes a commitment to sustainable development and implements practices and policies that embed the principles of sustainability in the daily routines of the school" (Inspectorate, 2022, p. 38)

Other recent education policy developments at national level are also reflective of a focus on the importance of ESD themes and engagement. In October 2020 the Teaching Council, which is the professional standards body for the teaching profession in Ireland, published updated guidelines setting out the core elements required of Initial Teacher Education (ITE) (Teaching Council of Ireland, 2020). These now include a specific requirement to incorporate GCE (including ESD) as part of all future teacher training programmes. Separately, as part of a broad reform of Senior Cycle education in Ireland a new subject specification for Climate Action and Sustainable Development will be introduced as part of the curriculum (National Council for Curriculum and Assessment, 2023). Commencing on a phased basis from September 2025, participating schools will provide this new subject as one of a suite of subjects offered in local contexts. Finally, a dedicated School Sector Climate Action Mandate was published in September 2023, encouraging schools to include and promote sustainability where possible as part of school leadership.

These developments have been pivotal not only in informing the progress of the Take 1 Programme of training, but also in highlighting the impactful and integrated nature of ESD. The Department of Education in acknowledging the effectiveness of the Programme to date, funds training for all second level school leaders as an action of the Implementation Plan of ESD to 2030, aligned to Priority Action Area 2: Transforming Learning Environments (Government of Ireland, 2022, p. 6). Transforming learning environments represents a whole of institution approach to ESD, creating learning environments where learners learn what they live and live what they learn. The Take 1 Programme objective as part of this Implementation Plan is to develop and support leadership for ESD as part of this National strategy.

Policy to Practice

Despite an explicit reference to sustainability in current policy and strategy documents; Looking at Our School, (Government of Ireland, 2022, School Self Evaluation (Department of Education, 2022); Second National Strategy on ESD: ESD to 2030 (Government of Ireland, 2022), many schools interpret ESD through the lens of climate, environmental and biodiversity issues only, with minimal reference to broader topics such as human rights, diversity, and equality. Where these themes are explored, their alignment to ESD and the United Nations SDGs, including their interdependent nature, is often not referenced.

While policy frameworks and national strategies for ESD implementation are important, the success of embedding sustainability themes in learning and teaching ultimately hinges on teachers' capacity and willingness to integrate them into their professional practice. A 2021 global survey of teacher readiness to engage with ESD themes, identified motivation, skills, and organisational support as key features of preparedness (UNESCO and Education International, 2021). Data indicated that while a significant portion of teachers (95%) (p. 3) believe teaching about sustainability is important, only 25% felt fully prepared to do so.

Business Studies	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Strand 1	Strand 2	Strand 3			
Personal Finance	**Enterprise**	**Our Economy**			
Learning Outcomes	Learning Outcomes	Learning Outcomes			
1.2 Identify and classify sources of income and expenditure, compare options available to best manage financial resources, evaluating the risks associated with each option and making informed and responsible judgements *1.9 Debate the ethical and sustainability issues that arise from their consumption of goods and services and evaluate how they can contribute to sustainable development through consumer behaviour*	*2.2 Describe the skills and characteristics of being enterprising and appreciate the role of an entrepreneur in an organisation, in society and to the economy* *2.5 Investigate the positive and negative impacts on a community of an organisation from an economic, social and environmental perspective*	*3.1 Explain how scarcity of economic resources results in individuals having to make choices; predict possible consequences of these choices* *3.6 Explain how economic growth can impact positively and negatively on society and the environment and justify the promotion of sustainable development* *3.11 Evaluate the benefits and costs of a government economic policy and assess who enjoys the benefits and who bears the costs*			

Source: Lewis, (2023). Take 1 Programme training materials.

Figure 1: SDG Mapping to Learning Outcomes in Business Studies Subject Specification

A key success of the Take 1 Programme is acknowledging the challenges faced in integrating ESD themes in learning and teaching and presenting a 'built-in' approach to engagement. The training aligns with prescribed policy directives and maps to subject syllabus content and curriculum aspirations. The training approach also requires that a member of senior management (principal or deputy principal) must attend the training. The Take 1 Programme training workshop provides participants with an introduction to ESD and the SDGs, resource materials for individual subjects which map the SDGs to learning outcomes and the relevant policy alignment rationale for planning and evaluation. Highlighting examples of how sustainability themes already exist in prescribed subject learning outcomes, whether implicit or explicit, demonstrates not only their embedded nature, but also ensures that teachers do not feel this is additional content in an already overcrowded curriculum.

While the training content of the Take 1 Programme is comprehensive, it concentrates on providing enough information to commence the process of embedding ESD, while also signposting the robust foundation and interconnected nature of the Global Goals. With an emphasis on how the SDGs are mapped to learning outcome in all subject areas the potential for whole school engagement is demonstrated in a flexible and bespoke manner (see Figure 1: example for Business Studies subject specification). This approach also moves action away from being the remit of one or a few 'champion' teachers, who traditionally engaged small cohorts of students in specific activities It additionally ensures that every student, in every subject and every classroom is exposed to the transformative capabilities of education for sustainable development.

The Take 1 Programme training workshop is the start of the ESD journey at individual and school level. The information and resources offered at each session provide a toolkit of knowledge which builds the capacity of educators to facilitate students' transition to sustainable ways of life. "In order to guide and empower learners, educators themselves need to be empowered and equipped with the knowledge, skills, values and behaviours that are required for this transition" (UNESCO, 2020, p.30). Participants are encouraged to share their learning, both with their teacher colleagues and students, and to seek an opportunity to put that learning into action. Schools are encouraged to engage in professional collaboration, both through sharing initial resource materials and by working collectively using a whole-school approach. One of the many strengths of the Take 1 Programme is that it is inclusive of all learners. As engagement is mapped to learning outcomes, no subject specific modifications are needed, no adjustment made for gifted or less able learners, nor senior or junior student. Learning and teaching about ESD and the SDGs, and their relevance to contemporary subject content, occurs as and when relevant subject content alignment appears. Individual teaching plans do not need to be adjusted or amended as teachers reference sustainability in an inbuilt and streamlined manner.

While it is emphasised that Take 1 Programme engagement is not time bound, two national show casing opportunities are coordinated, which offer schools, teachers, and students an opportunity to share their ESD activities. These showcasing events usually follow a training workshop and are presented as a platform to encourage participants to work towards putting their own learning into practice. Where schools have little or no previous engagement with ESD these events offer a chance to launch or commence actions. Where schools have a more embedded approach, these occasions offer an opportunity to reenergise and celebrate existing actions and activities.

Take 1 Week takes place during the second half of November each year. Teachers are asked to Teach 1 Lesson, about 1 SDG, to 1 Class Group at any point in their regular timetable of classes (Figure 2 – Take 1 Week promotional poster). This is a minimum engagement and teacher are free to do more should the opportunity arise. They are encouraged to work within their planned scheme of work, with no requirement to pause or amend regular activities or content, an approach which emphasises the permeated nature of ESD in subject content and curriculum. Additionally, if whole school participation can be encouraged, students are potentially exposed to numerous

Figure 2: Promotional poster for Take 1 Week 2024

experiences of learning about ESD throughout the school environment, as they move from subject to subject and classroom to classroom. Not only does this approach demonstrate the broad interdependent nature of sustainability and global citizenship issues to students, but it also highlights their imprint on all subject matter and establishes a collaborative example of communities of practice. A second episode of engagement occurs annually in early May (May Day for Sustainability) which is a focused single day of celebration of ESD engagement. Activities are shared on social media using aligned hashtags which showcase and celebrate all activities (#take1week #take1mayday)

The benefits of the Take 1 Programme approach are many: demonstrating ESD concepts as an embedded construct, interwoven throughout the learning; exposing all students in the class group to ESD learning; and demonstrating that ESD is the remit of all subjects, moving away from a siloed and subject specific approach. Additionally, the methodology responds to students' concerns and entitlement to learning about and for sustainability, while also allowing each school to move forward in a way that acknowledges their own needs and contexts. It has been evidenced that incorporating ESD into existing curricula helps improve students' quantitative reasoning and scientific understanding and enables them to apply their critical thinking abilities and problem-solving skills to the multifaceted and complex issues of global sustainability (United Nations, 2015).

Conclusion

Embedding ESD in learning and teaching has proved challenging and research undertaken over the last two decades has proposed many collective and individual explanations. Competition for time in an already overcrowded curriculum tends to relegate ESD to an elective position (Ballantyne, 1995) and despite its visibility and presence in the Junior Cycle Framework (Inspectorate, 2022), manifesting it as more than light touch can seem elusive. We must move away from the notion that ESD and teaching about the SDGs is only the remit of the teacher educator with expertise in sustainability. Learning and teaching about and for sustainable development across a range of disciplines communicates that sustainable development is essentially a collective endeavour for schools and wider society, whether in formal, non-formal or informal learning spaces. We must also apply that collective endeavour across the spectrum of global goals. While SDG 13 (Climate Action), including environmental education and biodiversity seem to be the sustainable priorities of the moment, it may be more productive to operate a broader perspective.

The 2030 Agenda for Sustainable Development contains a pledge that "no one will be left behind" and it is this mission of inclusivity, which should remain the singular focus for success. Should we wish to promote a champion for this aspiration it might be worth a closer look at the text aligned to SDG 17, which emphasises a systems thinking approach - policy, coherence, planning, and a desire to revitalize the Global Partnership for Sustainable Development (United Nations, 2015). The Take 1 Programme echoes many of

these aspirations, reflecting national education policies, coherence with prescribed curriculum, and an alignment to recommended planning and assessment frameworks. However, it is its capacity for collaborative engagement and transformational learning, which is its highest aspiration, demonstrating how ESD connects us, from classroom to classroom, throughout the school, and into the wider community, in a hopeful demonstration of a more sustainable future for all.

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Building a Decade of Ecosystem Restoration Education on a Solid Foundation: The Abu Dhabi Regional Centre of Expertise on Education for Sustainable Development (RCE)

Richard J. O'B., Perry[1]

Abstract

In response to the United Nations' Environment Programme Decade of Ecosystem Restoration Education Challenge 6.3 – "create interactive ecosystem restoration curricula for youth aged 10–16 and 16+"; Environment Agency – Abu Dhabi proposed establishing a Regional Centre of Expertise on Education for Sustainable Development. The 12th World Environmental Education Congress provided an opportunity to socialise ideas for the RCE with peers in a dedicated workshop session. This paper outlines the proposed foundations for the establishment of the RCE in Abu Dhabi.

Introduction

Education for Sustainable Development (ESD) has long been recognised as a pivotal driver in fostering a sustainable future (UNEP, 1978; Palmer, 1988; UNESCO, 1997). As we implement lessons learnt from the United Nations Decade of Education for Sustainable Development (2005–2014) (UNESCO, 2014) through the Global Action Plan (GAP) on ESD (UNESCO, 2014) and the ESD for 2030 framework (UNESCO, 2020), we move into the UN Decade on Ecosystem Restoration (2021–2030) (UNEP, 2023), where the integration of sustainability principles into educational frameworks has become increasingly important.

The UN designates specific days, weeks, years, and decades to mark particular events or topics in order to promote through awareness and action, the objectives of the Organisation. To this end, the UN declared 2005–2014 as the 'Decade of Education for Sustainable Development' (DESD) and 2021–2030 as 'Decade of Ecosystem Restoration' (DER).

This paper describes the Abu Dhabi ICE principles for ESD that were developed as part of the activities for the Decade of Education for Sustainable Development, and the proposed responses identified under the 'Action Plan for the UN Decade on Ecosystem Restoration, 2021-2030', and more specifically: 'Restoration Challenge 6 – Education.

Decade of Ecosystem Restoration

Building on the Decade of Education for Sustainable Development (DESD) that integrated sustainability principles into learning environments globally, the current UN Decade on Ecosystem Restoration (2021–2030) (DER) aims to mobilise efforts to restore degraded ecosystems and enhance biodiversity, while at the same time recognising the importance of education through Challenge 6 of the action plan (UNEP, 2023).

Abdul-Majeid Haddad, Deputy Regional Director, UN Environment Programme (UNEP), West Asia Office provided the workshop delegates with background information regarding the DER, setting the scene and providing guidance on the goals of the DER, which are:

"The vision for the UN Decade is a world where – for the health and wellbeing of all life on Earth and that of future generations – the relationship between humans and nature has been restored, where the area of healthy ecosystems is increasing, and where ecosystem loss, fragmentation and degradation has been ended.

Keywords: SDG, ecosystem restoration education, environmental education

(1) Environment Agency - Abu Dhabi, United Arab Emirates

Three main goals underpin the vision of the UN Decade's Strategy:

***Goal 1:** Enhancing global, regional, national, and local commitments and actions to prevent, halt and reverse the degradation of ecosystems.*

***Goal 2:** Increasing our understanding of the multiple benefits of successful ecosystem restoration.*

***Goal 3:** Applying this knowledge in our education systems and within all public and private sector decision-making.*

By achieving these goals, the UN Decade will assist societies globally to embark on a new ecological, economic, and social trajectory throughout the 21st century and beyond" (UNEP, 2023).

Within the UN Action Plan for the DER, several challenges are highlighted. Challenge 6 – Education for Ecosystem Restoration underscores the evolving nature of global sustainability efforts, creating a powerful synergy by merging educational advancements with urgent restoration needs. More specifically, Challenge 6.3 seeks to empower Generation Restoration through an interactive Ecosystem Restoration Curriculum for youth between 10-16 and 16+ years.

This shift in focus from ESD to ecosystem restoration speaks to the debate between Jickling and Wals, reminding us of the importance of not losing touch with nature and of the power of systems thinking (Jickling & Wals, 2012).

The DER emphasises the interconnectedness of education and environmental action. By embedding restoration principles into educational frameworks, we can cultivate a generation dedicated to restoring and protecting our planet's ecosystems, supporting both immediate and long-term sustainability goals.

Regional Centre of Expertise

In response to Challenge 6.3, the Environment Agency – Abu Dhabi (EAD) seeks to establish a Regional Centre of Expertise on Education for Sustainable Development (RCE) in Abu Dhabi. RCEs, according to the RCE Network, "are not a physical centre or building, but rather a network of individuals, organisations and experts who are committed to using education as a tool for building a sustainable future. ..." (RCENetwork, 2024).

RCEs are regionally based, and members bring in-depth knowledge of the challenges facing their regions. Each RCE's portfolio of activities is unique, with RCEs working closely with universities, schools and informal learning institutions, such as museums, parks, private businesses, local governments and organisations, NGOs and the media, to ensure that sustainability issues are integrated into all formal curricula and informal learning processes.

In addition to the best practices, knowledge and expertise from within EAD and its partners in ecosystem restoration, EAD will leverage the solid foundations of the DESD that have been encapsulated in the 11 Abu Dhabi ICE principles (see Appendix One - Abu Dhabi ICE Principles) as the basis for a curriculum for ecosystem restoration education that will be promulgated through the Abu Dhabi RCE.

Abu Dhabi ICE Principles

A decade prior to the 12th World Environmental Education Congress (WEEC2024), several hundred delegates attended an International Forum "Educating for Sustainability", also held in Abu Dhabi, UAE. A key outcome of which was the following list of 11 principles for ESD, grouped into the following 3 categories (hence the term ICE Principles):

Inspiring

1. Educating for Sustainability should catalyse change
2. Educating for Sustainability should challenge
3. Educating for Sustainability should be adaptive
4. Educating for Sustainability needs a framework

Connecting

5. Educating for Sustainability should embrace a systems approach to learning
6. Educating for Sustainability should encourage a sense of place
7. Educating for Sustainability needs to embrace balanced values
8. Educating for Sustainability should be experiential

Encompassing

9. Educating for Sustainability must be a life-long process
10. Educating for Sustainability must be integrative
11. Educating for Sustainability must be inclusive

The workshop held at the 12th WEEC reviewed the Abu Dhabi ICE principles to see if they were still valid as principles for the ecosystem restoration *curriculum* to be developed.

The workshop discussed ESD in general rather than technical details ecosystem restoration education, as the focus was on ensuring the principles and foundation of the education for ecosystem restoration were sound. During the actual curriculum development ecosystem restoration expertise will provide the technical content while the ICE principles will help to ensure the effectiveness of the *curriculum*.

Conclusion

The 11 ICE principles still stand as a solid foundation upon which to develop the ecosystem restoration *curriculum*. Given, their fairly high-level generic nature, this is not surprising. There will of course be a suite of ecosystem restoration best practices and science driven content that will need to be developed for the *curriculum* but in terms of over-arching principles, the Abu Dhabi ICE Principles offer a good start to ensuring the effectiveness of the curriculum to be developed.

During the workshop it was noted that accountability through monitoring and reporting was an important element for determining the success of any ESD endeavour and this will be borne in mind during the development of the *curriculum*.

Appendix One - Abu Dhabi ICE Principles

On 10th February 2014, ~350 delegates attended the International Forum "Educating for Sustainability", in Abu Dhabi, UAE. The speakers (in order of appearance) were:

- Fozeya Al Mahmoud
- Humaid Abdullah
- Dr Richard Perry
- Prof. David Orr
- Prof. Gunter Pauli
- Prof. Arjen Wals
- Mahesh Pradhan
- Dr Pamela Puntenney
- Cam Mackenzie
- Judy Braus
- Kartekeya Sarabhai

The outcome of the forum was that for education for sustainability to be transformative, then the following 11 principles, called the Abu Dhabi **ICE principles**, should be borne in mind.

Inspiring

12. **Educating for Sustainability should catalyse change**—to be genuinely effective, Educating for Sustainability needs to make a difference. This may well require a radically different approach towards reaching the hearts and minds of learners. It may well require extensive capacity-building amongst those entrusted to teach the rest of us how to live on this planet sustainably.
13. **Educating for Sustainability should challenge**—it is essential to capitalise upon the drive that challenge can bring. Enthusiasm and creativity are often best expressed when provided opportunity through a challenge. The challenge is to question, inspire and stretch ourselves and others to dream up creative, innovative solutions to the issues of sustainability.
14. **Educating for Sustainability should be adaptive**—not only to the context of its teaching but also to new ideas and technologies as well as the re-discovery of old technologies. Freshness and relevance in teaching help to reach the learner and inspire action. The environment is constantly changing, and education needs to be ready to change and educate how to deal with change.

15. **Educating for Sustainability needs a framework—**it is essential that education for sustainability has focus and direction. These come from the structure provided by a policy framework that can direct and inspire practitioners. In addition, such a framework facilitates coordination, leverages resources for, and focuses effort upon, areas of most significant concern, thereby ensuring efficiency of action.

Connecting

16. **Educating for Sustainability should embrace a systems approach to learning**—such an approach fosters a better understanding of interconnectivity and dependencies. A holistic understanding encourages the comprehensive design of solutions as well as enhanced critical decision making. We need to understand the consequences of action or inaction. The constraints of planet Earth push us to find better ways to utilise limited resources to avoid overstressing the systems upon which we rely for our very survival.

17. **Educating for Sustainability should encourage a sense of place**—this is vital. A "sense of place" within us all embeds theory within reality, garners a deeper understanding of the concepts of sustainability and a greater sense of stewardship and empowerment to work towards a sustainable lifestyle.

18. **Educating for Sustainability needs to embrace balanced values**—it is essential to balance the values espoused when educating for sustainable development. Balanced values strengthen inclusivity and integration and help to draw from historical wisdom and experience. In addition, there is a diversity of values from sources such as culture or religion, amongst others, that can play an essential part in ensuring a balanced, equitable and ultimately sustainable world.

19. **Educating for Sustainability should be experiential**—it is essential for reinforcing the lesson that environmental education is experience-based. Reflective, critical thinking based upon experience brings the message home very powerfully. Furthermore, it inspires positive action as the learner most readily associates with the impacts of the activity.

Encompassing

20. **Educating for Sustainability must be a life-long process**—the precepts of sustainability must be taught and understood by all, from the earliest age right up to adulthood. Humankind, to survive, needs fresh perspectives on how to live sustainably, and from the World's Leaders wise decisions based upon sound principles.

21. **Educating for Sustainability must be integrative**—the precepts of sustainability must be integrated across curricula, interwoven into the very fabric of our existence, and embedded as a way of life for all.

22. **Educating for Sustainability must be inclusive**—it is vitally important that education for sustainability is inclusive of all sectors of society. We all have a part to play in determining our future on this planet, from children, teachers, parents, the community at large to businesses and leaders. We all need to engage by caring for ourselves and each other, working together to achieve sustainability.

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490 Outdoor and Place-based Learning in the Decade of Ecosystem Restoration

Anita Saul[(1)]

Abstract

The UN Decade on Ecosystem Restoration launched in 2021, aims to prevent, halt and reverse the degradation of ecosystems across the world, on land and in the sea. This could help end poverty, diminish the effects of climate change and avert mass extinction of species. (UN Decade on Ecosystem Restoration website)[2]. In order to make all this possible, each one of us has a vital role to play. Nature-based outdoor environment education provides an appropriate base for creating and connecting responsible individuals who keenly feel the necessity of creating a sustainable tomorrow.

Unless we learn how to connect with nature and experience its positive impacts on our lives, we cannot be passionate about caring for nature or be truly concerned about the threats it is faced with. A person's inherent connection to nature can best be nurtured during the pivotal learning years in school and this is best achieved through an amalgamation of outdoor learning with classroom curriculum. Outdoor learning fosters exploration, independent problem-solving and critical thinking. It also offers children a chance to develop relationships, empathy and respect for others as well as the natural world.

As the world struggles to strive past the COVID 19 crisis, where young learners had been forced into sedentary indoor learning styles, nature-based outdoor learning in contrast, develops motor skills through physical activity and helps counteract the challenging effects of prolonged screen time, like aggression and depression. It also provides opportunities for socio-emotional development and team building. (Wilson, 2015)[3].

Researchers have found that children playing in green spaces tend to cooperate more and engage in more creative forms of play. (Bell & Dyment, 2006)[4] Outdoor settings moreover, offer dynamic environments which provide constant new stimuli to support learning.

Place-integrated learning enables students to experientially study biodiversity and the adaptations made by the flora and fauna to survive in their respective habitats. In the United Arab Emirates, for example, the Environment Agency of Abu Dhabi organizes and supports field trips for students to natural habitats like mangroves, deserts and beaches and also conservation sites for the Houbara, Arabian Oryx and Hawksbill Turtle. The Agency provides resource books to schools, outlining interesting outdoor learning activities and guidelines to identify plants, insects, mammals, reptiles and birds of particular habitats. Students learn to connect and engage in research-oriented projects while exploring these natural ecosystems.[5] Outdoor learning within environmental education generates a life-long effect in turning young learners into active and responsible citizens capable of bringing constructive changes to the environment later in life. (Mayer and Frantz, 2014)[6] Being in nature and visualising the consequences of climate change on our fragile ecosystems, allows learners to gauge the extent of human impact on the natural world and equips them with important skills to solve issues that affect the environment adversely.

In this decade of environment restoration, outdoor education makes learning an enlightening experience and helps hone skills and attitudes which we urgently need to restore vanishing habitats and sustain our vibrant planet.

Keywords: ecosystem, outdoor, restoration

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(2) https://www.onep.org

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550 Local Adaptation and Facilitation of Global Online Courses for Environmental Educators

Bomyung SEO (1)

In an increasingly interconnected world, the role of environmental education is more crucial than ever. Cornell University has been at the forefront of advancing this cause through its global online courses. These courses, which draw 500 to 1,000 participants each, are designed to foster social learning, create new knowledge, and engage learners in research-based education. With a comprehensive curriculum that includes webinars, discussions, case studies, and other interactive methods, Cornell's offerings such as "Introduction to EE," "EE and Community Engagement," "Climate Action," "E-STEM Education," "Urban EE," "EE Outcomes," and "Nature Education" are paving the way for a new generation of environmental educators.

As part of a global initiative to localize and enhance the impact of these courses, RCE Tongyeong, a key player in the Asia-Pacific region, has joined forces with Cornell University.

An RCE, or Regional Centre of Expertise, is a network of formal, non-formal, and informal organizations dedicated to promoting sustainable development through education within local and regional communities. The global network of RCEs serves as a Global Learning Space for Sustainable Development, integrating various stakeholders to achieve shared goals.

RCEs are grounded in four core elements:

1. **Governance:** Effective management and leadership structures are crucial for the successful operation of RCEs. This involves coordinating activities and ensuring that the RCE's mission aligns with local, regional, and global sustainability goals.
2. **Collaboration:** RCEs engage actors from all levels of education—formal, non-formal, and informal. This collaboration enhances the reach and impact of sustainability initiatives, ensuring that diverse perspectives are incorporated into the learning process.
3. **Research and Development:** Research is a cornerstone of RCE activities, contributing to the design of collaborative strategies and the development of innovative solutions for sustainable development. By integrating research with practical action, RCEs ensure that their activities are grounded in evidence-based practices.
4. **Transformative Education:** RCEs aim to transform existing education and training systems to better meet the demands of sustainable living and livelihoods. This involves not only teaching about sustainability but also embedding sustainable practices within the educational institutions themselves.

RCE Tongyeong, established in 2005, has been a driving force in spreading the message of ESD (Education for Sustainable Development) across the Asia-Pacific region. In 2010, RCE Tongyeong launched the Tongyeong Education Foundation for Sustainable Development, further solidifying its commitment to the cause. In 2015, the foundation opened Sejahtera Forest, the first ESD-specialized education institute in the region, providing a platform for promoting ESD and strengthening the RCE network.

As a member of the Key Partner network of UNESCO's Global Action Programme on ESD, RCE Tongyeong has been instrumental in activating ESD networks, strengthening lifelong learning for ESD, and spreading the principles of sustainable development throughout the Asia-Pacific region. By collaborating with schools, youth, administrative bodies, and civil organizations, RCE Tongyeong has created a robust ecosystem for ESD.

(1) Senior Programme Designer, RCE Tongyeong

The collaboration between Cornell University and RCE Tongyeong exemplifies the power of local adaptation in global education initiatives. By leveraging local expertise and networks, RCE Tongyeong has been able to tailor Cornell's global online courses to better meet the needs of environmental educators in the Asia-Pacific region. This partnership not only enhances the quality and relevance of the courses but also ensures that the knowledge and skills imparted are deeply rooted in local contexts.

The partnership between Cornell University and RCE Tongyeong demonstrates the potential of global-local collaborations in advancing environmental education. By integrating global knowledge with local expertise, these initiatives can create a powerful force for change, equipping educators with the tools they need to build a more sustainable future. As the world continues to grapple with complex environmental challenges, such collaborations will be essential in ensuring that education for sustainable development remains at the forefront of global efforts.

In the quest to make environmental education accessible and impactful across the globe, Cornell University has been offering a series of online courses designed to equip educators with the tools and knowledge they need to address pressing environmental issues. However, as these courses have attracted participants from diverse cultural and linguistic backgrounds, certain challenges have emerged. Two key insights have surfaced: Cornell University's commitment to inclusivity—"We aim to make our courses more inclusive for all educators"—and a common concern among Korean participants—"I'd like to participate in a global course, but I'm facing a language barrier." These insights highlight the need for a more tailored approach to make these courses accessible to non-English-speaking participants.

To address these challenges, RCE Tongyeong has developed a Local Facilitation Model that adapts Cornell University's global online courses to better serve Korean educators. This model revolves around three key components: Contextual Adaptation, building a Learning Community, and Enhancing Instructor Presence.

Contextual Adaptation

The first step in making global online courses more accessible to Korean participants is contextual adaptation. This involves translating course materials into Korean, which allows participants to fully engage with the content without the hindrance of a language barrier. By providing translations, participants can focus on the subject matter rather than struggling to understand the language.

In addition to translation, RCE Tongyeong has integrated the use of familiar digital platforms such as KakaoTalk and Notion, which are widely used in Korea. This ensures that participants can easily navigate the course content and communicate with their peers and instructors using tools they are comfortable with. Furthermore, the model allows for flexibility in submitting final assignments, which can be done in either Korean or English. This dual-language option acknowledges the varying levels of English proficiency among participants and ensures that language does not become a barrier to showcasing their knowledge and skills.

Building a Learning Community

A crucial aspect of the Local Facilitation Model is fostering a sense of community among Korean participants. RCE Tongyeong has facilitated this by organizing frequent online meetings, including orientation sessions, office hours, and collaborative work on final projects. These meetings provide participants with opportunities to interact with one another, discuss course content, and seek guidance on their assignments.

To further support this learning community, a supportive environment has been cultivated through instant messaging on platforms like KakaoTalk, where participants can quickly ask questions, share insights, and collaborate on assignments. Live discussions, held periodically, also give participants the chance to engage in real-time dialogue, deepening their understanding of the course material and reinforcing their sense of belonging within the learning community.

Enhancing Instructor Presence

Recognizing the importance of instructor presence in online learning, the Local Facilitation Model incorporates English/Korean-speaking teaching assistants (TAs) to bridge the gap between the global course instructors and Korean participants. These TAs play a pivotal role in facilitating learning activities, guiding participants through complex topics, and providing support as needed.

The TAs, who volunteer their time and expertise, are not only bilingual but also familiar with both the global course content and the local context in which the participants are situated. This dual understanding allows them to effectively assist participants in navigating the course, clarifying doubts, and ensuring that everyone remains on track. Their presence makes the learning experience more interactive and personalized, helping participants overcome any challenges they may face during the course.

Conclusion

The Local Facilitation Model developed by RCE Tongyeong exemplifies how global online courses can be adapted to meet the needs of diverse participant groups. By addressing language barriers through contextual adaptation, fostering a strong learning community, and enhancing instructor presence, this model ensures that Korean educators can fully benefit from Cornell University's environmental education courses.

As the world continues to grapple with complex environmental challenges, it is essential that educational opportunities are accessible to all. The Local Facilitation Model not only enhances inclusivity but also empowers educators to contribute more effectively to sustainable development in their communities. Through continued collaboration and innovation, the barriers to global education can be overcome, paving the way for a more inclusive and effective learning experience for all.

654 Towards Meaningful Engagement of Youth in SDGs Processes

Miki Fukuda[1]

Abstract

In many countries, young people are vital to advancing the sustainability agenda. However, the degree to which youth meaningfully participate in Sustainable Development Goals (SDGs) processes varies across countries. This study investigates the mechanisms that facilitate youth participation in SDG implementation. The research aims to uncover the key factors essential for effective youth engagement at the national level through a comparative analysis involving multiple countries in Europe and Asia, including Finland, Denmark, Germany, Japan, and Indonesia.

1. Introduction

At the midway point of the 2030 Agenda, it is becoming evident that we are not on track to achieve the Sustainable Development Goals (SDGs). A definitive course change is needed to accelerate SDG progress, which could be accomplished by engaging multiple diverse stakeholders. Among them, much attention has been focused on engaging the next generation—youth.

Youth participation has been a requirement of intergovernmental agreements since the adoption of the UN Convention on the Rights of the Child in 1989, which underlined their rights to express their views and opinions in the decisions that affect them (UN General Assembly, 1989). Young people are now recognized as essential to advancing the environment and sustainability agenda by their innovative ideas.

The importance of young people's involvement in the SDG process is gaining recognition at global and national levels. However, creating spaces for nominal participation is not enough. It is also important to focus on the elements that enable their engagement to be effective.

Since SDG implementation is mainly led at national levels, this research explores how countries can design mechanisms that enable young people to engage meaningfully in sustainability. To identify such elements, this research conducted a comparative analysis of five countries: Finland, Denmark, Germany, Japan, and Indonesia.

The paper's reminder is divided into three sections. The first section describes the research procedures, including an analytical framework developed for comparison, which consists of four elements: 1) Aims and Justifications, 2) Power-sharing, 3) Transparency and Accountability, and 4) Support. The second section uses that framework to compare Finland, Denmark, Germany, Japan, and Indonesia. The third section provides a conclusion of this research as well as recommendations for future inquiry.

2. Research Procedures

2.1 Developing an Analytical Framework

A growing number of youth involvement in SDG implementation have been reported; however, most are anecdotal evidence, often without quality analysis. This suggests a critical question: how can countries design mechanisms that enable meaningful youth engagement? Learning across countries is beneficial for improving the quality of youth engagement practices; however, little research has been done to compare how youth engage in sustainability processes.

Based on the several studies offering some insights into critical characteristics for meaningful youth participation, this research distilled four elements that can be compared across countries as they build mechanisms that encourage young people

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to work on the SDGs: 1) Aims and Justifications, 2) Power sharing, 3) Transparency and Accountability, and 4) Support.

1) **Aims and Justifications:** A clear presentation of the aims and justifications underlying youth involvement is arguably essential for meaningful youth participation. The need for such a clear presentation stems from young people's right to participate and express their views and opinions freely in all matters affecting them (rights). In so doing, they can offer suggestions that can help improve policies and services (Bárta *et al.*, 2021; Farthing, 2015; Lansdown, 2019).
2) **Power sharing:** Young people can initiate activities and make decisions independently. They are also considered capable, and their views are respected. Engagement mechanisms may aim to position young people as equal partners to improve the situation. This sentiment aligns well with the partnership principle of Agenda 2030 (Checkoway, 2011; Cockburn, 2001; Hart, 2013).
3) **Transparency and Accountability:** With open communication channels, young people can be well-informed about the issues and the roles they are expected to play along with other stakeholders. A possible, desirable side effect of transparency is strengthening accountability. That is, transparency around the SDGs will help allow decision-makers and young people to be held accountable for their commitments and actions (Fletcher, 2005; Kellett, 2009).
4) **Support:** Young people may need support to safely and continuously participate regardless of background, status, or identity. Such support includes but is not limited to, financial assistance for travel and accommodations, economic incentives, psychological and mentorship assistance, and learning and capacity development opportunities. The above needs are embedded in the No One Left Behind principles of SDGs, which call for support for people who are most vulnerable and excluded (Farthing, 2015; Ndayala & Kuya, 2016; Van Reeuwijk, 2018).

The above four key elements are selected because they are viewed as core components of meaningful youth participation while aligning with principles underpinning the SDGs. Using this framework, the next chapter of this paper will analyze youth participation mechanisms or activities in the SDGs implementation in five different countries.

2.2 Case Selection and Methods

Before proceeding to the results, this section will provide an overview of the selected countries and their corpus, as well as the methods. The four elements described above will be used to compare youth engagement mechanisms in five different countries. To analyze SDG implementation and youth engagement across countries,

The selection of five countries, Finland, Denmark, Germany, Japan, and Indonesia, were chosen as they performed relatively well in the Sustainable Development Solutions Network (SDSN) in the European and Asia regions. Also, they follow a similar reporting cycle of Voluntary National Reviews (VNRs), through which countries assess and present national progress made in SDG implementation.[2] This research used the latest version of the VNRs of each country for comparison, as summarized in Table 1. The text analysis was conducted on the youth-related SDG policies, programs, initiatives, and youth engagement patterns from the documents of respective countries.

(2) As part of its follow-up and review mechanism, the 2030 Agenda encourages Member States to "conduct regular and inclusive reviews of progress at the national and sub-national levels, which are country-led and country-driven" (para 79). The nationally developed VNRs serve as the basis for the annually conducted High-Level Political Forum (HLPF).

Table 1: SDGs-related Documents Included in the Analysis

Country	Reviewed Document	VNR Cycle
Finland (SDSN 2023 #1)	Report on the Implementation of the 2030 Agenda for Sustainable Development (2020)	2016, 2020
Denmark (SDSN 2023 #3)	Voluntary National Review 2021	2017, 2021
Germany (SDSN 2023 #4	Report on the implementation of the 2030 Agenda for Sustainable Development, German Voluntary National Review to the HLPF 2021	2016, 2021
Japan (SDSN 2023 #21)	Report on the implementation of 2030 Agenda ~Toward achieving the SDGs in the post-COVID19 era~ (2021)	2017, 2021
Indonesia (SDSN 2023 #75)	Indonesia's Voluntary National Review (VNR) 2021 Sustainable and Resilient Recovery from the COVID-19 Pandemic for the Achievement of the 2030 Agenda	2017, 2019, 2021

(Source: developed by author)

3. Results

As noted in the previous section, the text analysis on the latest VNRs of the respective countries was conducted to understand the different mechanisms employed in Finland, Denmark, Germany, Japan, and Indonesia. By all means, all selected countries acknowledge the importance of engaging young people in SDG implementation processes with some examples. Popular activities listed were thematic consultations, inviting youth to input on VNR development, awareness-raising, education (capacity development), and volunteer activities involving youth. However, how they framed youth slightly differed from country to country; for instance, Denmark and Indonesia touch upon youth participation with the SDGs' Leave No One Behind principle. Still, Japan and Germany integrate youth participation within the educational context. Following the above summary, the subsequent subsections will provide information on each country's cases.

3.1 Finland

Finland established a mechanism called the "Agenda 2030 Youth Group," established in 2017 under the initiative of then Vice-Chair of the National Commission on Sustainable Development. It comes up with the explicit aims to include more young people in the decision-making process and public dialogue and inform other young people about the SDGs (Finland Prime Minister's Office, 2020). The group comprises 14 people (15 to 28 years old) trying to represent various backgrounds across countries. According to the report, the members are often invited to high-level meetings, such as drafting the National Sustainable Development Strategy, budgeting, and VNR Preparation. They play active roles in public dialogue, utilizing social media platforms. At the same time, the autonomy in the activities is guaranteed, which led to the organization of the conference entitled "Our Climate 2030." Although more precise explanations may be needed, the Finish National Youth Council, called Alliansi, supports their member recruitment and some coordination with the government (Finland Prime Minister's Office, 2020).

3.2 Denmark

The Danish Youth Council (DUF) contributes to SDG implementation by involving young people in Denmark in many ways. DUF is an umbrella organization that supports and represents youth and youth organizations through education, partnerships, youth involvement, and financial assistance. Not only contributes to dedicating

one chapter on Youth for the VNR, but it also administers the programme for Denmark's Youth Delegates to the United Nations and supports youth-led activities and organizations addressing SDGs. At the same time, it is worth noting that there is a dedicated section recognizing participation by "vulnerable children and young people and child poverty," in which the government aims to "provide assistance and opportunities for youth with disabilities, minority backgrounds, and financial difficulties to realize their potential and participate" (Ministry of Finance, 2021, p. 139). In other words, Denmark considers youth not merely passive recipients of care but equal partners who can provide expertise if adequately supported.

3.3 Germany

Germany also reports several examples related to youth engagement. One item is the UN Youth Delegates for Sustainable Development, which individually developed a position paper in the VNR, providing the perspectives and opinions of future generations. It was focused on gender equality, anti-discrimination, education, and ensuring meaningful youth participation. (annex) Also, the German Federal Youth Council serves as a member organization of Dialogue Group, inviting stakeholders to the preparatory meeting for the State Secretaries' Committee on Sustainable Development since 2018. (The German Federal Government, 2021, p. 73)

The other item is the strong focus and commitment to Education for Sustainable Development (ESD), which aims to enable people to understand the impact of their actions on the world and make responsible, sustainable decisions.

3.4 Japan

Similar to Finland, Japan established the "Next-Generation Platform for Promoting SDGs" in 2018 under the initiatives of the then Prime Minister. The Platform comprises seven diverse Steering Committee Organizations. While the importance of young people is recognized, the launch of Japan's Next-Generation Platform is an excellent example of the government's effort to concretize that vision. However, there is no apparent justification for this initiative. The Platform members are likely working on the activities of each representative organization, but there is no reference to the activities initiated by the Platform itself. Additionally, since 2021, one member has participated in the "SDGs Promotion Round Table" consultations with other adult stakeholders; it does not clearly state to what extent young people can influence the decision-making processes.

Another example is the strengthening of ESD within the renewed National Curriculum Standards, which aims to foster "the builders of a sustainable society" across school education (Government of Japan, 2021, p. 49).

3.5 Indonesia

Indonesia mainly reported three channels involving young people: VNR Preparation, SDG Centers and Campus Ambassadors Project, and Internet-based Inclusive Monitoring and Data Collection. Similar to other countries, Indonesia invited youth organizations to participate in the VNR Preparation consultations. The VNR clearly provides information on the consultations, as well as the youth recommendations and policy response, which contribute to bolstering accountability for SDG implementation (Ministry of National Development Planning & National Development Planning Agency, 2021).

Another initiative is SDG Centers and Campus Ambassadors, which aims to disseminate and promote SDGs on and off campus through related activities. Another unique initiative is Inclusive Monitoring and Data Collection. During the COVID-19 pandemic, the government approached especially vulnerable young groups via the Internet to gain disaggregated data (age, gender, area) for better decision-making (Ministry of National Development Planning & National Development Planning Agency, 2021). As an emerging economy with population expansion, Indonesia still faces challenging situations in collecting robust data. In this context, utilizing citizen-generated data could be of help.

4. Discussion

Young people's involvement in SDG processes is essential, as it is gaining recognition at the highest levels in all five countries. There has been progress in involving youth in the SDGs and related processes, with notable examples of the top-down initiated 2030 Agenda Youth Group in Finland and the Next Generation Platform in Japan. However, there is arguably a need to dig deeper into the actual operations of these mechanisms and determine whether they truly help to support meaningful youth engagement.

Before drawing conclusions based on that table, it should be noted that analyzing stakeholder engagement only within SDG-related documents such as VNRs is an imperfect science; these documents do not consistently fully articulate their goals or outline relevant activities (UNDESA, 2019). In addition, four analytical categories are interrelated and difficult to disentangle. Having said that, the following discussion divides the comparison into four analytical categories for ease of presentation.

1) Aims and Justification: Defining the relevant aims and supporting justifications for participation is essential for engagement to be truly meaningful. The aims and justification for including youth in specific activities are clearer in detail in Finland and Denmark, but others tend to rest chiefly on the need for information sharing and awareness. The more explicit aims and justification would contribute to better efficiency of the decision-making, identifying the appropriate youth and providing an appropriate scheme to hear their opinions. In doing so, there would be a more deliberate effort to engage youth from different locations and social segments so as not to cater to, for example, socio-economically advantaged groups (Feldmann-Wojtachnia *et al.*, 2010)
2) Power Sharing: Like the first element, Finland and Denmark appear to have made more extraordinary efforts to balance power dynamics. To illustrate, young people are regularly invited to participate in high-level sustainable development meetings (Finland) while enjoying the autonomy to initiate their own activities, especially in Denmark. Despite the existence of the Platform, Japan seems to limit the power and autonomy offered to young people, keeping the scope of those activities circumscribed within their respective organizations.
3) Transparency and Accountability: In this context, Indonesia demonstrates a clear commitment to these principles and related practices. This is evident in the reference to the recommendation by youth through the consultation and the government response, which could boost accountability. In other countries, there is a little more scope for improvement in this aspect; Transparency around the SDGs will help hold decision-makers and young people mutually accountable for their commitments and actions.
4) Support: Perhaps all countries could improve their mechanisms and practices to some extent, ensuring varied participation channels to communicate with a broader youth segment and providing adequate compensation, capacity building, and empowerment, especially for underrepresented and vulnerable youth. One good example witnessed in three European countries was the National Youth Councils, which represent and consolidate the voices of youth and youth organizations. In addition, Internet-based data collection utilized in Indonesia, targeting the vulnerable and excluded youth, also lowers the barrier to involving a wider variety of youth.

The above comparison suggests that many governments have tried to engage young people; however, none of the countries have been perfect in any of the criteria. They may need to work more to do so effectively. The analytical framework could help governments and perhaps young stakeholders themselves examine and strengthen the quality of their engagement jointly.

5. Conclusion

At the most general level, participation requires a well-designed set of institutions that continually encourage diverse voices to engage in the public

sphere. Creating these institutions to foster the meaningful involvement of young people in sustainability processes is increasingly considered integral to accelerating progress on the SDGs.

This article investigated the varied practices and mechanisms established in five different countries. It then developed four analytical categories that have been argued to underpin meaningful youth engagement: 1) Aims and Justification, 2) Power Sharing, 3) Transparency and Accountability, and 4) Support. The framework was employed to assess how those countries perform in these areas.

The comparison suggests that many governments have made commendable efforts to engage young people; however, they may need to do more to extend support to involve young people more effectively. Their meaningful engagement can help build intergenerational trust and social cohesion and ensure fresh and forward-looking ideas that inform policies in which youth have strong interests, including education, (un)employment, climate change, and biodiversity loss (United Nations, 2023). Conducting this kind of study would ideally require expanding the number of cases and related assessments of youth engagement mechanisms. Importantly, this study offers a feasible approach for making that comparison.

For future inquiries, there is ample room to delve deeper into the dynamics of youth engagement, accounting for possible reporting gaps, demographic influences, and cultural nuances. This would ultimately advance our understanding of fostering effective youth participation in the SDGs in various contexts.

To achieve the 2030 Agenda and its SDGs, we need to make a collective effort to transcend generational boundaries in the spirit of partnership and solidarity. People from all generations must unite, for it is together that we can truly usher in a brighter and more equitable future.

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Mimicry of Scarcity: Reproducing Shortage as Educational Practice

Elena Bougleux[1]

Abstract

Water molecules are the main actors of a Summer School dedicated to Heritage and Environment realized on board of a boat in navigation, by a community of international and multidisciplinary students and teachers. During the last few years (2022-2024) the narrow spaces of a small wooden gulet have been acting as a floating classroom, meeting point and hostel for all School participants, while the limited spaces, power supply and fresh water available were shared among all. Sharing the scarce resources has represented the core educational texture of the Summer School on board.

0. Premise

It is a difficult educational challenge that of finding a catchy key concept+keyword in Environmental Anthropology able to trigger the interest of students and keep it high and engaged way. I am referring to the lasting continuative interest that lasts longer than the few hours of an academic course, and survives beyond a seasonal campaign. Sometimes it is difficult to maintain the interest and engagement active for even less than a campaign; it is also quite a challenge, on the other hand, to convey feelings of environmental worry and fear in relation to the multiple disasters we are provoking as a specie, and sensibilize about the risks we are running as a planet, without transferring also feelings of fright and anxiety, or even worse, helplessness and despair.

When dealing in the context of environmental education the well-known conceptual couple 'problem-solution' related to crises pervading today all anthropized spaces as well as remote unspoiled hideouts, we simply miss the third convincing conceptual element that would keep the learners' interest high: a credible strategy-out. So the loss of grip on interest and the vanishing long term engagement by students, and by citizens in general, can be read as the easy consequence of a weak conceptual framework: they are a self-defenses.

After many years of intensive labs, cooperative projects and applied papers, I decided to bet on the committing and engaging keyword of 'scarcity': an unusual concept to promote in the educational discourse, and an uneasy concept to handle in the super-prevailing rhetoric of the global north, which strives to defy all kinds of scarcities at whatever level and definition, in all contexts of life and research. Scarcity is unpleasant as we all as intriguing, familiar as well as unknown. The idea of scarcity servers in these pages as conceptual strategy-out and as polysemantic tool: a) rhetoric device, b) material construct, c) provocative descriptor (of objectively rich and dense scenarios, i.e. not scarce at all). Before articulating in details about the three semantic levels of scarcity, let's introduce the space-time location where our mimicry of scarcity unfolded.

1. The context

We are set on the eastern cost of the Adriatic Sea, from the Italian northern end with its historical Venetian legacy to the southern end of present Albania. Running (rather, sailing) down the thousand kilometers of the Adriatic Balkan cost is like making an estranging travel in time: only thirty-five years ago this coastline was entirely following Yugoslavia, nowadays sailing the same way south entails the crossing of four national borders: Slovenia, Croatia, Bosnia and Herzegovina, Croatia again, Montenegro. Among the many historical and political upheavals, the crucial element I want to stress here is the discontinuity in the status of environmental protection affecting this sea, and the variety of meanings attributed to the (anyway vaguely defined) spots known as Marine Protected Areas, MPAs.

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Italy and Slovenia, recently joined in UE by Croatia, necessarily interpret the MPA definition in the framework of UE legislation, despite each country applies such legislation with different limitations and enforce it with different level of control (Carreno and Lloret 2020). Bosnia doesn't really develop any marine regulatory law, while Albania and Montenegro have national local regulations. But sea waters and fish don't respect any border nor acknowledge any marine regulations. The juridical fragmentation in the watery material continuum produces a demoralizing picture of double scarcity for Adriatic sea Marine Protected Areas: scarcity of coherence, scarcity of relevance.

The Mediterranean Sea is crisscrossed every year by 350 million leisure boats (better would be to say every summer); as a pale balancing measure it also hosts 1215 MPAs, almost all of which are small or very small, and scattered along the northern side, i.e. along the European coasts (for a detailed account of the historic evolution of MPAs in the Mediterranean, see MedPAN 2023). Croatia, the main action theatre for the present paper, has dedicated over the 9% of its national territory to natural parks, both terrestrial ad marine, and this farsighted choice played a relevant part in the successful process of joining the UE; but being Croatia so small, the overall extension of the Croatian MPAs is anyway minimal.

In most MPAs across the Adriatic Sea, from the UE protected to the self-managed ones, some form of unregulated fishing is still allowed, and quite often leisure navigation isn't restricted nor regulated either. Leisure navigation is worth a special mention here since paradoxically it is the most environmental impacting: non-professional sailors are the least experienced and unaware of the damage they provoke by simple everyday actions like anchoring, lighting up underwater lights at night, producing unnecessary noises. Considering their numerosity and the difficulty in enforcing small scale control, leisure boats are a major and increasing threat to marine environment. Definitely the Mediterranean Sea MPAs, and in particular the Adriatic ones including those located in the same country, suffer an overall scarcity of surface, and as a consequence a scarcity of effectivity.

Unfortunately, all scarcities mentioned in this paragraph belong to what the 'worst' level of our polysemantic tool, the b) very serious material constructs: as they are materially and undoubtedly there.

2. The Core Concept

The environmental education experience set up in the Cration seas based on the concept-keyword of scarcity consists in a Summer School in navigation, conducted for three years (from 2022 to 2024, wishing to continue every yeas) along former Yugoslavian coasts: always navigating and never docking if not at night, never disembarking if not for fieldwork, especially and above all never using the facilities of marinas.

The choice of the eastern Balkan cost for our location is highly symbolical and entangled with one clear definition of scarcity: the fragmented political picture offered today by the small young countries of former Yugoslavia is a metaphor of a newly achieved condition of (scarcity of) political relevance, and (scarcity of) effectivity in environmental action. The condition of 'small and young county' doesn't represent a limit per se, of course: the constraint on relevance is rather posed by the controversial political relations, causing lack of integration in environmental planning and visions on the future. A persisting centrifugal force is still lingering among once united actors, dramatically reflecting on the sea conservation policies. But despite all such on-land mix-up, the sea still connects the coastlines in the same it did in historical way. Water keeps blending and mixing in a watery scenario what recent history has scattered in pieces. Sea waters luckily resist to this particular production of scarcity.

But actually the production of scarcity from former Yugoslavia young countries expands beyond the sphere of sea regulations: archeological sites in each new nation are, logically, fewer in total numbers and this state of 'archeological scarcity' unfortunately doesn't make any site more relevant nor protected: on the contrary, the lack of an integrated and autonomous archeological narration renders each site an exception, an isolated item, harder to treat and interpreted with

greater difficulty. Scarcity of historical coherent reconstructions of archeological sites isn't surely an issue per se, but scarcity of shared narrations make other elements appear like scarcities: sites are isolated and imaginaries around them are lacking, making them weakly protected, tending to invisibility.

Similar is the case of historical heritage from the recent past of Tito's times, and the XX century in general: when dealing with Yugoslavian memories it is hard to find shared interpretations, each of them reflecting from the polarized perspectives that each young country has assumed with respect of their own common past. Interpreting recent historical heritage suffers the strong constraints of todays' opposite political positioning, and for the time being it is going to be unavoidably so. The issue of scarcity enters the interpretation of recent history via the level a) of the polysemantic tool: it is a rhetoric device, as it emerges from failing narratives rather than being rooted in a materially scarce state of things. This a-type scarcity could be easily overtaken by highlighting all non-scarce elements well existing and available, but the prevailing rhetoric of political divergence makes such scarcity –at the moment– quite concrete and binding.

Turning an eye on former Yugoslavia industrial development, another striking element appears: new industrial plants and related dedicated areas have to be boosted almost everywhere either starting from scratch in new born coutries, or re-developing from the partial remains of Yugoslavian larger infrastructures, so putting a strong pressure on land exploitation and soil consumption; in the case of Croatia, land means coasts, and implies the exploitation of the the sea. Scarcity of land, of (new) industrial plants, of interpretation tools and normative frameworks are the most visible scarcities of type a) and b) of our experiential context.

The experience of navigation is places exactly at the center of the described entanglement, intending to highlight and at the same to mock the arbitrariness of the scarcities described, watching them from the sea. On our boat it is necessary to face every day localized yet challenging scarcities, like that of fresh water, power supply, and personal space: sharing these vital assets, all scarcely available on board, has metaphorically and materially promoted the awareness of reciprocal need and mutual interdependence among all members of the crew, no matter if sailors, students, teachers. Indeed when talking of mimicry we intend it in a double sense: we intentionally made fresh water and power scarce, by deciding never to dock in marinas to fill the tanks (marinas being some of the most polluting and impacting coastal infrastructures). We faced an intentional scarcity as a consequence of a collective responsible decision. Never refilling the tanks, the quantity of water available was known since the beginning: collective decisions were taken about how to consume it, what to give up onto, what the water consuming priorities where. One material scarcity could be dealt with.

The scarcity of power supply is also a consequence of the collective decision to switch off the boat engine at nights, while being off the power grid provided on land; from dusk to dawn our boat was just off. Indeed, darkness was partially compensated by the solar generated power, as we installed a solar panel and accumulator portable system, removable and separated from the boat engine supply. The boat didn't become self-sufficient per se, nor had fully renewable power sources, but we brought it and installed it, proving it feasible, easy and efficient. The management of the solar power system (4 AC plugs, 4 USB plugs) was fully in the hands of students, who had to consider – most of them for the first time ever – their individual energy needs. Both scarcities described in this paragraph enter in the b) category defined above, being rhetorical constructs: we made them being so, avoiding all behavioral shortcuts – like docking – that could have solved them away. This was part of the essential bet: checking how long and how far this mimicry of scarcity could be pushed.

The scarcity of space on a 24 meters gulet where 24 people are living together for 24 hour a day doesn't need to be explained in detail, but it's worth pointing out that the numerosity of the crew on board was once more a collective choice. We could have been less, but we choose not to. Sharing cabins, outdoor space, tables for eating and working, sockets for the cell phones and centimeters along

the clothesline, all these manufactured though real scarcities – all of them with a defined deadline, the end of the Summer School – made the navigating community behave as a whole body, a strong unite and a unique entity, marking and claiming its 'being different'. Despite knowing well that on-board scarcities were mimicked, the metaphorical effect worked well, producing a high level of reciprocal interdependence and most relevant, acting as magnifying lens to observe the other major, dramatic, awful scarcities around.

3. A Few Geologic-historic-Anthropological Details

Among all the intense days of in our itinerary in navigation, I choose to describe only one in detail in this paper, as it represents at best the density of interpretative layers, the complex interdependencies between ancient and recent past, all-scale environmental and political implications, and multiple scarcities (Figure. 1).

Figure 1: The itinerary in navigation around the Krk northern peninsula, from the harbor of Omisalj, blue dot at the center of the picture), to the LNG-ship, visible in the center bottom of the picture (Elaboration on G-Maps by the author).

The archeological site of Fulfinum Mirine sits on the western site of a narrow peninsula off the coast of the Croatian island of Krk. In an area less than one square km, it's easy to catch in a single glance: the remains of Fulfinum, a roman village from the first century BC, the remains of a paleo-Christian basilica of Mirine, from the IV century BC (Figure 2), the remains of Dina Petrokemija, an industrial plant of the late XX century which produced polyethylene until it was closed down in 2011 (Hydrocarbon-Technology.com 2024[1]) to become object of multiple post-bankruptcy market operations aimed at setting it in function again, with adverse fortunes (Ministry of Economy 2024[2]), the twenty shining white oil tanks owned by Janaf (the present Croatian national oil company) towering the landscape with their majestic cylindrical bodies (Figure 3), and finally, last and least, the brand new LNG floating re-gasifier plant named LNG-Hrvatska, docked at the new facility built on purpose and facing the Roman ruins, developed in the last few years (Figure 4).

Figure 2: The Mirine paleo – Christian basilica dating back to the IV Century (Photo by the author).

Figure 3: Five of the twenty oil tanks owned by Janaf, the Croatian national oil company (Photo by the author).

Such a complexity and amount of contradictions can actually escape the gaze of the not expert observer, because of the geographic features of the peninsula, narrow and hilly, and because a largest part of the coastline is not accessible to the public, nor walking nor driving nor swimming, being private property of Janaf. A good glance over the scenario of Janaf tanks and the LNG floating plant can be taken from the originally Venetian village of Omisalj, located on the top of the hill

(1) Last access on June 2024

(2) Last access on May 2024

surmounting the peninsula. Once reached the nice and cozy superelevated village of Omisalj, the sight from the top towards the sea is beautiful and kind of disquieting but the village is 'safe', far from the coastline and far (just enough) from the LNG plant noises.

Figure 4: The construction of the docking facility for the LNG-Hrvatska, in 2019-2020. In the background, on the hills, the village of Omisalj (Photo by Balkan Insight).

The Venetian toponym of the place still remaining in modern Italian is Castelmuschio, a late derivative of the Latin Castrum ad musculos¸ Castle over the muscles, obviously referring to the once abundant muscles growing ion the sea at the bottom of the cliffs. No need to say that nowadays there is no muscles growing nor fishing activity thriving in Omisalj. By the way, no one uses the old Venetian-Italian toponym anymore.

Another nice way to grasp the full sight of the place is offered by the sea, thus requiring a boat and therefore, as planned for the whole Summer School activity, by water-scaping. At first we docked our gulet in the small harbor of the peninsula on the opposite site of the archeological remains. A short walk in the little pine forest brings us in sight of the Roman basilica, perfectly restored: as we approach, the basilica emerges in front of us like a sunrise. When climbing downhill towards the archeological site along the easy walking track, also the yellow lights of the floating LNG plant appear in front of us. It's full day, yet the plants' lights are bright and striking.

The LNG ship is just out of scale in this landscape: we know that this re-gasifier can provide much more gas than Croatian consumers all together will ever need, so it is openly serving a different scope: it is as a large hub to supply politically reliable gas to eastern Europe (Gerebizza 2019): Omisalj happens to play a little part in the larger political framework designed to subtract eastern Europeans countries like Bulgaria, Hungary and Serbia from the dependance of Russian gas supply (Prtoric 2020, Łoskot-Strachota 2023). Indeed the LNG-ship is owned by a Norwegian company, the LNG gas company is based in Luxembourg, the financing dedicated to development of the docking site arrived to Zagreb government directly from the EU. Croatia provides 'just' the location.

Such a large plant anchored in this delicate archeological scenario, next to the little village once sitting on a lot of muscles, has been imposed on the local community of Omisalj by the national Croatian government, after a harsh confrontation lasted over a decade between the local mayor and his administration on one side, ministers and investors on the other, as witnessed by countless newspaper and media accounts. While the hard talks were going on, a group of archeologists started to dig around the Roman and paleo-Christian ruins, finding more and more evidence of the enduring relevance, lasting up to the Middle Ages, of the ancient site of Mirine as a harbor, as natural ship shelter and as a commerce hub (Causevic-Bully 2024). Unfortunately the scarcity of echo that such precious researches are having outside the circles of specialists is not helping to strengthen the policies of protection at a national level. In this ideal context, on the other hand, can be read the proposal of setting up an archeological park both on land and sea, dedicated to ancient navigation, cross cultural encounters and commerce in the Late Antiquity, despite at the moment the project is just on paper.

The images from the drones and satellites reveal a scarcity of relevance, mainly due to a scarcity of size, of the archeological area compared to the industrial area: hydrocarbon plants visually overcome the ruins, no matter what. On the other hand, when considering also the buffer zones of both activities, a different perspective and a better balance appear and develop (cfr. Img. 5 and Img. 6):

Figure 5, 6: Aerial view of the peninsula area, with highlights on the anthropic settlements and diverse activities, as the camping site and the plants.

The photo below shows the hypothetical areas dedicated to archelogy and industry, obviously mutually excluding each other (Photo elaboration on G-Maps by the author).

So scarcities in size and in relevance are a relative matters, depending on the adopted point of view: they are observer-dependent kinds of scarcity.

4. Conclusion

Let's analyze the three levels of meaning of the polysemantic tool of scarcity according to the definitions suggested at the beginning of the paper, for the specific case study of Omisalj. The level a) *rhetoric device,* is clearly visible in the rhetoric construction operated by the political sphere, narrating energy scarcity for the people of Croatia. Behind the claimed emerging need of gas from LNG source for Croatians familyhood and not only, lay other needs and drivers, not explicated and much less open; moreover, the attempted rhetoric describing the supply of gas from LNG as 'cleaner' - still being a fossil fuel - substituting the more polluting traditional oil, is just impossible to propose when in the very same area many oil tanks store crude oil waiting to be traditionally refined in the traditionally polluting way.

The level b) *material construction of scarcity*, is mainly unfolded through the manipulation of images. Pictures representing ruins and antiques are always framing small scales, very zoomed in, never showing any context around. Ruins seem to be standing alone in an empty space, with nothing contrasting or challenging them. On the contrary the images of industrial plants are always aerial views, wide and impressive large scales, well contextualized and fully understandable within their location. Their relevance emerges evidently at the eyes of the not expert: big is beautiful, big is technological, and it is the future, as it molds the landscape being unaltered and unaffected by whatever is already there. Our slow navigation around the peninsula approached the LNG ship where in theory is forbidden, and allowed a comprehensive vision of the full scenario with the real proximities, reciprocal interaction and clashes. The dimensional scarcity is interestingly fought by archaeologists, who are trying to expand the size of the archeological site not surely in space but rather in time, proving clues of its long(er) history, long(er) term duration, deep(er) past. The future of the archeological area is still unwritten.

As a final comment using the scarcity polysemantic level c) *provocative descriptor,* I wish to state that scarcities can be built, undone, mimicked, suffered, used and bluffed, as educational key concept and as a strategy-out. Water related issues and environmental commitments are proven to be able to overtake the artificial scarcities drawn by legislation, language and money. Water intended as a commons provides a decentered and unifying gaze over conflicts; water intended as overarching material and metaphorical concept allows the articulation of wide global perspective over environmental education that open up constructive discussions on the stewardship of the contemporary, that go well beyond the borders of environmental education.

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THE GOALS THEME 02

Environmental Education for a Sustainable Future

Theme Background:

In a world facing unprecedented environmental challenges, the role of education in fostering sustainability has never been more critical. Education, with its universal context, must prioritise environmental awareness and sustainable development to address the current global crisis effectively. Transformative educational approaches are essential to promote new ways of living and producing, focusing on environmental, social, and intergenerational justice. In alignment with the 2030 Agenda, there is a pressing need to explore how to integrate the Sustainable Development Goals (SDGs) into EE and ESD to guide society towards a more sustainable and equitable future.

This theme aims to delve into various aspects of EE that contribute to building competencies and transformative pathways across cultures. It underscores the significance of evaluating EE practices and the vital role of teacher education in advancing sustainability education.

Theme Objectives:

The theme, "Environmental Education for a Sustainable Future," aims to:

- Engage in debates, critical reflections, and sharing of experiences regarding the integration of SDGs into the field of EE and ESD. Explore the challenges, opportunities, and impacts of this integration on sustainable development.
- Showcase innovative EE and ESD proposals in higher education settings, highlighting how universities are shaping future generations of sustainability-conscious leaders.

Theme Focus:

- Strategies for incorporating SDGs into EE and ESD curricula and educational practices.
- Successful initiatives that align with specific SDGs.
- Curricular designs and programs that promote sustainability in university settings.
- Models for expanding EE and ESD initiatives to reach diverse learner populations.
- Lessons learned from global efforts to promote EE and ESD for sustainable development.

Theme Outcomes:

Share global experiences on integrating, scaling up, and sustaining environmental education across diverse contexts. Explore strategies to ensure that all learners acquire the knowledge and skills needed to promote sustainable development.

Theme Conclusions:

The thematic track on "Environmental Education for a Sustainable Future" aligns with the overarching goal of WEEC 2024, which is to "Connect People, Create Tomorrow." It emphasises the transformative potential of EE and ESD in shaping a sustainable and equitable future.

Together, we can explore effective strategies, share insights, and foster collaboration to advance environmental education and contribute to a more sustainable and resilient world for generations to come.

THE GOALS THEME 02

Environmental Education for a Sustainable Future

Proceedings

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359	Principles of Education Practices for Sustainability in the Amami Islands -A Structural Analysis of the Amami "Environmental Culture" Education Programs of Higher Education Institutions	Yuko Oguri	Oral communication
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016 SWOT Analysis of a Long-term Environmental Education Program

Adiv Gal[1]

Abstract

The article presents a SWOT analysis of a long-term environmental education program since 1996, focusing on endangered species conservation. It combines qualitative and quantitative approaches, using an instrumental case-study method and triangulation. Data methods include focus groups, interviews, and a questionnaire with 27 participants. Key stakeholders include Lesser Kestrels, students, teachers/school admin, parents, and regional council. Students and teachers benefit most. Weakness lies in teacher reliance on external experts. Ceasing financial support is the primary threat.

Introduction

Environmental Education (EE) programs in schools aim to cultivate students for sustainable living encompassing social, environmental, and economic dimensions. Schools seek to economize by minimizing energy consumption, paper usage, and promoting recycling. While most EE programs span a day to several weeks, few extend for several months or even a full academic year according to literature (Gal & Gan, 2018; UNESCO, 1975; Verhelst *et al.*, 2020). Frequent replacement of short-term EE programs raises questions about sustainability akin to replacing smartphones, cars, or washing machines frequently. Such practices conflict with SDG Goal 12 for sustainable consumption and production patterns (United Nations, 2015). The literature suggests that longer-duration EE programs yield greater impacts. Yet, despite evidence of their efficacy, long-term EE programs remain minimal. This raises questions about barriers to their implementation. Are there scenarios where long-term EE programs offer no advantage? How do organizations assess the pros and cons of EE programs and determine whether to pursue long-term initiatives? These questions underscore the complexity of decision-making in implementing EE programs (Braun & Dierkes, 2017).

Literature Review

Evaluating Environmental Education Programs

In the realm of EE, evaluations typically focus on program outcomes, spanning various dimensions such as knowledge, attitudes, behavior, and environmental literacy. However, there's a growing recognition of the importance of assessing program processes alongside outcomes. This study diverges from traditional outcome-focused evaluations to delve into the strengths, weaknesses, opportunities, and threats that contribute to the sustainability of the EE program. By scrutinizing the program's operational dynamics, the research aims to shed light on factors vital for its enduring success, thus offering valuable insights for the advancement of EE initiatives. (Ignell *et al.*, 2019; Jordan & Chawla, 2022; Ojala, 2012).

SWOT

This study employs SWOT analysis to assess a long-term EE program since 1996, focusing on conserving the Lesser Kestrel. It aims to reveal insights into the program's strengths, weaknesses, opportunities, and threats (SWOT), offering valuable lessons for similar initiatives worldwide (O'Brien *et al.*, 2020). By identifying key factors, the research aims to provide actionable recommendations for enhancing the sustainability and effectiveness of long-term EE programs, both locally and globally. Therefore, the aims of this research are to answer the following questions: What are the strengths, weaknesses, opportunities and threats (SWOT) of a long-term EE program founded in 1996, and designed to help conserve the Lesser Kestrel which made this EE program as a sustainable program? What are the key factors in making recommendations for implementing long-term EE programs according to experts?

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Methodology

This study primarily utilized a qualitative approach, employing an instrumental case-study methodology to describe the complex reality of long-term EE programs. The qualitative analysis involved first- and second-cycle coding analysis, allowing for the creation of categories emerging from interpretive data analysis. To address the limitations of SWOT analysis regarding quantitative analysis, the frequency of appearance of codes was examined, enabling the assignment of quantitative weights to each code (Saldaña, 2009; Yin, 2006).

Research Tools

The study employed triangulation with three research tools: a focus group with teaching staff and school administration, five semi-structured in-depth interviews, and a questionnaire distributed individually to participants familiar with the long-term EE program. The questionnaire collected expert opinions on the program's strengths, weaknesses, opportunities, and threats, with participants providing reasons for their answers.

Research Context

The "Lesser Kestrel" (LK) EE program engages fifth-grade students in preserving the LK nesting colony at their school since 1996. Its founders aimed to instill environmental commitment, nurture leadership skills, and foster community involvement. Students dedicate two hours weekly to LK studies, led by a zoologist and a teacher, focusing on Lucas' EE concept: in, about, and for the environment. Threats to the LK population include urbanization, intensive agriculture, and the invasive Myna species. "LK Day" showcases the colony and involves over 1,200 visitors annually. Parents, the local community, and all of Israel contribute, with funding from the regional council, the Society for the Protection of Nature, and local businesses.

Results

Participants

The 24 questionnaire participants had diverse backgrounds in familiarity with the program, averaging over 15 years of acquaintance. Some have known the program since its inception in 1996, providing a longstanding perspective.

SWOT Analysis

The inductive study that examined the strengths, weaknesses, opportunities, and threats of a long-term EE program, revealed the positions of experts familiar with the program and found that they addressed two main populations: The LK population and humans. The human population consists of four sub-populations: fifth-grade students, school teachers and administration, parents and a regional council. The separation between these two populations is reflected in the words of a representative of the administration who has been acquainted with the program for 22 years:

...The LK conservation project feels freshly kick-started every year by new students who are as excited about it just like before an upcoming holiday and with it comes an entire community, teachers, and regional council, giving backing to a beautiful tradition, one that should not be broken...

The representative of the school administration mentions all the populations in her remarks, that are repeated time and time again by all the interviewees, focus-group analysis and the questionnaire in the study.

LK Population

Participants unanimously attribute the long-term continuity of the LK program since 1996 to two main strengths: the school's environment and the Lesser Kestrel population itself. The connection between these two strengths can be understood from the following quote from one of the participants in the focus group: *"The school is located in the natural environment in which the LKs nest ... This unique location allows for and prolongs the existence of the program."* Another interviewee expressed the connection between the LKs and the environment in a slightly different way: *"A small bird that is endangered, nests in the school and finds food in the open areas around the school."* From these quotations it is clear that there is an understanding that these are not two detached factors. The school environment, where the program has been running since 1996, is a suitable living environment for the LK in which he can complete his life cycle while in Israel.

On the weakness side, the science teacher said: *"There is a big question mark regarding the achievement of the program's goals in rescuing the LK; the number of nesting pairs has not increased in recent years... the number of the pairs are reduced."* While this quote related to the outcome relating to fewer LKs and possibly the termination of the program, there were quotes that referred to the reason for the decrease in the size of the LK population. For example: *"...The Myna that harms the LK has arrived. The farmers' pesticides are also causing a reduction in the LK population in the area ... New construction is at the expense of the LK hunting areas."* This quote from a teacher, who has accompanied the program since its inception, indicates the three main challenges, according to her perception that the LK faces, which pose a threat to the plan and may result in its termination.

Students, Teachers and School Administration, Parents and Regional Council

Inductive analysis identified 88 codes across strengths, weaknesses, opportunities, and threats within the four populations. Distribution varied, with teachers/administration and the regional council encompassing all SWOT components. Students predominantly exhibited strengths, while parents primarily indicated weaknesses. These 88 codes were mentioned a total of 713 times. Among the codes identified, approximately 70% described program strengths, 4.5% outlined threats, 5% depicted opportunities, and 10.5% indicated weaknesses. Only codes mentioned by over 50% of participants across all three research tools were selected for focused examination, ensuring clarity and avoiding information overload.

Strengths

Strength codes appear only in the student population (15 times) and the teacher and administration population (7 times) expressing strength in incidence exceeding 50%. According to the study's participants, students are very eager to attend a program *("Building an expectation of a topic starting in the first grade")* that combines outdoor activities that encourage wonder and create a positive experience and emotion *("Finally learning what and how to love: a favorite animal theme for children... there are no books, tests, boring work. There is only learning outside the classroom and experiential learning")*. The program, as part of the school's enrichment activity *("The program is a special enrichment program")*, is based on LK observations encouraging experience in research processes *("Children research not only the LK, its lifestyle, food, enemies and needs, they learn far beyond in a professional and interesting way. Exploratory learning is integrative and includes broad areas of study")*, and thus encourages affinity and a sense of place *("The program is place-based and meets local needs, which promotes collaboration between school and community. Collaboration between school and community strengthens a positive school culture")*, affinity for the LK and nature *("...a unique program that characterizes the school and brings students closer to school, nature and the LK")*, enables personal empowerment, develops a sense of ability to work for the environment and encourages environmental citizenship *("From quiet, hesitant children, they become responsible, resourceful and self-confident, caring and working for their environment")* as part of the values that the school imparts *("Assimilation of values - messages that are conveyed in a stable and continuous manner, end up being absorbed and assimilated optimally")*. The above citations, which come from all three research tools, show that students' learning experience in long-term programs is systemic and holistic, which includes aspects of emotion, knowledge acquisition, hands-on experience, acquisition of values and activities for the environment.

As mentioned, the teachers and the school administration were the second population with codes stronger than 50%. These strengths focused on two levels. The first was the schoolwork routine. According to the participants, the program creates collaborations between the teaching staff and the administration *("The management team and the teaching staff see eye-to-eye on the importance of the program and there is a good relationship between them")*, enabling specialization based on experience *("A school has established itself as a*

leader, nationally, in the study of the LK, and has accumulated experience over years in the field"). The second level refers to a set of codes that the participants attributed to the long-term EE program. These codes include tradition *("There is the tradition here that is full of wonder and wonderful ... this is the greatness of this school. This is its excellence, the tradition"),* culture *("Persistence builds a unique school culture"),* values *("Teachers in the school impart environmental values "),* a sense of commitment *("The school administration and teachers are committed to the program")* and vision *("There is a clear vision - know where you want to go").*

Weaknesses

The main weakness of the long-term EE program pertains to the reliance on an external leader, who collaborates with science teachers. While integral to the program's success, ensuring the leader's continued presence poses challenges, including financial support and balancing responsibilities with school duties. Collaboration between the external leader and teachers enhances classroom engagement, emphasizing the importance of retaining this key figure. Regarding parents, two notable weaknesses, although not rated over 50% by participants, require consideration: lack of cooperation (mentioned by 28% of respondents) and conflicting priorities among parents (mentioned by 24%). Lack of cooperation may stem from the program's demand for parental involvement in various events throughout the year, potentially burdensome for some parents.

Opportunities

Fifty-two percent of respondents referred to school branding as part of the program's multi-year adoption. School branding included a number of references. First, the school is branded as one that is recommended, and therefore it is an opportunity to attract students *("a source of attraction for enrollment outside the regional council as well").* Another aspect referred to the branding of the school as fun *("There is pleasure in teaching in school, therefore, the program has made the school a source of attraction for teachers who want to teach in school.").* In addition, there is reference to the school's specialization *("The school established LK studies as its leader on a national level and gained knowledge over years in the field."),* which allowed for national recognition and awards for teaching the program *("We received a national education award thanks to program.").*

Threats

Eighty percent of the participants who filled out the questionnaire, (all the interviewees and focus-group participants) claimed that the main threat to the long-term EE program is its funding *("Such programs cost quite a bit; the school relies on money from outside, help that can always disappear and even now is quite limited.").* This financial threat remains not just a general reference, but is also reflected in the testimony of the partners who currently fund the program *("The cessation of the council's budget and the cessation of the support of the birding center.").*

Discussion

The findings of the SWOT analysis can be presented as a model of a three-branched evergreen tree (Fig. 1). The order of the branches does not indicate a particular hierarchy, but rather synergies between these branches.

Figure 1. The Evergreen Tree Model Summarizes the SWOT Analysis. (The tree trunk refers to continuity, tradition and specialization, the three branches of pedagogy, values and activities for the environment. The chainsaw on the side simulates the weaknesses and threats to the program. The deciduous leaves on the tree simulate the students, teachers and management staff. In contrast to the leaves (students, teachers and administration) that change, the tree base, trunk and the branches are the source of strengths and opportunities of a long-term EE program).

The tree trunk symbolizes continuity, tradition, and specialization. The program fosters a sense of continuity, beginning from early grades, aligning with the importance of exposing young children to nature. The anticipation of young children's involvement signifies the establishment of a lasting tradition in the school, fostering environmental engagement. This tradition facilitates the creation of a unified vision-based language among teachers,

Figure 1. The Evergreen Tree Model

mitigating burnout by fostering a sense of belonging (Netzer, 2019). Continuity in the long-term EE program enables staff specialization, aiding in addressing nature-deficit disorder (Louv, 2005). Nature-deficit disorder highlights the decrease in outdoor time, particularly among children, linked to various behavioral issues. Specialization of educational staff in a long-term EE program aligns with the professionalization requirement for EE educators. This specialization enhances outdoor activity knowledge and experience, addressing barriers like lack of knowledge and fear commonly cited by teachers worldwide (Dillon *et al.*, 2006).

First branch - pedagogy. In an outdoor activity-based program, diverse teaching fosters experiential learning, shaping understanding of nature through beauty, emotion, and continuous contact. Positive emotional experiences facilitate direct learning, strengthening the bond with nature and fostering attachment to specific places like the LK habitat. This pedagogy not only familiarizes students with reality and nature but also underscores the importance of understanding their interconnection, a fundamental goal of EE. (Ibáñez *et al.*, 2020).

Second branch - The long-term EE program's focus on imparting nature and environmental conservation values, particularly regarding endangered species, distinguishes its benefits. Research suggests that extended programs have a more profound impact on participants' value perceptions. Thus, the program since 1996 likely enhances environmental values among students and the community, potentially fostering substantial behavioral changes toward environmental stewardship within the school and local community (Bonnett, 2013).

Third branch - The long-term EE program equips children with practical skills to engage in

environmental action, such as guiding adults on LK Day and conducting surveys. These activities foster a sense of responsibility among students. Research supports the idea that spending time in nature instills a sense of empowerment in youth, motivating them to effect positive environmental change. Ultimately, fostering environmental action is a key goal of EE, transcending mere knowledge and attitudes. (Chawla, 2020; Gal & Gan, 2020).

The "leaves" on the tree symbolize students, teachers, administration, parents, and the council in the context of EE. Like an evergreen, they rejuvenate and change, yet remain integral to the tree, reflecting the interconnectedness crucial for successful environmental conservation programs (Engels & Jacobson, 2007).

Conclusions

This study underscores the importance and benefits of adopting long-term EE programs in schools. While focusing on the conservation of endangered species, such programs offer significant advantages to students, teachers, and administrators, aligning with the core goals of EE. Long-term EE initiatives not only foster environmental action but also provide continuity, allowing for the development of a deeper connection to nature and a sense of responsibility among participants. Despite the need for funding, the marginal cost of long-term programs decreases over time, making them more sustainable in the long run compared to short-term alternatives However, there remains a debate on the integration of EE into school curricula globally. In many countries, including Israel, EE programs are often treated as secondary or optional additions to the curriculum rather than being fully integrated. This highlights the need for a paradigm shift towards recognizing EE as an essential component of education, with long-term programs being a preferred approach. By promoting the inclusion of EE in national curricula worldwide, schools can play a pivotal role in nurturing environmentally conscious citizens and fostering sustainable practices for future generations.

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The Plastic Waste Crisis in the EU: Options for Action in Context of European Sustainability Policy - a Simulation Game for EU-related Learning and Teaching in Education for Sustainable Development

Prof. Dr. Andreas Brunold (1)

Abstract

As a first step the paper introduces the inherent didactical potential of the sustainability policies of the EU on the plastic waste crisis to synergistically combine EU-related Learning and Education for Sustainable Development (ESD) at secondary and tertiary teaching facilities. Adapted for the model game to be introduced, the paper further sketches an integrated competence-model for the two scopes of Civic Education to underline the potential skill- and competence-acquisition connected to this didactical approach. As a second step a concise overview of the plastic waste crisis and the EU-policies aiming at solving this issue is introduced as the context of the model game. In this context the paper depicts the transformation process of the EU-economy towards a circular economy as the fundamental goal of the European Green Deal introduced by the European Commission. As a last step the paper provides a ready-to-play model game simulating a meeting of stakeholders from politics, the economy and the public sector. The aim is to find regulations for the future of the European plastic and recycling industry, the export of plastic waste and the involvement of consumers on the way towards a circular economy. The model game was designed following the best practice approach and assessed and validated by numerous teaching professionals from secondary and tertiary teaching facilities.

Introduction

During the last decades plastic waste generation has exponentially increased and accumulated to nearly 10,000 million metric tons in 2023. It is predicted to further increase to over 25,000 million metric tons by 2050. In terms of CO_2-emissions for the production and waste treatment of plastic this adds up to 56 Gigatons of CO_2 by 2050. According to predictions in 2050 the plastic lifecycle will be responsible for the equivalent of 615 coal plants concerning emissions (Maurer, 2023). Furthermore, as Frans Timmermans pointed out, there are many more problems connected to plastic and plastic waste:

If we don't change the way we produce and use plastics, there will be more plastics than fish in our oceans by 2050. We must stop plastics getting into our water, our food, and even our bodies. The only long-term solution is to reduce plastic waste by recycling and reusing more. This is a challenge that citizens, industry and governments must tackle together [...]. We need to invest in innovative new technologies that keep our citizens and our environment safe whilst keeping our industry competitive *(EC, 2018a)*.

Against this background the paper argues that the sustainability policies of the EU on the plastic waste crisis encompasses the didactical potential to synergistically combine EU-related Learning and Education for Sustainable Development (ESD). To support this claim, a competence model adapted for a model game on the plastic waste crisis is introduced and the teaching materials are provided. The simulation was designed following the best practice approach and was assessed and validated by numerous teaching professionals from secondary and tertiary teaching institutions.

Keywords: EU-related Learning, ESD, Plastic Waste, Model Game, Circular Economy

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Relevance of the Plastic Waste Crisis for EU-related Learning and Education for Sustainable Development

An analysis of the transformation process of the economic system of the EU towards a circular economy, as well as of the European sustainability policies, reveals that low recycling rates, the excessive production of plastic waste and the resulting pollution of seas and oceans are fundamental environmental issues of the 21st century. Therefore, the plastic waste crisis has become a socially visible sustainability discourse in Europe. Given the ongoing legislative activities of the EU – solving the plastic crisis is a key goal of the *European Green Deal* by the European Commission – and the societal anchoring of the plastic waste discourse, the model game introduced in this article, offers the didactical potential to combine *Education for Sustainable Development (ESD)* and *EU-related Learning* (Kerscher, 2019a). Plastics and plastic waste play a crucial role for sustainability processes such as the transformation of the EU towards a circular economy. Considering that every individual can either support or undermine this process, the simulation game aims at fostering the awareness for sustainability and the critical reflection of (plastic) consumption patterns among learners. By simulating *solution- and future-oriented* negotiations of problems inherent in a linear economic system, such as the low recycling rate in the EU or water pollution, a fundamental understanding of interdependencies among actors in a circular-oriented economy can be created. In this way, the necessity of combining bottom-up and top-down processes for successful sustainable development processes can be conveyed. (Kerscher, 2019b)

Moreover, following Oberle and Forstmann (2015), learners should develop a conceptual understanding of the multi-level political system of the EU, legislative procedures and the principle of subsidiarity by simulating the actors or veto-players in the legislative process concerning the plastic crisis as a transnational problem. Thirdly, by simulating the action- and competence-

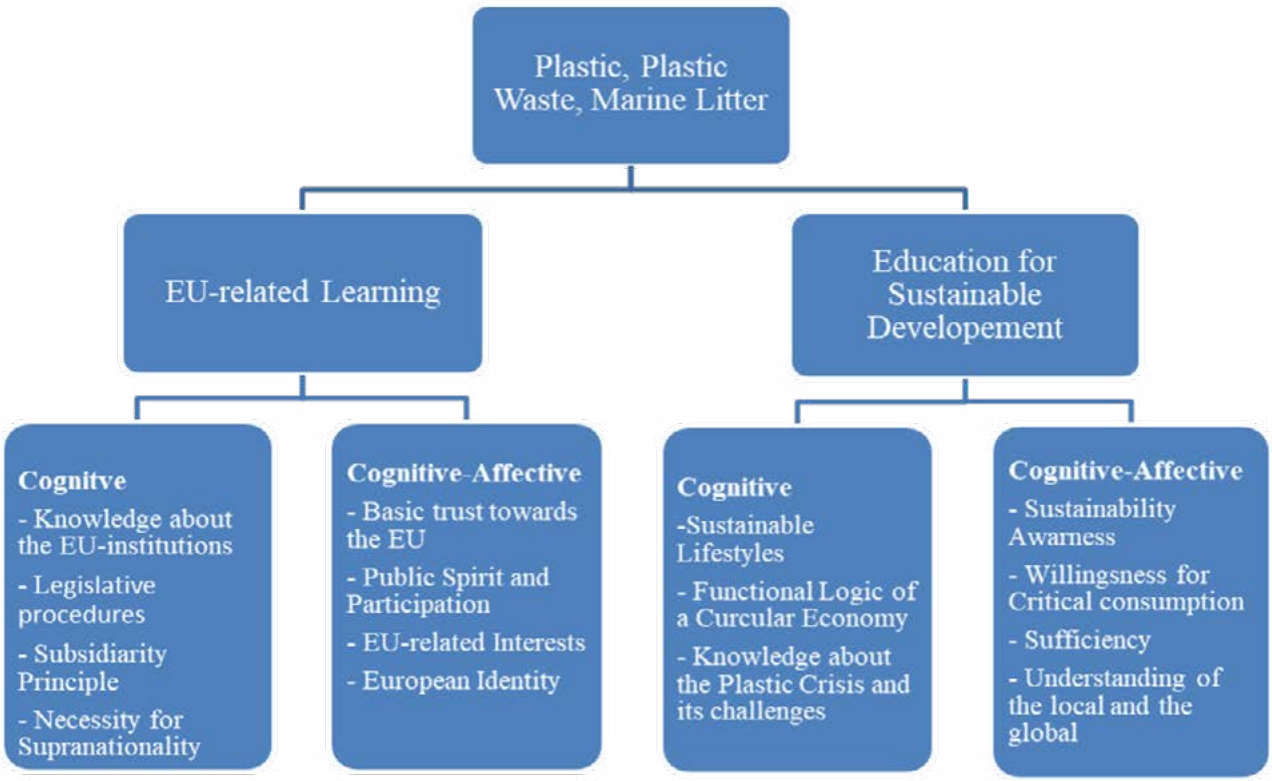


Figure 1. Cognitive and Cognitve-Affective Competence Dimensions for the Learning Field Plastic (Adapted from Kerscher, 2019b)

oriented internal perspective of the EU, learners are supposed to nurture EU-related interests, basic trust in EU institutions and a positive evaluation of the EU as a supranational institution for solving transnational problems. On a more abstract level, ideally, the simulation game also promotes the development of a European awareness and a European identity (Oberle & Forstmann, 2015).

Plastic and Plastic Waste in the EU

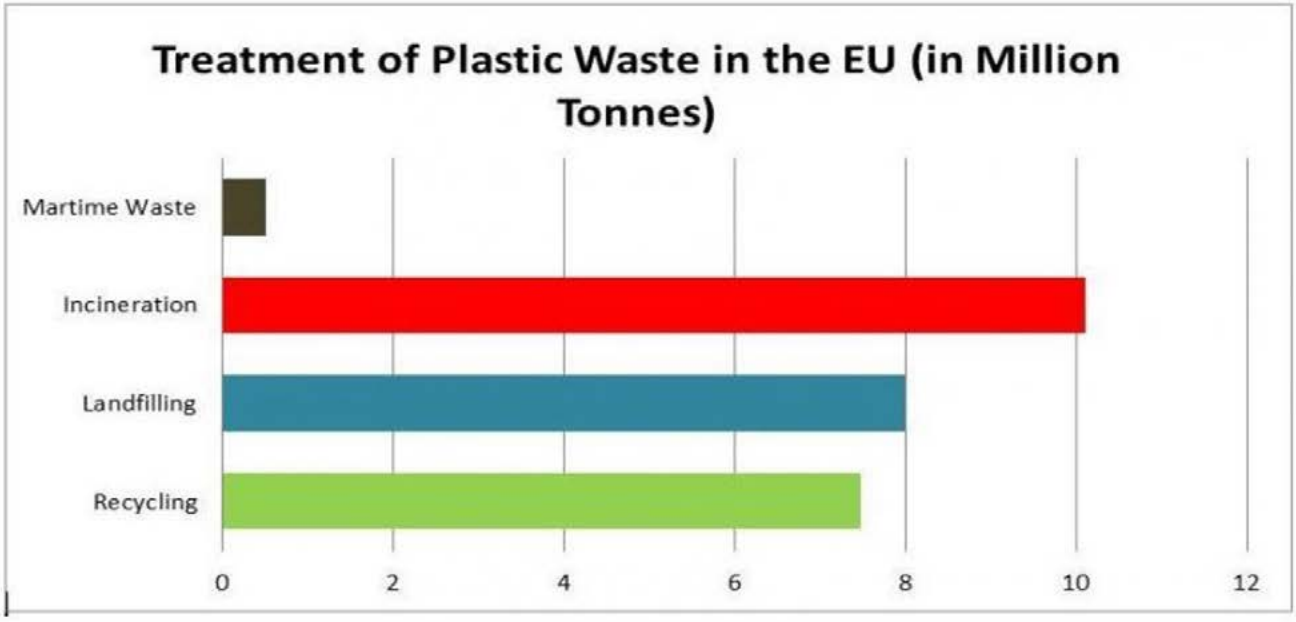
The plastic waste crisis is of a threefold nature. Firstly, there are already approximately 150 million tons of macro- and microplastics in the oceans, with an additional 10 million tons being added each year. This will have serious long-term consequences for the ecosystem and human health. Microplastics, for instance, find their way into the human body through the food chain. Moreover, marine creatures die due to plastic ingestion leading to agonizing deaths. Furthermore, the increasing amount of plastic waste pollutes the air, water, and soil tarnishing the natural landscape (EC, 2018b). Secondly, there is a significant need for improvement concerning waste management, recycling and the reuse of plastic as a secondary raw material, both within the EU and worldwide. Table 1 summarizes the treatment of plastic waste in the EU:

Thirdly, the low recycling rates are rooted in the design and manufacturing processes of plastic products. From an economic perspective, plastic producers lack incentives to ensure the recyclability of their products, as it would involve higher production costs. This reveals the contradiction between economic and ecological goals. During production, plastic is enriched with various chemical substances, allowing for a high degree of design flexibility to meet the aesthetic desires of the market. However, product designs complicate the recycling process, increases waste treatment costs and reduces the quality of recycled plastic. Consequently, recycling is currently not economically viable in the EU and the recycling industry is discouraged from investing in the modernization of its infrastructure (EC, 2018a).

Closing the Loop – An EU Action Plan for the Circular Economy (2015)

The first strategic initiative to address the issue of plastic waste and marine pollution was presented by the European Commission in December 2015. The main objective is to achieve the transformation of the EU towards a circular economy. This initiative also aims at enhancing the competitiveness of the economy of the EU and stimulating sustainable economic growth. The EU-Commission defines a

Table 1: Treatment of Plastic Waste in the EU in Million Tons per Year (Kerscher, 2019a).



circular economy as a system "where the value of products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste is minimized" (EC, 2015). This definition highlights that a circular economy is not compatible with disposable products and low recycling rates.

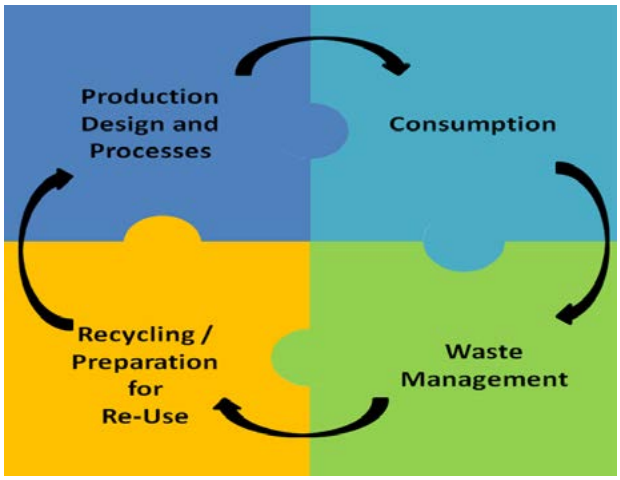


Figure 2. Conceptualization of the Circular Economy (Kerscher, 2019a)

Both the design phase and the production process have a significant impact on the use of resources, the reusability and recyclability of a product. These early stages of a product's lifecycle determine whether a product is suitable for a circular economy or not. Therefore, products must be designed with the end of the lifecycle – their recyclability or reusability – in mind (EC, 2015). However, the role of consumption is also crucial. Only by achieving further changes towards a more sustainable consumption behaviour can the transition to a circular economy be possible. Thus, it is essential to promote the willingness for sufficiency, which means refraining from unnecessary consumption, and establish it as a predominant consumption pattern (Kerscher, 2019b). It is the interplay of all phases in a product's lifecycle that characterizes the fundamental principle of a circular economy. To enable circularity, all four phases must be aligned with each other (EC, 2015).

The European Strategy for Plastics in a Circular Economy 2018

On January 16, 2018, the European Commission published another strategy paper to address the plastic issue and lay the groundwork for a new plastic strategy within the circular economy. For an effective transformation of the economy towards a circular economy and the implementation of this strategy, the EU is highly dependent on all stakeholders involved in the lifecycle of a plastic product. The plastic strategy encompasses the following six areas:

1. Improving the design of plastic products to make them more recyclable and reusable.
2. Strengthening recycling processes and infrastructure to increase the recycling rate and improve the quality of recycled materials.
3. Reducing single-use plastics and encouraging alternatives.
4. Curbing plastic littering and addressing the issue of microplastics in the environment.
5. Promoting voluntary action by the plastic and recycling industry to foster more sustainable plastic production and use.
6. Mobilizing global action to address the international dimension of the plastic problem.

Overall, this strategy aims at different aspects. On one hand, it seeks to reduce the use of disposable plastic products following the precautionary principle. On the other hand, it follows an efficiency strategy to stimulate growth and innovation, transforming the design, production, consumption, and recycling of plastic products. At the same time, the strategy aims to make the recycling industry more profitable to attract investments from the private sector (EC, 2018a).

As the first step towards implementing the plastic strategy, the European Commission published a directive on reducing single-use plastic on May 28, 2018. As a result, plastic products like plates, cutlery, straws, and cotton buds have been banned since January 2021 (EC, 2018b).

The Export of Plastic Waste and the 'Plastic Tax'

Approximately half of the plastics collected for recycling in the EU was – and still is - exported to countries outside the EU. As a result, the EU was one of the largest exporters of unsorted plastic waste. Until 2018, EU member states exported up to 87% of all plastic waste to China. Reasons for the export included the European recycling industry's insufficient capacities, technologies or financial resources to process all the waste within the EU. In 2018, China imposed an import ban on plastic waste from the EU. Since the ban, there has been an increase of plastic waste exports to Southeast Asian countries. For instance, export numbers from Germany show more and more waste being shipped to Malaysia. The country finds itself in a delicate balance between economic interests of their recycling industry and environmental protection efforts. While some companies made significant profits, enormous waste dumps emerged in the country, leading to illegal processing and incineration of imported plastic waste. As a reaction to the devastating consequences for waste-importing countries, the export of plastic waste is now conducted under the provisions of the *Basel Convention*. Since then, several ships carrying unsorted European plastic waste have been rejected by the importing countries and sent back to European ports (Perras & Timmler, 2018). Unsorted or contaminated plastic waste that is difficult to recycle is no longer allowed to be traded internationally and shipped, as there are concerns that it may be illegally dumped or incinerated in importing countries (BMU, 2021).

As part of the EU's multiannual financial framework, a plastic levy came into effect in January 2021. Often referred to as the "plastic tax," member states are obligated to pay 80 cents per kilogram of non-recycled plastic. According to this calculation basis, Germany is expected to face an additional burden of approximately 1.4 billion Euros per year (Deutscher Bundestag, 2020).

The Model Game: The Sustainability Policy of the EU on the Plastic Waste Crisis – Courses of Actions towards a Circular Economy

The model game was initially designed in the context of a Jean-Monnet-Project at the Chair for Civic Education at the University of Augsburg. The final didactical materials below were then assessed and validated by numerous teaching professionals from secondary and tertiary teaching facilities. During this assessment- and validation-process the ready-to-play materials were updated and adapted several times. Following the best practice approach the materials now consist of the synthesis of several simulation phases. The reflection phases after the simulations, post-simulation-interviews with the learners and a feedback-questionnaire indicate the actual skill- and competence acquisition is in line with the competence model introduced above.

Scenario, Roles and Role Cards of the Model Game

The model game simulates an informal stakeholder meeting in Brussels focusing on the sustainability policy of the EU addressing the plastic waste crisis. Stakeholder form politics, the economy and the public actors engage in negotiations concerning

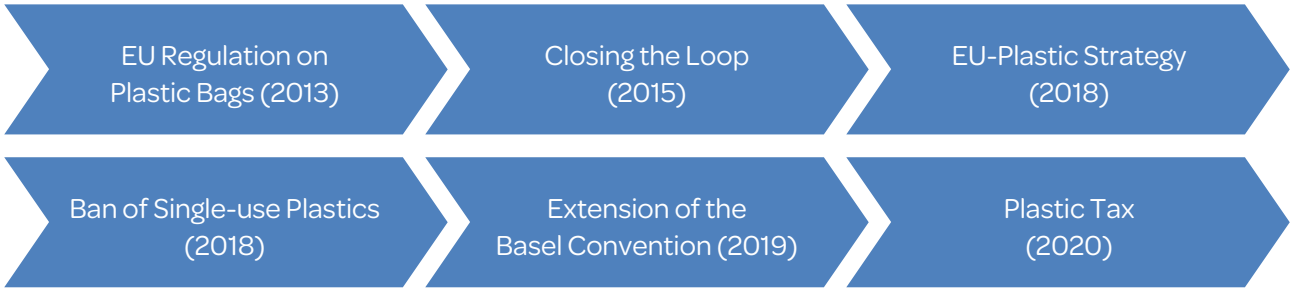


Figure 2. EU Sustainability Policy Concerning Plastic and Plastic Waste (Kerscher et. al., 2021)

possible steps to transform the EU's economy towards a circular model. The EU-Commission's objective is to increase recycling rates within the EU without pitting the economic interests of the plastic and recycling industries against each other as both are crucial for a circular economy. Amidst this complex setting, the EU Commission aims at developing an EU directive with majority support, outlining concrete measures to implement the European Green Deal. The selection of individual roles is aligned with the stages of a plastic product's lifecycle. The chosen roles are designed to reflect the economic interests of the two represented industries and the general conflict between economic and ecological objectives, which are expected to be the main focal points during the simulation phase. The role cards directly address the learners to increase the identification with the roles they enact. This is meant to support the process of assuming the perspective of their role.

M 1. Scenario of the Model Game

Stakeholder-Meeting in Brussels

The European Commission invites various stakeholders from politics, the economy and the public to a meeting in Brussels. The goal of this meeting is for the participants to agree on a roadmap addressing the plastic waste crisis. As political stakeholders participate the President of the EU-Commission, the German Ministry of the Environment and a delegation from Southeast Asian countries. Representatives from the economy include members of Plastics Europe, a trade association representing European plastic producers and the European Recycling Industries Confederation (EuRIC), which represents the interests of the recycling industry. Activists from the Rethink Plastic Alliance, a non-governmental environmental organization focused on combating plastic waste, are also present at the negotiations to provide input towards a Zero-Plastic solution. The European Commission expects to take concrete steps towards the implementation of its Plastic Strategy from 2018 during this stakeholder meeting. The starting point for the meeting is that both the European plastic and recycling industries are open in principle to modernizing their sectors, but not at the expense of their economic profitability or jobs. Furthermore, they do not want to bear all the costs of environmentally friendly investments in innovative technologies, as this would go against profit maximization. At the same time, Southeast Asian countries link further plastic waste imports to their participation in this modernization process. Additionally, the Rethink Plastic Alliance makes demands that go beyond the proposals of the Plastic Strategy.

Agenda and Aims of the Stakeholder-Meeting

The goal of the European Commission is to develop an EU directive with concrete measures that significantly increase the recycling rate by 2030 and regulate the role of plastic waste exports in a binding manner. The mentioned stakeholders are given the opportunity to participate in the development of this directive. Within the framework of this roundtable discussion, the participating actors must address fundamental questions:

1. How can the recycling rate in the EU be increased while also reconciling the different interests of the plastic and recycling industries?
2. Under which circumstances can the plastic waste export from the EU to Southeast Asian countries continue?
3. How can consumer behaviour be influenced in favour of sustainability?

These questions are crucial to finding a comprehensive solution to the plastic waste crisis and to formulating effective policies that align with the European Green Deal objectives. The stakeholders' active involvement is essential to achieving a consensus that promotes both environmental sustainability and economic viability for the industries involved.

M 2: Role Card – EU-Commission

As the President of the executive body of European politics you implement the regulations and directives that the Council of the European Union (Ministerial Council) and the European Parliament have agreed upon. You also ensure that all member states adhere to the decisions that have been made at the European level. Moreover, you are

responsible for the future development of the EU. To do so, your institution holds the exclusive right of initiative, which means only the EU-Commission can draft and propose new laws for the Union.

Your Challenge

As the host, your role involves leading and moderating the stakeholder negotiations. Your greatest challenge is reconciling the partially conflicting economic interests of the plastic and recycling industries while aiming at ecologically sustainable solutions to the plastic waste crisis. It is essential to strike a balance between these interests while also ensuring that the Southeast Asian countries are constructively engaged as equal partners in the problem-solving process. Given the financial impact of the COVID-19 crisis, your investment options are limited. Therefore, it becomes crucial to prioritize cost-effective solutions that can still drive meaningful progress towards achieving the EU's plastic waste reduction and recycling targets. But you can't pay for it all.

Your Position

- You aim at increasing the recycling rate in the EU by improving the recyclability of plastic products. This requires changes concerning product design and the manufacturing process. You try to hold the plastic industry accountable without losing it as an economic partner.
- You aim at an increase of the plastic waste levy, also known as "plastic tax".
- You aim at increasing the profitability expectations of the recycling industry and boosting the demand for recycled plastics to achieve a circular economy.
- One potential instrument for you is setting a minimum percentage of recycled raw materials (recycled plastic) in new plastic products. This would enhance the profit prospects for the recycling industry, but could also increase production costs for the plastic industry.
- You aim at shifting the responsibility for influencing the consumption behaviour of EU citizens to individual member states. You propose the establishment of preventive measures such as awareness campaigns for this purpose.
- You aim at continuing the export of waste to Southeast Asian countries, while interpreting the Basel Convention laxly. You want keep the expenses for this objective within limits.
- You aim at ensuring that the plastic levies from member states continue to flow into the EU budget without specific earmarking. You want to decide on its spending.

Your Strategy

- You particularly use bilateral informal negotiations with other stakeholders and offer possible concessions on other substantive issues. You try to tie several decisions together.
- You use your legislative initiative right as leverage in the negotiations. Especially economic instruments to steer the recycling rate can be used as pressure e.g., the plastic tax.
- You promise a budget for the research and development of innovative technologies for the plastic and recycling industries. However, you are not willing to directly fund the modernization of the recycling industry's infrastructure.
- You point out the necessity for EU-wide regulations to ensure economic prosperity. (EC, 2018a)

M 3: Role Card – German Environment Minister

As the delegate of the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety, you represent the German government and hence you try to pursue national interests at the EU level. You run the German ministry implementing EU guidelines and directives regarding plastic waste and plastic products in Germany. A German veto in the Council of the European Union effectively prevents the adoption of any law at the European level. Generally, your ministry is responsible for promoting sustainable environmental and nature-conservation policies in Germany. Plastic waste currently is a top priority of your ministry's efforts as expressed in your general approach: 'Less Plastic and More Recycling.' Overall, your ministry agrees on key points of EU Plastic Strategy.

Your Position

- You aim at reducing the use of unnecessary plastic products and packaging. You plan to achieve this through alliances with manufacturers and retailers, as well as by implementing bans on single-use items.
- You explicitly support the polluter-pays principle and advocate for the plastic industry to contribute to the costs of plastic waste disposal. You promote this idea at the European level and endorse the EU's plastic levy.
- You intend to influence product design through economic instruments. Well-recyclable products receive financial incentives; poorly recyclable products face financial sanctions.
- You demand that the EU legislation ensures resource efficiency, repairability, and recyclability. Your goal is to extend the product lifecycle.
- You announce your intention to increase the demand for products made from secondary raw materials in public investments to support the recycling industry. You suggest a minimum quota of secondary raw materials in new plastic products.

Your Strategy

Your primary focus is on sustainable environmental and nature-conservation policies. However, you also need to consider economic interests, particularly in regards to the significant plastic industry in Germany, which provides numerous job opportunities. Additionally, you have to keep in mind the interests of the Industrial Union of Mining, Chemicals, and Energy, which represents a significant part of the population. Therefore, you have to take into account the implications if your decisions on the upcoming federal elections.

- You threaten to withhold Germany's approval in the Council of the European Union if the negotiations do not go as planned.
- You advocate for more leeway for national states in the implementation of future EU legislation.
- You insist on using economic measures to influence product design and recycling rates. Voluntary commitments from the industry are not sufficient for you.
- You propose the support of the recycling industry in emerging countries as a reciprocal measure for accepting European waste.

(BMU, 2018)

M 4: Role Card – Delegation of Southeast Asian Countries

As representatives of the Association of Southeast Asian Nations (ASEAN), you advocate for the interests of the entire Southeast Asian region. Since China banned the import of plastic waste in 2018, countries in the ASEAN region have become new destinations for (plastic) waste exports from Western countries. Due to the inclusion of plastic waste under the provisions of the Basel Convention, the import of sorted and cleaned plastic waste remains lucrative for the ASEAN region. However, your willingness to continue importing (plastic) waste is tied to certain conditions.

Your Challenge

As the political representation of Southeast Asian states, you find yourself in a field of tension between the economic interests of your recycling industry and necessary environmental protection efforts in your countries. E.g., in 2018 54 companies from Malaysia actively imported plastic waste generating substantial profits. However, only eight of these companies complied with the existing environmental regulations. Consequently, huge waste dumps were created in the country and the imported plastic waste was subject to improper processing and burning. Your main challenge now is to modernize the recycling industry of your countries to continue participating in the lucrative plastic waste trade. At the same time, you have to address the demands of the protesting population for enhanced environmental protection.

Your Position

- You aim at preventing the emerging economies of the Southeast Asian region from becoming dumping grounds for waste from developed countries.

- You insist on implementing the Basel Convention, which states that only sorted, cleaned, and recyclable plastic waste should be traded.
- Your state that your countries are generally willing to issue new licenses for plastic waste imports.
- You point out that China could act as an alternative partner for the modernization of your recycling industry. Consequently, you are not unilaterally dependent on the EU.

Your Strategy

- You threaten to send back ships carrying unlicensed plastic waste as a mean to exert pressure on the international community and negotiation partners.
- At the same time, you signal a willingness to potentially issue import licenses for European plastic waste. But you want something in return.
- You attach conditions to these new licenses: you ask for the provision of technology for your recycling industry (technology transfer) and financial payments from the EU.
- As an additional leverage, you can also point out the possibility of expanding cooperation with the Chinese recycling industry at the expense of the EU. In recent years, Chinese waste processing companies have already invested 20 billion Euros in Southeast Asian countries.

(Global Alliance for Incinerator Alternatives, 2019)

M 5: EuRIC – European Recycling Industry Confederation

As the representative of the European Recycling Industry Confederation, you advocate for the recycling industry of the European Union. You are the spokesperson for the umbrella organization of the recycling industry encompassing over 5.500 companies across Europe. Your economic sector is responsible for recycling numerous materials and hence essential for the realization of a circular economy. Your companies recycle millions of tons of plastic, metal, glass, and paper annually generating nearly 100 billion Euros in revenue. The 300.000 jobs your members provide in the EU, which cannot be outsourced to countries outside the EU, further underline the significance of your industry. Your primary goal is to promote effective legislative frameworks that support recycling in Europe and ensure the economic competitiveness of the European recycling industry.

Your Position

- You support the inclusion of plastic waste under the provisions of the Basel Convention.
- You demand a legally defined minimum percentage of recycled materials for the production of new plastic products
- You also demand a legally mandated minimum recycling rate for various plastic products. You do not consider voluntary commitments from the plastic industry to be sufficient.
- You declare an increase in demand for recycled materials as a prerequisite for subsequent investments in the modernization and expansion of the recycling industry. Setting non-binding recycling targets alone is not enough.
- You call for financial penalties for plastic manufacturers that do not consider the recyclability und reusability of their products during the manufacturing process.
- You propose economic incentives to increase the use of recycled materials. On measure would be subsidizing secondary raw materials.
- You request European subsidies for the modernization process of the European recycling industry.

Your Strategy

As the representative of the European recycling industry, you find yourself in a complex situation. On the one hand, the EU strongly depends on your industry to implement the transformation process to a circular economy. On the other hand, the global demand for recycled plastic has declined due to China's import ban, posing a threat to the profitability of your industry and potentially leading to the loss of tens of thousands of jobs. Therefore, the expansion of the intra-European recycling market is also one of your key necessities.

- You declare a guaranteed minimum demand for recycled raw materials as a prerequisite for future investments in the modernization process.
- You stress the critical role of a well-functioning recycling sector for achieving a circular economy and highlight the dependence of the EU on the recycling industry.
- You call on the EU to provide financial support for the modernization process of the recycling industry. For example, directing the plastic levy towards funding recycling initiatives would be beneficial.
- You urge the EU to ensure the recyclability of plastic products by implementing regulations and standards in the production process.
- You hold the plastic industry responsible for producing recyclable products and advocate for their involvement in covering the costs of waste management.

Branchendachverband der Recycling- und Entsorgungswirtschaft (BVSE), (n.d. a,b)

M 6: PlasticsEurope

As the representative of PlasticsEurope, the association of plastics producers, you advocate for the political and economic interests of the pan-European plastic industry. Your organization comprises the companies that produce over 90 percent of plastics in the 27 EU member states and other countries such as Norway, Switzerland and the UK. PlasticsEurope is connected internationally through the World Plastics Council (WPC) and the Global Plastics Alliance (GPC). Additionally, you closely cooperate with national plastic associations in Europe and around the world. Prominent members of your organization include BASF, Exxon Mobile Chemical Company and Total Petrol Chemicals. Your industry sector provides up to 1,5 million jobs in nearly 60.000 companies across Europe. What is more, your members generate over 300 billion Euros in revenue. As the seventh-largest industry sector in Europe, you consider plastics to be the materials of the 21st century. You express scepticism towards EU regulations, instead you advocate for voluntary commitments within your industry.

Your Position

- You emphasize the positive contribution of single-use items to the quality of life and the preservation of food freshness.
- You call for measures by the EU to raise awareness among consumers regarding plastic recycling. You argue that waste generation primarily originates from consumers and not your industry.
- You emphasise your willingness to engage in voluntary commitments for the elimination of marine litter and the reduction of plastic waste in the future.
- You emphasise that existing regulations and laws are strict enough and only have to be properly implemented by member states. You aim at avoiding specific new laws.
- You stress the importance of waste reprocessing and recycling and call for the expansion of related infrastructure.
- You reject Extended Producer Responsibility (EPR) in the form of payments or the introduction of a plastic tax. You warn that this could prevent innovations in the plastic industry.
- While you generally support the use of recycled materials, you reject the legal introduction of minimum proportions for the usage of secondary resources for the production of plastic products. You seek to increase the use of secondary raw materials through dialogue between the plastic and recycling industries. Voluntary self-commitments are the way to go.

Your Strategy

As a representative of the European plastic industry, you find yourself in a complex situation. On the one hand, the EU strongly depends on your industry to implement the transformation process to a circular economy. On the other hand, you need the prevent the EU from setting strict regulations that could negatively impact the profitability of your companies.

- You warn against the potential loss of jobs in the plastic industry if the EU were to introduce a mandatory minimum share of recycled materials in the production of plastic products or a plastic tax.
- You emphasize the critical role of a profitable and innovative plastic industry for facilitating the transition to a circular economy.
- You call on the EU to provide financial support for the modernization process of the recycling industry.

(PlasticsEurope, 2017)

M 7: Rethink Plastic Alliance

Rethink Plastic is a transnational coalition of leading European NGOs with thousands of active regional groups and supporters across Europe. They are part of the global network Break Free From Plastic, which is a coalition of over 1.000 NGOs with millions of supporters. In general, your aim is to influence European legislation towards a future without plastic waste. With the ability to generate critical public awareness, you see yourselves as equal stakeholders for the roundtable.

Your Position

Your supranational NGO identifies three main problem areas: the manufacturing processes of plastic products, consumer behaviour and the recycling of plastic for reuse or as a secondary raw material.

- You call for the unconditional reduction of plastic waste to decrease the plastic footprint. This can be achieved through incentives for the recycling industry and consumers, restrictive legislation concerning plastic production and promoting sustainable plastic consumption.
- You advocate for increasing the plastic levy and introducing a minimum share of recycled materials in new plastic products.
- You demand a redesign of plastic products to extend their lifespan and improved recyclability to enable the use of recycled materials.
- You demand the plastic industry to contribute to the costs of plastic waste disposal.
- You call for improved waste treatment in Europe, including ending landfilling and incineration of plastic waste.
- You urge emerging countries to stop importing plastic waste and follow China's example.
- You promote the implementation of a meaningful plastic tax to influence consumer behaviour and internalize the damages caused by plastic products.
- You advocate for comprehensive educational programs to increase critical consumption practices.

Your Strategy

As a representative of a supranational NGO without direct competencies in the legislative process and without the possibilities and influence of an entire economic sector, you rely on the public visibility of the plastic issue. You are dependent on being able to persuade other stakeholders of your positions through informal negotiations.

- You highlight your potential to generate critical public awareness through social media campaigns and active protests on the streets.
- You try to act as a moral compass for other stakeholders.
- You announce that you have indirect influence on legislation due to your connection to the Green Party fraction in the European Parliament.
- As a last resort, you threaten direct actions such as occupying plastic manufacturing facilities, recycling centres and ports to generate media attention and cause economic repercussions to the negotiating parties.

(Rethink Plastic Alliance, n.d.)

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Programme de création d'un laboratoire junior d'écologie et de santé environnementale dans un lycée en France: Une approche pratique pour l'éducation à l'environnement

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Abstract

La question de l'éducation en santé environnementale à l'école est relancée par le Plan national santé environnement. Les rapports des inspections générales (Igas et CGEDD) ont souligné l'insuffisance de la formation dans ce domaine (Reis *et al.*, 2022). Pour combler cette lacune, notre étude se concentre sur un programme innovant : le laboratoire junior d'écologie et de santé environnementale dans un lycée en France. Il vise à sensibiliser les élèves aux enjeux environnementaux et sanitaires par la pratique, en mettant l'accent sur les principes du développement durable et les politiques de santé environnementale.

Introduction

La question de l'éducation en santé environnementale à l'école est relancée avec l'avènement du nouveau Plan national santé environnement (PNSE 4), qui affiche une volonté d'action claire (Ministère de l'Écologie, du Développement durable et de l'Énergie, 2023). Les rapports des inspections générales, notamment l'Inspection générale des affaires sociales (Igas) et le Conseil général de l'environnement et du développement durable (CGEDD), ont souligné l'insuffisance des PNSE successifs en matière de formation initiale et continue (Reis *et al.*, 2022). Les établissements scolaires sont souvent considérés comme des lieux privilégiés pour sensibiliser les jeunes aux enjeux environnementaux. L'intégration de programmes spécifiques dans les écoles pourrait non seulement transmettre des connaissances théoriques mais aussi développer des compétences pratiques et des attitudes responsables chez les élèves.

Cependant, il est postulé que les modules de formation actuels, intégrés dans le cadre scolaire, ne répondent pas entièrement aux besoins. Les contenus semblent souvent trop théoriques, limitant ainsi la capacité des élèves à saisir pleinement les enjeux concrets et les interrelations complexes entre l'environnement et la santé. Les cours traditionnels ne semblent pas fournir suffisamment d'opportunités pour des expériences pratiques, des projets de recherche ou des activités de terrain, qui sont considérés comme essentiels pour une compréhension approfondie et un engagement actif.

Cette lacune dans la formation initiale des élèves pourrait se traduire par une connaissance superficielle des concepts environnementaux et sanitaires, sans les compétences pratiques nécessaires pour appliquer ces connaissances dans la vie quotidienne ou dans des contextes professionnels futurs. De plus, il semble que la formation continue soit rarement mise à jour pour intégrer les dernières avancées scientifiques et les nouvelles problématiques environnementales et sanitaires. Les enseignants, souvent formés il y a plusieurs années, peuvent manquer de ressources et de formations nécessaires pour aborder ces sujets de manière dynamique et engageante.

Cette situation pourrait créer un cercle vicieux où l'enseignement de la santé environnementale reste statique et inefficace, ne parvenant pas à inspirer les élèves ni à développer chez eux les compétences et les attitudes nécessaires pour devenir des citoyens responsables et proactifs. Pour pallier ces insuffisances, il serait intéressant de repenser les modules de formation scolaire pour inclure des approches pédagogiques diversifiées, combinant théorie et pratique, et encourageant l'investigation scientifique et l'engagement des

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partenaires locaux. En intégrant des projets concrets et des expériences pratiques, les élèves pourraient non seulement mieux comprendre les enjeux de santé environnementale, mais aussi développer des compétences scientifiques transférables.

Le développement d'un laboratoire junior d'écologie et de santé environnementale vise à combler le manque de sensibilisation et à fournir une formation pratique aux jeunes, enracinée dans leur contexte local et global. Notre étude se concentre sur la conception et l'évaluation d'un programme innovant : le laboratoire junior d'écologie et de santé environnementale. Ce programme, mis en place dans un lycée du Tarn-et-Garonne, vise à sensibiliser les élèves aux enjeux environnementaux et sanitaires à travers une approche pratique et immersive. En mettant l'accent sur l'expérimentation, la recherche et le développement de projets concrets.

Cadre théorique

L'éducation à l'environnement au cœur des territoires constitue une approche pédagogique essentielle pour engager les élèves dans une compréhension profonde des enjeux écologiques et sanitaires. Selon Jaubert (2007), les situations scolaires formelles peuvent parfois rendre opaque, aux yeux des élèves, la signification des activités et des outils pédagogiques qui leur sont proposés. Cette opacité résulte souvent d'un manque de contextualisation des connaissances et de la difficulté des élèves à percevoir l'utilité concrète de ce qu'ils apprennent. Il est donc indispensable de s'intéresser à l'interprétation que les élèves font du contexte d'apprentissage intentionné par l'enseignant. Pour améliorer l'engagement des élèves, il semble important de renforcer la formation à la participation. Cela implique de développer des compétences de collaboration et de communication, en permettant aux élèves de s'exprimer et de participer activement aux processus décisionnels. Cette approche participative est essentielle pour les impliquer pleinement dans leur apprentissage et les rendre acteurs de leurs propres parcours éducatifs.

Le développement de la formation à l'accompagnement au changement est également essentiel. Selon Considère et Tutiaux-Guillon (2013), cette formation doit mettre l'accent sur les principes du développement durable et les politiques de santé environnementale. Cela comprend une éducation qui prépare les élèves à comprendre et à réagir aux défis environnementaux actuels, en les équipant des compétences nécessaires pour accompagner et conduire des changements vers des pratiques plus durables. L'utilisation d'approches et de méthodes pédagogiques diversifiées et non culpabilisantes est aussi important. Villaumé (2023) souligne l'importance de méthodes variées, incluant des approches scientifiques, artistiques, sensibles, ludiques et imaginaires. Ces méthodes permettent de rendre l'apprentissage plus engageant et pertinent pour les élèves, en répondant à leurs divers intérêts et styles d'apprentissage. En intégrant ces approches, les enseignants peuvent aider les élèves à développer une compréhension plus profonde et nuancée des enjeux environnementaux.

La construction des savoirs en éducation à l'environnement nécessite de comprendre comment les élèves perçoivent et interprètent le contexte d'apprentissage. Jaubert (2007) insiste sur l'importance de clarifier la signification des activités scolaires pour les élèves. Pour cela, il est essentiel de décontextualiser et de recontextualiser le savoir, en permettant à l'élève de comprendre l'utilité des outils de recherche appris en classe. Cette démarche aide les élèves à s'approprier le savoir, à entrevoir l'existence d'un nouveau champ de l'activité humaine, ses enjeux et l'intérêt personnel à en devenir des acteurs en s'en appropriant les outils et leurs usages.

L'implication active des élèves en tant que producteurs de savoir dans un laboratoire junior axé sur l'écologie, la santé et l'environnement peut transformer l'expérience éducative et contribuer à des solutions environnementales innovantes. Cette approche, bien que confrontée à des défis de collaboration et d'interdisciplinarité, présente de nombreuses opportunités pour renforcer les compétences et la sensibilisation des élèves. L'implication active des élèves ne se limite pas à l'acquisition de compétences scientifiques. Elle joue

également un rôle crucial dans leur développement en tant qu'acteurs citoyens conscients, sensibilisés aux enjeux environnementaux et capables de contribuer de manière significative à la société. Cette approche éducative, en favorisant une participation active et en intégrant des méthodes pédagogiques diversifiées, peut transformer l'expérience éducative des élèves en la rendant plus engageante, pertinente et efficace.

In fine, pour répondre aux défis éducatifs actuels en matière d'éducation à l'environnement, il est essentiel de renforcer la formation à la participation, de développer des compétences d'accompagnement au changement, et d'utiliser des approches pédagogiques diversifiées et non culpabilisantes. Cette démarche permettra de former des citoyens éclairés, capables de comprendre et de répondre aux enjeux environnementaux de manière proactive et innovante.

Cette étude nous permet d'interroger l'implication active des élèves en tant que producteurs de savoir au sein d'un laboratoire junior axé sur l'écologie, la santé et l'environnement. En examinant cette approche, nous cherchons à comprendre comment elle peut transformer l'expérience éducative en intégrant des méthodes pratiques et collaboratives. L'objectif est de voir comment cette participation active peut non seulement enrichir l'apprentissage des élèves mais aussi contribuer à des solutions environnementales innovantes.

Contexte de l'étude

Le programme vise à sensibiliser les élèves aux enjeux écologiques et sanitaires en leur fournissant des connaissances sur les écosystèmes, les cycles naturels, les impacts des activités humaines sur l'environnement, et les liens entre santé et environnement. Il a également pour but de développer des compétences pratiques par le biais d'expériences de terrain et de projets de recherche. Les élèves ont l'opportunité de participer à des activités de laboratoire, de réaliser des expériences scientifiques et de collaborer avec des experts. Le programme encourage une approche interdisciplinaire pour une compréhension systémique des défis climatiques, en intégrant des éléments de diverses disciplines, y compris les sciences, les technologies, les sciences sociales et les arts, afin d'offrir une vision globale et intégrée des problèmes environnementaux.

Par ailleurs, le programme s'ouvre à l'université en impliquant de jeunes chercheurs dans les ateliers, favorisant ainsi un échange de connaissances et d'expériences entre les élèves et le monde académique. Cette collaboration permet aux élèves de bénéficier de l'expertise des jeunes chercheurs, tout en les motivant à envisager des parcours académiques et professionnels dans les domaines de l'écologie et de la santé environnementale. Enfin, le programme promeut l'engagement citoyen en sensibilisant les élèves aux politiques publiques et aux initiatives locales en matière d'environnement et de santé, et en les encourageant à participer activement à des projets avec des partenaires locaux.

Méthodologie de recherche

Pour évaluer l'impact du programme, une combinaison de méthodes qualitatives et quantitatives a été utilisée. Des questionnaires ont été conçus pour évaluer plusieurs aspects, notamment la connaissance des concepts clés tels que l'écosystème, le développement durable et la santé environnementale, ainsi que la perception des risques climatiques et des problèmes de santé liés à l'environnement. Ils ont également mesuré l'attitude et la disposition des élèves à s'engager dans des actions environnementales. En complément des questionnaires, des observations ont été réalisées pendant les activités du laboratoire junior, incluant des captations vidéos et des transcriptions verbatim des interactions entre les élèves et les intervenants. Ces observations visaient à analyser la dynamique des séances, l'implication des élèves et les méthodes pédagogiques employées. Par ailleurs, des entretiens semi-directifs ont été menés avec un échantillon d'élèves pour recueillir des données qualitatives sur leur expérience et leur perception du programme. Ces entretiens ont exploré les motivations des élèves, les défis rencontrés et les bénéfices perçus de leur participation, offrant ainsi une perspective approfondie sur l'impact du programme sur leur apprentissage et leur engagement.

Résultats et Discussion

Les résultats montrent une augmentation significative de la compréhension des concepts écologiques par les élèves, ainsi qu'une amélioration de leur capacité à discuter des enjeux de santé environnementale. Les données collectées avant et après l'implémentation du programme révèlent des progrès notables dans plusieurs domaines clés. Les résultats des questionnaires et des observations montrent que l'approche pratique et immersive du laboratoire junior a eu un impact profond sur les connaissances et les attitudes des élèves.

Les questionnaires distribués avant et après le programme ont révélé une nette amélioration de la compréhension des élèves des concepts écologiques fondamentaux. Par exemple, le nombre d'élèves capables de définir correctement un écosystème a triplé après leur participation au laboratoire junior, passant de 12 à 32. Cette augmentation suggère que l'expérience pratique et les projets de recherche ont renforcé leur compréhension des concepts écologiques de base.

De même, les connaissances des élèves sur le développement durable ont significativement augmenté, passant de 15 élèves ayant une bonne réponse avant l'expérimentation à 39 après. Les élèves ont également montré une meilleure compréhension des risques climatiques, avec un triplement du nombre de bonnes réponses sur ce sujet. Avant l'expérimentation, seulement 10 élèves pouvaient correctement définir les risques climatiques, contre 29 après le programme. Ce résultat démontre l'efficacité du programme à sensibiliser les élèves aux défis climatiques actuels et à les préparer à y répondre de manière informée.

La notion de santé environnementale a également connu une amélioration notable, avec plus du double d'élèves (45 contre 20) pouvant correctement définir ce concept après l'implémentation du programme. Cette augmentation montre que le laboratoire a joué un rôle crucial dans la sensibilisation aux liens entre l'environnement et la santé, un aspect essentiel pour former des citoyens conscients et engagés.

Enfin, une meilleure connaissance des initiatives locales a été observée. Le nombre d'élèves capables de citer et de discuter des initiatives locales de protection de l'environnement est passé de 15 à 28. Cette meilleure compréhension peut être attribuée à des interactions accrues avec des acteurs locaux et à des projets concrets discutés et initiés durant le programme.

Les entretiens semi-directifs menés avec les élèves ont également révélé des changements significatifs dans leurs perceptions et attitudes. Avant l'implémentation du projet, certains élèves exprimaient des incertitudes telles que: «Je ne saurais pas définir un écosystème » ou «Je sais ce que ça veut dire mais je ne sais pas comment le dire». D'autres manifestaient un désir d'engagement sans savoir comment s'y prendre: «J'aimerais m'engager davantage mais je ne sais pas comment ?».

Après l'implémentation du projet, les élèves ont montré une meilleure articulation de leurs connaissances et une plus grande confiance en leur capacité à s'engager. Par exemple, un élève a mentionné : « On peut parler de l'étude de l'impact comme on a vu avec les explications du doctorant », tandis qu'un autre a illustré ses propos en disant : « Je peux l'illustrer avec l'exemple de l'analyse de l'eau qu'on a réalisée avec Mme X ». De plus, des idées d'initiatives concrètes ont émergé, telles que : « On peut créer un vernissage et inviter des personnes mobilisées. Nous pouvons l'organiser ».

L'analyse des discours des élèves montre l'apparition de nouveaux concepts, notamment l'anticipation des problèmes de santé liés aux facteurs environnementaux, incluant les agresseurs chimiques, physiques et biologiques. Cette capacité à prévenir et à anticiper est une indication claire de l'impact profond du programme sur la formation de leur pensée critique et de leur engagement environnemental.

Les résultats obtenus confirment les observations théoriques de Jaubert (2007) sur l'importance de rendre les activités pédagogiques plus compréhensibles et significatives pour les élèves. Les réponses aux questionnaires et les entretiens semi-directifs ont montré que l'implication active des élèves dans des activités pratiques et collaboratives, comme celles proposées par le

laboratoire junior, a considérablement amélioré leur compréhension et leur engagement. Les élèves ont pu mieux interpréter et contextualiser les concepts appris.

En outre, l'importance de la formation à la participation et à l'accompagnement au changement, telle que soulignée par Considère et Tutiaux-Guillon (2013), a été mise en évidence. Les méthodes pédagogiques diversifiées utilisées dans le programme, intégrant des expériences de terrain et des projets de recherche, ont effectivement encouragé une plus grande implication des élèves. Cette approche a favorisé l'application des principes du développement durable et des politiques de santé environnementale dans des contextes concrets.

Les observations et les données recueillies indiquent que cette approche éducative a non seulement enrichi l'expérience des élèves, mais a aussi permis une meilleure appropriation des connaissances et une motivation accrue à participer à des actions environnementales. Ces résultats soulignent l'efficacité des approches pédagogiques diversifiées et pratiques pour former des citoyens responsables et engagés, conformément aux recommandations de Jaubert (2007) et Considère et Tutiaux-Guillon (2013).

Selon Jaubert (2007), les situations scolaires formelles peuvent parfois rendre opaque, aux yeux des élèves, la signification des activités et des outils pédagogiques qui leur sont proposés. Il est donc essentiel de s'intéresser à l'interprétation qu'ils font du contexte d'apprentissage initié par l'enseignant. Pour y parvenir, il est indispensable de renforcer la formation à la participation. Cela inclut le développement de la formation à l'accompagnement au changement, en mettant l'accent sur les principes du développement durable et les politiques de santé environnementale (Considère & Tutiaux-Guillon, 2013).

Les résultats obtenus confirment l'importance des approches et méthodes pédagogiques diversifiées et non culpabilisantes, comme le souligne Villaumé (2023). Les méthodes pédagogiques variées utilisées dans le laboratoire, incluant des approches scientifiques, artistiques, ludiques et imaginaires, rendent l'apprentissage plus attrayant et pertinent pour les élèves. Par exemple, les élèves ont participé à des projets de recherche scientifique sur la qualité de l'eau, réalisant des analyses d'échantillons et discutant des résultats avec des doctorants. Ils ont également créé une exposition de peinture sur les impacts de la pollution, exprimant artistiquement les enjeux environnementaux. Des ateliers ludiques ont permis aux élèves de simuler des politiques environnementales pour résoudre des crises écologiques fictives, tandis que des activités créatives, comme la conception de maquettes d'écosystèmes durables, ont aidé les élèves à visualiser et comprendre les dynamiques écologiques. Ces méthodes aident à captiver l'intérêt des élèves, à rendre les concepts complexes plus accessibles et compréhensibles, et à faciliter l'acquisition de compétences scientifiques.

En effet, à travers le programme, les élèves ont développé diverses compétences, telles que la recherche documentaire, la vérification des sources et la consultation des revues scientifiques. Ils ont également amélioré leur esprit critique et leurs compétences orales, éléments cruciaux pour leur développement global. La synergie et l'innovation ont été au cœur du programme, favorisant le développement de partenariats locaux et la collaboration entre les élèves, les doctorants, les intervenants et les partenaires. Cette collaboration a été essentielle pour l'implémentation réussie du programme et pour l'atteinte de ses objectifs éducatifs. Le programme du laboratoire junior a ainsi mis en œuvre ces principes en offrant aux élèves des opportunités d'apprentissage variées et interactives. Les activités de laboratoire, les projets de recherche sur le terrain et les interactions avec des professionnels ont permis aux élèves de développer des compétences pratiques et de mieux comprendre les enjeux écologiques et sanitaires. L'approche interdisciplinaire et participative du programme a encouragé les élèves à s'engager activement dans leur apprentissage, à développer leur esprit critique et à collaborer avec leurs pairs et les experts.

Conclusion

En conclusion, la mise en place d'un laboratoire junior d'écologie et de santé environnementale a démontré l'importance de la collaboration active des partenaires et des élèves. Les défis de coordination et d'engagement ont été surmontés grâce à une approche didactique innovante, où les élèves ne sont plus de simples récepteurs de savoirs, mais des producteurs actifs de connaissances. Cette transformation de leur rôle a eu un impact durable, préparant les élèves à devenir des citoyens écologiquement conscients et capables de contribuer de manière significative à la société.

Ainsi, cette étude met en lumière l'importance de renforcer la formation à la participation et l'accompagnement au changement, conformément aux recommandations de Jaubert (2007) et Considère et Tutiaux-Guillon (2013). En intégrant des méthodes pédagogiques diversifiées et en favorisant une approche interdisciplinaire, les programmes éducatifs peuvent non seulement améliorer les compétences scientifiques des élèves, mais aussi les préparer à relever les défis environnementaux et sanitaires de demain. L'impact durable de ce laboratoire junior témoigne de la nécessité d'innover dans les pratiques pédagogiques pour une éducation plus complète et intégrée, alignée sur les impératifs du développement durable et de la santé environnementale.

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Inspired by Laudato Sì': An Ecological Approach to Education and Training

Cristiano Chiusso[1]

Abstract

Pope Francis' encyclical Laudato Sì' offers a contribution to the third transition affecting the world, in addition to the digital and ecological one: the educational transition. The encyclical proposes the paradigm of integral ecology: it transposes the sustainability turn to which the world through the COPs adheres and complements the goals of Agenda 2030 by proposing the 7 goals of Laudato Sì', together with the ecological virtues.

Education changes radically: interdisciplinarity, experiential learning, social learning and self-learning become the cornerstones of the educational transition.

1. Introduction

The ecological transition is an issue on the agenda of governments around the world meeting at the COPs (Conference of the Parties): the United Nations Climate Change Conferences are the world's highest decision-making body on climate issues and one of the largest international meetings in the world. The host of the 28th United Nations Climate, or COP28, was held the United Arab Emirates (UAE) in 2023.

The younger generations are the ones most interested in and exposed to the ecological problem: awareness of the environmental crisis is part of their cultural background; sensitivity to environmental issues is a typical trait of the younger generation; respect for the environment and the way consumer goods are produced, the resources needed for their production, and the resulting industrial waste are very close to the hearts of young people. The key word has become "sustainability": it means a new way of life, in which respect for the environment is as important as profit, that is, that the latter should not be the only purpose of individual and social enterprise.

2. Educational Transition

The problem facing adults is the same, seen from a different angle: how to educate the younger generation about environmental sustainability? It is an issue that the older generations were not as aware of as the younger generations, since the topics of debate and discussion in the past century were more social and economic than environmental. The educational problem revolves around the question of how best to prepare new generations who, yes, have a strong awareness and sensitivity, but who nevertheless need to organize and structure their awareness into new knowledge, skills and abilities.

The professional skills of the older generations are, in fact, no longer those of the new generations: the complexity of today's society has given rise to new skills necessary to face not only the ecological transition, but also the digital one. Both transitions, in addition to making today's world complex, are intertwined, making the educational task even more difficult and challenging. It becomes necessary, therefore, to understand not only what knowledge to promote, but also what idea of the citizen of the future is at stake, in order to provide him or her with the skills needed for tomorrow's challenges.

Clearly, skills are in turn continually updated, given the liquid world of work that has changed profoundly from that of the last century. Along with skills, the ecological transition and the digital transition bring with them another transition that is implicit in the changing and transforming world but is not yet talked about enough: the educational transition. Indeed, how is it possible to educate the citizen of the future for sustainability if sustainability itself is a new subject, if the world in transition is an unprecedent world, if therefore education and training are also affected by this profound change and cannot remain the same as in yesterday's world?

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3. A New Paradigm

Sometimes the answers to such important and complex questions come from unexpected places: for example, from an encyclical.

Pope Francis' "Laudato Sì" is a valuable document for educational workers: it, in fact, suggests a new paradigm for teachers, trainers and educators who want to face the challenge of the three current transitions.

The following cognitive questions are addressed here:

- How does the integral ecology paradigm affect teaching and education?
- How can sustainability be taught in an integral way?
- Does the way of teaching remain the same as before and only the content change, with the inclusion of new subjects?

It is always worth investing in education, indeed, it is worth its life, because it is the future of humanity, the future of the planet. Education, in short, is the idea of the citizen of tomorrow, immersed at the same time in the digital and natural worlds and respectful of both as a citizen of both.

It is always equally worthwhile to invest in sustainability: the planet we have at our disposal is the only possible planet, and safeguarding it means safeguarding the future of humanity. The encyclical recalls that sustainability is not only environmental, but also social and economic. The sustainable approach is at the same time a social and economic approach: man's and woman's responsibility is also towards their neighbor and to the way they has chosen to live together with others, to make community, society; the economic system based on profit as the only value is criticized as the origin of poverty, inequality, exclusion.

The encyclical then proposes the theme of integral ecology: what does integral mean? It means that it affects the totality of existence in that everything is connected, everything is interdependent.

It announces the crisis of anthropocentrism understood as man at the center of the universe: at the center is not man, but the relationship between man and his neighbor, man and the environment, man and God for the believer; these are the three fundamental relationships of existence, interdependent on each other. If everything is connected, there is no longer a center, but a network consisting of multiple centers: natural and digital reality are an interconnection of ecosystems.

4. Goals and Virtues

The encyclical proposes 7 goals that are not meant to replace the 2030 Agenda SDG goals (Sustainable Development Goals), but to complement them in light of the integral ecology construct.

They are:

1. Response to the cry of the earth: the earth is exploited and mistreated by man, who is disrespectful of the earth as he is the cause of pollution and devastation of the environment;
2. Response to the cry of the poor: humans are also mistreated and exploited by other humans, disrespectful of the common condition of human beings;
3. Ecological economy: respecting the timing of natural reproduction of resources and ecosystems of animals and plants is urgent;
4. Adoption of sustainable lifestyles: changes in lifestyles and the introduction of less impactful daily behaviors are urgent;
5. Ecological education: an educational modality which in turn respects the environment and the human beings is urgent;
6. Ecological spirituality: not addressed only to believers, as the dimension of the question of the meaning of existence affects all human beings;
7. Resilience and community empowerment: human beings are embedded in a network made up of community relationships that has to be cultivated and respected.

Along with the above-mentioned goals, the encyclical proposes 7 ecological virtues: there is a responsibility of man to nature, to the neighbour, and to God for the believer that man can decide to assume if he is ecologically converted, assuming an existential posture marked by respect and care for the relationship with nature, with the neighbour, and with God for the believer.

They are:

1. Sobriety
2. Simplicity
3. Humility
4. Solidarity
5. Gratuity
6. Justice
7. Love

5. Ecocentrism

The ecological virtues are virtues that aim at coexistence, cohabitation, respect for the environment and for the neighbour, the change of anthropocentric paradigm whereby ecocentrism is placed instead of egocentrism.

Francis proposes nothing less than a cultural revolution, as he invites man to observe the world from a no longer self-centered point of view: he calls it "ecological conversion" in that he first, initially indifferent to ecological issues, experienced a personal crisis that led him to take a completely different perspective on nature and environment.

He addresses not only Catholics, not only Christians, not only believer of all religions: he addresses all people of good will, for the taking charge of the fragile common home challenges every inhabitant of the planet.

Ecological conversion involves the spiritual dimension of existence, beyond religions and beliefs. Spirituality, among many definitions, is the awareness that there is Something greater than ourselves, which preceded us in our existence: it is God for the believer, nature for the non-believer.

But the task that awaits the inhabitants of the planet is a common one: what shape to give to the future of our planet?

Ecological conversion reveals that man's position is no longer at the center of the universe, that he is no longer the owner of the earth: man is the owner of anything, that is the revolutionary aspect. The land has been given to him as steward, not as owner, and man's responsibility is to return it possibly intact, if not better than how he received it.

The encyclical invites man not only to contemplate nature, but also to act: it contains an ethical imperative to transform ideas into action.

A possible method is suggested to us by the Social Doctrine of the Church, namely the VE.G.A. (from the Italian Vedere, Giudicare, Agire) method, divided into 3 stages:

1. Seeing: to be able to look at the world with new eyes, in the light of integral ecology;
2. Judging: to be able how to discern what needs to be changed;
3. Act: to be able how to put it into practice, how to be the change.

6. Ecological Learning

Education plays a key role in this landscape: preparing the younger generation to inhabit change by living a new paradigm. The change comes primarily through education, which is affected by the integral ecology paradigm in quantitative and qualitative terms.

On the quantitative level, there are new disciplines, there are new skills and new attitudes to work on: ecological competences, green skills, ecological virtues to deal with the digital and ecological transition underway. On the qualitative level, the way of education also changes radically.

4 are the key points of this revolution:

1. Interdisciplinarity

If everything is interconnected, if everything is interdependent, so are the disciplines: to give an example outside the classroom, there is no such thing as mathematics, history, geography as separate areas of existence, but there is life which is made up of mathematics, history, geography. A teaching mode with separate disciplines is not respectful of real life.

2. Experiential Learning

Ecological conversion imposes a re-learning of the world from a different perspective, which necessarily passes through the subject's experience of the world. Experiential learning corresponds to this process of revising one's worldview, of questioning one's point of view in order to open up new possibilities of interpretation of reality.

3. Social Learning

If everything is interconnected, learning is also interdependent, as the human learner is always embedded in a historical and social context. The crisis of anthropocentrism also implies abandoning the individualistic view of learning in favor of a contextualized, situated, social view in which learning is a community event.

4. Self-learning

To facilitate this change, it is up to the subject to choose whether to accept responsibility for care and respect toward others, toward the world, toward God if a believer. This responsibility also invests learning: the subject, by activating personal agency, assumes consequently responsibility for his or her own learning according to directions of meaning and personal values: the educational model that best corresponds to this process is self-directed learning or self-learning.

7. Conclusions

The paradigm of integral ecology promotes a vision and practice of politics entirely centered on and animated by a new "ecological citizenship," which breaks the patterns of political representation and belonging by calling each and every person into the agora, so that each person becomes a responsible actor for the collective good, in which what is "common" constitutes the key value, connects people and constitutes them as a community.

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327 Contribution à l'élaboration d'une stratégie nationale d'éducation environnementale en Guinée

Kadiatou Barry[1]

Résumé:

La présente réflexion est une contribution dans les échanges avec les principaux acteurs du système éducatif guinéen en vue de promouvoir l'éducation environnementale en milieu scolaire à l'échelle de tout le pays.

L'intérêt pour ce sujet procède du rappel de la mémoire des engagements internationaux et nationaux de la Guinée en matière de protection de l'environnement. Le pays a en effet ratifié plusieurs conventions internationales et adopté des lois nationales portant sur la biodiversité et les changements climatiques.

Le pays est exposé à plusieurs menaces qui pèsent lourdement sur les écosystèmes entraînant leur dérèglement et leur dégradation. En effet, on constate que les couvertures forestières s'amenuisent, les cours d'eau s'assèchent, les sols s'érodent avec comme conséquence une diminution de la capacité de l'écosystème à fournir des biens et services pour ses bénéficiaires. La croissance démographique et l'expansion anarchique des établissements humains y sont pour quelque chose. Mais on sait que derrière ces menaces, il y a la responsabilité des humains qui abusent du capital naturel en dépassant les seuils de prélèvement recommandés. Il y a donc un besoin réel de prise de conscience pour promouvoir des comportements responsables vis-à-vis de la nature. Cela passe nécessairement par la préparation de la jeune génération à un engagement citoyen de protéger l'environnement.

Le système éducatif doit donc se remettre en question et repenser ses curricula pour y intégrer l'éducation environnementale de manière explicite. Il faudra évidemment pour cela disposer d'une stratégie nationale qui indiquera les principales étapes à suivre afin de mettre en place des programmes actualisés prenant en compte les thèmes environnementaux.

Cet article se veut donc à ce sujet être un apport à partager avec les principaux acteurs concernés du milieu éducatif guinéen, dans l'espoir que leur retour pourrait faire avancer l'élaboration d'une stratégie nationale d'éducation environnementale.

L'article rappelle le contexte international et les réalités nationales qui ont prévalu ces 3 dernières décennie sur l'état de l'environnement mondial et local. Il ressort les déficits de réaction constructive face aux menaces qui pèsent sur cet environnement, en particulier le manque d'une approche pédagogique claire de préparation de la jeune génération à apprendre à être des citoyens responsables face à la situation critique des écosystèmes. Il se réfère aux recommandations faites par les conférences mondiales à travers les conventions internationales ratifiées par le pays, et propose des pistes à suivre pour promouvoir une éducation qui prend effectivement en compte la dimension environnementale du développement.

1. Introduction

L'éducation environnementale est depuis plus de quatre décennies - 1972 à nos jours - une préoccupation majeure face aux menaces sur l'environnement provoquées par les activités humaines, notamment les modes de consommation qui abusent des prélèvements sur le capital naturel entraînant des gaspillages de ressources renouvelables et d'énergie. A cela sont venus s'ajouter les effets néfastes du changement climatique.

Il est dès lors important que les jeunes générations soient éduquées à comprendre les défis et enjeux majeurs qui marquent leur quotidien et à agir de manière responsable pour participer à la promotion de solutions des problèmes environnementaux.

(1) Guinée Écologie

Voilà pourquoi l'éducation environnementale doit être inscrit au centre des réflexions sur l'amélioration du système éducatif. Ce qui justifie la production d'une stratégie nationale à cet effet. Celle-ci devra entre autre s'inspirer des recommandations faites à l'échelle internationales par les institutions intergouvernementales comme l'UNESCO et les organisations internationales comme l'UICN, et des engagements de la Guinée dans des conventions internationales tout en tenant compte des lois du pays.

Un rappel du contexte mondial ainsi que le contexte national sont présentés dans les sections qui suivent et des propositions sont faites pour une discussion sur les bases d'une stratégie nationale à développer.

2. Aperçu du contexte mondial de l'éducation environnementale

C'est un euphémisme de dire aujourd'hui que le monde traverse une grave crise environnementale. En effet, après plus de trente ans de la tenue du Sommet de Rio en 1992, et la succession de rencontres mondiales appelées Conférences des Parties, cela est revenu dans toutes les déclarations et résolutions précédées de rapports et de discours d'engagement des États-Parties. On se répète sans cesse à défaut d'avoir trouvé de vraies solutions aux maux qui gangrènent notre planète Terre. C'est à se demander où sont vraiment les progrès accomplis en matière d'amélioration de l'état de l'environnement tant il est évident que celui-ci continue de se dégrader de manière plus inquiétante que jamais.

Au nombre des préoccupations ressorties dans ces conférences, l'éducation environnementale a toujours été évoquée comme une priorité à inscrire dans les programmes nationaux. Sur le mouvement de conscience à travers le monde à ce sujet des moments historiques ont été enregistrés avec comme point de départ la Conférence des Nations Unies sur l'environnement tenu du 5 au 16 juin 1972 à Stockholm en Suède[1] et la Conférence intergouvernementale sur l'éducation relative à l'environnement, du 14 au 26 octobre 1977, Tbilissi, URSS[2].

Un bref sur l'auteure de la proposition

Je suis Kadiatou Barry (Mme Diallo), biologiste de formation, diplômé de l'Université Gamal Abdel Nasser de Conakry. J'ai été attirée par l'éducation environnementale lors de stages de volontaire auprès de la Croix Rouge Guinéenne dont je suis membre depuis plus de 10 ans. J'ai été confrontée lors de nos opérations de secours à des situations environnementales inquiétantes qui m'ont renforcé dans ma conviction qu'il faut nécessairement conduire des activités de sensibilisation auprès des communautés tant urbaines que rurales sur l'importance de maintenir un cadre de vie sain en vue d'éviter les risques de santé. Au-delà de l'environnement de proximité ma vue s'est élargie également aux écosystèmes paysagers dont j'ai pu observer la dégradation et compris les causes qui sont derrière. C'est ainsi que j'ai décidé de rejoindre l'ONG Guinée Écologie (www.guineeecologie.net) et de m'engager avec cette organisation dans la promotion de l'éducation environnementale en Guinée. J'ai depuis consacré du temps à prendre part à de petits projets et à réaliser des supports visuels et audio-visuels sur les thématiques clés de l'environnement en les liant aux programmes scolaires en vigueur. Ayant une parfaite maîtrise des trois plus grandes langues nationales du pays (Pular, Susu et Maninka), j'ai ajouté à cette éducation en milieu scolaire la sensibilisation en milieu communautaire urbain et rural. Je crois dans le lien indispensable entre l'école et la communauté qui s'influencent vice-versa. Je l'applique actuellement au niveau de six préfectures de la région côtière de la Guinée à savoir Kindia, Coyah, Forécariah, Dubréka, Boffa et Boké. Je n'ai pas encore beaucoup d'expériences, c'est pourquoi je recherche toute aide utile qui me permettra de poursuivre les activités que je mène présentement sur le terrain.

Je peux, à la demande localisée, partager des rapports que j'ai préparé sur ces activités.

1 En 1972, la Conférence des Nations Unies sur l'environnement qui s'est tenu à Stockholm est la première conférence mondiale qui fait de l'environnement une question majeure. Les participants y adoptent une série de principes pour une gestion écologiquement rationnelle de l'environnement dont la Déclaration de Stockholm et le Plan d'Action pour l'Environnement ainsi que plusieurs résolutions. dont la décision de création du Programme des Nations Unies pour l'Environnement (PNUE).

2 Les principaux points inscrits à l'ordre du jour de cette Conférence de Tbilissi (1977),étaient les suivants : (i) les grands problèmes de l'environnement dans la société contemporaine ; (ii) le rôle de l'éducation dans les actions visant à faire face aux problèmes de l'environnement; (iii) les efforts déployés au niveau national et

La Déclaration de Stockholm a placé les questions écologiques au rang des préoccupations internationales et la Conférence de Tbilissi a pour sa part, cinq ans après celle de Stockholm, souligné que l'éducation relative à l'environnement doit adopter une perspective holistique tenant compte des aspects écologiques, sociaux, culturels et autres de chaque question. Si l'on adopte une telle approche orientée vers la solution des problèmes et vers l'action, l'éducation relative à l'environnement prendra le caractère d'une formation permanente et tournée vers l'avenir.

Mais il faudra attendre 1983 pour que l'Organisation des Nations unies mette en place la Commission mondiale sur l'environnement et le développement, qui va publier son rapport final en 1987 intitulé *"Notre Avenir à Tous"*.

Puis cinq ans après la Conférence des Nations Unies sur l'Environnement et le Développement se tient du 3 au 14 juin 1992 à Rio de Janeiro. Au nombre des résultats principaux de ce sommet il faut noter la Déclaration de Rio et ses 27 principes universels, la Convention-cadre des Nations Unies sur les changements climatiques, la Convention sur la diversité biologique et la Déclaration relave aux principes sur la gestion des forêts. Ce sommet a également conduit à la création de la Commission du développement durable, et a démarré des négociations en vue de l'établissement d'une Convention sur la lutte contre la désertification.

C'est dans ce contexte mondial marqué par le souci grandissant de prendre en compte les aspects environnementaux du développement que se situent l'urgence de promouvoir la sensibilisation citoyenne et l'éducation environnementale comme moyens d'élever la conscience internationale et nationale. Le but visé étant de réduire les menaces qui pèsent sur le capital naturel et l'environnement quotidien en engageant les uns et des autres à agir ensemble pour inverser la tendance pouvant aller jusqu'à la perte nette d'espèces clés de la biodiversité.

En relisant les diverses résolutions de ces grandes conférences mondiales on note effectivement les engagements de tous les États à promouvoir l'éducation environnementale.

Pour rappel, toutes les 3 conventions de Rio font une place importante à l'éducation et à la sensibilisation du public sur l'environnement et le développement durable.

La CDB, dans son article 13 engage les Pays-Parties à « favoriser et encourager une prise de conscience de l'importance de la conservation de la diversité biologique et des mesures nécessaires à cet effet et à en assurer la promotion par les médias, ainsi que la prise en compte de ces questions dans les programmes d'enseignement ».

La CCNUCC, dans son article 4, appelle les Pays-Parties à « encourager et soutenir par leur coopération l'éducation, la formation et la sensibilisation du public dans le domaine des changements climatiques et à encourager la participation la plus large à ce processus, notamment celle des organisations non gouvernementales ». Et dans son article 6, elle demande à procéder à « l'élaboration et l'application de programmes d'éducation et de sensibilisation du public sur les changements climatiques et leurs effets », et à « la mise au point et l'échange de matériel éducatif et de matériel destiné à sensibiliser le public aux changements climatiques et à leurs effets » ainsi qu'à « la mise au point et l'exécution de programmes d'éducation et de formation, etc. ».

La CCD, dans son article 19, invite les Pays-Parties à « coopérer les unes avec les autres et par l'intermédiaire des organisations intergouvernementales compétentes, ainsi qu'avec des organisations non gouvernementales, pour entreprendre et appuyer des programmes de sensibilisation et d'éducation du public ... afin de faire mieux comprendre quels sont les causes et les effets de la désertification et de la sécheresse et combien il importe d'atteindre les objectifs de la présente Convention ».

Et c'est ainsi que l'Organisation des Nations-Unies pour l'Éducation, la Science et la Culture (UNESCO),

international pour développer l'éducation relative à l'environnement ; (iv) les stratégies pour le développement de l'éducation relative à l'environnement au niveau national ; (v) la coopération régionale et internationale et le développement de l'éducation relative à l'environnement : besoins et modalités.

faisant l'état des lieux de l'éducation et de la sensibilisation du public sur l'environnement et le développement durable et constatant des lenteurs d'engagement des Pays-Parties aux Conventions de Rio, a élaboré un Plan international de mise en œuvre de la Décennie des Nations-Unies pour l'éducation en vue du développement durable (DEDD, 2005-2014) axé sur cinq objectifs : (i) dynamiser le rôle de l'éducation en vue du développement durable ; (ii) faciliter la mise en réseau des parties intéressées; (iii) promouvoir toutes les formes d'apprentissage et de sensibilisation de l'opinion allant dans le sens du développement durable; (iv) favoriser l'amélioration de la qualité de l'enseignement concernant le développement durable ; et (v) élaborer des stratégies à chaque niveau pour renforcer les capacités d'éducation au service du développement durable.

3. Aperçu du contexte national

Pays situé en zone côtière d'Afrique de l'Ouest, couvrant une superficie de 245.857 km2 et habité par près de 13 millions de personnes, la Guinée est un pays aux paysages variés qui sont drainés par plus d'un millier de cours d'eau. Le profil paysager de la Guinée est marqué par une zone côtière de 350 kms en bordure de l'océan Atlantique, les plus hautes montagnes de l'Afrique de l'Ouest, de vastes savanes sahéliennes et une zone forestière où culmine le Mont Nimba à 1750 mètres d'altitude.

La Guinée a une importante couverture forestière, de vastes savanes boisées et une zone de mangrove, cet ensemble d'écosystèmes constituant des habitats naturels de la biodiversité abritant de nombreuses espèces de flore endémique, plus de 700 espèces d'oiseaux et plusieurs mammifères dont des primates (chimpanzés et babouins), des éléphants, des hippopotames, des félins, des chauve-souris dont une espèce endémique, des amphibiens dont le crapaud-vivipare endémique à la Guinée.

Cette riche biodiversité est hélas menacée par plusieurs facteurs dont entre autres le développement des infrastructures minières, routières et des barrages hydroélectriques réalisées ou en perspective d'être réalisées.

Quant au développement urbain qui va avec une croissance démographique considérable, il y a là aussi des situations non moins préoccupantes. Les villes s'étendent sans une planification rigoureuse de l'occupation des espaces ni de directives claires de construction. Ce qui ouvre la voie à l'anarchie et au désordre visible dans les milieux urbains où se côtoient industries, marchés et habitations. Et comme conséquence, on retrouve çà et là des dépotoirs sauvages de déchets et des sources de pollutions qui exposent les populations à des risques majeurs pour leur santé.

Le pays a produit plusieurs documents de planification environnementale pour faire face à la situation. Mais les lenteurs d'exécution de ces plans ou le manque de moyens de les réaliser n'a pas permis le moindre progrès remarquable quant à la protection de l'environnement.

La Guinée a ratifié les 3 conventions de Rio et s'efforce de son mieux à en remplir les obligations. Elle prend part à toutes les Conférences des Parties où elle présente son rapport national pour chacune des conventions. Mais c'est seulement en 2019 qu'elle a pu se doter d'une Stratégie Nationale de Développement Durable (SNDD). Et la même année elle a adopté un nouveau code de l'environnement qui en son article 21 demande à l'État "d'oeuvrer à la promotion de l'éducation environnementale à tous les niveaux".

En 1994, la Guinée s'était dotée d'un Plan National d'Action Environnemental (PNAE) qui dans sa section 1.3.2. intitulée "Message environnemental" mentionnait ce qui suit: "La notion de conservation est souvent étrangère au comportement guinéen bien que des pratiques ancestrales concouraient à préserver certains espaces. Il y a là un handicap important dans la réalisation de toute action de développement durable. Le changement des habitudes et des comportements demandera certainement beaucoup de temps, mais c'est une obligation, que devrait prendre en compte les médias, et les contacts qu'ont avec les citoyens, les responsables politiques, les agents de la fonction publique, les membres des ONG, etc...

Quelques initiatives pour intégrer l'éducation environnementale en milieu scolaire ont été

néanmoins entreprises à une certaine échelle. C'est le cas de l'appui du Programme d'Aménagement des Bassins Versants du Haut Niger et de la Haute Gambie financé par l'Union Européenne dont l'une des composantes portait sur l'éducation environnementale. Puis au cours des années 2000, le Partenariat Régional pour la Conservation de la Zone Côtière et Marine d'Afrique de l'Ouest (PRCM) sur financement de la Fondation MAVA a aussi lancé le Programme Régional d'Éducation Environnementale (PREE) qui couvrait 5 pays de la Sous-Région à savoir la Mauritanie, le Sénégal, la Gambie, la Guinée Bissau et la Guinée. Deux ouvrages ont été produits comme supports pédagogique d'éducation environnementale dans les écoles du littoral de ces pays. Mais toutes ces initiatives fort louables du reste n'étaient basées sur aucune stratégie nationale. D'où les difficultés à poursuivre les activités une fois que les projets ont pris fin hélas. Ces deux dernières années, l'Herbier National de Guinée, Royal Botanical Garden - Kew et Guinée Écologie se sont mis ensemble pour développer un programme d'éducation environnementale pour la protection d'arbres menacés en Basse Guinée et en Guinée Forestière[3].

Le problème fondamental est donc le manque de stratégie et de plan d'action au niveau national pour favoriser l'éducation environnementale sur l'ensemble du territoire. Ce vide qui pourrait être comblé est de la responsabilité régalienne du Ministère de l'Éducation Nationale à travers la Direction Générale de l'Institut de Recherche et d'Action Pédagogique qui est sur le point de produire la stratégie en question.

4. Vers une stratégie nationale d'éducation environnementale: principes et grands axes

En matière de stratégie d'éducation environnementale, ce ne sont pas des expériences et des leçons apprises à travers le monde qui manquent. Elles sont nombreuses qui sont documentées et qui peuvent bien inspirer les pays qui en manquent comme c'est le cas de la Guinée. Bien qu'ici aussi ce ne soit pas un vide absolu depuis qu'en 1996, avec un appui d'un projet financé par l'Union Européenne, il a été produit un premier document-guide sur l'éducation environnementale en milieu scolaire. Le pays a, en outre, crée une institution entièrement dédiée à cette préoccupation qui est le Centre d'Éducation à l'Environnement et au Développement (CEED) de Pita qui a vocation de former les enseignants capables de conduire des activités pédagogiques d'éducation environnementale à travers sur l'insertion des thèmes environnementaux dans les curricula. Ce centre est hélas pour le moment dépourvu des moyens de sa mission. Il y a donc certes un effort à reconnaître, mais aussi un besoin crucial de renforcer le cadre de l'éducation environnementale avec une stratégie forte pouvant orienter la conduite d'activités pédagogiques efficaces en milieu scolaire guinéen.

La **vision** de cette stratégie pourrait s'énoncer ainsi qu'il suit : **« Des élèves, jeunes citoyens et citoyennes engagé(e)s et responsables vis-à-vis de leur environnement grâce à des connaissances, des compétences et des pratiques solides assurant la protection des milieux naturels et cadres de vie dans lesquels ils évoluent ».** Il s'agit comme disent certains sous d'autres cieux « préparer le futur dans le présent ».

L'**objectif global** de cette stratégie serait de dégager dans un document de référence les principes et les axes permettant de préparer des plans d'action et des projets pertinents d'appui à l'éducation environnementale.

Comme **objectifs spécifiques** on retiendrait :

Sous l'égide de l'INRAP :

i. S'accorder sur des **principes** à prendre en compte, à savoir, et pas seulement :
   - Intégration explicite de thèmes environnementaux dans les curricula en vigueur ;
   - Liaison des thèmes proposés aux réalités locales ;

3 L'auteure de cet article (Kadiatou Barry) est la chargée de ce programme dans plusieurs écoles de 3 préfectures en Basse Guinée et 3 préfectures en Guinée Forestière. Elle est également co-auteure avec Charlotte Couch de deux ouvrages et de supports visuels d'éducation environnementale portant sur la protection des arbres menacés en Guinée.

- Approche pédagogique intra-muros renforcée par la pratique de terrain ;
- Rattachement aux engagements internationaux en matière d'environnement, biodiversité et climat ;
- Prise en compte des recommandations du Congrès Mondial sur l'Éducation Environnementale qui se tient tous les deux ans depuis deux décennies, des guides de l'UNESCO, de la FAO et de l'UICN sur l'éducation environnementale ;
- Participation des parents d'élèves ;
- Communication des résultats;
- Capitalisation et réutilisation des meilleurs pratiques.

ii. S'accorder sur des **axes** à suivre, à savoir, et pas seulement :

- Élaboration de programmes de formation des enseignants ;
- Préparation de guides des enseignants ;
- Préparation de supports visuels et audio-visuels ;
- Reproduction de matériels pédagogiques ;
- Diffusion de supports d'éducation environnementale ;
- Mobilisation des ressources financières ;
- Accompagnement de projets ;
- Préparation d'une stratégie de suivi-évaluation ;

5. Conclusions

Le présent article est un plaidoyer citoyen et une contribution personnelle en faveur de la promotion de l'éducation environnementale en Guinée, espérant qu'il sera pris en compte dans la réflexion nationale sur ce sujet brûlant.

Il est urgent d'entreprendre ce chantier comme une priorité dans le secteur de l'éducation. Il s'agit. en effet de prendre en compte les enjeux environnementaux dans le développement de la mentalité et du comportement de la jeune génération pour un présent et un avenir durable à travers les programmes d'enseignement. Le pays ne s'en portera que mieux avec des citoyens éduqués à être responsables de leur environnement.

Il faut espérer que les autorités de l'éducation pourront s'intéresser aux idées que cet article aborde. Aussi qu'il y ait un élargissement des échanges sur la question à l'ensemble des acteurs intéressés. Et quid pourquoi pas d'États Généraux sur l'Éducation Environnementale en Guinée.

Références:

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"Programme d'éducation environnementale en milieu sccolaire: leçons de trois pays africains", 2000.

3. **UNESCO**
"Décennie des Nations unies pour l'éducation en vue du développement durable", DEDD, 2002.

4. **République de Guinée**
"Code de Protection de l'Environnement", 2019.

Femmes d'une Association Locale de Conservation de la Nature - Village de Pellel Koura, Labé, Guinée.

Kadiatou Barry, Auteure de cet article, première à droite, en compagnie d'élèves et de leur enseignant d'une école primaire de Kindia, Guinée.

Kadiatou Barry, l'auteure de cet article, en pleine campagne de sensibilisation et d'éducation environnementale dans des écoles élémentaires et avec des communautés rurales de Guinée.

338 FuturePitch@Smartfeld: Prototyping Tomorrow with Entrepreneurship and New Technologies

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Abstract

In 2015, 17 Sustainable Development Goals (SDGs) were defined as an urgent call for global action. "Creating tomorrow" sustainably requires innovative use of new technologies and interdisciplinary collaboration. FuturePitch combines STEM education with sustainable development, aiming to provide self-efficacy experiences in technology, entrepreneurship, and SDG challenges. Students engage in hands-on activities, creating and refining prototypes. This workshop fosters critical thinking, teamwork, and communication, inspiring students to contribute to sustainable development through innovation.

Introduction

The United Nations defined 17 Sustainable Development Goals (SDGs) in 2015 as an urgent call for action by all countries in a global and collaborative partnership (United Nations 2015). The SDGs aim to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030.

Sustainable Society and the Aspects of Innovation, Entrepreneurship and New Technologies

"Creating tomorrow" with such a sustainable world in mind means that society is fundamentally dependent on continuous innovation, which in turn thrives on a steady influx of new ideas. In order to tackle the complex and multifaceted challenges posed by a sustainable development (Akkari und Maleq 2020), societies thus must foster (learning) environments where creativity and innovative thinking are encouraged and supported.

But creativity and innovation alone are still not enough. Even the best ideas need advocates who can effectively communicate and sell them to the broader public. This requires individuals with the skills to discuss, pitch and promote innovative ideas.

Additionally, it requires teams with a collaborative skills set in order to realize these ideas by transforming them into tangible products and solutions. Because only the combination of persuasive communication and practical implementation ensures that innovative ideas gain the traction and support necessary for widespread adoption and implementation.

Finally, the use of new technologies can act as a powerful additional catalyst in achieving the SDGs (Mondejar *et al.* 2021). Creative use of advanced technologies such as artificial intelligence (AI), big data analytics, and the Internet of Things (IoT) enable more efficient and effective solutions to complex global challenges. For instance, AI-powered precision agriculture technologies can optimize resource use and increase crop yields, directly contributing to SDG 2: Zero Hunger. Similarly, IoT-orchestrated renewable energy technologies such as solar and wind power together with smart storage solutions can play a crucial role in achieving SDG 7: Affordable and Clean Energy. Likewise, digital platforms and communication tools can enhance education or healthcare delivery, supporting SDG 4: Quality Education and SDG 3: Good Health and Well-being. By leveraging the potential of these cutting-edge technologies, society could accelerate progress toward the SDGs, ensuring that sustainable solutions are scalable, inclusive, and impactful.

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Fostering innovative thinking, entrepreneurship and experiencing positive self-efficacy in the combined fields of new technologies, STEM-education (science, technology, engineering and math) and SDGs were the main ideas behind the development of the FuturePitch-Workshop at Smartfeld (www.smartfeld.ch).

Workshop Overview

Goals and Objectives

The primary goal of FuturePitch is to enhance learners' self-efficacy in applying new technologies and entrepreneurial skills to address SDG-related challenges. Key objectives include (1) encouraging students to apply their personal imagination and problem-solving skills in impactful ways (2) developing competencies in new technologies, problem-solving, and entrepreneurship through hands-on activities and (3) fostering an understanding of entrepreneurship, scalable solutions and their benefits in addressing global challenges.

Structure and Implementation

The workshop has been designed as a co-creative partnership project between the school and the extracurricular educational lab Smartfeld. It consists of four to six preplanned lessons conducted at school and two half days spent at Smartfeld. The structure intentionally ensures that the SDG awareness-raising and the creative phase occur within the school environment in order to prevent an over-favorable perception of Smartfeld as the "cool & innovative place" and the school just as the "normal place." In this setup, schools serve as the incubators for idea generation and as a “take-off base” of an exceptional learning experience, while Smartfeld provides the resources and expertise to further develop, refine and technologize these ideas. This approach reinforces the role of teachers, positioning them as key facilitators in the creative process and ensuring that the school remains a central and engaging part of the learning journey.

School Phase 1: SDG – Sensibilization and Ideation

In Phase 1 of the workshop, students are sensitized to the Sustainable Development Goals and then regroup into interest-based teams aligned with specific SDGs. To do so, they are presented with various challenges, framed as short stories about potential inventions that could help achieve the SDGs. These challenges not only encourage students to think creatively and collaboratively about innovative solutions but also help them understand that global issues can also be addressed locally. This phase raises awareness about the global and local importance of the SDGs and inspires students to actively engage in developing impactful ideas that can make a difference in their own communities.

To enhance the ideation process, students are engaged in typical creativity exercises common in the design-thinking toolbox (Lewrick *et al.* 2020), e.g. "30 Circles" or "Create as many ways as possible for a duck to cross a street without walking". These exercises aim to convey that the core message or idea is what truly matters, rather than the aesthetic quality or realistic aspects of a first solution. By emphasizing the importance of innovative thinking over perfection, these activities encourage students to freely explore a wide range of ideas and develop their creative problem-solving skills.

School Phase 2: Prototyping and Plussup-method

Now, the ideas are brought together into an analog prototype, such as a model made from cardboard and glue (figure 1). This process helps to manifest the idea, making it tangible and open to further development. To enhance this development, we use the "plussing" method, popularized by Pixar, which is a collaborative brainstorming technique designed to enhance and build upon initial ideas in a constructive manner rather than just pointing out what`s wrong. Instead of saying "no" or "but," students say "yes, and..." to add their own thoughts to someone else's idea with the mindset of letting the other person’s idea shine. We observed that this approach tremendously helps to induce a positive and creative atmosphere with a feeling that everyone's ideas can grow and get better. By working together and plussing to each other's suggestions, students very often realize that they can make their projects together far more exciting and effective as the original idea.

The plussing-additions are collected and, if agreed upon, incorporated into the cardboard prototype, enriching the initial concept. Additionally, students complete in this phase a paper-sheet project organizer to document their output and to prepare for a smooth and efficient transfer of their project to the Smartfeld Lab.

The project organizer sheet lists the team members, the SDGs the project addresses, the purpose and function of the analog prototype, the challenges faced, the approach taken, and the solutions developed. To facilitate understanding for themselves and for the Smartfeld-team of how the prototype should work students also create an instruction manual. Since the prototype is analogue, the project organizer concludes with a section for technical questions addressed at the Smartfeld-team, e.g. which technical tasks the analogue prototype should be able to perform at the pitch event.

But only on the surface this last section seemed to be addressed to the Smartfeld-Team. It`s real purpose is to relieve the teacher of any technical responsibility or questioning so that they are not put off by the apparent technical complexity of technologizing an analogue prototype – these questions thus remain the responsibility of the Smartfeld team to solve.

An example for a typical challenge that was developed together with teachers and pupils is the development of a more sustainable and more user-orientated drinks vending machine (see figure 3). SDG-related ideas include saving on plastic bottles by preparing drinks from local fruit syrup, which is diluted with still or sparkling water according to taste and poured into users' cups or bottles. As different juices can be dispensed, the machine allows individual flavours to be mixed. To make it attractive to users, it recognizes the user, knows their individual preferences and can support the user's health by, for example, reducing the sugar content over time, reducing the amount of caffeine in the drinks (as many students currently prefer caffeinated drinks but want to reduce their daily caffeine intake) or, for example, adding certain vitamins that the user prefers or needs in their drinks.

The realization of the analogue prototype is typically a large cardboard-box with a slot where you can place your mug or bottle, and the project-organizer-sheet includes questions like: Really? How can a cardboard-box ID you? How do we program this? And – How can we show at a pitch that this sustainable drinks vending machine knows when the bottle is full?

This might demonstrate why we allow to keep the technical solutions out of the ideation phase and, if preferred, out of the responsibility of the teacher – even the experts at Smartfeld are often challenged by some if not most of these questions on how to use new technologies to promote the SDGs.

Other challenges include a waste bin, shown in figure 1, that helps users dispose of their waste correctly and promotes the recycling process, a user-friendly and energy-efficient smart home, a movement game for school breaks that helps to relax and promotes concentration or a “plant taster” – an agricultural robot who can recognize plants and their needs and then supply them individually with water and fertilizer, thus strongly saving resources.

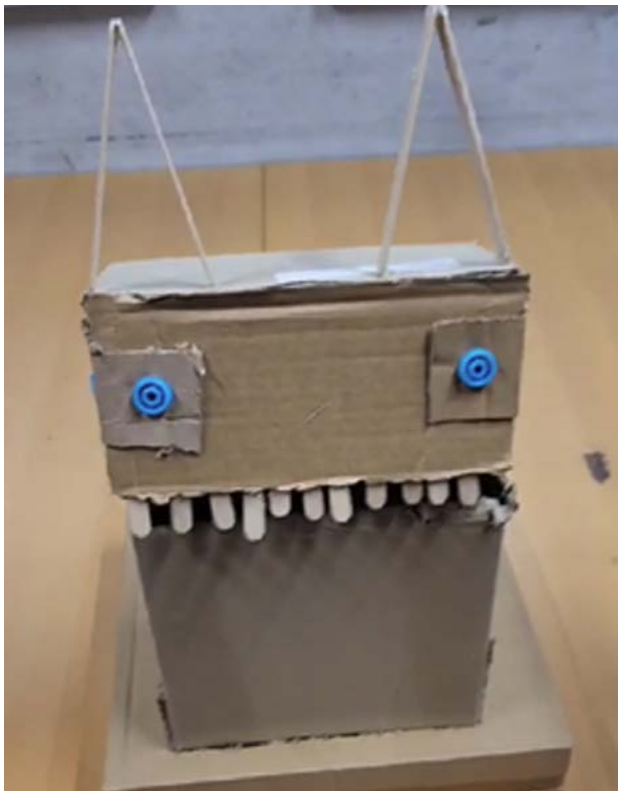

Figure 1: Example of a cardboard prototype of a "Recyclomat", a waste-bin which shall help users to collect and recycle waste. It senses that users are close-by (e.g. ultrasonic sensor), attracts them to use the waste-bin (e.g. by attractive light signal or sound) and sorts the waste (e.g. by color sensor and moving internal wiper). Waste bins energy supply shall be by solar cells.

Smartfeld Phase 1: Technologization

In the first phase at Smartfeld, students bring their analog prototypes along with their ideas to further develop them. Here, they are tasked with adding sensors, actuators, and the micro:bit platform to enable their prototypes to perform their intended tasks conceptually. For example, in the case of a drinks vending machine prototype, the students would demonstrate that it can identify a mug and pour an individualized drink into it. This part of the workshop is the most complicated, as many students are not familiar with using sensors and actuators or programming them. To alleviate fear or the feeling of "I cannot do this," we introduced the Smartfeld bit:boards (figure 2). The Bit-boards demonstrate over 28 different circuits with which students can directly interact. They can explore how the same sensor or actuator can be used for different tasks, such as using an ultrasonic sensor to measure distances or to sense when a mug is full, and on how to use colored LEDs e.g. to simulate hot or cold water flowing from one tank into another. By experimenting with the bit:boards, students gain numerous ideas on how to conceptualize and enhance their prototypes, making the task of integration of technology much more accessible and engaging.

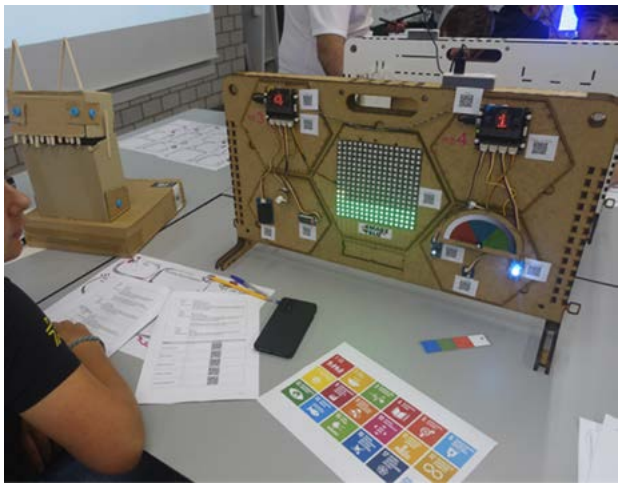

Figure 2: A Smartfeld bit:board which enables students to interact instantly with sensors and actuators and explore potential integration into their prototype. QR-codes on bit:board link to an online-wiki with information and code-examples for sensors and actuators to use and adapt.

All circuits of the bit:Board are documented in a Wiki, where examples of the block-based software code in Microsoft MakeCode are stored, along with explanations of how the sensors or actuators actually work and can be programmed. This resource allows students to quickstart with a working example they have just experienced and that they can then modify and adapt to the specific task they want to incorporate into their prototype. This approach is crucial for the workflow at Smartfeld, as it enables the teams to work independently and in parallel from each other and efficiently reduces the need for technical support for common programming task. Thus, the Smartfeld-experts can refocus on answering to more complex questions of the students.

More importantly, students learn that many of their apparently very specific tasks can be solved by adapting existing and documented code solutions, rather than having to design it from scratch - very similar to today's approach to programming.

By providing this wiki with accessible, pre-written code-examples and clear instructions, students experience a workflow where they can focus on customizing their projects and applying their newfound knowledge effectively – and see how their analogue prototype becomes more and more interactive and engaging.

At the same time, this phase allows us to address various challenges posed by modern technology, for example: What advantages, but perhaps also disadvantages, can there be if the drinks machine knows you personally - is it perhaps enough for it to recognize the cup instead - and what difference does this make from a data protection perspective?

In this phase, the project increasingly follows the typical basic concepts of design thinking, especially experimental iteration, and as the prototype becomes more and more tangible, new ideas develop that can be tested and implemented directly, which in turn often lead to further new ideas.

Smartfeld Phase 2: Refinement, Pitch and Discussion

The second phase culminates in the pitch of the prototype, which serves as a significant motivation

for the teams. This impending pitch drives them to integrate the most suitable and feasible ideas into their prototypes within the remaining available time. To ensure that innovative ideas which may exceed the current programming skills of the students or are technically constrained are not left out, students are encouraged to include a future outlook in their pitch. They might say, "Additionally, our machine will soon be able to do this ... and thus address that SDG...." Since the success of their pitch hinges on the overall persuasiveness of the project, students tend to select solutions that appear achievable rather than presenting mere fantasies. This approach ensures a balance between creativity and feasibility, highlighting practical and convincing solutions.

Figure 3: The sustainable drink vending machine is an example of a technologized prototype presented during the pitch in Smartfeld Phase 2. This machine can detect individual cups using color codes on the bottom of the cups and a color sensor. Upon identification, it automatically loads individualized drink preferences, which users can adjust, such as sugar content. The mixing and pouring process is visualized with colored LED stripes. Additionally, the machine tracks metrics such as sugar or caffeine intake and provides support to the user based on their consumption patterns.

After the pitch, a short retrospective session begins, during which the different projects, the solutions their prototypes offer, their potential impacts concerning the SDGs, and the teams' experiences during the workshop are discussed. Given that the whole second phase at Smartfeld is particularly energetic and demanding for the students, teachers are also encouraged to discuss the outcomes of the workshop in more detail during regular school lessons. Since all resources are open source, the prototypes can be brought back to school for further refinement or more detailed discussion, thus enhancing the conversation about the use of new technologies for a sustainable future.

Outcomes and Discussion

Feedback from students and teachers shows that FuturePitch has the potential to efficiently foster skills related to the SDGs and STEM. Participants report increased self-efficacy after moving from theoretical discussions to concrete problem-solving activities. The workshop not only promotes critical thinking, teamwork and effective communication, but also instils a strong problem-solving mindset, which is essential for future challenges.

The FuturePitch workshop has yielded several key findings that underscore the effectiveness of its approach. Firstly, the importance of making tangible objects cannot be overstated; hands-on creation helps students to better understand and engage with the concepts they are learning.

Analogue prototyping, in particular, creates significant value to the ideation process by allowing students to visualize and iterate on their ideas in a physical form. This approach also underscores the product-oriented nature of the workshop, which focuses students' motivation on creating viable, but innovative solutions. Additionally, the pitch component of the workshop promotes along with entrepreneurship a sense of ownership over the projects, as students must articulate and defend their ideas to their peers and mentors. Finally, the "work in progress" approach inherent in the pitch and prototype format encourages continuous improvement and iterative development, fostering a mindset of ongoing learning and adaptation.

On the other hand, the prototype status of the solutions presented avoids the claim that viable solutions for a sustainable future can be created within just a few days. The workshop does not claim to find real solutions. Instead, it emphasises from the outset that the aim is to develop the necessary skills to understand and tackle the SDGs.

However, the key element for the 'creative flow' observed during the workshop seems to be the development of the Smartfeld bit:board, i.e. a tool that (1) significantly lowers the access barriers for the creative use of modern technologies and (2) enables individual experimentation. As the bit:board is always close to the students during the technologization- phase, 'just-in-time' learning is supported, i.e. the pupils can deal step by step with precisely the technical or programming problem that interests them most at the time - allowing for a personal "flow"-experience in the combined field of SDGs and new technologies.

These elements combined create a robust educational experience that effectively integrates innovation, self-learning, entrepreneurship, and sustainability. By bridging the gap between theoretical learning and practical application, FuturePitch enables young learners to see the potential impact of their creativity and problem-solving skills on global challenges.

Conclusion

The FuturePitch workshop exemplifies how entrepreneurship, technology, and sustainability can be blended into an engaging and cohesive learning experience that prepares young individuals to be proactive contributors to a sustainable future. The workshop not only addresses the urgent need for innovative solutions to SDG challenges and the potential of the use of new technologies to address these - but also empowers the next generation of inventors with confidence and skills to make a difference.

Smartfeld at a Glance

In St.Gallen, the higher educational institutions have created a common lab to fuse technology and creativity for STEAM-Education: Smartfeld (www.smartfeld.ch). Smartfeld currently reaches out to 4000 pupils per year. Backed by foundations, it started in 2022 to develop, implement and run its new open source workshop "FuturePitch: Prototyping tomorrow" by combining the creative potential of its partners and active teachers in a co-creative approach based on the OECD Learning compass 2030 (OECD 2019). In short, it tackles SDGs, future skills and physical computing in co-creation with active teachers and influenced by entrepreneurial start-up spirit. Smartfeld's feedback loops represent a shortcut between teacher education and the students' educational system, thus "lessons learned", as well as established good practices, can rapidly be distributed and discussed between relevant stakeholders, as well as disseminated, e.g., via teacher training events, conferences and research-based formats.

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Principles of Education Practices for Sustainability in the Amami Islands - A Structural Analysis of the Amami "Environmental Culture" Education Programs of Higher Education Institutions

Yuko Oguri[1]

Abstract

Based on the perspective that the island is an effective field for considering the requirements and measures to sustainably utilize limited resources and maintain livelihoods and productive infrastructure, the author has developed, implemented, and designed the Amami "Environmental Culture" Education Program based at Kagoshima University. The purpose of the Amami Education Program is to help people understand the regional characteristics of their own islands and communities from the perspective of Amami's "Environmental Culture," to gain a deeper understanding of the unique characteristics of each island and community, to enhance its value, and to support the creation of new jobs and creative solutions to life and community issues.

This research analyzes and organizes the theory underlying this educational practice, focusing on the principles that drive the program and the logic behind the curriculum organization. Inconclusion, author clarified that both academic and indigenous knowledge are needed to understand the "complexity" of SD, and that productive activities are required to discover and enhance the value of the connection not only with people but also with the nature and history of the local area. It has also become clear that the 17 goals of Agenda 2030 are embedded in a hierarchical structure within the Amami "Environmental Culture" Education Program itself.

Introduction

The land area of Japan consists of many islands. The five most commonly known islands are, from north to south, Hokkaido, Honshu, Shikoku, Kyushu, and the main island of Okinawa (mainland). However, there are 416 islands other than these that are inhabited (census, 2020). In contrast to the mainland, these islands, which we call remote islands, are completely surrounded by the ocean and are characterized geographically by their relatively small land masses compared to the mainland (main islands)*(Miyauchi, 2016*). On the other hand, the socioeconomic characteristics of remote islands have always been problematic, and measures have been taken to address the backwardness, or socioeconomic disparity, caused by their isolation from the mainland. Conversely, however, their physical isolation makes them an appropriate field for considering requirements and measures to sustainably utilize limited resources and maintain livelihood and production infrastructure. In fact, the author has been studying the Amami Islands (8 inhabited islands, 12 municipalities, total population of 104,088 (2020)), located between Kyushu and the main island of Okinawa, to envision a sustainable society and to study the educational requirements there. This study is an introduction to one such attempt.

This study takes the position that an important requirement for the formation of a sustainable local society is to make use of the resources available on the island to create jobs, earn money, and circulate the earned money within the island. However, islands cannot live on self-sufficiency, and while trade and exchange with the outside world is essential, it is important for the region's self-sustaining development not to be overly dependent on it. What kind of learning and educational opportunities, then, will support the realization of these things? The development and implementation of the Amami "Environmental Culture" Education Program sought to address and

(1) Kagoshima University

clarify this issue. This study presents an overview of the program and clarifies its features and principles.

1. Outline of the Amami "Environmental Culture" Education Program

Since FY2021, Kagoshima University, led by the author, has been developing, implementing, and designing the Amami "Environmental Culture" Education Program (hereinafter referred to as the Amami Education Program) for working people living in or planning to move to the Amami Islands (Amami Oshima, Kikaijima, Tokunoshima, Okino-erabujima, and Yoronjima).

The purpose of the Amami Education Program is to redefine the regional characteristics of the island/shima (community) where they live from the perspective of Amami's "environmental culture," to gain a deeper understanding of the regional individuality of each island/shima, to enhance its value, and to support the creation of new jobs and creative solutions to lifestyle and community issues. The curriculum of this program has been designed with the goal of forming a mindset for sustainable utilization of local resources, acquiring basic knowledge and skills, and encouraging the creation of friendships. The Amami Education Program is the collective name for several programs (courses), and is still in progress as of FY2024, through a process of trial and error, including restructuring the content and launching new programs based on socioeconomic trends surrounding the archipelago and the needs of the region and students.

The total number of hours for each program is approximately 70 hours, the duration of the program is approximately 6 months, and the number of applicants is approximately 30 for each course. In designing the program, we were careful to make it equally accessible to people from all over the Amami Islands, regardless of family financial situation, educational background, or study history. This is also the reason why the program is free of charge. Traveling to the mainland Kagoshima Prefecture, as well as between the archipelago, is expensive and time-consuming. For those who could not access the course online, we asked the local municipal governments to provide the necessary equipment and location. Lectures were held mainly on Saturdays, Sundays, and evenings, and the number and frequency of lectures per month were adjusted to reduce the impact and burden on work and daily life as much as possible. On-demand lectures and real-time simultaneous delivery of lectures were combined to ensure opportunities for mutual learning among lecturers and students.

Amami environmental culture is not something that can be understood only through the acquisition of academic knowledge or objective knowledge, but is a manifestation of "complexity. The islanders themselves, who live in the natural environment of Amami, are the bearers of the inheritance and creation of <environmental culture>, and learning is not possible without the opportunity to directly experience it on the ground. The curriculum was unique in that it included practical training with overnight stays on five islands, where not only local experts but also local villagers and local businesses served as lecturers (educators), providing opportunities to learn about indigenous knowledge in a variety of ways.

2. Principles Driving the Amami Education Program

The principles that drive the Amami Education Program are the ideas and concepts that drive the program, and can be read as the scope of the program and its methods.

The principle (basic idea) of the Amami Education Program lies in the motivation for its launch. At the time, the Amami Islands were suddenly experiencing an active influx of people, goods, and money (capital) from outside the islands in anticipation of the registration of Amami Oshima and Tokunoshima as World Natural Heritage sites in the summer of 2017. If the market value of the Amami Islands increases as a result of their registration as World Natural Heritage sites, it is only natural that foreign capital would come to the islands. From the standpoint of the theory of endogenous development*(Tsurumi & Kawada, 1989)(Oguri, 2005)* and the philosophy of "JIMOTOGAKU" (local learning or neighborhood studies)*(Yoshimoto, 1995)(Yoshimoto, 2008) (Oguri, 2008),* it is

necessary to be able to convert outside power into a force for independent development of the islands, i.e., the islanders themselves must reaffirm the value and attractiveness of the Amami Islands and act while choosing what to protect and what to change. The most fundamental idea is to provide learning opportunities to support this.

The idea of <environmental culture> was the basis for realizing this. The concept of "environmental culture" was born in the 1990s when Yakushima Island in Kagoshima Prefecture became the first island in Japan to be registered as a World Natural Heritage site, as a strategic image for the development of a new region. The strategy was to evaluate the historically accumulated relationship between nature and people on Yakushima Island as "environmental culture" and to make the most of it for the sake of regional individualization, in order to create a region that aims for both nature conservation and development. At the same time, this attempt had the double meaning of addressing the historical issues common to all civilizations in the world, where the balance between the natural world and human activities has been disrupted since the modern scientific and technological civilization. "Environmental culture" is proposed as 'the totality of the processes and results of human interactions with nature that have been historically created in the unique natural environment,' and is more specifically defined as "the totality of the consciousness and lifestyles and modes of production formed and acquired by the people of the islands as they interacted with and influenced nature on the islands".

The scope of the program covers the entire Amami Islands. Only two islands (including the three attached Islands) have been registered as World Natural Heritage sites, and Kikai Island, Okinoerabu Island, and Yoron Island have been excluded. However, the value of the Amami Islands cannot be reduced to the scientific value of a World Natural Heritage site. The Amami Islands have natural and geographical characteristics that are unique to each island or territory (village), which are described as "high islands (mountain islands)" and "low islands (plateau mountains)". In addition, the islands have a unique history of complicated administrative governance (expanding and contracting national territory) as a national "border area," including the Ryukyu Islands, the Satsuma Clan, and U.S. military rule, and the culture that has been nurtured in the midst of this history. The postwar reconstruction of the Amami Islands was slower than that of the mainland, and the spirit of "yui" (unity), valuing nature and people, is still alive in the Amami Islands.

The first issue to be addressed by the Amami educational program is support for professionals. We did not limit industries or attributes, but targeted a wide range of people, including private sector, civil servants, and village support workers, in order to form clusters for practice across industries and disciplines. However, from the outset, there was also a plan to expand the developmental program to meet more specialized needs in the future. In fact, in the second year, a core program was established as a basic course, and in the third year, a new social implementation program for <Environmental Culture> was developed and implemented.

3. Curriculum Logic

Curriculum logic refers to the way of thinking that serves as the basis of values and standards of judgment when organizing the curriculum. Curriculum is composed of educational objectives, learning goals, abilities to be acquired, learning outcomes, educational content, educational methods, etc. In this section, we will focus on the most important aspects of the program content organization.

The common goal of all courses in the Amami Education Program is to "acquire a deep understanding of Amami's environmental culture, enhance its value, and acquire the mindset, basic knowledge, and skills to utilize it sustainably as a local resource. The curriculum of the 2022 core program developed to achieve this goal is described below.

The challenge in organizing the curriculum is how to combine limited resources to achieve the set goals. It is not easy to maximize the effectiveness of the program, given the constraints of time, budget, and instructors that can be arranged, while also considering the mindset to be fostered, the knowledge and skills to be acquired, and the exit

options after completion of the program. This program, which is not limited by age or educational background, also entails the difficulty of taking into consideration the diversity of the participants.

In developing the curriculum, the author and other instructors exchanged opinions, and the curriculum was reorganized as necessary to reflect the opinions of the students. It was also important to organize the curriculum based on the principles of learning content organization in social education and adult learning theory, so that the learners themselves would be actively involved in selecting the abilities to be acquired and the content and methods of learning. It was a process of continuous trial and error, but the following are some of the key points.

Table 1 shows an overview of the curriculum of the program implemented in FY2022.

Table 1: Curriculum overview of the core Program

Subject Groups	Video Viewing	Topic Based Handouts	Live Streaming	Face-to-Face	Total
1) Environmental Culture as Deciphered from Cultural and Historical Perspectives	4.5	0	3.5	0	8
2) Environmental Culture as Interpreted from Nature	4.5	0	4.5	0	9
3) Creation and Collaborative Formation of Environmental Culture	3	0	8	0	11
4) Experiencing Environmental Culture (practical training)	0	3	3	24	30
5) Environmental Culture Connected to Real Life	1.5	0	7.5	3	12
Total hours	15.5	3	26.5	27	70

The subjects (1) to (5) in Table 1 are designed to understand Amami's <environmental culture> and its value. To this end, the program was designed to deepen students' understanding of the unique characteristics of each island and community by considering the influence of natural characteristics and history, by actually experiencing the sites, by considering the information they have seen and heard, and by exchanging opinions with lecturers and other students. The point was that understanding <environmental culture> requires both interdisciplinary knowledge (academic knowledge) and the wisdom of daily life rooted in nature and history (indigenous knowledge).

Although the former was divided into two subject groups, (1) culture and history and (2) nature and geography, careful selection of what constituted basic knowledge was required within the limited time available. Regarding culture and history, the history of the Ryukyu Kingdom and the Satsuma Domain, and the accompanying differences in settlement structures, dialects, etc., were also important points. As for nature and geography, understanding the archipelago's topography and climate, as well as its marine and terrestrial ecosystems, was fundamental. The combination of researchers and practitioner teachers was also a necessary requirement in understanding the region.

Table 2 shows the components that have been used as criteria in assembling the practical training to be conducted on each of the five islands over a two-day period (subject group(4)).

Table 2: Kagoshima University, Amami <Environmental Culture> Practicum Content Structure

Point 1	To make a tour of the island's characteristic nature and geography and to identify its historical landscape Natural elements and natural
	a) Natural elements and natural environment: natural characteristics of mountain islands and plateau islands b) Anthropogenic and historical elements: relationship between natural and geographical characteristics and history
Point 2	Visit two villages on two separate days
	c) Settlement walks, d) Environmental and cultural experiences, e) Interviews with villagers, f) Mini-symposiums and roundtable discussions
Point 3	Summary of practi cal training
	g) Workshop

Local coordinators were selected for each island, and practical training was planned and implemented through discussions with the coordinators. The emphasis of the practical training was on a comparative perspective, which overlaps with the previously mentioned content. This meant a comparison of the five islands and also a comparison within the same island and between villages. Point 1, shown in Table 2, confirms in the field what was learned in advance in the subject groups (1) Culture and History and (2) Nature and Geography in Table 1 in principle. Point 2, on the other hand, is an opportunity for training in another type of knowledge for understanding <environmental culture>, namely, indigenous knowledge and how to acquire that knowledge. The islanders are the bearers of the inheritance and creation of environmental culture, and they are also the owners of "knowledge" that cannot be formalized. In particular, they treat their feelings toward the island and its people as important "knowledge. It is knowledge acquired through experiences deeply rooted in the land.

In order to understand the unique spatial structure of the islands, the participants are given the opportunity to walk around the village asking local residents to guide them (see (c)), to acquire "knowledge" through methods other than objective knowledge (see (d)), to hear "knowledge" directly through dialogue (see (e)), and to consider issues related to the sustainability of the islands and the community (see (f)). We have tried to include opportunities to think about issues related to the sustainability of the island and its people.

The speakers were local residents with diverse attributes, and the themes tended to deal with issues related to village maintenance and island industries, with an awareness of targeting contradictions such as the gap between generations and between people on and off the island, and conflicts among industries over water and land use.

The subjects in Table 2 (3), "Creation and Collaborative Formation," were selected because collaboration with a wide variety of people is essential to enhance the value of environmental culture and apply it to one's work and daily life. The purpose of this group of subjects was to make students aware of the educational field of social education and its principles and theories, and to make them useful. It was also used as an opportunity to understand the unique Japanese educational system and collaborative formation from the perspective of adult learning, as well as the concept of resident-oriented development and the community from a social scientific perspective. It also included opportunities to learn practical skills in dialogue facilitation as a way to hear directly from residents about their <environmental culture>.

The (5) "Connecting to Real Life" subject group in Table 2 is a time to summarize the learning from (1) to (4), verbalize (make conscious) them, and express (present) them. During the process leading up to (5), many opportunities for communication with themselves and others were included. The former corresponds to the submission of reports in each course, and the latter to workshops and reflections during practical training, and group discussions during the live-streamed classes. Emphasis was placed on ensuring that students had time to internalize the diverse information they received.

4. Considering the Principles of Educational Practice for Sustainability in the Amami Islands

Finally, based on the premise that the 17 goals of Agenda 2030 (Sustainable Development Goals (SDGs)) represent the "complexity" of SD, I would like to summarize the relationship with the Amami <environmental culture> understanding. Figure 1 shows that the Amami Education Program incorporates the SDGs in a hierarchical structure.

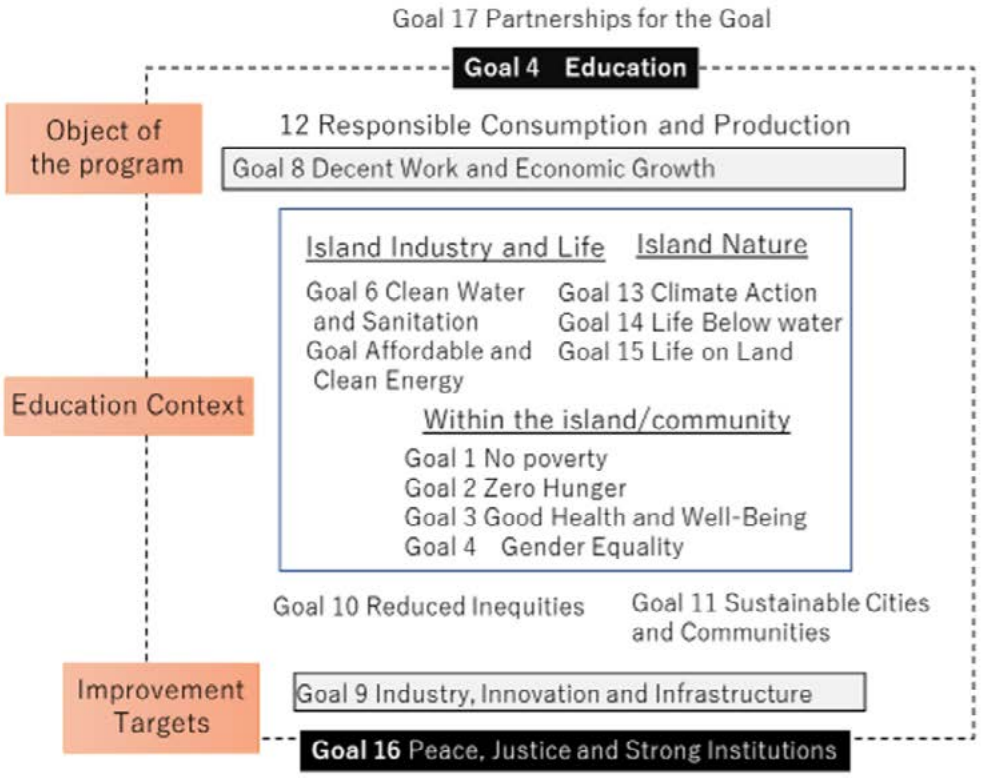

Figure 1: Relationship Diagram between the Amami Education Program and the SDGs

In turn, in the Amami Islands, while the industrial and technological innovation infrastructure (Goal 9) has been developed through the budget related to the Amami Islands development promotion, the establishment of sustainable consumption and production patterns (Goal 12) and the creation of humane jobs (Goal 8) have remained a challenge. This was also the goal set by this program. On the other hand, in order to realize these goals, how to sustainably secure the island's water and energy (Goals 6 and 7) while maintaining the island's natural environment (Goals 13, 14, and 15) as basic conditions. In addition, how can we promote initiatives while bringing to light the problems inherent in Goals 1-3 and 5 on the island and in the island society? These were all addressed as educational content for the program. Goals 10 and 11 were goals that could be set to review and improve relations between and outside the archipelago, as well as within islands and settlements. Goal 16 was

a real problem for the Amami Islands, which are required to play a role in homeland defense. Goal 17 is an essential component for the educational program to function as a system.

On the other hand, "culture," the subject matter of the Amami educational program, is not explicit, although it is found in the Agenda Declaration and some of the Goals. The focus on "culture" as a keyword that links multiple goals is unique to this program. Although the 17 goals in Figure 1 appear to be reduced to issues within the island, this is by no means the case. The double meaning of the idea of <environmental culture> is to connect issues that are open to the world and promote change based on the way we live on the island.

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In (d) Environmental and Cultural experience, participants experienced crafts and cooking using dances and natural materials, making the most of the characteristics of each village. For crafts and cooking, the participants were asked to actually pick natural materials in the village to experience them.

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Determination of the Relationship between High School Students' Knowledge, Awareness and Attitude Levels towards Sustainable Development

Murat GENÇ[(1)], *Erol Sözen*[(2)]

Abstract

The current study investigated the relationship between high school students' knowledge, awareness and attitude levels towards sustainable development. The sample of the study consists of 650 students. "Sustainable Development Knowledge Scale", "Sustainable Development Awareness Determination Scale" and "Attitude towards Sustainable Development Scale" were used as data collection tools. It was determined that high school students' sustainable development knowledge scores were at a good level. In addition, it was determined that the level of Sustainable Development Awareness of high school students was at a medium level, and students' Attitude towards Sustainable Development was at a good level.

Introduction

"Sustainable development", a development model that can meet the needs of present generations without compromising the ability of future generations to meet their needs, entered the world agenda towards the end of the 20th century and became a global implementation plan with international agreements signed in the 1990s. The sustainable development approach sets "sustainability" as the common denominator in the economic and social development goals of countries. This common goal, which also embraces the future, aims to enable everyone to meet their basic needs and expectations for a better life. Implementation of a development strategy that does not link the environment and socio-economic development may meet current needs, but it may jeopardize the fulfilment of people's basic needs in the future. This is because there is no certain limit beyond which growth can lead to environmental disasters, and environmental degradation is often irreversible. Therefore, a holistic assessment of the interaction between the economic and social structure and the environment, ensuring that present and future generations benefit equitably from the opportunities that development brings, constitutes the basic philosophy of sustainable development. Past experiences better emphasize the importance of this approach. Today, the world is experiencing dramatic change and development in many areas. This situation also changes social and individual needs. The ability of countries to develop is closely related to their ability to keep up with this change. However, when this development and change is sustained and sustainable, rather than short-term, a permanent development is achieved in that country. From this perspective, the importance of education is indisputable. The more qualified individuals the education system raises, the more it contributes to the future of the country.

The issue of sustainability is at the heart of the energy, economy and environment triangle, and is therefore discussed by a wide range of people from social scientists, science and natural scientists, politicians, local and international environmental organizations, as well as governments and intergovernmental organizations (Yeni, 2014).

The process of human beings understanding nature dates back to ancient times. Every scientific and technological development in this process has enabled humans to utilize natural resources more (Teksöz, 2014). In ancient Egypt, Mesopotamia, Greek and Roman civilizations, environmental problems such as desertification, salinity and soil infertility were experienced just like today's sustainability problems. Philosophers such as Plato, Strabo and Columella stated that human activities such as farming, logging and mining caused environmental degradation in the

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pre-bellum period. Concerns in the face of this consumption began to present the responsible utilization of natural resources by present and future generations as a new pattern of thinking for human existence (Du Pisani, 2006).

The concept of sustainability began to gain acceptance when it was mentioned in a series of international meetings starting in the 1970s and 1980s. The first time the concept was put forward was in the report titled "Limits to Growth" published by the Club of Rome.In this report, the dangers awaiting mankind in the 21st century are emphasized (Meadows *et al.*, 1972).

Sustainable development is defined in the international literature as meeting the needs of present generations without compromising the needs of future generations (OECD 2001:13; UNWCED, 1987: 54). In other words, sustainable development is the development process in which the needs of the present generation can be met without compromising the ability of future generations to meet their needs (World Commission on Environment and Development, 1987). Sustainable development is defined as "an environmentalist world view that aims to ensure economic development without sacrificing the principle of using environmental values and natural resources in a rational way that does not lead to wastefulness, taking into account the rights and benefits of present and future generations" (Keleş, 1998: 112). As can be seen, sustainable development cannot be considered independent of the environment, that is, the geography in which we live and what this geography has to offer. The relationship between geographical space and planning is an important factor in sustainable development. It is very difficult to achieve sustainability independently of space (Sözen, 2013). As long as people can harmonize with the environment they live in, we can talk about efficient development and progress. As a part of the ecosystem, humans, like all other living things, are dependent on the external environment and must submit to its laws. However, unlike other living beings, human beings, with the culture and knowledge they have created and developed, have been able to shape nature by taking a combative position in the face of its limitations, and have been able to use natural power resources by directing and shaping them in line with their own interests. Accordingly, the need for renewable energy resources and recycling have become indispensable.

In addition, the economic, social and ecological dimensions of sustainable development should not be ignored. In order to ensure the social dimension of sustainable development, it can be said that governments, donors (Global Environment Facility, etc.), non-governmental organizations and the private sector should work together (United Nations, 2012: 30-31). Economic growth and production patterns have significant impacts on the environment. Environmental Indicators-Towards Sustainable Development (2001:71) states that economic activities play a key role in determining the economic, social and environmental aspects of sustainable development. In the 1980s, the focus of development shifted towards "structural adjustments" such as trade liberalization, elimination of government deficits, unduly high exchange rates and the abolition of ineffective public organizations (Harris, 2000).

In the 18th century, the increasing population began to create problems in terms of land and energy, which necessitated revolutionary steps. The Industrial Revolution, which started in England during this period, increased the use of coal instead of wood. The rapidly increasing use of coal began to cause a number of problems in practice, such as mine construction, water pumping, transportation and controlled combustion. In the light of these developments, the increased need for labor in the mining and factory environments necessitated the elevation of science and technology to prominent positions in human society. All these developments led to changes that no one could have imagined. Machines, not land, have come to constitute the basic meaning of production (Mebratu, 1998: 495). Traditionally, religions and cultures have developed ideas about how to perceive and treat the non-human environment. Sacred beliefs try to explain the non-human world, which is at the source of life, in human terms. In addition, sacred beliefs bless the bond between humans and non-human air, earth, water and other living beings, emphasizing the need to treat them with kindness (Mebratu, 1998: 497).

It is stated that the world population will stabilize around 9-10 billion by the end of this century. Low population increases will reduce the pressure on natural resources. If there is a higher increase, land scarcity will bring many different problems. (Tümertekin and Özgüç, 2004:183) In addition, increasing consumption per capita will also create pressure. Therefore, it is very important to adopt consumption and production patterns that will ensure the sustainability of natural resources (Uysal, 2003:3). In addition, in the next 50 years, world income is expected to grow by around 3 percent per year, which means a 4-fold increase in the world's total GDP. One of the important problems here is the imbalance in distribution.

When the word sustainability is analyzed in terms of meaning, it can be said that it meets expressions such as continuity, permanence and continuity. At the international level, the word sustainability is used in relation to concepts that directly depend on human will and actions such as the use of natural resources, air pollution, wastes left to nature, environment, economy and development (Akgül, 2010:135). Sustainability in education can be added to all these.

In this framework, it is an important necessity to ensure that sustainable development is not an "imported" concept and is integrated into daily life through continuous education/information and increasing public awareness. For all these reasons, the views, attitudes, awareness and knowledge levels of high school youth towards sustainable development are very important.

In this context, the following questions were sought to be answered in this study:

1. What are the sustainable development knowledge, awareness and attitude levels of high school students?
2. What is the relationship between high school students' knowledge, awareness and attitudes towards sustainable development?

1. Importance of the Study

Sustainable development has an important place in ensuring the continuity of future generations. In this context, it is important to ensure that human beings live a life by taking into account their many needs in terms of energy, food and security. In order to ensure sustainability, a person's skills such as knowledge, attitude, awareness, perception, etc. must be sufficiently developed. For this, education comes to the fore. Education, which is effective in social changes, plays a vital role for a sustainable society. Through education, awareness about new developments can be raised. Through education, professionals are trained to develop systems and tools that will be used in the future (Jennings, 2009). Sustainable social life can be achieved through efforts such as increasing the use of renewable energy sources, less consumption and more recycling. For this, it is important to determine and improve the knowledge, awareness and attitudes of future generations about sustainable development. For this reason, in this study, the knowledge, awareness and attitudes of secondary school students towards sustainable development were investigated.

2. Method

In this study, the relational survey model was used to determine the knowledge, awareness and attitudes of high school students towards sustainable development. Relational screening model is a screening approach that aims to determine the existence of change between two or more variables together. In the relational survey model, it is tried to determine whether the variables change together and if there is a change, how it happens (Karasar, 2013: Wiersma and Jurs).

2.1. Study Group

A total of 650 high school students having an education at different high schools in the city of Duzce in the academic year of 2023-2024, participated in the study. In Table 1, the distribution of secondary school students by their grades and gender over the total is presented.

Table 1: Gender Distribution of the Study Group According to Grade Level

Gender	Grade Level				
	9th Grade	10th Grade	11th Grade	12th Grade	Total
	N	N	N	N	N
Female	161	95	47	75	378
Male	103	99	58	12	272

2.2. Data Collection Tools and Analysis

In this study, a "Scale of Knowledge in Sustainable Development" was applied with a purpose to determine the knowledge of the secondary school students in sustainable development and a "Scale of Attitude towards Sustainable Development" to determine their attitudes towards sustainable development. The Scale of Knowledge in Sustainable Development was developed by researchers and has a one-dimensional structure. The Cronbach Alpha reliability coefficient of the scale was calculated as .701. The Scale of Attitude towards Sustainable Development however, was developed by Kaya (2013) and is a 3-dimensional 21- item scale. According to the research data, while the overall reliability coefficient of the scale was .933 that of the "Social" sub-dimension was .857, the "Environment" sub-dimension was .813 and the "Economic" sub-dimension was .851. «Sustainable Development Awareness Survey" has been applied to high school students. Sustainable Development Awareness Survey was developed by Çobanoğlu and Türer (2015).

3. Findings

In this section, the findings obtained from scales of knowledge, awareness and attitude related to sustainable development of high school students are given under various headings.

Findings Related to the First Sub-problem

In this study, in which the knowledge, awareness and attitudes of high school students towards sustainable development were investigated, the levels of students are given in Table 2.

Table 2: Levels of Attitude, Awareness and Knowledge Scores of High School Students towards Sustainable Development

Scales	N	X	S	Levels	Assessment
Knowledge	650	28,291	,1908	5-16,66-28,32-40	Medium level
Awareness	650	59,531	,4347	5-38,33-71,66-105	Medium level
Attitude	650	77,498	,6290	5-38,33-71,66-105	High level

Table 3: The relationship between high school students' attitudes, awareness and knowledge levels towards sustainable development

Correlation	Knowledge	Awareness	Attitude
Knowledge	1,00	,022	,324**
Awareness	,022	1,00	,021
Attitude	,324**	,021	1,00

According to the results of the research, it is seen that the knowledge level of high school students towards sustainable development is at a medium level. In addition, it is seen that their awareness levels are also at a medium level, but their attitudes are at a high level.

Findings Related to the Second Sub-problem

The results obtained when the relationship between high school students' knowledge, awareness and attitudes towards sustainable development is examined are given in Table 3.

Research results show that; There is a moderate correlation between high school students' knowledge and attitude levels towards sustainable development. This shows that as students' knowledge levels increase, their attitudes also increase. There is no significant relationship between other dimensions.

4. Discussion

According to the results of the research, there is a moderate correlation between high school students' knowledge and attitude scores towards sustainable development. Öztürk Demirbaş (2015) states in his study that pre-service teachers' sustainable development awareness levels are at a "high" level. In addition, it is seen that there is no correlational relationship between other dimensions. Today, sustainable development constitutes an important place. Now, the curriculums of primary, secondary and higher education institutions need to be prepared in accordance with sustainable development conditions. When individuals received education in accordance with these conditions, their knowledge, awareness and attitude would increase and they would act as individuals that are more responsible. In this respect, there is a need for curriculums to be re-structured. Increasing knowledge in the subject positively affects the environmental attitudes towards the subject (Arcury, 1990; Bailey and Watson, 1998; Bradley, *et al.* 1999; Genç, 2015; Genç, 2019; Waliczek and Zajicek, 1999; Chawla, 1998), and individuals with positive attitudes and adequate knowledge however, support and improve the knowledge and attitudes of ones around them (Malone and Tranter, 2003; Wilke, 1985). Therefore, these results obtained from the research can be considered in terms of effective sustainable development education. Today, sustainable development constitutes an important place. Now, the curriculums of primary, secondary and higher education institutions need to be prepared in accordance with sustainable development conditions. When individuals receive education in accordance with these conditions, their knowledge, awareness and attitude will increase and they will act as individuals who are more responsible. In this respect, there is a need for curriculums to be re-structured.

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Enhancing Climate Change Education for Primary School Children in Kenya

Emmanuel Gichuru Muchora

Abstract

Climate change is a serious threat to Kenya, and its impacts are already being felt by children.

Increased flooding, drought, and heat waves are disrupting education, making it difficult for children to learn and grow. Climate change is also causing food insecurity and water shortages, which are putting children's health and well-being at risk.

Climate change education is essential to help children understand the causes and impacts of climate change, and to develop the skills and knowledge they need to act. Climate change education should be integrated into the primary school curriculum and should be age-appropriate and engaging. It should focus on the following key areas:

1. The science of climate change
2. The impacts of climate change on Kenya
3. What children can do to reduce their carbon footprint
4. How children can adapt to the impacts of climate change

Climate change education can empower children to be agents of change. By learning about climate change, children can develop the skills and knowledge they need to make informed decisions about their own lives and the future of their planet. They can also take action to reduce their carbon footprint and help to mitigate the impacts of climate change.

Here are some specific examples of climate change education activities that could be implemented in primary schools in Kenya:

- **Storytelling:** Teachers can use stories to introduce children to the concepts of climate change and its impacts. For example, they could read stories about animals that are being displaced by climate change, or about children who are taking action to reduce their carbon footprint.
- **Games and activities:** There are many games and activities that can be used to teach children about climate change. For example, children could play a game about conserving water, or they could create a model of a solar panel.
- **Field trips:** Field trips to local parks, forests, or rivers can help children to learn about the natural world and the impacts of climate change. For example, children could visit a river that has been polluted by runoff from farms, or they could observe the effects of deforestation.
- **Community projects:** Children can get involved in community projects that help to address climate change. For example, they could plant trees, help to clean up a polluted river, or advocate for policies that reduce greenhouse gas emissions.

Climate change education is an important part of preparing children for the challenges of the future. By teaching children about climate change, we can help them to become informed citizens who are ready to take action to protect their planet.

1.0 Introduction and Background

Climate change is a global challenge that poses severe threats to ecosystems and human well-being. The impact of climate change is particularly pronounced in developing countries like Kenya (IPCC, 2022), where vulnerable populations are susceptible to the adverse effects. Recognizing the importance of early education in fostering environmental awareness and sustainable practices, this research project investigates the current state of climate change education for primary school children in Kenya.

1.2 Objectives

This research aims to:

1. Assess the integration of climate change education in Kenyan primary schools (MoE, Kenya, 2019).
2. Identify gaps in curriculum coverage, teaching methodologies, and teacher preparedness (UNESCO, 2012).
3. Explore primary school children's knowledge, attitudes, and environmental behaviors (Yeo *et al.*, 2014).
4. Propose effective multidimensional strategies for enhancing climate change education in primary schools.

2. Methodology

2.1 Study Design

A mixed-methods approach (quantitative and qualitative) will be employed. Surveys will gather data from teachers on curriculum coverage and preparedness (Fien *et al.*, 2014).Surveys will be administered to primary school teachers to gather data on curriculum coverage and teacher preparedness as well as provide information on their knowledge, attitudes, and behaviors related to climate change.

Interviews will be conducted with educators, curriculum developers and policymakers to gain insights into the challenges and opportunities in climate change education. Interviews with educators, curriculum developers, and policymakers will explore challenges and opportunities (Azeiteiro *et al.*, 2019).

Classroom observations will assess teaching methodologies. Surveys and focus group discussions with students will provide information on their knowledge, attitudes, and behaviors related to climate change (MoE, Kenya, 2019)

2.2 Sampling

A representative sample of primary schools, teachers, and students from different regions of Kenya will be selected to ensure diversity in the data collected.

3. Data Analysis

Quantitative data from surveys will be analyzed using statistical tools to identify trends and patterns. Qualitative data from interviews, observations and focus group discussions will be analyzed thematically to extract meaningful insights.

4. Findings

4.1 Curriculum Assessment

Preliminary findings suggest gaps in the coverage of climate change topics in the primary school curriculum. Comprehensive integration addressing both natural and social dimensions of environmental challenges is necessary (UNESCO, 2014).

4.2 Teacher Preparedness

Teacher training programs are identified as crucial for enhancing climate change education. Educators need to be equipped with the necessary knowledge and pedagogical skills to effectively convey complex concepts to young learners (Azeiteiro *et al.*, 2019).

4.3 Student Knowledge and Attitudes

Students exhibit varying levels of awareness and understanding of climate change. While some show positive attitudes towards environmental issues, others lack awareness and exhibit environmentally unsustainable behaviors (Yeo *et al.*, 2014).

5. Recommendations

5.1 Curriculum Integration

Propose the comprehensive integration of climate change topics into the primary school curriculum, emphasizing both the natural and social dimensions of environmental challenges. Include age-appropriate content addressing local climate-related issues relevant to Kenya (UN CC: Learn, 2018).

5.2 Teacher Training

Advocate for teacher training programs focusing on climate change education, ensuring educators are well-prepared to deliver age-appropriate content to primary school children.

Encourage collaboration with universities and NGOs to provide resources and expertise for teacher training (UNESCO, 2017).

5.3 Interactive Teaching Materials

Develop interactive and age-appropriate teaching materials, leveraging technology and incorporating real-world examples relevant to Kenya's climate context.Utilize virtual reality, simulations, and gamification to engage students in interactive learning experiences (UN CC:Learn, 2018).

5.4 Collaborative Efforts

Recommend collaborative efforts involving government agencies, non-governmental organizations, communities and educational institutions to create a holistic and sustainable approach to climate change education.Encourage partnerships between schools and local environmental organizations to provide students with opportunities for hands-on learning and action (Azeiteiro *et al.*, 2019).

6. Conclusion

This research project contributes valuable insights into enhancing climate change education for primary school children in Kenya. By addressing curriculum gaps, improving teacher preparedness, and fostering collaboration, the study aims to contribute to the development of an environmentally conscious generation capable of addressing and adapting to the challenges posed by a changing climate. By empowering the next generation, we can contribute to a more sustainable and resilient future for Kenya and beyond.

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Effective Citizen Science: Playing a Role in Marine Life Restoration

Environmental Education and Marine Conservation

Ahmed Nabil(1)

Abstract

Great barrier reef of Australia lost around 65% of its corals, there are immense efforts exerted by scientists and marine biologists to protect and maintain the remaining 35%. [1]

Red Sea and Arabian Gulf are highly threatened as well.

The philosophy of "protection is always preferred over restoration" is a luxury that no longer applies to most regions.

NOW Restoration is necessary to preserve the biodiversity and functionality of reefs and ensure the sustainability of their resources.

The abstract is about "Effective citizen science" for a Sustainable Future.

The training program consists of 2 sections:

a. Raising awareness

b. Practical efforts

The Program is designed to give participants an introduction to Coral Reef Ecology & Restoration.

Participants should have full knowledge about climate change and its impact on marine life. Conservation strategies and how to contribute in restoration efforts. Participants should leave a positive impact by creating a new marine life. (Artificial and/or natural habitat) to present an effective Citizen science.

Program structure:

a. Raising Awareness Over workshops

b. Practical efforts Over field study and projects

Participants shall be capable of:

- Identifying & Monitoring corals for health condition and status
- Conducting advanced research and / or restoration projects
- Identifying rare or endangered species of coral
- Create new habitat for corals and marine animals –artificial and / or natural

It is a holistic approach regarding ecosystem, focusing on the long-term sustainability and adaptability of the ecosystem rather than just trying to add more corals into areas where they will not survive.

Full Paper

These abstract tackles the challenges facing the coastal ecosystems at Western Indian / Easter Africa and Annex coastlines. The conservation approaches to be implemented as well as an overview of the unique site approach to ecosystem restoration.

This nature-based solution is designed to re-establish the integration of ecosystem services provided by mangroves, seagrass, molluscs (native oysters and mussels) and coral reefs.

It is a unique scientific community programme that protects and restores coastal ecosystems. The target is to bring volunteers, corporates, schools, academia and governments together to actively create positive ocean impacts. It delivers education to people of all ages from 15+ about the ocean and how to protect it.

To prepare specialist divers who can be the pillars for marine conservation projects, including but not limited to planting mangroves and sea grass, growing corals, create, restore and rehabilitate benthic and habitats.

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[1] Coral Disease Handbook Guidelines for Assessment, Monitoring & Management
Editors: Laurie J. Raymundo, Courtney S. Couch and C. Drew Harvell

Why even to consider reef rehabilitation? Firstly, many coral reefs that are relatively free of human impacts have shown remarkable resilience to mass-bleaching and coral mortality such as occurred in 1998 in the Indo-Pacific.[2]

By contrast, those reefs that were already impacted by more localized human impacts such as overfishing, or pollution have often shown little or no recovery. We thus infer that locally stressed reefs will have almost no chance of surviving the climate change impacts predicted for the 21st century (at least, in a form resembling what we consider a healthy "coral reef" today), whereas resilient ones will have a significantly better chance.

Reef rehabilitation techniques are one tool of those trying to manage human impacts in reef areas. If these techniques, along with other local management interventions (fisheries regulations, MPAs, pollution control, etc.), improve ecosystem resilience, then those reefs have at least some chance of surviving as productive and functional systems in the face of the global impacts that cannot be managed at the local level. Coral reefs currently provide food and livelihoods for hundreds of millions of coastal people in over 100 countries via the harvestable resources they generate.

Anything that can contribute to their resilience and thus the food security of the peoples dependent on them seems a sensible use of resources.

Despite considerable advances over the last 35 years, coral reef restoration is still in its infancy as a discipline. A few rehabilitation projects appear to have been successful on a scale of up to a few hectares; many have failed or not met total expectations.

The primary aims of this program are:

1) to train and prepare a fully skilled and competent divers for marine conservation
2) to reduce the proportion of reef rehabilitation projects that fail
3) to introduce protocols for methods that could allow larger areas of degraded reef to be repopulated with corals whilst minimizing collateral damage to reefs where corals are sourced
4) to highlight factors to take into consideration at the planning stage so as to minimize the risk of failure
5) to underline the current limitations of reef rehabilitation.

The goals of citizen science training are:

A. How to construct and manage nurseries to farm coral fragments
B. How to rear coral larvae for restoration
C. How to deploy coral transplants to degraded reef areas
D. An overview of the steps needed in designing and planning a rehabilitation project
E. Criteria for deciding whether it is appropriate to attempt active restoration at a particular site as opposed to implementing management measures that allow natural recovery
F. Provide more detailed hands-on exercise, based on lessons-learnt from previous experience, on how to carry out coral reef rehabilitation in a responsible and cost-effective manner
G. How to transplant Mangroves
H. How to grow seagrass

The focus is on corals because these are the keystone species that give structure and topographic complexity to coral reef ecosystems. Unfortunately, they are also among the groups most vulnerable to global climate change.[3]

Common Reasons for Carrying Out Reef Restoration:

- Lack of awareness in a local community and a poor appreciation of the economic and cultural value of reef ecosystems.
- Loss of biodiversity.

[2] Coral Disease Handbook Guidelines for Assessment, Monitoring & Management
Editors: Laurie J. Raymundo, Courtney S. Couch and C. Drew Harvell

[3] Reef Restoration Concepts and Guidelines: making sensible management choices in the face of uncertainty. Coral Reef Targeted Research & Capacity Building for Management Programme: St Lucia, Australia. iv + 38 pp.
Edwards, A.J., Gomez, E.D. (2007).

- Loss of productivity (food species).
- Loss of key reef components (usually coral, but also adjacent seagrass or mangroves) due to natural disturbances (bleaching, storm damage, coral predation and disease),
- Loss of key ecosystem processes (e.g. recruitment of juvenile corals, grazing of macroalgae by herbivorous fish or urchins) and services.
- Provision of alternative livelihoods (e.g. culture of aquarium products, tourism) for stakeholders who agree to stop harvesting reef resources.
- Mitigation for developments that will adversely impact coral reef species at a site, especially the relocation of threatened corals.

Common Aims that Restoration Projects have Cited as their Motivation: [4]

1. Building public awareness and environmental education.
2. Promoting recovery of biodiversity.
3. Increasing biomass and productivity.
4. Assisting recovery of key reef species or ecosystem processes.
5. Development of alternative livelihoods.
6. Mitigation of damage or degradation.

The considerations and protocols that will maximize success are often the same for intervention effort (restoration, or less ambitious goal of rehabilitation),

The intervention seeks to improve the state of the habitat and resilience of the ecosystem. It should be emphasized that restoration science is still an effort to recreate fully functional reef ecosystems.

Similar coral communities should already be present at the transplant site.

If a different coral community (or almost no coral) is present at a proposed recipient site, there is probably a good reason for this, check for it and identify (sewage, water quality, water temperature else ..)

The efforts to introduce different coral species (that would change the structure and function of the local community) are not proven.

These sites are likely to fail in the medium to long term.

There is a danger of equating the act of coral transplantation with "restoration" or "rehabilitation".

The latter are long-term processes; coral transplantation is an activity and just one tool among a suite of management measures that can be used to try to reverse a trajectory of reef decline.

There is no shortage of hard substrate and a focus on trying to rehabilitate patches of consolidated reef that have lost their living coral. It is easy to tackle project for reef restoration and a relatively cost-effective approach.

Despite this, there has been inordinate attention paid to restoring or introducing coral cover to unstable rubble and sand patches with the concomitant need for (costly) artificial structures.

Artificial structure can vary from: deliberately sunk ships and metal structures, iron bedframes to purpose built concrete and ceramic modules, 3-D print tiles and benthic to which coral transplants can be attached.

The need for training and expert advice: [5]

Coral reef rehabilitation is not a simple procedure that can be carried out by communities without training or expert advice.

What Factors can Hinder Active Restoration Efforts?

Bleaching events, coral predators and other unexpected disturbances are likely to hinder active restoration interventions, this is the norm, not the exception.

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[4] Coral Reef Restoration Toolkit - A Field-Oriented Guide Developed in the Seychelles Islands
Edited by Sarah Frias-Torres, Phanor H Montoya-Maya, and Nirmal Shah

[5] PADI Marine Conservation Program, Distinctive Speciality
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Be careful and realistic in terms of expectations for coral reefs to be rehabilitated.

Reef restoration should never be oversold. Corals are among the organisms that are most susceptible to climate change (e.g. rising sea temperature) and may be subject to large scale regional phenomena such as bleaching induced mortality and predation by Crown-of thorns starfish over which rehabilitation project managers have no control.

In addition, they may be threatened by local stressors.

Nursery raising of corals from fragments or larvae allows a marked reduction in collateral damage to reefs (as a result of sourcing of transplants).

Corals transplantation has Two-step process:

1. small fragments of coral or coral spat need to be reared in nurseries to a size where they have reasonable prospects of survival on a degraded reef.
2. nursery-reared colonies need to be transplanted to stable areas and attached securely.

Framework for a rehabilitation project:

- Active reef restoration is not an alternative to proper coastal management.
- Rehabilitation of habitat is always more expensive than protecting it from degradation in the first place.
- There is no point in attempting active restoration unless the area to be restored is under effective management (e.g. within a marine protected area) or not under significant local human pressure.
- Resilient reefs (generally those unimpacted by mankind) are likely to recover from disturbances (e.g., storms, bleaching) without human intervention.
- Reefs significantly impacted by humans tend to recover poorly from disturbances (i.e. have lost resilience), still good management can improve their resilience.
- Effective management at an adequate spatial scale needs to be in place before active restoration can succeed.
- Active restoration should be part of a broader integrated coastal management plan. It should not be an isolated act.

In addition to local human impacts, Coral reefs have a range of climate change related stresses to cope with over the coming decades. **Rising sea temperatures, ocean acidification.**

Rising Sea Temperatures:

The most serious damage to coral reefs happened due to abnormal warming of the oceans temperature.

Sea temperature increases of 1–2°C above the long-term maximum for a particular area are enough to trigger mass-bleaching of corals; if these temperatures persist for several weeks, Most likely it will be followed by mass-mortality.

Example: Indo-Pacific in 1997–1998 - some areas experienced almost 90% mortality of shallow water corals.

It is to be mentioned that many areas have shown good recovery within 10 years.

Ocean Acidification

The oceans are acidifying as burning of fossil fuels drives up the atmospheric partial pressure of CO_2. It leads to lower rates of calcification in marine organisms with calcium carbonate skeletons. (Mainly corals, crustose coralline algae, mollusks and foraminifera's).

Declines in coral skeletal growth and calcification have been reported over the last 30 year.

Model predictions suggest that as a result of this acidification, coral reefs could cease to grow and start to erode.

What Do We Mean by "Recruitment Limited"?

By recruitment, we mean the addition of juvenile corals to the reef community.

If there is good recruitment, we should find lots of small (0.5-5 cm) corals on the reef if look carefully.

If cannot find any, or very few, juvenile corals, this suggests there is poor recruitment.

What will Happen If the Numbers of Juveniles Recruiting are not Sufficient to Replace the Adult Colonies Dying?

The coral community is not sustainable and will ultimately decline.

Before to Attempt Active Restoration, We Need to Know:

1. What type of coral reef community we are trying to restore.
2. What caused the reef to become degraded.
3. That damaging human impacts on the reef ecosystem have stopped or are under control (e.g. effective management is in place)
4. That the site is unlikely to recover naturally (e.g. because it is recruitment limited).
5. That transplants will not be damaged by shifting sand and rubble.

What to Do to Reduce Risk?

1. transplant a broad cross-section of appropriate species with due regard to both the "reference site" and availability of source material. Use your "reference site" to guide the density at which you transplant, remembering that a doubling of density may quadruple costs.
2. transplant corals in well-separated patches within the rehabilitation site.
3. Work with natural recovery processes and think long term.
4. At every stage make sure that your plans match the financial and human resources available.

How to Minimize Impacts on the Natural Reef?

To use some of the nursery cultivated (Grown first generation) transplants as sources of fragments for further cycles of raising and transplantation.

Monitoring: It should Include:

- Regular systematic surveys to measure progress of the project
- Routine checks on the coral transplants and conditions at the rehabilitation site.

The Systematic Monitoring should Focus on:

1. track progress towards objectives
2. allow you to evaluate success
3. provide feedback to stakeholders.

The Frequent Routine Checks:

1. transplants so that potential problems can be identified early, and adaptive management undertaken.
2. the set-up control sites on adjacent healthy reef to show whether losses of coral are due to translocation or external factors.

What is to Set up "Control" Sites?

Coral site where no active interventions are carried out. This is to assess whether it is natural recovery or your active rehabilitation that has led to improvements.

Asexual Transplanting Corals Considerations for Corals Nursery:

- Active rehabilitation of degraded coral reef is likely to require tens of thousands of coral transplants per hectare (i.e. millions per square kilometre).
- Rearing small coral fragments in nurseries allows you to minimize the collateral damage to the natural reef involved in sourcing transplants.

- Simple *in situ* coral nurseries can be constructed from readily available and inexpensive materials
- Good site selection is crucial to the success of a coral nursery.
- The conditions (particularly depth) at the nursery site must be appropriate for rearing the types of corals that survive well at the degraded reef which you are planning to rehabilitate.
- Choosing a nursery type (e.g floating or fixed) and nursery site always involves trade-offs between quality of conditions for rearing, convenience, operating expense and logistics (e.g. available manpower and resources).
- Rope nurseries allow low-cost rearing of large numbers of corals, yet non fully proven success methods of effectively deployed corals
- The costs of materials to build a coral nursery are small compared to the costs of stocking and maintaining corals in the nursery and then transplanting them to a degraded reef.
- It is a false economy to try to save money by compromising on quality of nursery materials.
- Rearing corals on substrates that can be fixed quickly and securely to degraded reefs is the key to cost-effective transplantation.

Practical Tips While Corals Nursing:

- Minimize collateral damage to healthy reefs by using "corals of opportunity" (naturally detached fragments with a low chance of survival)
- Always remove dead, dying, or diseased tissue from corals of opportunity before transplanting directly or rearing in a nursery.
- Base your choice of coral species to rear in a nursery on what you expect will survive well at the site you wish to rehabilitate or a comparable "reference" site
- As a precautionary measure, aim to remove no more than 10% of a donor colony if obtaining fragments by pruning coral colonies *in situ.*
- Build coral nurseries out of robust and durable materials. Poor construction can lead to the death of corals.
- When deciding on the size of mesh rearing trays, put into consideration how to transport the grown colonies from the nursery to the rehabilitation site. Smaller trays (e.g. 30 cm x 50 cm) are easier to handle and transport.
- "Environmentally friendly" anti-fouling paint applied to mesh of rearing trays and other structural parts of a nursery can reduce maintenance by about a half.

Rearing Substrates for Coral Fragments should:

1. be cheap and easy to obtain,
2. allow coral fragments to be easily managed and maintained in the nursery,
3. allow grown colonies to be quickly and easily deployed at the rehabilitation site.

"Cleaning" of the Nursery

Removal of algae and fouling invertebrates, accumulated sediment, corallivorous organisms, and any diseased corals – It must be carried out regularly.

Use of Sea Surface Temperature (SST)

Using anomaly charts and inexpensive temperature loggers can allow to anticipate bleaching events and take measures to try to protect corals being reared in a nursery (e.g. shading, lowering in water column).

Making Protocol for Coral Fragments for Nursery Rearing:

- The collected coral fragments should be kept wet with clean seawater at all times.
- For branching species it is recommended that the height of the fragment should be no more than 2–3 times the diameter of the base and should not exceed 3–5 cm. This allows a more stable attachment to rearing substrates and thus lower detachment rates of fragments in the nursery.
- When fragmenting branching corals of opportunity, you can use branches from all

parts of the colony – tip,mid-branch and bases. Additional fragments can be made by cutting the coral pieces using side-cutting pliers, hammer and chisel, or hacksaw.

- Exposed coral skeleton is susceptible to attack by various organisms. When cutting encrusting/ massive species having a thick skeleton with only a thin tissue layer (e.g. *Diploastrea heliopora* or massive *Porites*) it is advisable to reduce the skeleton thickness to allow faster coverage of the exposed area by new tissue and facilitate attachment to the nursery substrate (a hacksaw is effective in trimming excess skeleton).
- After cutting, wash tissue and skeleton debris from fragments by shaking them in fresh seawater.
- To protect exposed skeleton, coat with epoxy-glue when attaching it to the nursery rearing substrate.
- Attach prepared fragments to a nursery-rearing substrate either by gluing the base with a drop of cyanoacrylate glue ('superglue') to the substrate or by inserting the fragments into plastic wall-plugs or tubing11.
- Do the work out of water (i.e. on the deck of a boat or on shore),
- Make sure that the corals remain moist and in the shade, and use cotton (or surgical) gloves in order to minimize damage to coral tissues

Conclusion

The last few years have signified a time of transition and growth for the Coral Restoration Foundation. During this time, we refined restoration techniques, enhanced our monitoring efforts, developed standardized training programs for non-marine biology professionals.

Representing an effective role model for citizen science, making a positive & tangible impact.

Consequently, we will be able to strengthen our restoration program, build a solid platform for increasing restoration capacity, collect consistent data, and track data in a database for future analysis and in collaboration with partners. The net effect will be to increase out planting capacity and a more than tenfold increase in restoration activity.

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El proyecto ALEC: un enfoque regional para la educación sobre el cambio climático

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Resumen

El Proyecto ALEC (América Latina para la Educación Climática) ha marcado un estándar en educación climática global con sus cuatros pilares: desarrollo de recursos educativos basados en los informes del IPCC y adaptados a contextos locales, desarrollo profesional para docentes, creación de comunidades de práctica y evaluación del proyecto. Ha logrado integrar la educación climática en los currículos mediante colaboraciones con socios locales y ha capacitado a más de 5000 educadores en Colombia y México. Sus metodologías han inspirado proyectos en otros seis países de la región e inspirado el proyecto ARRICE en África, que se lanzará en 2024.

En 2018, el panorama de la educación sobre el cambio climático a nivel mundial mostró una clara disparidad entre la ambición y la acción. Aunque el 51% de los países teóricamente incorporaron la Educación para el Desarrollo Sostenible (EDS) en sus marcos educativos, en la práctica, apenas el 7% extendió esta integración para incluir el desarrollo profesional de los docentes. Esta discrepancia destacó una brecha significativa en el enfoque del sistema educativo ante uno de los desafíos más críticos de nuestro tiempo: el cambio climático (CC). A pesar del impulso generado por acuerdos internacionales como la Convención Marco de las Naciones Unidas sobre el Cambio Climático (CMNUCC) y el Acuerdo de París, que enfatizaron los esfuerzos de Acción para el Empoderamiento Climático (ACE)[1], los esfuerzos estuvieron predominantemente centrados en elevar la conciencia pública en lugar de incorporar la educación sobre el cambio climático dentro de los sistemas educativos formales (UNESCO, 2019).

En las aulas de todo el mundo, la situación reflejaba esta falta de atención global. Aunque la EDS estaba comenzando a incorporarse en los relatos educativos, el tema específico del cambio climático seguía en gran medida sin abordarse. Varios factores contribuyeron a esta omisión: la complejidad de la ciencia climática, una muy baja integración de este tema en los currículos escolares, la falta de materiales educativos dedicados y un vacío significativo en la formación docente sobre el asunto (UNESCO, 2021). Este escenario no sólo subrayó una brecha educativa, sino también la seria necesidad de una intervención dirigida que pudiera cerrar la división entre la inclusión teórica de la EDS y una educación sobre el cambio climático práctica y efectiva. Fue en este contexto que se concibió el proyecto ALEC en 2019, con el objetivo de catalizar un cambio hacia un paradigma educativo más informado y consciente del clima mediante un enfoque regional adaptado a los desafíos y realidades ambientales locales.

El proyecto piloto ALEC se destaca como una iniciativa pionera lanzada por la Office for Climate Education (Oficina de Educación Climática), marcando su primera incursión en un esfuerzo educativo sobre el cambio climático dirigido e impactante. Iniciado con el respaldo financiero de la Facilidad Francesa para el Medio Ambiente Global (FFEM), el proyecto está operativo en México y Colombia, abarcando desde 2020 hasta 2024. Su objetivo principal se alinea perfectamente con el objetivo más amplio de la OCE: empoderar a los docentes de escuelas primarias y secundarias para integrar conceptos y cuestiones de cambio climático en sus aulas, además de proporcionar apoyo político a los sistemas educativos nacionales.

(1), (2), (3), (4) Office for Climate Education

[1] Acción para el Empoderamiento Climático (ACE) es un término adoptado por la Convención Marco de las Naciones Unidas sobre el Cambio Climático para denotar el trabajo bajo el Artículo 6 de la Convención y el Artículo 12 del Acuerdo de París. El objetivo general de ACE es empoderar a todos los miembros de la sociedad para participar en la acción climática, a través de los seis elementos de ACE: educación sobre el cambio climático y conciencia pública, capacitación, participación pública, acceso público a la información y cooperación internacional sobre estos temas.

1. Lanzamiento del proyecto ALEC, 6 de octubre de 2021, Ciudad de México, México

El proyecto ALEC se articula alrededor de cuatro objetivos principales. Primero, busca equipar y empoderar a los docentes mediante la creación y distribución de recursos educativos interdisciplinarios y de alta calidad, basados en los informes del IPCC, que son de acceso libre, asegurando que los docentes y formadores estén bien preparados para involucrar efectivamente a los estudiantes. En segundo lugar, el proyecto enfatiza la mejora del desarrollo profesional de los docentes y formadores, reconociendo su papel crucial en informar y moldear el enfoque de la próxima generación hacia el cambio climático, a través de capacitaciones y desarrollo ajustados a sus necesidades. Además, ALEC tiene como objetivo fomentar una comunidad de práctica uniendo a un grupo diverso de interesados, incluyendo docentes, formadores, instituciones, legisladores, investigadores y familias, para facilitar un rico intercambio de conocimientos e ideas, enriqueciendo la experiencia educativa y amplificando su impacto. Por último, garantizar la efectividad y escalabilidad del proyecto es un objetivo clave, logrado mediante una coordinación, monitoreo y evaluación cuidadosos para recoger percepciones y adaptar el modelo exitoso para una aplicación más amplia, potencialmente en otras regiones y países.

¿Por qué México y Colombia?

Elegir México y Colombia para el proyecto ALEC fue una decisión estratégica influenciada por sus singulares paisajes ambientales, socioeconómicos y educativos. Ambas naciones enfrentan los profundos impactos del cambio climático, especialmente en sus sectores agrícolas vitales, lo que magnifica la urgencia de intervenciones educativas dirigidas. Su estatus como algunos de los países con mayor biodiversidad del mundo añade otra capa de complejidad y relevancia a su selección. Esta biodiversidad, junto con su variada geografía que abarca montañas, costas, desiertos y bosques tropicales, los expone a un amplio espectro de efectos del cambio climático, lo que hace necesarios enfoques específicos regionales para la educación sobre el clima.

La diversidad socioeconómica dentro y entre México y Colombia, reflejada en sus calificaciones del Índice de Desarrollo Humano (IDH)[2], destaca las disparidades existentes, subrayando aún más la necesidad de estrategias educativas adaptables e inclusivas. Por otro lado, el sistema educativo de ambos países es administrado por estados individuales y regulado por un Ministerio Nacional de Educación, lo que facilita las alianzas con las secretarías de educación por región y, por ende, la implementación de un proyecto. Además, sus sistemas educativos consideran el lugar de la ciencia y tecnología - y por lo tanto su razonamiento y sus aplicaciones - en la educación de sus alumnos. La paridad está mejor asegurada que en otras regiones con niveles económicos comparables. No obstante, la formación docente en servicio y los recursos en las aulas son inadecuados o inexistentes cuando se trata de alejarse de la pedagogía "frontal", especialmente al abordar temas nuevos y altamente interdisciplinarios.

Finalmente, ambos países comparten un desafío común: la insuficiente incorporación del Cambio Climático (CC) en los currículos y materiales educativos (Bonilla D. y Quesada B., 2024) y una notable falta de formación docente en esta área.

¿Por qué un enfoque piloto a escala media?

En lugar de dirigirse a un pequeño número de escuelas con recursos intensivos, el proyecto

[2] En 2022, México registró un Índice de Desarrollo Humano (IDH) de 0,781, situándose en el puesto 77 a nivel mundial, mientras que Colombia tuvo un IDH de 0,757, situándose en el puesto 91 a nivel mundial.

ALEC apunta a un enfoque piloto a "escala media". Esta estrategia asegura que, aunque el proyecto no sea a gran escala desde el principio, sea lo suficientemente robusto para enfrentar desafíos del mundo real y esté preparado para una futura expansión. El objetivo es involucrar al menos a cientos de docentes en cada país, con un objetivo inicial directo de alcanzar a 6,000 docentes. Este enfoque permite al proyecto probar estrategias, recopilar datos y refinar métodos de manera práctica y ambiciosa.

Para que el proyecto ALEC logre su objetivo de adopción generalizada e impacto a largo plazo, debe abordar varias preguntas críticas relacionadas con la escalabilidad. Estas incluyen estrategias para involucrar a autoridades educativas nacionales, regionales y locales; capacitar a intermediarios dentro del sistema educativo como formadores, inspectores y directores de escuela, no solo a los docentes de primera línea; llegar a áreas rurales y de otro modo inaccesibles; superar barreras como el acceso desigual a internet; y involucrar a las comunidades indígenas en toda su diversidad.

Al centrarse en estas áreas estratégicas, el proyecto ALEC busca crear un modelo de educación sobre el cambio climático que sea efectivo en aumentar la conciencia y comprensión entre los alumnos y lo suficientemente sostenible para expandirse a diferentes regiones y países. El enfoque de ALEC está deliberadamente diseñado para ser más inclusivo e impactante a largo plazo.

¿Qué enfoque pedagógico?

En el corazón de la estrategia de ALEC se encuentra el énfasis en pedagogías activas que incorporan fundamentos científicos sólidos con un enfoque interdisciplinario. El currículo está diseñado para ser orientado a la acción, involucrando a los alumnos en la resolución de problemas del mundo real relacionados con el cambio climático. Central para este enfoque pedagógico es el lugar de los docentes en el núcleo del proyecto. Al proporcionarles los recursos necesarios, la capacitación y el apoyo local, ALEC tiene como objetivo empoderar a los educadores para que se conviertan en actores clave de la adaptación al cambio climático en sus comunidades.

2. Capacitación docente sobre el efecto invernadero, 8 de mayo de 2019, Santiago de Chile, Chile

Nuestra visión para la educación sobre el cambio climático adopta un enfoque sistémico: primero, enfatizando la importancia de proporcionar a los docentes recursos científicos y pedagógicos multilingües y gratuitos. Luego, a través de talleres de capacitación, buscamos mejorar la cultura científica de los docentes sobre temas climáticos y su comodidad con métodos de enseñanza interdisciplinarios y basados en la indagación. Por último, nos esforzamos por crear comunidades de práctica para que los educadores compartan experiencias y se conecten con la comunidad científica, fomentando finalmente proyectos de aula que involucren a comunidades enteras en la acción climática.

3. Capacitación docente sobre la acidificación del océano, 6 de octubre de 2021, Ciudad de México, México

La metodología se centra en la Educación Científica Basada en la Indagación, el aprendizaje basado en proyectos y los juegos de roles para comprender la complejidad del sistema climático, incluyendo sus diversos componentes e interacciones. Este enfoque fomenta el pensamiento crítico y la empatía, empoderando a los estudiantes para visualizar sus futuros en un mundo cambiante (Monroe *et al.* 2019; Lazonder *et al.* 2016; Nolet 2009).

Dado el desafío moderno de navegar por información a menudo engañosa o cargada emocionalmente sobre el cambio climático, el papel de los educadores se vuelve crucial para guiar a los estudiantes hacia un análisis razonado, ayudándoles a comprender y confiar en la información que encuentran. Esta filosofía educativa tiene como objetivo dotar a los alumnos de habilidades para involucrarse críticamente con los problemas del cambio climático y contribuir a soluciones sostenibles (Olsson *et al.* 2022; Baldwin *et al.* 2022; Meya *et al.* 2018; Ojala 2012).

La implementación del proyecto ALEC en Colombia y México

La implementación del proyecto ALEC en Colombia y México destaca la importancia de la colaboración, entrelazando la experiencia y fortalezas de una variedad de socios locales (instituciones científicas, autoridades educativas, ONGs) para enriquecer profundamente la educación sobre el cambio climático. En Colombia, la colaboración incluye a Fondo Acción y STEM Academia, así como a la Universidad del Rosario, cada uno aportando perspectivas valiosas sobre los impactos climáticos locales, investigaciones sólidas e innovación educativa. Esta asociación garantiza una comprensión profunda de los problemas climáticos entre los alumnos, respaldada por investigaciones de alto calibre y soluciones prácticas. En México, el éxito del proyecto se ve reforzado por alianzas con INNOVEC y Eco-Schools México, junto con el Centro Mario Molina, todos cruciales para avanzar en la educación climática, mejorar la educación científica para los jóvenes y formular políticas públicas para abordar el cambio climático y sus múltiples desafíos. Estas alianzas estratégicas no sólo son instrumentales para los objetivos inmediatos del proyecto, sino que son vitales para su coherencia, sostenibilidad y visión a largo plazo. Al alinearse con socios locales que comparten un compromiso con la educación y el medio ambiente, el proyecto ALEC se integra en el tejido de las comunidades que sirve, asegurando que sus iniciativas respondan a las necesidades locales y sean sostenibles a lo largo del tiempo. Este modelo colaborativo se erige como un testimonio del enfoque holístico del proyecto, buscando crear un cambio duradero al integrar las fortalezas de diversos actores en la lucha contra el cambio climático.

4. Capacitación docente sobre educación en cambio climático, 5 de mayo de 2022, Ciudad de México, México

A través de estas alianzas, el proyecto ALEC tiene como objetivo llegar a aproximadamente 16,000 aulas formando a 6,000 docentes, fomentando la implementación de proyectos de aula centrados en la adaptación o mitigación del clima, y promoviendo la integración de temas de cambio climático en los currículos escolares. Este esfuerzo busca transformar la percepción del cambio climático de ser visto meramente como un tema extracurricular a convertirse en un componente fundamental del recorrido educativo de los estudiantes, asegurando una experiencia de aprendizaje integral que los capacite para enfrentar los desafíos climáticos de manera efectiva.

Ejemplos concretos

Adaptación de los recursos de la OCE

Los recursos educativos desarrollados en el marco del proyecto ALEC pasan por un proceso de dos etapas. Inicialmente, la OCE desarrolla recursos educativos "genéricos" y abiertos (REA) con la ayuda de sus socios internacionales, basados en informes del IPCC: resúmenes para profesores, manuales para docentes, actividades de desarrollo profesional, animaciones multimedia, etc. Una vez validados por expertos y probados por docentes en varios países, estos recursos se adaptan al contexto local de México o Colombia. La adaptación local, realizada por los socios latinoamericanos de ALEC, se centra tanto en el contenido científico (problemas climáticos locales, impactos, soluciones) como en los aspectos pedagógicos (vínculos con los currículos, materiales disponibles en las aulas, etc.). Los recursos adaptados luego se prueban en aulas locales y son validados por la OCE antes de ser distribuidos a gran escala. Este enfoque es más eficiente en términos de costo y tiempo que comenzar desde cero el desarrollo de nuevos recursos, al tiempo que garantiza un alto nivel de precisión científica. En 2023, esta adaptación incluyó el refinamiento del manual del profesor "Suelos y cambio climático"[3] por INNOVEC en México, y el manual integral "Educación para enfrentar el cambio climático" y su lección acompañante sobre eco-ansiedad, elaborado por STEM Academia en Colombia. Estas modificaciones hicieron que los recursos fueran culturalmente relevantes y adaptados al contexto, asegurando que resonaran efectivamente con las audiencias objetivo.

Para abordar desafíos regionales específicos, los socios de ALEC ampliaron sus esfuerzos más allá de la simple adaptación. Desarrollaron un conjunto de recursos complementarios destinados a abordar directamente las demandas ambientales y educativas únicas de sus regiones. Esto incluye protocolos detallados de formación para talleres diseñados para docentes y alumnos, creados por Fondo Acción e INNOVEC. Además de videos instructivos para lecciones y talleres, podcasts que capturan las experiencias de docentes capacitados y artículos académicos destinados a ampliar el alcance e impacto de las estrategias de educación sobre el cambio climático.

Proyectos escolares para mitigar y/o adaptar al cambio climático

Una parte integral del proyecto ALEC es la creación de proyectos escolares que sirven como plataformas prácticas de aprendizaje. Por ejemplo, Fondo Acción lanzó una iniciativa ambiciosa en el Instituto de Ciencias Agroindustriales y Ambientales - ICAM en Ubaté, Cundinamarca. Esta iniciativa transforma un área ambientalmente degradada en un laboratorio de educación ambiental al aire libre. Esta área, que fue afectada durante décadas por la minería de piedra y grava, sufrió daños ecológicos significativos—pérdida de biodiversidad y la desaparición de un arroyo.

Desde 2007, se han estado llevando a cabo esfuerzos para rehabilitar este sitio. La tierra, comprada por una fundación a finales de 2006 y gestionada por el ICAM, una escuela bajo su ala, ha experimentado una restauración de trece años involucrando a más de 2,500 alumnos y sus familias. Este proyecto de restauración participativa a gran escala ha convertido el área en un laboratorio dinámico al aire libre donde los conceptos ambientales y las estrategias de mitigación del cambio climático no solo se enseñan, sino que se implementan activamente.

Hoy, el laboratorio abarca 11.5 hectáreas y está situado entre altitudes de 2,550 a 2,700 metros sobre el nivel del mar, con una temperatura promedio de 14°C. Ubicado en la finca Guanacas, nombre derivado del idioma Muisca que significa "Cercado de la alta montaña", este espacio ahora es un modelo de educación, recreación y producción sostenible. Sirve como testimonio de cómo las iniciativas educativas pueden fomentar la conciencia, alentar prácticas sostenibles y crear soluciones adaptativas al cambio climático, transformando efectivamente el conocimiento teórico en acciones prácticas y orientadas a la comunidad.

[3] El manual «Suelos y cambio climático» desarrollado por INNOVEC es una adaptación del manual para docentes «El Cambio Climático y la Tierra» de la OCE.

Estrategia de influencia regional y nacional para la ECC mediante eventos comunitarios y de alto nivel anuales

El proyecto ALEC no solo está dirigido a docentes y escuelas, sino también a los tomadores de decisiones, para fomentar su participación y comprensión de la educación sobre el cambio climático, un tema nuevo para la mayoría de los sistemas educativos. Este apoyo a la política pública se manifiesta a través de talleres de capacitación para funcionarios de los ministerios de educación y medio ambiente, apoyo científico y pedagógico para proyectos de reforma curricular y la facilitación de comunidades de práctica.

En este sentido, se organizan eventos nacionales y regionales sobre educación en cambio climático cada año como parte del proyecto ALEC (en Colombia y México, los primeros países de implementación, pero también en terceros países como Chile). Estos eventos reúnen a tomadores de decisiones, educadores, científicos y sociedad civil, para construir y mantener el impulso, compartir experiencia, conocimientos y avances de diferentes actores, para asistir en la adopción y difusión de las herramientas desarrolladas dentro del proyecto. Esto no solo asegura la sostenibilidad del proyecto, sino también su expansión a través de la participación de autoridades públicas y otros países de la región.

Eventos internacionales (como la COP climática, reuniones de la Greening Education Partnership o el WEEC) sirven para destacar el trabajo realizado en el terreno y comparar las estrategias y herramientas desarrolladas con las mejores prácticas observadas a nivel mundial.

Los resultados

El proyecto ALEC ha logrado avances significativos en la educación sobre el cambio climático en México y Colombia, demostrando resultados tangibles en términos de desarrollo profesional docente, divulgación educativa y proyectos implementados en escuelas.

En México, el proyecto ha avanzado significativamente la educación sobre el cambio climático (CCE) a través de programas completos de formación docente realizados por INNOVEC y el Centro Mario Molina. En 2022 y 2023, las sesiones de capacitación presencial de INNOVEC, compuestas por 50 horas de desarrollo profesional, alcanzaron exitosamente a más de 2,000 educadores en varios estados, mejorando significativamente su capacidad para enseñar sobre el cambio climático. Además, INNOVEC organizó talleres para 341 formadores, extendiendo aún más el alcance y el impacto del proyecto. El Centro Mario Molina también hizo una contribución sustancial al capacitar a más de 900 profesores de todo el país a través de un curso en línea. Colectivamente, las diversas actividades del proyecto, incluyendo esfuerzos de divulgación, conferencias y talleres, han impactado a más de 17,000 profesores, enriqueciendo la educación sobre el cambio climático en todo México.

5. Docente sosteniendo el manual para docentes de la OCE "Cambio Climático y Tierra", 23 de octubre de 2023, Copacabana, Antioquia, Colombia

En Colombia, el enfoque ha sido igualmente impactante, con más de 600 docentes capacitados en línea a través de un modelo híbrido, cubriendo 65 horas de instrucción por docente, en ocho regiones diferentes del país. Además, otros 300 profesores están actualmente inscritos en capacitaciones, lo que indica un compromiso continuo y una expansión del alcance del proyecto. Lo notable

de este enfoque es el seguimiento y monitoreo diligente que se proporciona a los participantes del curso, lo que se refleja en la impresionante tasa de finalización que supera el 70%.

La evaluación intermedia del proyecto ofrece comentarios positivos, indicando un progreso sustancial en varias áreas clave. Un notable 94% de los docentes capacitados ha informado una mejor comprensión del cambio climático, con un 96% integrando este nuevo conocimiento en sus actividades de aula, subrayando el éxito de la capacitación.

El desarrollo y distribución de materiales educativos también han logrado avances significativos, incluyendo 2 manuales, 5 protocolos de formación docente y 10 guías pedagógicas que se alinean con los informes del IPCC y están adaptados a las necesidades locales, complementados por 8 videos educativos, 4 cursos en línea y docenas de animaciones multimedia para uso en clase. Estos recursos han enriquecido enormemente el panorama educativo para el aprendizaje del cambio climático en estos dos países. Además, la firma de 14 acuerdos de colaboración con secretarías de educación locales y la organización de aproximadamente 20 conferencias y eventos de alto nivel han mejorado significativamente la visibilidad e influencia del proyecto, creando un ambiente propicio para avanzar en la educación sobre el cambio climático desde un punto de vista operativo y político.

6. Capacitación docente sobre cambio climático y agricultura, 15 de noviembre de 2023, Xalapa, Veracruz, México

Estos resultados demuestran el enfoque integral del proyecto ALEC hacia el desarrollo profesional, la creación de recursos y la divulgación educativa, avanzando significativamente la educación sobre el cambio climático en México y Colombia. A través de la capacitación dirigida a docentes, el desarrollo de materiales educativos a medida y asociaciones estratégicas, el proyecto está logrando avances hacia su objetivo de integrar temas de cambio climático en los currículos escolares e inspirar un cambio práctico entre los docentes y los sistemas educativos formales.

¿Qué viene después?

Añadiendo al éxito que el Proyecto ALEC ha demostrado en México y Colombia, la OCE y sus socios están expandiendo su enfoque innovador y sostenible hacia la educación sobre el cambio climático a una escala regional y global. La base del proyecto se apoya en cuatro pilares críticos: la producción de recursos educativos basados en los datos del IPCC y adaptados a contextos locales; el desarrollo profesional para docentes; el fomento de comunidades de práctica; y una evaluación exhaustiva del proyecto. Estos elementos han culminado en la integración exitosa de la educación climática en los currículos escolares, hecha a medida para el contexto único de cada comunidad a través de sólidas asociaciones locales y colaboración con los ministerios de educación.

Con la mirada puesta en construir sobre sus logros iniciales, el Proyecto ALEC está activamente expandiendo su influencia a nuevas regiones, con avances notables en Perú, Argentina y Centroamérica. En Perú, se ha establecido una asociación significativa con el Consejo Nacional Educativo para apoyar el mejoramiento de políticas públicas y la renovación de currículos, marcando un paso crucial hacia la incorporación más profunda de la educación sobre el cambio climático en el sistema educativo nacional. Esto tiene como objetivo preparar a los jóvenes peruanos con el conocimiento y las habilidades necesarias para enfrentar los desafíos climáticos de manera efectiva. En Argentina, el proyecto se ha asociado con socios locales para lanzar programas de capacitación para formadores, diseñados para proporcionar a los educadores de 24 escuelas

en tres regiones las herramientas y metodologías esenciales para integrar temas de cambio climático en su currículo. Los socios locales están buscando activamente financiación adicional para extender el programa a 40 escuelas más. Ya se ha capacitado a 16 formadores y 55 docentes. En Centroamérica, específicamente en Honduras, Guatemala y Costa Rica, la expansión del proyecto refleja un compromiso de satisfacer las necesidades de educación climática de contextos geográficos y culturales diversos. Adaptando sus estrategias a los desafíos y oportunidades únicos de cada país, el Proyecto ALEC busca establecer una red amplia e inclusiva dedicada a iniciativas de educación sobre el cambio climático.

7. Alumnas que han establecido huertos escolares, 26 de octubre de 2023, Copacabana, Antioquia, Colombia

Esta expansión estratégica subraya la visión de ALEC de un sistema educativo global donde la conciencia y la acción frente al cambio climático son parte integral del aprendizaje. Al adoptar evaluaciones tanto cuantitativas como cualitativas, incluyendo la revisión de materiales pedagógicos y la observación directa de los impactos en las aulas, el proyecto ha demostrado mejoras tangibles en la participación estudiantil y en la implementación de proyectos climáticos basados en las escuelas.

El éxito del proyecto y su continua expansión sirven como testimonio del poder de una educación sobre el cambio climático colaborativa, bien informada y adaptada localmente. A medida que entra en nuevas regiones, el proyecto continúa construyendo sobre sus logros, con el objetivo de inspirar y movilizar a una comunidad global de educadores, estudiantes y tomadores de decisión hacia una gestión sostenible del cambio climático.

Presentación del proyecto ARRICE para África

Basándose en las metodologías del proyecto ALEC, el alcance de la educación innovadora sobre el cambio climático se está extendiendo aún más con la introducción del proyecto ARRICE (Iniciativa Regional Africana de Resiliencia sobre Educación Climática, por sus siglas en inglés). Programado para lanzarse en 2024, ARRICE es un testimonio del alcance impactante y la adaptabilidad de los enfoques del proyecto ALEC, con el objetivo de replicar y adaptar estas estrategias para ajustarlas a los paisajes ambientales, sociales y educativos únicos de África. ARRICE busca desarrollar una educación de alta calidad sobre el cambio climático en escuelas primarias y secundarias en Kenia, Mauricio y Senegal. El objetivo principal del proyecto es subrayar el papel transformador de las escuelas en fomentar la resiliencia climática, reconociendo la educación como un elemento fundamental para preparar a las futuras generaciones para enfrentar los desafíos climáticos de manera directa.

El proyecto ARRICE representa una expansión emocionante de los esfuerzos de educación climática en África, demostrando la escalabilidad y adaptabilidad de las metodologías desarrolladas a través del proyecto ALEC. Al enfocarse en países (Kenia, Mauricio, Senegal) con climas y desafíos ambientales diversos, ARRICE tiene como objetivo crear un modelo de educación sobre el cambio climático que pueda adaptarse e implementarse en todo el continente y más allá.

A medida que ARRICE se prepara para su lanzamiento, se presenta como un modelo para futuras iniciativas que buscan hacer de la educación sobre el cambio climático una piedra angular de los esfuerzos globales de resiliencia y sostenibilidad. El proyecto no solo tiene como objetivo educar, sino también inspirar acción, fomentando una generación de individuos informados y empoderados listos para contribuir a la lucha global contra el cambio climático.

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Air Quality at New York University Abu Dhabi: Measuring the Effects of Information Provision on Knowledge, Behavior and Policy Preferences[1]

Hilina Bayew(1)

Abstract

Research has shown that while environmental disease burden in the UAE is lower than global average, outdoor air quality remains the number one leading factor for premature death. In the past, environmental literacy has been found to have significantly positive impacts on students' environmentally responsible behavior. By providing air quality information in the form of bi-weekly email summaries and critical level (AQI 200) email alerts, this study examines whether providing information about local air quality affects community members' knowledge, behaviors and policy preferences related to the local environment. Participants were randomly assigned into one of three groups: critical level messaging, bi-weekly summaries, control. Randomization was blocked by respondent type, i.e., faculty, contracted workers, and students. The study found that overall levels of concern regarding air quality were high among all participants, and messaging had no significant impact on these levels. Furthermore, the bi-weekly summaries did not result in significant changes in participants' knowledge, behavior, or policy preferences regarding air quality. However, the critical alerts treatment did lead to increased knowledge among participants on several dimensions, as well as a higher frequency of air quality checks before going outdoors, indicating a positive impact on behavior. While neither treatment had a notable effect on policy preferences, a large percentage of participants expressed interest in receiving timely messaging about air quality. Overall, the study suggests that the critical alerts approach is a more effective intervention strategy for providing air quality messaging to the NYUAD community compared to the bi-weekly summaries.

1. Introduction

Since the industrial revolution, poor air quality has become an increasingly significant issue globally. In the 19th and early 20th centuries, the primary source of air pollution was domestic coal burning, which led to severe smog episodes and respiratory related hospital admissions in cities such as London and New York (Bell and Davis, 2001). With the advent of industrialization, however, industrial processes and transportation have become major contributors to air pollution (Mylona, 1996). The combustion of fossil fuels, such as coal, oil, and gas, releases harmful pollutants into the atmosphere, including particulate matter, nitrogen oxides, and sulfur dioxide (Maciejczyk, Chen and Thurston, 2021). The rapid growth of urban areas has also led to an increase in air pollution, with higher levels of emissions from vehicles, factories, and power plants. Geographically, air pollution tends to be most prevalent in areas with high population density, such as cities and industrial zones (Gurjar *et al.*, 2010). However, less industrialized regions, such as parts of Asia and Africa, also experience high levels of air pollution due to factors such as desert dust, wildfires, and agricultural burning (Brauer *et al.*, 2016). According to the World Health Organization (WHO) in 2016, outdoor air pollution was estimated to have caused 4.2 million premature deaths globally. Today, the WHO fact sheet reports that approximately seven million premature deaths occur annually as a result of poor air quality.

Air pollution is a critical global health risk that is now estimated to have a burden of disease that is equivalent to other significant health hazards, such as obesity and tobacco smoking, according to the World Health Organization (WHO). This

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issue directly affects the Middle East region and is of utmost importance. According to WHO, in 2021 at least 7 million premature deaths were a result of being exposed to fine particulate matter (PM2.5) which causes lung cancer, heart disease, and strokes among other diseases (UNEP, 2022).

The United Arab Emirates (UAE) has experienced a significant increase in air pollution over the past few decades due to rapid industrialization, urbanization, and transportation. A 2012 study found outdoor air quality to be the number one leading factor in premature death in the UAE (Gibson and Farah, 2012). A study by Environment Agency - Abu Dhabi (2020) found that the concentration of particulate matter (PM2.5) in the UAE exceeded the World Health Organization's (WHO) guidelines (5 g/m3 of PM2.5 for the annual mean and 15 g/m3 for the 24-hour mean (World Health Organization, 2021), with annual average concentrations ranging from 30 to 45 tg/m3 between 2012 and 2022 in Abu Dhabi. This high level of air pollution has led to adverse health effects and an increased disease burden in the population. A study estimated that in 2007, approximately 545 excess deaths within the UAE in 2007 were due to the presence of particulate matter in ambient air (Li *et al.*, 2010). These findings highlight the urgent need for effective air quality related studies in the UAE to protect public health and reduce the burden of disease.

Despite the increasing amount of scientific research on the subject, the general public is still relatively uninformed about the dangers of air pollution. This lack of awareness can be attributed, in part, to insufficient information provision that fails to meet the needs and expectations of the public (Beaumont *et al.*, 1999). As a result, despite the clear evidence linking air pollution to health risks, the public remains largely unaware of the hazards associated with exposure to polluted air. The invisibility of air pollution, as well as the delayed onset of its health effects, further contributes to this lack of public awareness. This lack of awareness regarding the impact of air pollution on the environment and human health raises multiple questions. In particular, this study aims to address the following question: Does providing information about local air quality have an effect on the knowledge, behaviors and policy preferences of community members with regards to the local environment? In other words, this study will investigate whether educating individuals on local air quality has an impact on how they view and interact with their environment.

Information provision has been found to significantly shift policy preferences towards prevailing scientific opinion (Diamond *et al.* 2020). According to the Bayesian model of information processing, individuals update their beliefs and attitudes after receiving relevant information (Slovic and Lichtenstein 1971). However, this is primarily the case when individuals' beliefs about a given topic are weakly held and appear to be challenged by the message provided (Bullock, 2009). This study provides new insights on the relationship between information provision and air quality awareness, focusing on fine particulate matter (PM2.5), which is most threatening for human health (Cassee *et al.*, 2013).

To understand the effects of information dissemination on community members' knowledge, behaviors and policy preferences, I conducted a survey among New York University Abu Dhabi (NYUAD) community members. An initial survey was conducted among around 800 undergraduate and graduate students, campus safety officers, facilities staff, administrative staff, and faculty members to establish a baseline understanding of participants demographics, knowledge and behavior. Following this baseline survey, all participants were randomly assigned into one of three groups: critical messaging treatment, bi-weekly summaries treatment, control group. The first two treatment groups received air quality updates via email from January 26th, 2023 until March 28th, 2023 after which participants in all three groups were asked to take an endline survey to measure whether their knowledge, attitudes and behaviors regarding air quality had changed.

To the best of my knowledge most previous studies have been correlational. Additionally, there is yet to be a study that measures the impacts of how air quality information is delivered to respondents and how the delivery system affects their knowledge, behaviors and policy preferences related to the local environment. My study contributes

an experimental design that varies air quality messaging in order to measure the impacts on the outcome variables of knowledge, behaviors and policy preferences related to the local environment. For the purposes of this study the air quality monitors used will be displaying fine particulate matter (PM2.5)

My study found that overall levels of concern regarding air quality were high among all participants, and messaging had no significant impact on these levels. Furthermore, the bi-weekly summaries did not result in significant changes in participants' knowledge, behavior, or policy preferences regarding air quality. However, the critical alerts treatment did lead to increased knowledge among participants for certain variables, as well as a higher frequency of air quality checks before going outdoors, indicating a positive impact on behavior. While neither treatment had a notable effect on policy preferences, a large percentage of participants expressed interest in receiving timely messaging about air quality. Overall, the study suggests that the critical alerts approach is a more effective intervention strategy for providing air quality messaging to the NYUAD community compared to the bi-weekly summaries.

The remainder of this paper will proceed as follows: First, in the next section, I will provide a brief overview of particulate matter and air quality in the UAE. I will then delve into the theoretical motivation behind this research and describe the methodology used. Next, I will explain the research design and present my findings. Finally, I will discuss the implications of these findings and provide recommendations for future interventions.

2. Particulate Matter and Air Quality in the UAE

This section will provide an overview of particulate matter and its various types. To begin, I will define particulate matter and explain its sources. Then, I will discuss the different types of particulate matter, including PM10 and PM2.5, and describe their characteristics. Finally, I will examine the Air Quality Index (AQI) and the levels that are monitored by the stations within the UAE.

Particulate matter (PM) consists of both solid and liquid droplets that are microscopic enough to be suspended in the air for a prolonged period of time. Particulate matter can be classified into PM10 (coarse particles less than 10 micrometers in diameter) and PM2.5 (fine particles less than 2.5 micrometers in diameter) (Cities Air, N.d.). PM2.5 mainly results from human activities such as the combustion of coal and diesel, motor vehicle emissions, and industrial processes (Cities Air, N.d.). These microscopic particles are extremely hazardous and invisible to the naked eye.

Although the Emirate of Abu Dhabi currently has twenty air quality monitoring stations reporting data on four pollutants (particulate matter (PM), ozone (O3), nitrogen dioxide (NO2) and sulfur dioxide (SO2)), these monitors downplay the hazardous impacts the air quality within Abu Dhabi have on our human health. These monitors report PM10 which gives the false impression that the air quality within Abu Dhabi is 'satisfactory' (NCM, 2022) when in reality, the levels of PM2.5 on some days are considered 'hazardous' for human health.

On the one hand, these monitoring stations serve as a great step towards monitoring air quality within the city to align with the United Arab Emirates (UAE) vision to move away from unclean energy sources, such as oil and coal, towards more green alternatives.

This aligns with Sheik Mohammed's Green Economy initiative launched in January of 2012 which is anchored in making the UAE the model of a green economy and preserving the environment for generations to come (UAE Government, 2022). On the other hand, however, the lack of PM2.5 levels being reported gives false impressions and could pose potential threats to human health. Therefore, this study is essential in disseminating information regarding PM2.5 levels within the community in order to increase knowledge and awareness. These PM2.5 levels will be reported in accordance with the air quality index.

Next, I will give a brief overview of the air quality index used to measure particulate matter. Air quality index (AQI) is a measure that runs from 0 to 500 and provides information on how clean

or polluted the air we breathe around us is in accordance with the amount of fine particulate matter (PM2.5) that is present. AQI further provides information on the implications of air quality on our health. Since particulate matter is microscopic, it is capable of penetrating deep into our lungs and bloodstream causing damage to our bodies. The microscopic nature of particulate matter makes it the most threatening to our health in comparison to other forms of air pollution (Cassee *et al.*, 2013). Although the levels of particulate matter in Abu Dhabi have been decreasing over the past few years, they still remain well above the annual limits set by the WHO. Thus, air quality awareness and monitoring to protect our well-being remains of significant importance (World Health Organization, 2021).

3. Theoretical Motivation

Information plays a crucial role in shaping people's beliefs and attitudes in a political context (Diamond, Bernauer and Mayer, 2020). For instance, the general public could be skeptical of policies that rely on scientific evidence when their own understanding of science is narrow and insufficient (Allum *et al.*, 2008). The Bayesian model of information processing suggests that increased exposure to information affects people's beliefs and attitudes positively (Slovic and Lichtenstein, 1971). In Bayesian inference, prior beliefs are updated in light of new information, resulting in posterior beliefs. This means that as individuals are exposed to new information, their prior beliefs are updated, and their attitudes and beliefs may become more positive.

Thus far, relevant literature has informed us about the positive impacts of discussing climate related topics in school environments and how it positively impacts climatefriendly behavior (Yildirim Tasti & Akar, 2021). It was also found that environmental literacy had significantly positive impacts on students' environmentally responsible behavior (Kolenaty`, Kroufek and Činčera, 2022). The indirect link between climate change awareness and environmental quality emphasized the importance of climate related topics being discussed in classroom environments, potentially as mandatory courses, to raise overall awareness of climate related issues and save the environment (Kousar *et al.*, 2022).

A further intervention of mobile-health interactive messaging for 2.5 months during the COVID-19 pandemic was found to have effectively increased the knowledge levels of parents regarding safe and effective postpartum care (Wulandari *et al.*, 2022). Generally, messaging for disease prevention (e.g. HIV) and awareness are effective (Gold *et al.*, 2011). Additionally, such messaging has been found to effectively reach different demographics including high-proportions of young adults that have low education levels (Wulandari *et al.*, 2022). This motivates the first hypothesis of this study regarding a knowledge outcome:

Respondents who receive any type of air quality information will have higher levels of knowledge about air quality than those in the control group.

In the context of this research, the provision of information on air quality and environmental pollution is likely to change beliefs and attitudes in individuals who are skeptical of the scientific consensus of environmental pollution rather than individuals who already believe in environmental pollution (Diamond, Bernauer and Mayer, 2020). If an individual's prior attitudes on environmental pollution are weak then they are more likely to be persuaded by the new information that is provided. Research carried out via prior public opinion surveys suggests that most individuals do not have high levels of scientific knowledge on environmental issues particularly that of climate change (Evans and Durant, 1995; Jallinjoa and Aro, 2000; Allum *et al.*, 2008). Less scientific knowledge can be associated with weaker attitudes about a topic, therefore it can be suggested that providing information on air quality is likely to persuade the opinions of participants towards more climate friendly beliefs and attitudes. Additionally, several studies have found that text-message based health interventions are effective in promoting healthy behavior (Dai *et al.*, 2021). For instance, a meta-analysis that included 19 randomized control trials reported positive outcomes of messaging on smoking cessation and physical activity interventions (Head *et al.*, 2013). These studies found interventions to be significantly

more effective when the messages were tailored and personalized. In another study, interactive mobile health messaging over a 3.5 month period during the COVID19 pandemic was found to effectively improve postpartum care behavior in both mothers and their husbands (Wulandari *et al.*, 2022). Mkumbachi, Astina and Handoyo (2020) conducted a correlational study among university students and found that environmental literacy has a significantly positive impact on students' environmentally responsible behavior. In fact, Diamond, Bernauer and Mayer (2020) showed that individuals provided with air quality information are likely to change their behavior by reporting less time outdoors during poor air quality and more likely to report checking the air quality before spending time outdoors. This motivates the second hypothesis of this study regarding a behavior outcome:

a) Respondents who receive either type of air quality information will be more likelyto report minimizing spending time outdoors in poor conditions than those in the control group

b) Respondents who receive either type of air quality information will report checkingair quality before spending time outdoors more frequently than those in the control group

There is also a growing literature on the frequency of messages received and their effects on people's behavior and attitudes. Fjeldsoe, Marshall and Miller (2009) studied how providing information about interventions to enhance healthy behavior via mobile phone SMS messages impacts short-term healthy behavior. SMS messaging was found to have a small but significant positive effect on a wide range of healthy behaviors. Additionally, the provision of credible web links related to the message content, for example regarding the barriers to HIV testing, proved to be an effective tool of positive behavior promotion since information coming from credible sources can promote positive behavior change (Middleton *et al.*, 2020; De Vasconcelos *et al.*, 2018). This study found text message intervention to be effective in raising HIV awareness levels, increasing STI testing and engaging participants as a large proportion clicked on the short web-links provided in order to access external sources. In another study where air quality information was provided to respondents in order to raise awareness levels, respondents indicated a strong need and interest in receiving local information regarding air quality (Beaumont *et al.*, 1999). Generally, those who received messaging indicated a desire to continue receiving messaging (Head *et al.*, 2013). This motivates the third hypothesis of this study regarding a policy preference outcomes:

a) Respondents who receive either type of air quality information will be more likely tosupport university-wide messaging on local air quality conditions than those in the control group.

b) Respondents who receive either type of air quality information will be more likelyto support more comprehensive monitoring of local air quality conditions than those in the control group.

Additionally, varying the frequency of messaging has been found to be more effective than using a fixed messaging frequency (Willoughby, King and Adams, 2022; Head *et al.*, 2013). Thus, I expect varied temporal messaging that alerts and educates participants about air quality to be more effective in increasing participants' knowledge levels, promoting positive behavior and guiding more support towards policies regarding air quality messaging over constant temporal messaging. This motivates the fourth hypothesis of this study:

The effects of air quality messaging on participants knowledge, behavior and policy preferences will be more pronounced in the critical messaging treatment condition than in the bi-weekly summaries treatment.

Demographic factors may also determine both people's knowledge and behavior regarding air quality. A study took the form of a discrete choice experiment where respondents were presented with a game of sorts. In this game participants were given different choice cards of possible interventions to improve the poor air quality in South Delhi. The options presented to respondents included improved public transportation, improved technology, building waste recycling plants, and no action. Respondents had to vote for one of the presented choices and had the option to take no action if they didn't like any of the programs or

felt they were too costly. This study found that people with a higher level of education and income were more willing to pay to alleviate the impacts of poor air quality (Mariel, Khan and Meyerhoff, 2022). This gives a clear indication that levels of education, among other demographic factors, influence both levels of knowledge and behavior of people regrading air quality. Instead of measuring willingness to pay based on knowledge and education level, my study looks at respondents' willingness to support university wide policies on air quality messaging. My study further controls for different demographic characteristics (i.e. gender, major, education level, age, nationality, class year, major) in order to assess the impacts of said characteristics on the three outcome variables.

4. Research Design

4.1 Experimental Design

This study was conducted as a field experiment at the New York University Abu Dhabi (NYUAD) campus, with a wide range of participants including undergraduate and graduate students, campus safety officers, facilities staff, administrative staff, and faculty members. These participants were recruited through fliers, emails, and word of mouth.

For convenience, participants were placed into three categories: faculty, comprising administrative staff and faculty members; contracted workers, including campus safety officers and facilities staff; and students, encompassing both undergraduate and graduate students. This categorization helped to simplify the study's procedures and ensure that participants were grouped based on their role on campus. Overall, this approach allowed the study to efficiently recruit participants and gather data from a diverse range of individuals on the NYU Abu Dhabi campus.

This study seeks to examine the effects of providing information on local air quality, through email alerts, on NYUAD community members knowledge, behavior, and policy preferences. Specifically, the study period ran from January 26th, 2023, to April 12th, 2023, during which air quality information was sourced from the air quality monitors managed by the Center for Interacting Urban Networks (CITIES) research center on the NYU Abu Dhabi campus. By analyzing the impacts of email alerts on participants' responses, we can gain valuable insights into how to effectively communicate environmental information and promote positive actions related to air quality.

To recruit participants, a baseline survey was conducted in November 2022, which included questions about participants' demographics, the buildings or areas they frequent on campus, and their knowledge and beliefs on whether they are personally impacted by poor air quality. A total of 1050 people started the survey, with 704 providing their email addresses for follow-up communication. Using block randomization, respondents were assigned to one of three groups: critical alerts, biweekly summaries or control. Randomization was blocked by respondent type, i.e., faculty, contracted workers, and students.

The critical alert and biweekly summaries treatment groups were designed to receive different types of email alerts. In contrast, the control group did not receive any air quality information. At the end of the study period, the effects of the email alerts on participants' knowledge, behavior, and policy preferences regarding air quality were measured in the endline.[2]

In the following sections, I will describe in more detail the two treatment groups and their specific email alert interventions. Additionally, I will highlight key survey measures used to assess the effectiveness of the email alerts in promoting knowledge and behavioral changes related to air quality. By carefully examining the impacts of the critical alert and biweekly summaries treatment groups, we can gain valuable insights into how email alerts can be used to communicate important information to the NYUAD community and promote positive health practices.

Treatment Group 1: Critical Level Messages

The first treatment group received emails whenever the air quality exceeded the threshold of AQI 200. These emails had the subject line **"Very Unhealthy air quality conditions (AQI: value)"** and contained a large screenshot of the value of the current critical

[2] The survey instrument can be found in the Appendix.

AQI level (see Appendix). In addition, the emails also included a sentence that read, *"This is an email alert to inform you NYUAD's air quality at present is poor. The current Air Quality Index (AQI) is value, which is considered Very Unhealthy."* At the bottom of the screenshot, there were links attached directing participants to the CITIES Air website, followed by a link to download the IQAir app. To track the frequency of clicks, these links were attached to bit.ly. The emails also had a small section that provided general air quality information.

Treatment Group 2: Bi-weekly Summary

The second treatment group, on the other hand, received biweekly summaries via email, providing a summary of air quality in the previous two weeks. These emails were titled **"Air quality conditions at NYUAD, start date of 2-week period – end date of two-week period"** and included a graph displaying the AQI levels over the same two-week period. The email's content began with the sentence: *"This email will highlight the average air quality conditions at NYUAD over the past two weeks. The average Air Quality Index (AQI) is **value**, which is considered Moderate."* Additionally, the emails contained a section providing recommendations for outdoor activities based on the average air quality conditions (see Appendix). Like the first treatment group, links were included at the bottom of the graph to the CITIES Air website and the IQAir app, both attached to bit.ly links to track clicks. The emails also contained general air quality information.

Control

The participants assigned to the control group solely completed the baseline and endline surveys without any intervention from the study, meaning they did not receive any air quality information through email alerts or otherwise.

4.2 Sampling Strategy

To recruit participants for the study, I employed a multi-faceted approach. Firstly, on my behalf, CITIES made use of their mailing list to send out an email with the baseline survey to NYUAD students. Secondly, the Office of Social Responsibility helped me by sending out an email with the baseline survey to all contracted workers, including campus safety, EFS, dining hall staff, and athletics assistants. This method successfully recruited around 180 contracted staff into the study. Thirdly, I obtained email addresses of some faculty and staff members from official NYUAD websites and sent them a recruitment email with the baseline survey. Finally, QR codes were placed across various campus buildings and elevators, allowing anyone passing by to scan and participate in the baseline survey. Overall, this multi-pronged approach effectively recruited a diverse group of 704 participants for the study.

4.3 Endline Survey

After the 10-week air quality messaging period for the treatment groups, all participants were recontacted via email and invited to take the endline survey. This survey was designed to measure the impact of the air quality messaging on participants' knowledge, behaviors, and policy preferences.

The survey was divided into several sections, including a knowledge section with both true/false and multiple choice questions, a behavior section with questions related to participants' actions in response to the air quality messaging, and a policy preferences section with questions about participants' attitudes towards campus policies related to air quality. Participants in the treatment groups also received a section with questions regarding the messaging they received, including whether they recalled seeing it and how useful they found it.

To incentivize participation, only those who completed both the baseline and endline survey were eligible to enter a raffle for one of 284 gift cards.

4.4 Key Measures and Variables

The study's independent variable is the type of air quality information provided to participants through email updates (either critical alerts or bi-weekly summaries based on the treatment participants were assigned to). The dependent variables of this study are the changes in participants' knowledge, behavior, and policy preferences in response to the air quality messaging.

As part of the study, I also collected demographic information from the participants, which included their gender, age, nationality, and education level. Additionally, I asked if they had any history of asthma and if so, the severity level.

4.5 Summary Statistics

To begin, I will describe the sample of the study, including summary statistics on demographic variables and baseline levels of knowledge about air quality and air quality monitoring. Among those who completed the baseline survey, approximately 40% of the sample (295 participants) were female, as shown in Table 1. Women comprised about half the sample among faculty and students in both the baseline and endline surveys, but a large disparity was observed among contracted workers, with women comprising less than 15% of the contracted workers represented in the sample.

Next I will take a look at the median age represented within this study based on category. The age of participants across the baseline and endline surveys remained fairly consistent, with the median age for faculty ranging from 35-39 years and for students ranging from 20-24 years, as expected. However, for contracted workers, older workers were more likely to complete the endline survey, with the age range shifting from 30-34 years in the baseline to 35-39 years in the endline.

Moving further to analyze the amount of time spent outdoors, a significant discrepancy can be observed among the different types of participants based on the nature of their work. Notably, contracted workers spent considerably more time outdoors/ on-campus compared to faculty and students. This can be attributed to the fact that contracted workers include campus safety staff, athletics assistants, dining hall staff, and efs personnel, who spend a considerable amount of time outdoors performing tasks such as equipment assembly, cleaning, and patrolling. Conversely, students and faculty members typically spent only 30 minutes to an hour outdoors daily. However, during weekends, the median time spent outdoors for all three categories was between 2 to 3 hours.

Table 1: Summary Statistics for Demographics

	Faculty Mean (SD)	Contracted Staff Mean (SD)	Students Mean (SD)
% female (BL)	0.49 (0.50)	0.14 (0.35)	0.52 (0.50)
% female (EL)	0.54 (0.50)	0.13 (0.34)	0.53 (0.50)
% any level asthma (BL)	0.09 (0.29)	0.03 (0.18)	0.09 (0.28)
% any level asthma (EL)	0.08 (0.28)	0.03 (0.19)	0.06 (0.24)
Campus days	5.10 (1.44)	5.72 (1.03)	6.50 (0.97)
	Median	**Median**	**Median**
Age (BL)	35-39 years	30-34 years	20-24 years
Age (EL)	35-39 years	35-39 years	20-24 years
Education Level (BL/EL)	Masters	Secondary School	Bachelors
Weekday outdoor time	30 mins - 1hr	1-2 hrs	30 mins - 1hr
Weekend outdoor time	2-3 hrs	2-3 hrs	2-3 hrs
On-campus outdoor time	30 mins - 1hr	1-2 hrs	30 mins - 1hr

Baseline AQI Knowledge

This section will discuss the knowledge that participants had about Air Quality Index (AQI) at the beginning of the study when they took the baseline survey. In particular, we will examine whether participants believed air quality had an impact on their personal health, their knowledge of the AQI level that posed a danger to all groups, their familiarity with the AQI monitors located on campus, and the number of days they spent on campus.

As shown in Table 2 most participants reported believing that air quality had an impact on their personal health.[4] Interestingly, faculty appeared to have a greater awareness of the impact of air quality on their personal health, while over one-third of contracted workers reported that they did not believe air quality had an impact on their own health. Participants were also asked to identify the level of AQI that posed a danger to all groups.[5] The table indicates that this measure of AQI knowledge was low across all three participant categories.

At the time of the study there were two air quality monitors located indoors on the NYUAD campus. The readings from these monitors were shown on large screens designed to be visible to the public. The majority of participants in each category appeared to have encountered the AQI monitors located on campus (Figure 1).Participants were also asked to name the buildings where monitors were located. This variable, "Correct monitor location", was coded as a count variable.[6] Students appeared to be more knowledgeable about the monitor locations relative to faculty and contracted workers. This result was not surprising as the indoor monitors are situated in C2 and D2, which are known as hotspots for students since these locations host various facilities such as the gym, classrooms, library, convenience store, and the dining hall. Therefore, it is expected that students spend more time in these areas and are more familiar with the monitor locations. In contrast, contracted staff and faculty typically identified the location of only one monitor correctly.

Table 2: Summary Statistics for AQI Knowledge

	Faculty	Contracted Staff	Students
AQI Personal Effects (belief)	0.87 (0.34)	0.61 (0.49)	0.74 (0.44)
AQI Knowledge	0.07 (0.26)	0.06 (0.23)	0.08 (0.27)
Seen Monitors	0.93 (0.26)	0.91 (0.29)	0.98 (0.15)
Correct monitor location (count, 0-2)	1.07 (0.50)	0.97 (0.40)	1.66 (0.53)
Incorrect Monitor Location	0.12 (0.33)	0.17 (0.38)	0.11 (0.31)

[4] A value of 1 indicates a belief that air quality affects personal health and 0 indicated no belief or uncertainty.

[5] This was a binary variable with a correct response of AQI 150 and above coded as 1 and an incorrect response as 0.

[6] This count variable was coded as 0 if participants did not not name any correct locations, 1 if they correctly named one building location, and 2 if they correctly named both buildings.

Additionally, an Incorrect Monitor Location variable was generated to assess whether participants identified an incorrect building as having an air quality monitor.[7] Across all three categories, relatively few individuals identified an incorrect building for the monitors.

In summary, this section has shed light on the AQI knowledge that participants had at the beginning of the study, including their beliefs about air quality affecting personal health, their knowledge of the AQI level that posed a danger to all groups, along with their familiarity with the AQI monitors located on campus.

4.6 Outcome Variables

This section will discuss the knowledge variables present within the baseline. Table 3 presents the regression analyses examining the relationship between demographic characteristics and the four outcome variables: the number of correct monitor locations, the number of incorrect buildings named for monitor location, AQI knowledge about which level is harmful for all groups, and knowledge that AQI affects personal health. The demographic variables included gender and participant type. I also included levels of asthma as an indicator for the treatment groups, though these should be unrelated to outcomes measured before treatment assignment.

Table 3: Predictors of Air Quality Knowledge

	(1) Monitor Correct b/se	(2) Monitor Correct b/se	(3) AQI Knowledge b/se	(4) AQI Personal Effect b/se
Critical	-0.012 (0.043)	-0.039 (0.029)	-0.021 (0.023)	-0.005 (0.039)
Biweekly	-0.004 (0.043)	0.004 (0.029)	-0.013 (0.023)	0.013 (0.038)
Contracted Staff	-0.128** (0.063)	0.048 (0.042)	-0.028 (0.033)	-0.250*** (0.057)
Students	0.591*** (0.055)	-0.014 (0.037)	0.008 (0.029)	-0.131*** (0.049)
Female	-0.065* (0.038)	0.015 (0.025)	-0.033* (0.020)	0.026 (0.034)
Any asthma	-0.107 (0.070)	-0.054 (0.047)	-0.038 (0.037)	0.037 (0.062)
Constant	1.119*** (0.060)	0.132*** (0.040)	0.103*** (0.031)	0.848*** (0.053)
N	796	796	796	796
R_2	0.292	0.011	0.007	0.031

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

[7] a binary variable (Incorrect Monitor Location) takes a value of 1 if a respondent lists a building that does not have a monitor.

Upon examining the table, it is evident that most demographic variables do not significantly predict the outcomes. However, I have observed a noteworthy finding, indicating that contracted workers have a significantly lower likelihood of correctly identifying monitor locations. Furthermore, they are also significantly less likely to believe that poor air quality has a personal impact on their health.

It is important to note that the magnitude of this finding is quite substantial. Specifically, contracted workers are 25 percentage points less likely to perceive air quality as affecting their health compared to faculty. Given that contracted workers are more likely to be exposed to outdoor air quality due to the nature of their work, these findings are especially significant, as they suggest that they are the group most affected by poor air quality.

In addition to the previous finding regarding contracted workers, the table also reveals an interesting finding regarding students and faculty. Specifically, students are significantly more likely to correctly identify the monitor locations in comparison to faculty, which is not surprising given that these monitors are located in buildings C2 and D2 which are frequented my students as they contain facilities such as the gym, dining halls, and library.

However, despite this finding, it is worth noting that students were significantly less likely than faculty to believe that poor air quality has a personal impact on their health. This is an important observation, as students are an especially vulnerable population that spends a significant amount of time on campus and are therefore at risk of exposure to poor air quality.

To better understand the reasons underlying these findings, further research may be needed. Nonetheless, these finding underscores the need for targeted education and awareness campaigns, particularly among students and contracted workers, aimed at increasing their knowledge and understanding of the potential health impacts of poor air quality. By doing so, we can promote healthier behaviors and attitudes towards air quality among students and other members of the community.

5. Results

In this section, I present the effects of the critical and biweekly treatments on the knowledge levels, behaviors, and policy preferences of the participants in this study.

Out of the initial 704 participants who completed the baseline survey between January 26th, 2023 and February 14th, 2023, a total of 462 participants completed the endline survey between March 28th, 2023 and April 12th, 2023. Attrition was balanced across treatment groups, but there was a significantly higher number of contracted workers who did not complete the endline survey. Individuals with asthma were also significantly less likely to complete the endline (See AppendixA, Table A5). While this does not affect our assessment of the treatment effects, it could have implications on the interpretation of differences in outcomes across respondent types.

5.1 Concern

I begin by presenting the results of the two treatments on perceptions of air quality. As shown in Table4, neither of the treatments had an effect on respondents' assessment about the effect of air pollution on their own health or general concern about air quality.

However we do see that students and contracted workers are significantly less likely than faculty to believe that their health is not personally affected by air quality, and students have significantly lower levels of concern about air quality than faculty.

The absence of a treatment effect for the variable AQI Personal may be due to ceiling effects. Over 80% of all respondents reported that air quality affects their health personally. As a result, it may be challenging to detect a significant effect in the treatment groups since the high rates at baseline leave little room for improvement.

However, for the variable AQI concern the average response for all participants was over 3.4 on a scale from 1-5 with 5 being very concerned. This indicates that most people are indifferent or somewhat concerned about the air quality in Abu Dhabi.

Table 4: Treatment effects on AQ Concern

	(1) AQI Personal b/se	(2) AQI Personal b/se	(3) AQI Concern b/se	(4) AQI Concern b/se
Critical	0.052 (0.040)	0.057 (0.040)	0.163 (0.127)	0.153 (0.124)
Biweekly	0.038 (0.041)	0.042 (0.040)	0.020 (0.124)	0.019 (0.122)
Contract		-0.179*** (0.050)		-0.104 (0.182)
Students		-0.109*** (0.028)		-0.429*** (0.120)
Female		0.042 (0.032)		0.159 (0.099)
Constant	0.831*** (0.031)	0.916*** (0.041)	3.429*** (0.090)	3.667*** (0.132)
N	462	462	434	434
R_2	0.004	0.035	0.005	0.035

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

5.2 Knowledge

Next I examine whether the treatments impacted knowledge about air quality. We hypothesised that the treatments would have increased participants' level of knowledge because the answers to most of the questions asked within this table were in the email alerts that were sent out.

First I show the treatment effects on a set of true or false questions about air quality. The first of these questions was regarding PM 2.5 particles being invisible to our naked eye. The second was regarding these same particles being too large to penetrate our lungs. The third question referred to the size of PM and how that relates to the level of danger it posses to people. The last of these true/false questions referred to the effectiveness of surgical masks in protecting us against fine dust particles.

I find that, in general, there were no treatment effects on the likelihood that a respondent correctly answered the true or false questions. The only exception is for the second variable where I find that those in the critical treatment group were more likely to know that PM2.5 can penetrate our lungs.

We also see that there was variation in the likelihood that respondents correctly answered each question. They were most likely to correctly answer questions about PM2.5 particles penetrating our lungs and our inability to see these particles with our naked eye. However, participants were less likely to answer the question about the effectiveness of surgical masks correctly.

Additionally, contracted workers showed significantly lower rates of correct answers for the second and third true/false questions, indicating a potential disparity in knowledge acquisition across respondent type.

Table 5: Treatment effects on AQ Knowledge (True/False)

	(1) Invisible to Naked Eye	(2) PM25 Penetrate Lungs	(3) Danger of Larger PM	(4) Effectiveness of Masks
Critical	0.039 (0.058)	0.116** (0.055)	0.067 (0.053)	-0.001 (0.041)
Biweekly	-0.013 (0.057)	0.015 (0.055)	-0.015 (0.051)	-0.010 (0.040)
Contract	-0.029 (0.083)	-0.343*** (0.077)	-0.313*** (0.071)	-0.070 (0.048)
Students	0.017 (0.067)	-0.101 (0.062)	0.012 (0.065)	0.056 (0.046)
Female	-0.062 (0.049)	0.049 (0.049)	-0.021 (0.048)	0.037 (0.037)
Constant	0.561*** (0.074)	0.611*** (0.070)	0.385*** (0.072)	0.114** (0.053)
N	462	462	462	462
R_2	0.006	0.066	0.074	0.026

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

Table 6 shows the treatment effects for another set of knowledge questions about air quality. The findings suggest that the critical messaging tended to increase knowledge, while the biweekly messaging did not affect levels of knowledge. This is particularly true for the following three variables: Campus PM2.5 which asks what type of particulate matter is measured on campus; AQI 200+ which asks when the last time was that campus

AQI reached 200+; and PM2.5 Organs which asks which of our organs are affected by PM2.5 entering our bloodstream. For the sixth outcome variable regarding the percentage of deaths in the UAE attributed to outdoor air pollution however, people in the biweekly treatment were more likely to answer incorrectly.

Additionally, as is with the other tables, contracted workers were often less likely to get these questions correct. Specifically, three questions: related to the AQI level dangerous for everyone; related to when last campus AQI reached 200+; related to the percentage of deaths in the UAE that can be attributed to outdoor air pollution.

Women were also less likely to get three out of these six questions correct. They seemed to not know the type of particulate matter that is measured on campus. They seemed to also get both questions regarding the AQI levels dangerous for sensitive groups and for everyone incorrect.

To sum up, this section has assessed the results for the knowledge outcomes and has found four variables that support the first hypothesis regarding respondents that receive air quality messaging having higher levels of knowledge in comparison to the control group. However, this is only the case for the critical treatment and no significant increase in knowledge levels were found for those in the bi-weekly treatment group. On the contrary, for the outcome variable *%UAE Deaths* those in the bi-weekly treatment were significantly less likely to get the question correct.

Table 6: Treatment effects on AQ Knowledge (PM2.5 Levels)

	(1) Campus PM2.5	(2) AQI Everyone	(3) AQI Sensitive	(4) AQI 200+	(5) PM2.5 Organs	(6) % UAE Deaths
Critical	0.108** (0.051)	0.025 (0.046)	0.030 (0.052)	0.304*** (0.051)	0.112* (0.057)	-0.063 (0.038)
Biweekly	0.038 (0.049)	0.049 (0.046)	0.008 (0.051)	0.028 (0.046)	0.078 (0.057)	-0.078** (0.037)
Contract	-0.097 (0.068)	-0.182*** (0.066)	-0.070 (0.075)	-0.174** (0.071)	-0.152* (0.082)	0.121** (0.053)
Students	0.084 (0.058)	-0.037 (0.058)	-0.027 (0.061)	-0.066 (0.060)	-0.048 (0.066)	0.025 (0.036)
Female	-0.118*** (0.044)	-0.072* (0.041)	-0.074* (0.044)	0.034 (0.043)	-0.013 (0.049)	-0.000 (0.030)
Constant	0.247*** (0.062)	0.275*** (0.063)	0.331*** (0.066)	0.248*** (0.063)	0.495*** (0.073)	0.118*** (0.041)
N	462	462	462	462	462	462
R_2	0.040	0.024	0.007	0.105	0.016	0.027

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

5.3 Behavior

Next I turn to the results on behavior. We hypothesised that the treatments would lead participants to report minimizing spending time outdoors in poor conditions than those in the control group. Additionally, it was also hypothesized that those receiving air quality messaging would report checking air quality before spending time outdoors more frequently than those in the control group. I find that neither treatment had broad effects on behavior. The only finding worth noting is that those in the critical messaging group were significantly more likely to report checking the air quality more frequently.

It is also worth noting that contracted workers reported checking air quality more frequently and were more likely to report that they avoided being outdoors if the air quality was poor. Women were also significantly more likely to avoid the outdoors during times of poor air quality. Students, on the other hand, were significantly less likely to avoid outdoors and close their windows during times of poor air quality.

To sum up, this section has assessed the results for the behavior outcomes and has found one variable (AQI Checking Frequency) that supports the second hypothesis regarding respondents behavioral changes after receiving air quality messaging. However, this is only the case for the critical treatment and no significant behavioral changes have been observed for participants in the bi-weekly treatment group.

Table 7: Treatment effects on Behavior

	(1) App Use b/se	(2) AQI Checking Frequency b/se	(3) AQI Avoid Outdoors b/se	(4) AQI Windows Closed b/se
Critical	-0.016 (0.043)	0.317* (0.171)	0.084 (0.150)	0.025 (0.144)
Biweekly	0.011 (0.045)	0.201 (0.174)	0.093 (0.146)	0.029 (0.147)
Contract	-0.046 (0.073)	0.550** (0.248)	0.418** (0.211)	-0.025 (0.220)
Students	-0.159*** (0.059)	-0.083 (0.187)	-0.509*** (0.146)	-0.439*** (0.140)
Female	0.044 (0.037)	-0.041 (0.154)	0.311** (0.127)	0.239* (0.123)
Constant	0.278*** (0.061)	1.369*** (0.198)	3.596*** (0.167)	4.228*** (0.162)
N	456	423	423	422
R_2	0.038	0.046	0.086	0.039

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

5.4 Policy Preferences

5.4.1 AQI Monitoring and Messaging

Finally, I turn to a set of results on preferences concerning policies related to air quality monitoring and messaging. We hypothesised that the treatments would lead participants to be more likely to support university-wide messaging on local air quality conditions than those in the control group. Additionally, it was also hypothesized that those receiving air quality messaging would be more likely to support more comprehensive monitoring of local air quality conditions than those in the control group. We find that there was no significant effect of the treatments on participants' willingness to receive messaging or the AQI level at which they wanted to receive messaging (see Table A1 in the appendix). However, it is important to mention that almost 90% of participants across all groups indicated an interest in receiving air quality messaging explaining why a significant difference was not seen in the treatment groups.

The results of Figure 2 show that there are different preferences for receiving air quality messaging depending on the category of participants. The majority of faculty and students indicated that they would like to receive messaging when the air quality index (AQI) reaches Unhealthy levels, which is at or above AQI 150. On the other hand, the majority of contracted workers expressed a desire to receive messaging at an even lower level of AQI 100, which is the level considered unhealthy for sensitive groups.

Overall, out of the 385 participants who expressed interest in receiving air quality messaging, over 69% indicated that they would like to receive messaging at unhealthy levels (AQI 150+) or lower. These findings suggest that there is a significant interest in receiving air quality messaging among the different categories of participants, but the preferences for

the levels at which said messaging goes out differ depending on participant category type. The results could be useful in tailoring air quality messaging to different groups of individuals, such as providing messaging at lower levels for sensitive groups of individuals, and at higher levels for others.

6 Discussion

6.1 Treatment Effects

In this study, the treatments did not seem to have a significant impact on participants' levels of concern regarding air quality, perception of personal health impacts, or policy preferences. However, it is worth considering that the levels of concern among participants were generally moderate to high across all categories, and many already demonstrated a high level of awareness regarding the health risks associated with poor air quality. This may have made it challenging for the treatments to have a substantial effect on participants' behavior or levels of concern.

Nonetheless, we observed a significant impact of the critical treatment on participants' behavior of checking local air quality frequently. However, this effect was not observed on other variables related to behavior. One possible explanation for this finding is that the frequency and threshold level of the messaging may not have been adequate to elicit changes in behavior across all variables. It is possible that more frequent messaging or setting a lower threshold for critical alerts may have resulted in a greater impact on participants' behavior.

Initially, the critical messaging value was set at AQI 150, which is the level that most participants indicated they wanted to receive air quality messaging in the endline (see Figure 2). However, during the study, the air quality frequently exceeded the AQI 150 threshold, resulting in critical message alerts being sent out daily. This may have caused some participants to feel overwhelmed, with a few even requesting to be removed from the study within the first four days. To prevent further attrition, the critical messaging threshold was changed to AQI 200 after the fourth day. While this prevented further dropout, it also meant that critical alerts were only sent out twice more for the remainder of the study, as air quality during the cooler seasons in Abu Dhabi is generally better. Thus, changing the critical threshold value was a tradeoff between preventing attrition and reducing the frequency of critical alerts sent out.

These findings highlight a clear tension between participants' stated messaging preferences and the realities of how frequently air quality levels surpass the 150 threshold. It may be necessary to reevaluate the appropriate threshold level for critical messaging, taking into account the actual frequency of high AQI levels experienced in the study location.

Despite the lack of significant impacts on behavior, the study did reveal the potential effectiveness of the critical treatment in changing participants' knowledge levels. This suggests that the critical alerts approach may be useful as an educational tool, even if it may not be enough to prompt significant behavioral change. However, it is possible that participants' work or other responsibilities remained unchanged, which could explain the lack of behavioral change. This indicates the need for broader institutional and societal changes, such as policy interventions, to effectively tackle the impacts of air pollution. For instance, mandatory outdoor sporting classes could have indoor alternatives during times of poor air quality to reduce exposure to harmful pollutants.

In my personal experience, I have observed my athletics coaches taking proactive steps to address the impacts of air pollution on their athletes. Whenever they received my alerts, they would monitor the outdoor air quality carefully before carrying out their respective running and tennis classes. In instances where the air quality was deemed unsafe, they rescheduled their classes to be held indoors. My running coach for example, utilized the indoor track while my tennis coach made use of the indoor squash courts for her lessons. This type of policy intervention is a positive step towards reducing exposure to harmful air pollutants, protecting individuals' health, and promoting a healthier environment. It highlights the importance of individual and institutional responsibility in addressing the impacts of air pollution and encourages similar proactive measures to be implemented across different departments.

To sum up, the air quality messaging findings suggest that the critical alerts approach is the more effective intervention strategy for providing air quality messaging to the NYUAD community in comparison to the biweekly summaries. It is important to note that despite not finding the desired treatment effect for some outcomes, almost 80% of participants in the treatment groups recall having seen these alerts at least once, with almost two thirds of them indicating having seen it more than once. Therefore, it is unlikely that people completely ignored and disregarded the emails. In conclusion, the critical alerts approach should be considered as the preferred intervention strategy for air quality messaging.

6.2 AQI Monitor Location Preferences

During the study, participants were asked to provide feedback on the adequacy of the three air quality monitors in NYUAD located at the campus center (C2), east dining hall (D2), and outdoors. The majority of participants expressed a desire for more AQI monitors on campus. When asked to specify their preferred location for said air quality monitors, the results showed that outdoor fields (north site) and dorms were the most common choices across all three participant types. However, the level of interest in monitoring these locations varied slightly among different categories of participants. For instance, students were found to be particularly interested in having additional monitors in dorms, while facilities workspaces were of less interest to students but more interesting to faculty over contracted workers, which is an intriguing finding.

In general, the preferences for monitoring locations were quite similar among the three categories of participants, with Outdoor Fields, Dorms and Campus Safety Workspaces ranking as highly preferred and classrooms as the least preferred. These findings suggest that there is generally a high demand for more AQI monitors on campus,. Additionally, the study highlights the importance of considering different participant categories when assessing preferences for monitoring locations, as their perspectives may differ depending on where they spend the most time on campus.

6.3 Generalizability and Next Steps

The present study included a more diverse demographic, with participants from 96 different countries taking part. The majority of participants were from India, the UAE, Pakistan, the US, Nepal, Bangladesh, and Kazakhstan, with roughly 50 percent of the total number of participants coming from these countries in descending order (see Appendix A1). This diverse sample enhances the generalizability and external validity of the study findings, as it represents a wider range of perspectives and experiences related Figure 3: AQI Monitor Location Preferences to air quality concerns.

Although this study was not specifically designed as an information intervention project, the feedback received from participants provides valuable insights into how we can improve air quality messaging on the NYUAD campus. Moving forward, we could explore additional avenues for providing information and education, not only during times of critical air quality but also in general, to raise awareness and knowledge about air quality and its implications on human health. By doing so, we can help individuals better understand the importance of air quality monitoring and the steps they can take to protect their health and well-being.

The feedback received from participants can be categorized into three main themes: content, timing, and alternative platforms. Firstly, participants expressed a desire for air quality messaging that incorporated more future-oriented data, rather than relying solely on historical data. While the biweekly summaries were appreciated, some participants in this treatment indicated a preference for critical alerts that would provide more timely information. Secondly, participants expressed a desire to be informed when air quality improves, in addition to being notified when it is poor. Participants also recommended including more safety precautions in the messaging, with specific recommendations for minimizing the risks of poor air quality during periods when they have no choice but to be outdoors. Lastly, some participants recommended that the information be presented in a more user-friendly format, rather than the graphs sent out in the biweekly email alerts.

Regarding the timing of air quality messages, participants held varying opinions. Some preferred to receive daily alerts along with critical alerts, while others felt that too frequent alerts would make them less attentive to the messaging, and preferred to receive alerts only when the air quality is hazardous. Therefore, it is recommended that air quality messaging be tailored to individual preferences and needs, taking into account the timing and frequency of the alerts. This can be achieved by allowing participants to customize their preferences on how they receive alerts, such as through an opt-in or opt-out system, where they can choose the frequency and format of messaging that suits them best. It is also recommended that critical alerts be prioritized over daily summaries, especially during periods of severe air pollution.

Participants provided interesting recommendations for the platforms through which they would like to receive air quality messaging. Suggestions included the use of an air quality app that could replace email alerts with push notifications or SMS messaging. However, obtaining phone numbers for SMS messaging could be a challenge. Fortunately, the app IQAir, which was linked to every email alert, has the capability to provide push notifications. Therefore, we may consider advertising the app more prominently in future alerts. Another recommendation is to incorporate air quality messaging into the NYU Safe app. This would enable push notifications to be sent to all NYU community members across all three campuses when the air quality is poor.

The feedback from participants has taught us that future air quality messaging on the NYUAD campus should incorporate more future-looking data, focus on critical alerts rather than just summaries, provide recommendations on minimizing the risks of poor air quality during outdoor activities, and offer more user-friendly information. We should also consider the use of an air quality app, push notifications, or incorporating air quality messaging into existing campus safety apps to provide more accessible and effective messaging to the NYUAD community. In addition to the above findings, the feedback from participants highlights the need for more personalized air quality messaging. It may be beneficial to provide individuals with the option to opt-in/opt-out and customize their AQI messaging based on their preferred frequency of alerts and notification levels. By doing so, individuals can receive air quality updates that are tailored to their needs and preferences, ultimately improving the effectiveness of air quality messaging on the NYUAD campus.

6.4 Limitations

Given that the sample of the study consisted of various members of the NYUAD community, including undergraduate and graduate students, campus safety officers, facilities staff, administrative staff, and faculty members, there was a risk of spillover occurring. It was possible that individuals in different groups of the study (treatment/control) communicated with each other and became aware of the study's purpose. To assess the effects of spillover, I asked participants whether they had discussed air quality with anyone. Although the study did not find any treatment effects on discussion, the overall discussion levels were relatively high, hovering around the fifty percent mark, indicating a good chance of spillover (see Appendix A3). Interestingly, contracted workers were significantly less likely to discuss air quality in comparison to faculty, highlighting a potential disparity in communication and access to information within the NYUAD community .

Further analysis of the type of people participants discussed air quality with revealed that those in the critical treatment group were significantly more likely to discuss air quality with NYUAD administrators, suggesting that critical alerts may have increased awareness and engagement with institutional stakeholders. However, contracted workers were significantly less likely to discuss air quality with all NYUAD and non-NYUAD community members, except for other contracted staff members (see Appendix A4). Interestingly, students were more likely to discuss air quality with their peers but less likely to engage in discussions with faculty, administrators, and family members. Additionally, women were significantly less likely to discuss air quality with campus safety.

Another potential limitation of this study was the pre-existing presence of air quality monitors in the campus center (C2) and dining hall (D2), which

could have primed participants and increased their knowledge and concern about air quality before the study began. Furthermore, NYUAD had been sending out email updates that referred to the air quality monitors on campus, and the data from these monitors was available on both the NYUAD student portal and the mobile application IQAir, which could have further heightened community members' awareness. To address this limitation, the study included a question in the endline survey that asked participants whether they had seen the monitors and where they had encountered information about air quality on campus. Over 95% of participants in both the baseline and endline recalled having seen an air quality monitor somewhere on campus previously.

Overall, these findings suggest that there were spillover effects that occurred which may have resulted in an underestimation of the treatment effects since the control group is likely to have also been exposed to air quality information.

7 Conclusion

In summary, this study has important implications for policy and practice related to environmental health both in the NYUAD campus and the wider Abu Dhabi Emirate. The findings demonstrate that providing information about local air quality can have a positive impact on knowledge and behavior among community members, and the critical alerts approach was found to be more effective than bi-weekly summaries in increasing knowledge and promoting behavioral change.

Given the continued importance of outdoor air quality as a leading factor for premature death in the UAE, policymakers and practitioners should consider implementing the critical alerts approach as part of their environmental health communication strategies. This study underscores the need for ongoing communication and information dissemination to promote healthy behaviors and increase public awareness of environmental health risks related to poor air quality. Furthermore, the high levels of concern regarding poor air quality demonstrated by participants within this study further highlights the need for on-going air quality messaging.

Future research should aim to build upon these findings by exploring the long-term impacts of critical alerts on behavioral change and climate action. Additionally, researchers could investigate the potential for other types of interventions, such as educational programs or policy changes, to inform on the dangers of poor air quality and promote healthy behaviors.

In the context of the NYUAD campus, it is important to explore additional methods of providing air quality messaging, such as email, push-notifications, or other avenues, in order to allow individuals to opt-in and receive air quality information as desired. To improve the effectiveness of air quality messaging, future-looking data should be incorporated, informing community members when it is safe to go outdoors again. NYUAD should also provide more air quality monitors in various locations across campus, including outdoor fields and dorms, which are among the most highly requested locations for additional AQI monitors. This would allow community members to access real-time air quality data, enabling them to make more informed decisions about their activities. Lastly, divisional policy recommendations should be taken into account to allow alternatives to outdoor activities during times of poor air quality, such as indoor exercise or alternative outdoor locations. By implementing these recommendations, NYUAD can promote a culture of environmental health awareness and engagement, protecting the well-being of community members and promoting healthy behaviors.

Overall, this research provides a valuable approach for information intervention on air quality, emphasizing the significance of information provision to increase awareness and drive behavioral changes. The study's findings contribute to our understanding of the effects of environmental literacy interventions on knowledge, behavior, and policy preferences, highlighting the need for sustained efforts to promote public awareness and engagement in environmental health issues. Overall, this research demonstrates the potential of targeted information interventions in increasing knowledge and facilitating positive behavioral changes.

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Appendix

A Further Results

Table A1: Treatment effects on Messaging Preferences

	(1) Messaging Willingness b/se	(2) Messaging Level b/se
Critical	-0.008 (0.042)	0.019 (0.126)
Biweekly	-0.033 (0.043)	0.031 (0.125)
Contract	-0.071 (0.064)	-0.539*** (0.175)
Students	-0.024 (0.047)	0.008 (0.148)
Female	0.003 (0.038)	-0.052 (0.114)
Constant	0.873*** (0.053)	1.760*** (0.159)
N	456	455
R_2	0.008	0.038

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

Table A2: Treatment effects on Monitor Location Preferences

	(1) Monitor Preference b/se	(2) L1: Dorms b/se	(3) L2: North Site b/se	(4) L3: Classrooms b/se	(5) L4: Facilities Workplaces b/se	(6) L5: Campus Safety Workplaces b/se
Critical	0.036 (0.057)	-0.032 (0.050)	0.087* (0.051)	0.016 (0.041)	-0.014 (0.047)	-0.019 (0.050)
Biweekly	0.011 (0.058)	0.031 (0.052)	0.035 (0.049)	-0.004 (0.039)	-0.042 (0.045)	-0.058 (0.048)
Contract	0.010 (0.082)	-0.077 (0.066)	0.013 (0.076)	-0.053 (0.055)	-0.095 (0.075)	-0.003 (0.071)
Students	-0.009 (0.067)	0.072 (0.058)	-0.033 (0.062)	0.006 (0.049)	-0.152** (0.060)	-0.008 (0.058)
Female	-0.116** (0.050)	0.022 (0.045)	-0.089** (0.043)	-0.015 (0.034)	-0.037 (0.040)	-0.028 (0.041)
Constant	0.583*** (0.072)	0.212*** (0.064)	0.273*** (0.069)	0.140** (0.055)	0.351*** (0.066)	0.260*** (0.064)
N	456	456	456	456	456	456
R_2	0.026	0.032	0.025	0.015	0.049	0.014

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

Table A3: Treatment effects on Discussion

	(1) AQI Discussed b/se	(2) AQI Discussed b/se
Critical	0.052 (0.058)	0.055 (0.058)
Biweekly	0.014 (0.057)	0.019 (0.057)
Contract		-0.202** (0.083)
Students		-0.092 (0.066)
Female		0.041 (0.050)
Constant	0.486*** (0.041)	0.565*** (0.073)
N	462	456
R_2	0.002	0.025

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

Table A4: Treatment effects on Discussion with Category

	(1) With Students b/se	(2) With Faculty b/se	(3) With Admin b/se	(4) With Campus Safety b/se	(5) With EFS b/se	(6) With non-NYUAD b/se	(6) With Family b/se
Critical	0.041 (0.052)	-0.007 (0.032)	0.073*** (0.022)	0.011 (0.022)	-0.003 (0.024)	-0.045 (0.032)	-0.027 (0.040)
Biweekly	0.048 (0.052)	0.002 (0.033)	0.040** (0.020)	-0.004 (0.020)	0.001 (0.023)	0.007 (0.036)	-0.007 (0.040)
Contract	-0.160*** (0.060)	-0.160*** (0.054)	-0.252*** (0.054)	0.139*** (0.044)	0.187*** (0.048)	-0.132*** (0.050)	-0.242*** (0.062)
Students	0.285*** (0.057)	-0.135*** (0.052)	-0.252*** (0.053)	-0.004 (0.016)	-0.024 (0.021)	-0.065 (0.048)	-0.183*** (0.059)
Female	-0.004 (0.047)	0.035 (0.029)	0.014 (0.020)	-0.027** (0.013)	-0.011 (0.014)	0.022 (0.031)	0.030 (0.035)
Constant	0.191*** (0.064)	0.194*** (0.051)	0.221*** (0.050)	0.022 (0.019)	0.036 (0.024)	0.168*** (0.051)	0.310*** (0.064)
N	456	456	456	456	456	456	456
R_2	0.148	0.042	0.190	0.103	0.144	0.030	0.056

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

Table A5: Predictors of Attrition

	(1) Attrition b/se
Critical	0.015 (0.045)
Biweekly	-0.021 (0.043)
1.female_b	0.038 (0.038)
Contract	0.281*** (0.063)
Students	0.020 (0.053)
Asthma	0.133* (0.073)
AQI Personal	-0.028 (0.040)
Constant	0.305*** (0.066)
N	704
R_2	0.057

Significance levels: *** p<0.01; ** p<0.05; * p<0.10

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GREEN Olympiad: A Case Study to Augment Learning through Non-formal Education

Taru Mehta[1], *Livleen K Kahlon*[2]

Abstract

With an increase in human aspirations and urbanization, development is happening at a largely unsustainable pace. Hope still resides in the power of education to offset unsustainable actions by promoting Environmentally Responsible Behaviour (ERB) amongst our younger citizenry. ERB can put knowledge into practice, thereby ensuring sustainable environments, healthy communities, and social cohesion. Through programmes like GREEN Olympiad, students are sensitized to enhance their knowledge levels and pave the way to become environment-conscious citizens. The programme converges with the deliverables of National Education Policy (NEP) 2020 in India and draws its linkages to SDG 4.7.

Introduction

According to the Department of School Education and Literacy, Ministry of Education, India has approximately 1.5 million schools, making it one of the countries with the highest number of schools in the world and total school enrolment in India for the academic year 2021-22 was 26.50 million students (Department of School Education and Literacy, 2022). These young citizenry will add up to an existing 'young' population and will become the key decision-makers in society. The year 2030 is important as it will show the world the progress it has made towards economic, social, and environmental development. To be able to make a mark in the achievement of SDGs, India, with its largest youth population in the world has to make special efforts to invest in education and capacity building of youth now. This will facilitate the aspirations of its young population as it steps into the labour market, which is set to grow by over 8 million per annum over the coming decade (Goedhuys). It is equally important that they are sensitised to promote sustainable choices in decision-making. TERI believes that the best time to influence youth mindsets and attitudes is when they are in their learning years of academic rigour. Government of India is initiating new schemes and education-based reforms have done a strong comeback. The National Education Policy 2020 (NEP 2020) is the first education policy of the 21st century that aims to address many growing developmental imperatives of our country. This policy proposes a revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st-century education, including Sustainable Development Goal 4 (SDG4), while building upon India's traditions and value systems.

GREEN Olympiad: TERI's Flagship Initiative Project on Environment Education

GREEN Olympiad is a leading school-based initiative of TERI. The journey started in 1999 as India's premier environment quiz for school students and is an established EE brand within schools in South Asia and Middle East. Reaching out to thousands of schools annually, this Olympiad is attempted by students of Std. 4-12. Major objectives of GO include sensitization and capacity building of students on issues related to environment, sustainability, and green skills. The relevance of GO is also manifested by NEP 2020, which states Olympiads as a medium to minimize rote learning and encourage holistic development and 21st century skills. Further GREEN Olympiad reinstates the relevance of SDG 4.7 (Quality Education). This goal states: "Ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through Education for Sustainable Development (ESD) and sustainable lifestyles, human rights, gender

Keywords: Education for Sustainable Development (ESD), Environmentally Responsible Behaviour (ERB), National Education Policy (NEP) 202, SDG 4.7

(1) & (2) The Energy and Resources Institute (TERI)

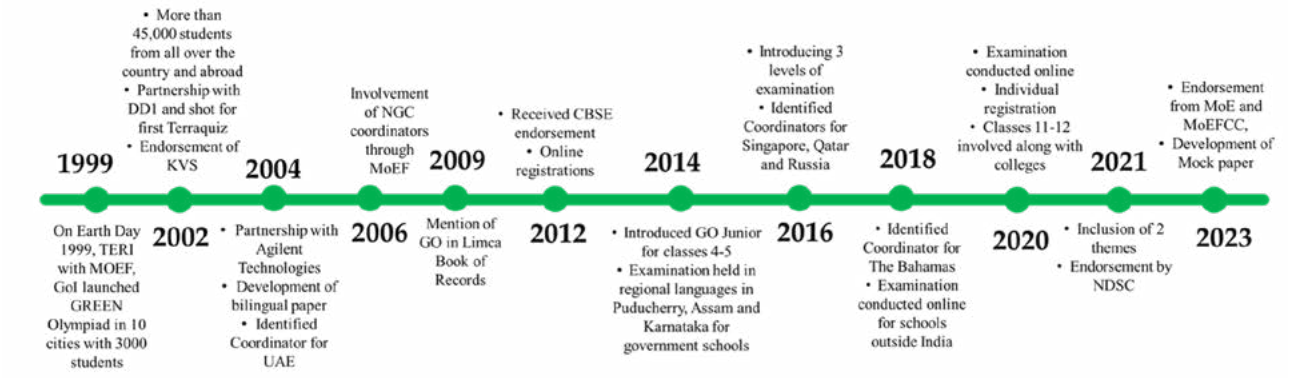


Figure 1: Growth Trajectory of GREEN Olympiad

equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development by 2030".

Major Highlights of GREEN Olympiad

- GREEN Olympiad has an inter-sectoral approach, covering a range of topics like water, waste, energy, air, biodiversity, climate, global warming, sustainable development, culture, green skills and contemporary developments related to environment and sustainable development
- GREEN Olympiad maintains a pace with national priorities, as it is supported by creating awareness about Mission LiFE through the examination content
- GREEN Olympiad is student-friendly and comprises of multiple-choice questions.
- Schools and students are assessed and graded as per the knowledge level
- GREEN Olympiad certificates of participation is given to all students along with merit and distinction based on their performance scores

Journey of 25 years

GREEN Olympiad started as a pilot on the Earth Day of 1999, with participation of 3000 students in 10 cities. Since then the programme added layers every year, reaching new milestones catering to development of networks, increased school outreach, content development and new forms of partnership. The figure below shows multiple avenues of growth for the project since its inception.

Deliverables of GREEN Olympiad

GREEN Olympiad is designed in an innovative manner. While the programme aims to assess knowledge levels of students, it rests on a vision that awareness about sustainable development issues will provide an empowered youth stewardship for our planet. GREEN Olympiad enriches interdisciplinary knowledge, skills, and eco- values necessary for achieving sustainable development. Various deliverables as part of the programme and knowledge gained through participation in this Olympiad is translated into environment improvement activities at the school level. The following figure gives an overview of the activities undertaken as part of GREEN Olympiad.

International and National Relevance of GREEN Olympiad

UNESCO is the leading agency for leading the current framework of ESD, ESDfor2030. It continues the work of the United Nations Decade of Education for Sustainable Development (2005-2014) and the Global Action Programme (GAP) on ESD (2015-2019) with five priority areas:

1. Advancing policy
2. Transforming learning environments
3. Building capacities of educators
4. Empowering and mobilizing youth
5. Accelerating local level action (UNESCO, 2024)

GREEN Olympiad as an ESD initiative features caters to all the above priority areas by engaging with teachers and students and encouraging actions at grassroots through policy level buy-in from the line ministries.

Knowledge Sharing and Content Development	Partnerships and Networking	Communications and Media Outreach
• GREEN Olympiad Examination Announcements, Application • GO Question paper • Workshop for Teachers & Students • Sample Papers • Resource Booklet • Felicitation Ceremony	• Multi Stakeholder Meetings • Endorsement received from Ministry of Education and Ministry of Environment, Forest and Climate Change, GoI • Outreach support from Central Board of Secondary Education, Kendriya Vidyalaya Sangathan, Navodaya Vidyalaya Samiti • Networks with State departments and other allied bodies	• Managing GO Website • Social Media Campaigns • Video Tutorials • Coverage in National Daily's • Podcast

Figure 2: Deliverables of GREEN Olympiad

In India, environmental education is deeply rooted in the ethos of Government of India mandates through various line ministries. The programme supports the principles of Mission LiFE. LiFE stands for "LiFEStyle for Environment", a relatively self-explanatory term that Sh. Narendra Modi, Prime Minister of India introduced on November 1, 2023, at COP26 in Glasgow, Scotland. It was added to India's Nationally Determined Contribution (NDC) on August 3, 2022, making India the first country to do so. It is aimed to be a mass movement for "mindful and deliberate utilization, instead of mindless and destructive consumption" of goods and services, especially natural resources in order to preserve and protect the environment (MOEFCC, 2023). GREEN Olympiad propagates about Mission LiFE and helps in encouraging communities and individuals to adopt a lifestyle that is synchronous with nature.

Linkages of GREEN Olympiad with Education for Sustainable Development (ESD) and Formal Education

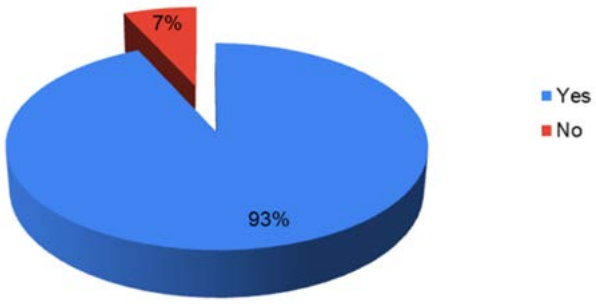
ESD is a means to build capacity, prepare the next generation learners, sensitize and educate the citizenry for undertaking developmental processes keeping in mind what value is it creating for current and future generations and what resources are being utilised without compromising its availability in the future. One way to cultivate this mindset in youngsters is by encouraging sustainable lifestyles. In this way, ESD incorporates learner-centered approaches which help individuals take decisions over their actions and it's impact on the environment. The process of changing behaviours is time taking but pays back in the long run, especially when the young brigade of our generation becomes decision-makers. GREEN Olympiad as an ESD example, enables learners to adopt lifelong learnings and help in promoting the cause of the environment.

ESD can be incorporated in thoughts and actions through formal, non-formal, and informal means of education. In India, ESD is making its way through all the mediums; incorporating environment studies in science, geography, history, economics, and several other subjects in the formal education system. Having live demonstrations in schools on colleges such as compost units, paper recycling, declaring no plastic zone, installing rainwater harvesting, retrofitting low flow taps, LEDs, etc. are a few ways to touch upon the non-formal ways of teaching within the school. Informal ways of teaching happen at every level whether at home or in a playground. GREEN Olympiad proactively reaches its students by engaging them in a competitive mode, thus

impacting their soft skills like creativity, healthy competition, and collaboration among the learners.

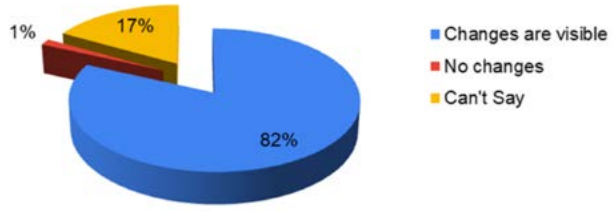
Assessment of Teachers' Viewpoint for GREEN Olympiad 2023

- 93% teachers say students are influenced to adopt community engagement activities and peer to peer learning through various environment education activities in schools including GREEN Olympiad



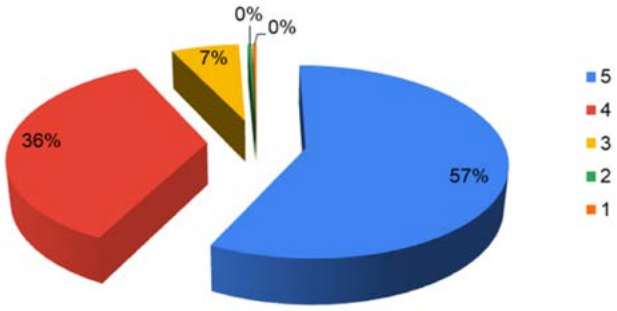
Graph 1: GREEN Olympiad encouraged students to collaborate with their peers or engage in community-based environmental activities

- 82% teachers say that they have observed noticeable changes in the behaviour of students after participating in GREEN Olympiad



Graph 2: Teachers' observation on noticeable changes in the knowledge and behaviour of students who participated in GREEN Olympiad

- Students have contributed to tree plantation initiatives, recycling campaigns, gardening projects and participation in eco-clubs activities
- The majority of teachers believe programmes like GREEN Olympiad enhance their knowledge and awareness



Graph 3: Programmes like GREEN Olympiad contribute to raising awareness
(Scores given by teachers on the scale of 5)

Outcomes of GREEN Olympiad

- GREEN Olympiad promotes education for sustainable development (ESD) in schools and instill a sense of responsibility amongst students, teachers and the school community towards the planet.
- GREEN Olympiad enriches interdisciplinary knowledge, skills, and eco- values necessary for achieving sustainable development.
- Builds aspirational goals and values amongst students by learning about 'green skills'
- Creation of a robust students' network nationally and internationally.
- Over the years, GREEN Olympiad has become a featured activity in the school calendar.
- In 2023, the programme reached out to 150,000 students. In 25 years, the programme has impacted 2.2 million students globally.

Acknowledgement

Authors wish to express their gratitude to TERI for providing support for execution of this project. Special thanks to Ministry of Environment, Forest and Climate Change and Ministry of Education, Government of India. Heartfelt gratitude to all the educational boards and institutions for reaching out to schools in India and abroad, and a special mention of Central Board of Secondary Education, Kendriya Vidyalaya Sangathan, Navodaya Vidyalaya Samiti, and state education directorates for their valuable endorsements to the project. Members of the entire environment education and awareness team and researchers at TERI are acknowledged for their contribution to the project activities, especially thankful to Ms Monmi Barua, Mr Ravi S Das, and Ms Saltanat M Kazi. We are thankful to the management of member schools, teachers and students for their participation in the project.

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345 Boost Project-drive Environmental Education for Sustainability in the Basque Country: Collective Intelligence for Networking

Introduction

Environmental Education for Sustainability as we understand it in the Basque Country, must be a process of continuous training of an informed and involved citizenry, who has creative tools for problem solving, a scientific and social culture, and commitment to lead responsible actions, both individual and collective. These actions will help guarantee a sustainable future considering all the axes of sustainability: social, environmental and economic, promoting eco-social transformative action.

The central idea is **the use of collective intelligence and networking** with the different organizations that are working intensively in the field of sustainability (Authorities, Education, Science and Research Sector, Third Sector, Private Entities,...) about and how we can convert the work carried out into an asset for Basque society, thus contributing to the **achievement of a new environmental ethic in Euskadi.**

Core Goal

Creation of an ecosystem in the form of a network of entities that work in the Basque Country in the field of Environmental Education for Sustainability (EAxS), which interacts in the areas of training, innovation and knowledge management, activates communities, **promotes learning per to per** inter entities and that, **through a technological platform and digital communication channel that is a reference in The Basque Country** in the field of EAxS, **connects with citizens, to enable their awareness, training, development of skills and sensitization,** both in the protection of the environment **as well as the achievement of a new environmental ethic** based on that **necessary intelligent relationship between said environment and human activity.**

Ideary

- **Promote a New Environmental Ethics.** *"Environmental education plays a decisive role in promoting an environmental ethic that is concerned with ecological balance, quality of life and the needs of future generations."* Belgrade Letter. **1975**
- **Trained Citizenship** *"Form citizens who are aware and concerned about the environment and who have knowledge, aptitude, attitude, motivation and commitment to work individually and collectively in the search for solutions to existing problems and to prevent new ones."* Letter from Belgrade. 1975.
- **Use environmental education to address the current human impacts of climate change,** such as weather-related disasters and climate injustice, while creating and balancing a new world for the future.
- Construction of collaborative bridges to take education beyond the classroom **(non-formal and informal education).**

Strategic Lines

Consequently we must:

Help Understand the Context

Helping individuals and social groups to acquire a basic understanding of the environment as a whole, related problems and the presence and role of humanity in it, which entails a critical responsibility

Innovate by applying smart solutions

Develop tools for Training, Monitoring, Analysis, Evaluation and contextualized dissemination of Data

Strategic Projects...

B center:

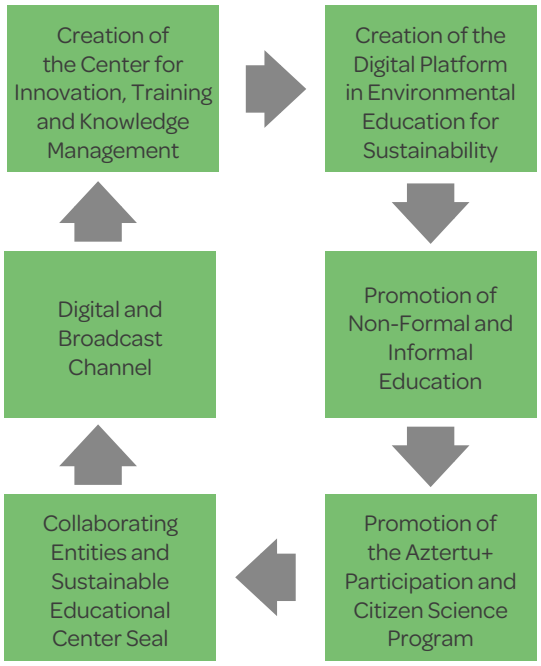
Technological platform + Basque Digital Channel in Environmental Education for Sustainability (EExS)

- Common core for confluence, distribution and support of information and content in the field of EExS in Basque Country
- Interoperable with public and private platforms that work in Basque Country in this area
- Managed by the Center for Innovation, Training and Knowledge Management at EExS (B center)

Basque Country EExS Boost model

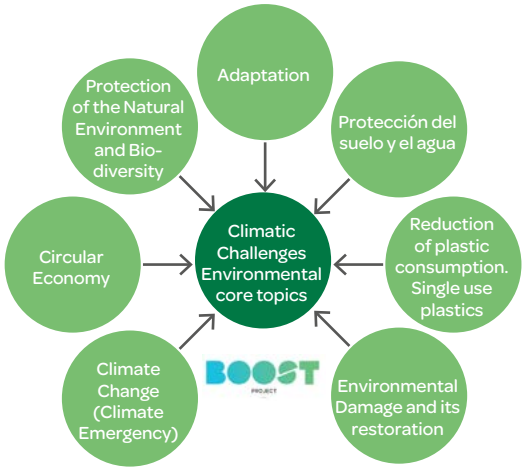
Frame. Core Objectives

Core Objectives Decree...



Basque Country EExS Boost model

Climate Challenges. Environmental Core Topics



Basque Country EExS Boost model

12th WEEC
CONNECTING PEOPLE
CREATING TOMORROW

In 2024...

We continue the path...

learn together

connecting people

creating tomorrow

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Programa De Formación Ambiental En Reducción De Riesgos De Desastres Para Estudiantes De Universidades De Cuba, Latinoamérica Y El Caribe

Mirurgia Aguilar Velázquez[1]

Resumen

La investigación contribuye a la formación ambiental en los estudiantes de universidades de Cuba, Latinoamérica y el Caribe para la gestión en la reducción de riesgos de desastres. La elaboración del programa crea nuevas herramientas para el desarrollo del proceso docente educativo referente a conocimientos, habilidades y el refuerzo de valores, que garanticen una actuación consecuente en el desempeño de las funciones así como en el accionar responsable hacia el medio ambiente. La investigación aborda la gestión de riesgos de desastres, en el aumento de la resiliencia a los posibles impactos negativos de los peligros de origen natural, tecnológico y sanitario, la reducción de la exposición, no crear nuevas vulnerabilidades y reducir los riesgos de desastres. La propuesta tiene relación con:

La Convención Marco de Naciones Unidas sobre Cambio Climático, La Agenda 2030 para el Desarrollo Sostenible de gran relevancia a la reducción del riesgo de desastres como elemento clave para el logro de los Objetivos de Desarrollo Sostenible (ODS), El Marco de Acción de Hyogo, El Marco de Sendai para la Reducción del Riesgo de Desastres 2015-2030, a la Directiva No. 1 del Presidente del Consejo de Defensa Nacional de Cuba actualizada y perfeccionada en el año 2022 y la Tarea Vida, prioridad que el Estado cubano brinda a la prevención o mitigación de los eventos naturales peligrosos. Es muy oportuna la investigación en un momento que el mandato es avanzar con pasos sólidos hacia la búsqueda de soluciones preventivas ante el actual incremento de los desastres de origen natural y las necesidades de adaptación a los impactos del cambio climático. La propuesta se valora mediante el criterio de expertos y se realiza la evaluación de impacto del programa indica su pertinencia en la formación de estudiantes universitarios.

La gestión en la reducción de los riesgos: fundamentos teóricos para la capacitación. Para abordar la gestión en la reducción de los riesgos, en particular el componente referido a la prevención, tienen un papel importante los programas de capacitación, donde responden a la interrelación existente entre desarrollo, deterioro ambiental y desastres. En los tres procesos mencionados anteriormente están presentes, por igual, las dimensiones económica, ecológica y social que simultáneamente se dan en un mismo espacio y en su intervención participan los mismos actores.

La gestión en la reducción de riesgos en Cuba

En todo el territorio de Cuba, al igual que el resto del Planeta, existen riesgos de desastres antes diferentes peligros, como se ha expresado en diferentes documentos y declaraciones oficiales, para el gobierno cubano, la reducción de los desastres ha sido y será una prioridad de primer orden.

La caracterización general de los peligros de desastres son definidos en la Directiva No.1 del Presidente de Consejo de Defensa Nacional, 2022, que identifica los mismos, según su origen: en naturales, tecnológicos y sanitarios.

La posición y características geográficas del archipiélago cubano, condiciona en gran medida los peligros de desastres, fundamentalmente de origen natural, así como sus probabilidades, frecuencia e intensidad.

La política de Cuba para el enfrentamiento y reducción de los riesgos de desastre se sustenta

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en su sistema social y modelo de desarrollo socio-económico, que dado su carácter eminente social, tiene como objetivo fundamental elevar la calidad de vida de toda la población y sostiene principios como la igualdad de derechos y deberes de los ciudadanos, distribución equitativa de las riquezas, acceso a los servicios básicos de salud, educación, a la cultura, y otros.

Desde los primeros años de la Revolución se comenzaron a adoptar medidas para la protección de la población ante agresiones y desastres, mediante Ley 1194, que trata sobre el Sistema de Medidas (Defensa Civil, 1966), la que fue perfeccionándose a partir de las experiencias adquiridas, el desarrollo del país y las experiencias internacionales. Actualmente existe un marco legal, encaminado a la protección del país y a la reducción de riesgos, compuesto por leyes, decretos, decretos leyes, resoluciones, directivas, indicaciones y normas.

Para la dirección de las medidas y acciones de Defensa Civil se cuenta con un sistema organizativo que integra toda de la estructura del país. El órgano de dirección es el Estado Mayor Nacional de la Defensa Civil, cuya función fundamental es velar por el cumplimiento de la política y de las medidas de defensa civil, además garantiza la coordinación de acciones y los vínculos con los organismos de la administración central del estado y otras instituciones, entre ellas las científicas. Se encarga de orientar y facilitar el cumplimiento de los planes y medidas para la reducción de riesgos de desastres y su integración a las estrategias de desarrollo económico-social.

Los órganos de gobierno en cada una de las instancias, elabora sus planes de reducción de desastres para su territorio, provincia y municipio. Se involucra en la gestión de la reducción de riesgo, al gobierno, los sectores, las entidades productivas, de servicios y las organizaciones políticas y de masas.

Los impactos y consecuencias de los desastres, constituyen un asunto de seguridad nacional y se consideran situaciones excepcionales. Las organizaciones de masas y sociales, juegan un papel determinante en la movilización y participación de la población en la ejecución de las medidas de reducción de desastres.

¨Los planes de reducción de desastres contemplan medidas principales que se deben cumplir en cada etapa del ciclo de reducción de desastres, (prevención, preparativos, respuesta y recuperación)¨, (Directiva No.1 del Presidente de Consejo de Defensa Nacional, 2022).

La identificación de las medidas se soporta en estudios de peligro, vulnerabilidad y riesgos, realizados por investigadores, especialistas, técnicos, y con la participación de otros actores de los territorios, tomando como partida la experiencia práctica y acumulada en el enfrentamiento a los diferentes peligros.

La autora hace referencia que nacional e internacionalmente los resultados concretos del país en la reducción de los riesgos de desastres, y su vínculo con el desarrollo económico y social. La efectividad lograda en cuanto a la protección de las vidas humanas se refleja en los resultados, pero indudablemente queda mucho por hacer sobre todo, en lo referente a reducción de las pérdidas económicas que obstaculizan el desarrollo sostenible del país y afecta la calidad de vida de la población.

Actualmente se trabaja en el programa de enfrentamiento al cambio climático, teniendo en cuenta sus impactos. El cambio climático puede incrementar los desastres, por eso se hace necesario de adoptar medidas preventivas, como los programas de capacitación para preparar y elevar la percepción del riesgo en este caso los decisores.

Gestión en la reducción de riesgos de desastres. Conceptos fundamentales

Existe una estrecha relación entre desarrollo y la reducción de los desastres; y entre estos y los problemas ambientales.

Un desastre tiene lugar cuando se producen pérdidas de vidas, de asentamiento humanos,

de un elemento o grupos de elementos, de un lugar, objetos, bienes materiales o actividades socioeconómicas ante cualquier evento potencialmente destructivo que constituya un peligro.

Otros autores abordan en esta temática orientada para minimizar los impactos el desarrollo de Programa de Investigación Orientado hacia el Desarrollo de Ciudades Sostenibles (Guasch, F. y Vega, C., 2006).

El riesgo de desastre surge cuando las amenazas o peligros interactúan con factores de vulnerabilidad. (Resolución 1 Declaración de Hyogo, 1997).

Dentro del concepto de vulnerabilidad, ¨se integra la susceptibilidad de toda la infraestructura económico-social necesaria para la vida del hombre y constituye el factor principal sobre el cual el hombre puede incidir para reducir los efectos de los posibles desastres¨, (Batista, 2009: 12). En este se expresan las pérdidas y daños que pueden producirse de acuerdo con el peligro y la vulnerabilidad de elementos expuestos.

Y como vulnerabilidad: ¨es la susceptibilidad de un escenario, sistema o elemento expuesto, a sufrir daños bajo la acción de un fenómeno peligroso o perturbador de una energía determinada. Puede expresarse desde el punto de vista matemático como un número entre cero (0) y uno (1). Esto implica que un valor 0 para un evento de determinada intensidad los daños son nulos y 1 los daños son totales¨ (Chuy, 2011: 21).

Para determinar el riesgo de desastres, se requiere analizar y estimar los daños esperados desde el punto de vista físico, económico, social y ecológico de un espacio geográfico, sector productivo, de servicio, de un proceso o una instalación particular. En esa evaluación tiene un gran peso la experiencia práctica de los actores sociales. La evaluación del riesgo depende de estudios detallados como plantea (Cardona, O. D 1989) y ha trabajado desde enfoques metodológicos para la apreciación del peligro por sismos con otros investigadores en Perú y España (Cardona O. D. y Barbat, A. H, 2000).

En la actualidad las definiciones de riesgo de desastre rescatan lo social y lo económico y tienden a plasmarse en definiciones del tipo: ¨el riesgo de desastre comprende la probabilidad de daños y pérdidas futuras asociadas con la ocurrencia de un evento físico dañino¨. O sea, el énfasis se pone en los impactos probables, (Narváez L. y Col., 2009: 22).

En la existencia del riesgo y sus niveles actúan dos fuerzas determinantes, el peligro y la sociedad.

El riesgo está en función de la vulnerabilidad y el peligro y sobre la primera es que se puede actuar para su reducción, en dependencia de la actuación, de las medidas aplicadas científicamente argumentadas. (Sandi, H.1983).

Los problemas ambientales existentes constituyen vulnerabilidades o crean condiciones de estrés que posibilitan que los impactos o que las consecuencias de un peligro sean más intensos y que se incrementen los riesgos y los desastres. Los daños provocados por un desastre, pueden acentuar los problemas ambientales.

(Narváez L., y Col., 2009), en su visión de la construcción social del riesgo, exponen que éste se fundamenta en la idea de que el ambiente presenta una serie de posibles eventos físicos que pueden ser generados por la dinámica de la naturaleza, pero su transformación en amenazas reales para la población está intermediada por la acción humana. Es decir, una amenaza no es el evento físico en sí, sino el peligro asociado con ella, el nivel del cual es determinado, entre otras razones, por factores no naturales o físicos, tales como los grados de exposición o vulnerabilidad de la sociedad. Claramente la concepción de la construcción social del riesgo se deriva del involucramiento de las ciencias sociales en el estudio del riesgo, lo cual ha obligado a una redefinición de múltiples aspectos y conceptos emanados en sus primeras instancias por el papel y rol que han jugado las ciencias naturales y aplicadas sobre el tema. El enfoque multidisciplinario del riesgo y el desastre trajo consigo una inevitable reelaboración de conceptos y definiciones.

Cuando los riesgos no se conocen y no se gestionan en función de su reducción por la sociedad en todas sus instancias y con la participación de todos los actores, se incrementa la posibilidad y la gravedad

de los desastres. En esta temática, (Fernández Polcuch, 2000) ha realizado investigaciones sobre la medición del impacto social de la ciencia y la tecnología.

Para considerar que se ha producido un desastre, los daños y pérdidas deben alterar considerablemente el funcionamiento normal de la sociedad y su cotidianeidad.

Los desastres generalmente se clasifican, al igual que los peligros que producen, de origen natural, tecnológico y sanitario.

El Glosario de Términos de Defensa Civil (Estado Mayor Nacional de la Defensa Civil, 2002: 233), plantea como definición de desastre: ¨Generalmente se denomina así a un acontecimiento o serie de sucesos de gran magnitud, que afectan gravemente las estructuras básicas y el funcionamiento normal de una sociedad, comunidad o territorio, ocasionando víctimas y daños o pérdidas de bienes materiales, infraestructura, servicios esenciales o medios de sustento a escala o dimensión más allá de la capacidad normal de las comunidades o instituciones afectadas para enfrentarlas sin ayuda.¨

La incidencia de la sociedad en el impacto del desastre, será diferente de acuerdo con su modelo socio-económico, sus características, relaciones sociales y sus políticas. La situación económica, el desarrollo tecnológico, las capacidades institucionales y humanas constituyen también factores que inciden en los desastres, además la cultura de las poblaciones afectadas y las actuaciones colectivas e individuales condicionan la forma de prevenir y enfrentar los desastres. Otros autores (Baños Rodríguez, Z. y Roca Fernández, Y, 2006), plantean las incidencias de la población en la vulnerabilidad de las viviendas del centro histórico por su antigüedad como es el caso de la provincia de Santiago de Cuba.

Los desastres son limitantes o constituyen un freno para el desarrollo sostenible, debido a las afectaciones que producen y los recursos que demandan los proceso de recuperación, se afectan la ejecución de las inversiones previstas, los planes sociales y todos los proyectos y la estrategias de desarrollo, incluyendo aquellas encaminadas a la conservación y protección de los recursos naturales y ecosistemas.

La ocurrencia de los desastres de origen natural, ha tenido una tendencia creciente a partir de las últimas décadas del siglo pasado, debido al incremento de la vulnerabilidad de la población es ante los fenómenos que lo generan. Según Zeballo (1999), varias agencias especializadas estiman que el conjunto de pérdidas de vidas, heridos y damnificados en el mundo, en el periodo 1970 a 1999 supera la cifra de 150 millones de personas, así como de grandes pérdidas económicas, fundamentalmente en los países subdesarrollados. Y citaba que la CEPAL estimó la pérdida de más de 10 000 millones de dólares en tan solo 5 eventos que afectaron a América Latina y el Caribe en la década de los 80.

En la Resolución 1 Declaración de Hyogo (Naciones Unidas, 2005: 84), ¨se reconoce que pese a que se va comprendiendo y reconociendo cada vez más la importancia de la reducción del riesgo de desastre y que han aumentado los medios de respuesta, los desastres y en particular la gestión y la reducción del riesgo siguen representando un desafío mundial¨.

¨La Gestión del Riesgo de Desastre como concepto central para la discusión en torno a la intervención en el riesgo y el desastre, datan de la última mitad de los años noventa del siglo pasado y desde entonces ha reemplazado, en muchos lugares, las nociones de manejo, gestión o administración de desastres tan comunes desde los años sesenta¨ (Narváez y Col., 2009: 147).

La autora considera que la Gestión de Riesgos de Desastres requiere de políticas definidas y estrategias para su reducción, de capacidades institucionales y humanas que coordinen y dirijan las acciones en la sociedad en general y en las comunidades, la participación de todos los actores (en los diferentes niveles de la sociedad, en especial a nivel de localidad) y a la toma de decisiones administrativa y organizativa consecuente con los objetivos y necesidades de la gestión del conocimiento y la información.

La Gestión de Riesgo se define, (Estrategia Internacional para la Reducción de Desastres, 2005: 28): ¨como el conjunto de decisiones administrativas, de organización y conocimientos operacionales desarrollados por sociedades y comunidades para implementar políticas, estrategias y fortalecer sus capacidades con el fin de reducir el impacto de las amenazas naturales y de los desastres ambientales y tecnológicos¨.

El glosario terminológico de la Defensa Civil de Cuba 2002: 28, plantea como definición de Gestión de Riesgos de Desastres: ¨aquella que constituye un proceso de análisis, identificación, caracterización, estudio y control de disímiles riesgos vinculado al desarrollo socioeconómico de un territorio, institución o actividad¨.

La Gestión del Riesgo de Desastre, (Narváez y Col., 2009:131) definida en forma genérica, se refiere ¨a un proceso social cuyo fin último es la previsión, la reducción y el control permanente de los factores de riesgo de desastre en la sociedad integrada al logro de pautas de desarrollo humano, económico, ambiental y territorial sostenibles¨.

El problema a resolver y el objetivo a lograr, con la gestión de riesgos, es su reducción y requiere que las acciones, tareas y actividades estén íntimamente interrelacionadas entre sí y con otros procesos que tienen lugar en el sistema social, su meta fundamental es el desarrollo para el bienestar de la población. La interrelación entre desarrollo sostenible, problemas ambientales y desastres orienta el carácter transversal de la gestión de riesgo y la gestión ambiental, en la gestión local. Esta temática es abordada por Guasch, F (2006, 2007 y 2008).

La autora considera los desastres un hecho social, ya que entre sus causas, un componente no despreciable está vinculado o relacionado con la actividad humana y es la sociedad y sus integrantes los que sufren sus consecuencias directa o indirectamente, con más o menos intensidad. Es la sociedad la que está en capacidad también de gestionar su reducción.

En este trabajo la autora asume el concepto de Gestión de Reducción de Desastre desde una perspectiva social, tomada del documento "La Gestión local del riesgo. Concepto y Prácticas" (PNUD, CEPREDENAC, 2005:87), donde se define: ¨como un proceso social complejo cuyo fin último es la reducción o prevención y control permanente del riesgo de desastres en la sociedad, en consonancia e integrada al logro de metas de desarrollo humano, económico, ambiental y territorial sostenible. Ella incluye la gestión correctiva (reducir los riesgos existentes) y la prospectiva (evitar generar nuevos riesgos)¨.

Desde la perspectiva de la política pública, la gestión del riesgo de desastre debe hacerse operativa a través de la organización institucional, los instrumentos de planificación e inversión y los mecanismos de seguimiento y control.

Para la Gestión de Reducción de los Riesgos de desastres, como esquema de intervención en el proceso Riesgo-Desastre, agrupa las acciones en seis procesos claves o procesos constitutivos esenciales. (Narváez y Col., 2009:152). Donde se definen:

1) generar conocimiento sobre el riesgo de desastres en sus diferentes ámbitos;
2) prevenir el riesgo futuro;
3) reducir el riesgo existente;
4) preparar la respuesta;
5) responder y rehabilitar; y
6) recuperar y reconstruir.

¨El ciclo de la gestión de reducción de riesgo de desastres en Cuba, consta de cuatro etapas; prevención, preparación, respuesta y recuperación¨ (Estado Mayor Nacional de la Defensa Civil, 2022:198).

No se puede entender la prevención o la reducción de riesgos sin que previamente exista una gestión del conocimiento sobre el riesgo de desastres, inmersa en la dinámica del desarrollo. Una de las salidas para prevenir la reducción de riesgos es mediante los programas de capacitación.

Programa de formación ambiental en reducción de riesgos de desastres para estudiantes universitarios

La política de reducción de riesgos está definida en el país y su aplicación consecuente ha posibilitado logros sobresalientes, no obstante de ser un país pobre, la misma ha estado en continuo perfeccionamiento. Del análisis crítico de los resultados alcanzados, se ha señalado la necesidad de pasar de una actuación solamente de respuesta a la de prevención, para continuar protegiendo la integridad física de las personas y disminuir las cuantiosas pérdidas económicas que limitan el desarrollo, elevar la calidad de vida y disminuir las vulnerabilidades. Es por ello que se debe contemplar el ciclo de reducción de desastre del país: la prevención, preparación, respuesta y recuperación (Directiva No.1 del Presidente del Consejo de Defensa Nacional, 2022 para la Reducción de Desastres), en cualquier proyección.

La gestión de reducción de riesgo local tiene que verse como un proceso social complejo cuyo fin es la reducción, prevención y control permanente del riesgo de desastres en la sociedad, en consonancia e integrada, con el logro de metas de desarrollo humano, económico, ambiental y territorial sostenible (PNUD CEPREDENAC, 2005).

Dada la connotación política-social de los desastres y teniendo en cuenta los objetivos y su alcance, este debe considerar la gestión de riesgos como un nuevo escenario de trabajo, en pro de la calidad de vida de la población, actuando sobre el comportamiento humano y los sistemas sociales, para producir cambios a partir de la reducción de los riesgos.

El insuficiente conocimiento de los estudiantes sobre los desastres, motiva la organización de un proceso educativo enfocado a esta problemática específica, que pueda incrementar los saberes, capacidades y el sentido de responsabilidad para producir un cambio en la gestión para la reducción de riesgos. Este proceso educativo debe constituir un factor de desarrollo, de transformación de las personas y de la comunidad, en el que formen parte los actores económicos, sociales y todos los grupos, para lograr la actuación coherente, producir el cambio necesario, aun con obstáculos estructurales y diferentes niveles de cultura en el entorno.

Por tanto, se hace necesario perfeccionar la formación ambienta; porque a partir de la misma se lograrán cambios sustanciales no solo en aspectos técnicos y teóricos, sino culturales, ideológicos, sociales y económicos, debido a que los mismos son actores sociales que tienen un rol específico en la esfera económica y social y así contribuir en la educación ambiental de otros actores y de la comunidad en general, para lograr los objetivos y metas de un desarrollo sostenible.

De forma general, se pretende preparar a estas personas para dar respuesta a las nuevas exigencias que les demanda la sociedad.

Los resultados de esta investigación constituyen la base principal para la concepción del Plan de Estado para el Enfrentamiento al Cambio Climático en la República de Cuba “Tarea Vida”.

El programa de educación ambiental dirigido a estudiantes universitarios desarrollado por diferentes instituciones a nivel nacional e internacional, con el propósito de crear capacidades para el enfrentamiento ante situaciones desastres como respuesta a los problemas que se encuentran en los diagnósticos previos a su elaboración y como base para orientar acciones posteriores.

La educación ambiental juega un importante papel en el apoyo e impulso hacia un nuevo paradigma del desarrollo, la misma puede contribuir a alcanzar este objetivo, sin ella no es posible lograr el tránsito hacia una sociedad sostenible.

Como resultado, cada vez más se deposita una mayor confianza en el proceso educativo, con el objetivo de poder contribuir a dar respuesta a los principales problemas ambientales y a la posibilidad de las personas de tener un papel cada vez más protagónico.

El diseño del programa que se presenta en esta investigación pretende el aprendizaje del tema de manera clara, sencilla y con aplicación inmediata en la reducción de riesgos de desastres,

una vez termina la carrera se incorporan como profesionales en las diferentes áreas de la sociedad, y pueden tributar los conocimientos adquiridos a establecer sistemas de alerta temprana, a la propuesta de medidas que responden al ciclo de reducción de desastres, para la inmediata aplicación en disminuir el impacto ambiental que lleva implícito desde cada puesto de trabajo. De manera que se eleve la percepción del riesgo expuesta y contribuya como material de consulta en la gestión para la reducción de riesgos de desastres.

El programa de formación tributa a la planificación estratégica y se tiene en cuenta las características de los estudiantes de las carreras técnicas y de letras de Cuba, América Latina y el Caribe.

El programa tiene un carácter teórico-práctico-integral e incluye contenidos relacionados con la gestión en la reducción de riesgos, conocimientos, requisitos básicos y procedimientos, a través de los cuales se puedan desarrollar determinados hábitos, habilidades y valores, para la organización y ejecución de actividades que se contemplan en el programa. Se incrementa la percepción por parte de los estudiantes, fomenta su auto transformación, responsabilidad, y estimula el sentido de pertenencia. Se identificación del peligro por su origen, las evaluaciones de las vulnerabilidades y la estimación del riesgo, para alcanzar en los estudiantes una adecuada educación ambiental, elevada percepción del riesgo para un desarrollo sostenible.

El programa responde a una asignatura, consta de 5 temas, distribuido en 18 horas de conferencias, 6 horas de seminarios y 10 horas de actividades prácticas y 8 horas de talleres, 3 horas del taller final, con una duración total de 45 horas clases.

Al concluir el programa los estudiantes deberán haber alcanzado:

1. Una formación ambiental integral para la gestión en la reducción del riesgo, para que no solo manejen los modelos y razonen desde un punto de vista como estudiantes, sino posibilitarles una visión integrada de peligro, vulnerabilidad y riesgo por cada peligro, desde la perspectiva social y económica.
2. Una preparación encaminada a conocer el proceso de planificación para la reducción de riesgos desastres.

Se realiza la propuesta de seguimiento del programa de formación para la evaluación de sus impactos.

Los resultados que se puedan alcanzar con el programa no solamente se tendrán en cuenta los aspectos positivos o negativos, sino también el impacto en las esferas socioeconómica y ambiental.

Para ello existirán dos momentos para el seguimiento y monitoreo:

1. Durante la ejecución del programa.
2. Con posterioridad a la aplicación del programa.

Constituyen criterios de éxito de este programa:

- Incremento de la efectividad de la gestión de riesgos en los territorios.
- Disminución de las vulnerabilidades y los riesgos asociados al peligro por sismos.
- Mayor incorporación de la dimensión ambiental en las asignaturas vinculadas a la temática.

Constituyen resultados (impactos) esperados los siguientes:

Estudiantes con incidencia en el desarrollo sostenible, que estén formados y con incorporación práctica a la gestión en la reducción de riesgos de desastres.

- La adopción de medidas expresadas en decisiones, acciones, análisis y actividades para la prevención o solución de vulnerabilidades en zonas de mayor riesgo.
- La generación de acciones de formación ambiental para la gestión de riesgo.

Con vistas a desarrollar el seguimiento y monitoreo se proponen las siguientes acciones generales:

Establecimiento de un sistema de información periódica del desarrollo del programa.

- Intercambio de comunicaciones con los estudiantes.
- Entrevistas de opinión a los estudiantes.
- Observación directa (en debates, ejercicios prácticos y reuniones en las que participen los estudiantes).
- Recopilación de informaciones que posibiliten determinar y evaluar las acciones para mejorar y solucionar las vulnerabilidades en zonas de mayor riesgo, así como los cambios cualitativos en este sentido en los estudiantes.

Las acciones específicas de seguimiento y monitoreo que se proponen son:

Durante la ejecución del programa de formación a estudiantes.

Se han previsto un grupo de instrumentos para la evaluación del programa, los que se refieren a continuación:

Encuesta informal. Para ser aplicada por el profesor(a) responsable al final de cada tema. Evalúa la comprensión, utilidad e importancia del tema, así como el tiempo dedicado al mismo.

Entrevista a estudiantes. Tiene la intención de recoger pareceres de los estudiantes acerca del diseño temático del programa, la organización, la calidad de los textos, los medios didácticos utilizados, las expectativas y sugerencias.

Informe final. Lo elabora el profesor(a) responsable de conjunto con los expertos de las temáticas, donde se resumen las incidencias positivas y negativas del desarrollo del programa, de forma cuantitativa y cualitativa, incorporando sugerencias a tener en cuenta en posteriores réplicas del resultado.

Conclusiones

1. El estudio realizado confirma que los estudiantes universitarios no pueden poner en práctica el desarrollo económico y social sostenible, sin tener una adecuada educación ambiental especializada, que garantice que mediante su gestión se logre que en las actividades que realicen se tengan presentes, la gestión para la reducción de riesgos de desastres, lo cual se obtendrá a partir de la adquisición de conocimientos, conciencia y compromisos que se transformarán en comportamientos, actitudes y participación ante la solución y prevención de los peligros naturales.
2. La formación ambiental en sentido general y de manera particular en los estudiantes universitarios de Cuba, América Latina y el Caribe ha transitado por diferentes momentos como reflejo de la evolución de la problemática ambiental global, sobre todo a partir de la aplicación de la política ambiental regional. Y los resultados de los estudios que en el orden conceptual, organizativo, metodológico y práctico se realizan, demuestran la importancia que los estudiantes, como actores sociales estén formados en la gestión para la reducción de riesgos de desastres, desde sus diferentes posiciones tanto como futuros profesionales y como ciudadanos.
3. El programa de formación se caracteriza por la flexibilidad necesaria para adaptarse a los diferentes contextos que se desarrolla el estudiante universitario en diferentes lugares tiene una concepción transformadora de la gestión para la reducción de riesgos basada en un sistema de seguimiento y monitoreo del programa para evaluar no sólo los resultados sino cómo se desarrolló el proceso, cuál fue su conducción y su impacto en las diferentes esferas de la vida económica, social y política, lo que evidentemente puede conducir a un mayor impacto social.
4. La valoración realizada por los expertos referentes al programa propuesto de formación ambiental, indicó la factibilidad de la implementación del mismo, corroborado por los resultados de los análisis cualitativos y cuantitativos que lo catalogaron de muy adecuado para aplicarlo en los estudiantes universitarios de Cuba, América Latina y el Caribe para una mejor gestión en la reducción de riesgos de desastres.

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CLUSTER

03

The Dimensions

Theme 01:
A Matter of Values and Cultural Diversity - Indigenous Knowledge and Culture

Theme 02:
Aesthetics Ethics and Emotional Dimensions - The Role of Art and Design in EE

THE DIMENSIONS THEME 01

A Matter of Values and Cultural Diversity - Indigenous Knowledge and Culture

Theme Background:

The late Sheikh Zayed bin Sultan Al Nahyan, the father of the United Arab Emirates, eloquently stated, "On land and in the sea, our forefathers lived and survived in this environment. They could do so because they recognized the need to conserve it, take from it only what they needed to live, and preserve it for succeeding generations."

His wisdom underscores the profound importance of indigenous knowledge and traditional practices in the survival of both people and their environment. This is especially evident in the delicate desert ecosystem of the UAE, where sustainable practices have been vital for generations. Notably, a quarter of the world's land area is owned, managed, used, or occupied by indigenous peoples and local communities.

Indigenous knowledge is deeply rooted in cultures and traditions, offering invaluable insights into sustainable living, resource management, and ecosystem preservation. The contributions of indigenous peoples are crucial in designing and implementing solutions to sustainability and ecosystem restoration issues on a global scale.

Theme Objectives:

The theme, "A Matter of Values and Cultural Diversity: Indigenous Knowledge and Culture," aims to:

- Examine the connection between local wisdom and cultural practices with international agendas, particularly within the framework of the Sustainable Development Goals (SDGs). How can indigenous knowledge contribute to the achievement of global sustainability objectives?.

Theme Focus:

- Initiatives that incorporate indigenous knowledge into environmental education.
- The role of storytelling, oral traditions, and indigenous arts in environmental education.
- Indigenous perspectives on sustainability and their relevance to SDGs.
- Curricular designs that incorporate indigenous perspectives and teachings.

Theme Outcomes:

A discussion on how environmental education communities learn from indigenous cultures and traditional practices, emphasizing the significance of values, indigenous knowledge, and culture in connecting people and creating a better tomorrow.

Theme Conclusions:

The thematic track on "A Matter of Values and Cultural Diversity: Indigenous Knowledge and Culture" aligns with the overarching goal of WEEC 2024, which is to "Connect People, Create Tomorrow." It underscores the critical importance of recognizing and respecting indigenous knowledge, cultural diversity, and traditional practices in the context of environmental education and sustainability.

Together, we can celebrate the richness of indigenous cultures, honour their contributions to sustainable living, and forge meaningful connections that will shape a better tomorrow for all.

THE DIMENSIONS THEME 01

A Matter of Values and Cultural Diversity - Indigenous Knowledge and Culture

Proceedings

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049 Land-based Learning as a Form of Resiliency During Pandemic

Ranjan Datta[(1)], *Jebunnessa Chapola*[(2)], *Prarthona Datta*[(3)], *and Prokriti Datta* [(4)]

The COVID-19 pandemic has presented various challenges all over the world. In Canada, immigrant communities became at serious risk because of systematic structural challenges, including limited access to healthcare, occupational risks, racial discrimination, living conditions, and language and cultural challenges. It wasn't easy to overcome these challenges without structural support from governments, NGOs, and local communities. As social interaction was minimal and not at all, many immigrant communities faced extra burdens as many needed family support in a new country. Following a relational and decolonial research framework, this study explores how learning and practicing Indigenous land-based practices were critical in building resilience during the pandemic immigrant families. Indigenous land-based learning and practices have different forms, including learning land-based stories from Indigenous Elders, Indigenous Elder-led land walks, intergenerational story sharing, community gardening, music, dance, and artworks. All these land-based practices encompass various aspects of health, including physical, mental, emotional, and spiritual health, that helped communities cope with the challenges brought about by the pandemic.

Covid-19 and Its Impacts on Immigrant Communities

Immigrants may encounter barriers to accessing mental healthcare services during the pandemic. These barriers may include language barriers, lack of health insurance, fear of immigration enforcement, and cultural differences in help-seeking behaviours. Limited access to mental healthcare can further contribute to mental health disparities among immigrant populations. The COVID-19 pandemic has significantly impacted Canada's physical health, particularly in immigrant and refugee communities. Immigrants, particularly undocumented or vulnerable, may face additional challenges and barriers to accessing healthcare and maintaining well-being. Studies on immigrant health found various reasons contributing to this issue, including limited access to healthcare, occupational risks, living conditions, language and cultural challenges (Nocon & Bharadwaj, 2020). Limited access to healthcare can delay or prevent timely medical interventions, testing, and treatment for COVID-19 and other health conditions, thus potentially worsening their health outcomes (Benjam *et al.*, 2021; Gibso, *et al.*, 2021; Wu *et al.*, 2021).

Many immigrants work in industries deemed essential during the pandemic, such as healthcare, agriculture, food processing, and transportation. These occupations often involve close contact with others, making immigrants more susceptible to COVID-19 exposure. Additionally, some immigrants may work in low-wage jobs with limited access to personal protective equipment (PPE) or job security, further increasing their vulnerability to the virus (Cherry, *et al.*, 2023; St-Denis, 2020). Immigrants, especially those in low-income communities, often live in crowded housing arrangements due to economic constraints. Overcrowded living conditions make maintaining physical distancing and isolation measures challenging, increasing the risk of COVID-19 transmission within households and communities. Limited English proficiency and cultural differences can make it difficult for immigrants to access accurate and timely information about COVID-19 prevention, testing, and vaccination. Language

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barriers can also hinder effective communication with healthcare providers, leading to potential misunderstandings or inadequate healthcare (Smith *et al.*, 2023).

Mental Health Impact

The pandemic's psychological toll, including stress, anxiety, and social isolation, can also impact physical health. Immigrants may experience heightened stress due to concerns about employment, financial instability, family separation, and the well-being of loved ones in their home countries. Immigrants may experience heightened stress and anxiety due to various factors related to the pandemic (Bhatia & Wallace, 2021; Mirzaei *et al.*, 2020). These may include fears of infection, financial insecurity, language barriers, limited access to healthcare, and concerns about family members' well-being in their home countries and the host country. Immigrants may experience increased social isolation and loneliness during the pandemic, as restrictions on mobility and social gatherings can limit their opportunities to connect with their communities and support networks Romero *et al.*, 2020; Usher *et al.*, 2020). This can have a negative impact on their mental well-being.

Discrimination and Stigmatization

Immigrants may face increased discrimination and stigmatization during the pandemic, including xenophobia and scapegoating. Such experiences can lead to heightened psychological distress and negatively impact mental health outcomes (Lobato & Powell, 2020; Quosh & Mitra, 2021). Efforts have been made to address some of these challenges and mitigate the impact on immigrant physical health. For instance, community organizations, healthcare providers, and governments have worked to improve access to healthcare services, provide multilingual information, and expand COVID-19 testing and vaccination efforts in immigrant communities. However, ongoing efforts are necessary to ensure equitable access to healthcare and support the overall well-being of immigrant populations during and beyond the pandemic.

Researchers Positionality

As a racialized immigrant family, we have lived in Treaty 6 and 7 territories for the last 13 years. We are so grateful to all Indigenous Nations for the opportunities. We also have been lucky to have learning opportunities from various Indigenous Elders and Knowledge-keepers regarding land-based learning and practice, Indigenous sustainabilities, colonial settler histories of Canada, and environmental justice. All these learning helped us to understand who we are in this Indigenous land as uninvited guests and our responsibilities. We acknowledge that we have many responsibilities to this land and Indigenous people. For doing this, we have developed a long-time relationship with many Indigenous Nations. In this research, we wanted to learn respectfully from Indigenous Elders and Knowledge-keepers and implement our learning knowledge in everyday practice.

Theoretical Frameworks and Methods

We choose a relational theoretical framework for this research as it not only centers the researcher's relational accountability in research but also helps the researcher's transformation as a continuous process (Battiste, 2013; Cajete, 2000; Datta, 2025). It recognizes the importance of relationships, spirituality, land, and cultural practices. The relational frameworks from Land-based learning perspectives highlight the interconnectedness of all beings and elements of the natural world. This includes recognizing the relationships between humans, animals, plants, ancestors, and the spiritual realm. These relationships are often viewed as reciprocal and guided by respect, reciprocity, and responsibility principles.

The relational frameworks in Land-based learning view well-being as encompassing physical, mental, emotional, and spiritual dimensions (Durie, 2004; Kirmayer, *et al.*, 2011). The well-being of individuals is intertwined with the well-being of their communities, cultural practices, and the land. This holistic approach emphasizes balance, harmony, and a sense of belonging. The relational frameworks emphasize the importance of cultural continuity and revitalizing traditional knowledge,

languages, and practices. This includes fostering intergenerational relationships, promoting cultural pride, and reclaiming Indigenous ways of knowing and being (Archibald, 2008; Smith, 2012).

The relational frameworks acknowledge the deep connection between Indigenous peoples and their traditional lands (McGregor, 2004; Simpson, 2017). The meaning of Land refers to cultural, spiritual, and historical significance. Indigenous peoples' relationships with the land are integral to their identities and ways of life. Following the relational theoretical research framework, we used five Land-based research methods in this research Indigenous Elders and Knowledge-keepers Land-based stories, Land-walk, our reflective writing, using cross-cultural arts, dance, and music, and fishing as a form of resiliency. In our research, we strongly followed Indigenous Elders and Knowledge-keepers' continuous form of consent if we can reflect our learning from their teaching. All the Elders and Knowledge-keepers consented and suggested that sharing our learning knowledge is also our responsibility.

Importance of Indigenous Land-based Learning and Practice

Indigenous Land-based learning and practice are essential to us for several reasons. We have learned that Indigenous Land-based learning and practice are essential for cultural preservation, environmental stewardship, holistic well-being, empowerment, resilience, and intergenerational transmission of knowledge. By honouring and taking responsibility for the land and Indigenous people, we learned how to create our belongingness with this Land, challenge colonial perspectives within and from the system, maintain our cultural identities, build meaningful relationships among Indigenous and immigrant and refugee communities, promote sustainable practices, and foster overall community strength and well-being.

Create Challenges in Western Perspectives

We have experienced that Land-based learning helped our family to challenge Western perspectives that have not been helpful during this pandemic and beyond. We have seen that many immigrants and refugee communities come to Canada from different parts of the world; however, in most cases, they need to know which land they came from, what they are doing, and what they need to do. All these gaps create lots of alienation within among own immigrant community and other immigrant communities. Moreover, these gaps promote comparison among immigrant communities in which Nationality is the "Best" than others. Even they become more serious when this "best" tendency undermines other immigrant and Indigenous communities within the same communities. However, we have seen that all these gaps are systematically created challenges instead of individual issues, as immigrant communities do not get learning opportunities. Our Land-based learning helped us understand which land we are standing on, how to take responsibility for the land, and how to learn the colonial history of Canada and all people. During the pandemic, we got many opportunities to learn directly from Indigenous Elders and Knowledge-keepers and connect with our Land-based stories.

Build Trust

Indigenous Land-based learning is critical to creating a meaningful bridge between immigrant and Indigenous communities. For Instance, during the Covid-19 pandemic, many Indigenous Elders and Knowledge-keepers helped us to learn that we are all connected to each other. Indigenous people have been living on this land sustainably for a long time. All these stories became so relevant during this crisis to know why we all need to work together to protect our environment so that we do not destroy our surrounding environment, such as land, water, native plants, animals, etc. Our deep respect and learning of these Indigenous Elders and Knowledge-keepers' stories helped to build trust among our racialized immigrant family and Indigenous communities. Many Indigenous Elders and Knowledge-keepers call us relatives; it means we are in relationships. Once in a relationship, we become responsible for each other and our environment.

Create Belongingness

The land is deeply intertwined with Indigenous cultures and traditions. It holds significant spiritual, historical, and social value for Indigenous communities. Land-based learning and practice help preserve and pass on Indigenous knowledge, wisdom, and practices to future generations. Since we as a family also immigrated to Canada from Land-based culture and practice, this learning was so helpful in reclaiming our knowledge and practice.

As many Indigenous peoples have deep-rooted connections to specific lands inhabited by their ancestors for generations, learning from Indigenous Elders and Knowledge-keepers' Land-based stories allowed us as a racialized family to develop a strong sense of belonging and identity by connecting with the Indigenous meanings of Land, Indigenous people, and other immigrants' communities. It strengthened our cultural and spiritual ties to the land, fostering a sense of continuity and respect for Indigenous heritage. Indigenous communities have long-standing relationships with their lands, often characterized by sustainable practices and a profound understanding of local ecosystems. Our Land-based learning and practice promote ecological knowledge, conservation, and sustainable resource management. Indigenous peoples' traditional ecological knowledge helped us to contribute valuable insights into addressing the Covid-19 pandemic.

Develop Health Well-being

Indigenous Land-based learning and practice encompass physical, mental, emotional, and spiritual aspects of well-being. Spending time on the land and engaging in traditional activities like community gardens, Indigenous Elders-led Land walks, observing the land, and storytelling positively affected our overall health. The land provides a natural environment for physical activity, a source of nutritious food, and a space for cultural ceremonies, healing practices, and community-building. For instance, we did lots of land walk. Our daughter explained how land-walk helped her during pandemic.

During this COVID lockdown, it is important to go outside, so that is why my family and I go on walks outside. Going for a walk helps me breathe in the fresh air and get outside. When I go for walks, I feel fresh, happy and free. My family and I walk in many different places away from people. We go to the river, the countryside, and different parks. We make sure we do not touch any playground equipment, benches, trash cans, or anything anyone else could have touched. Walking can be therapeutic because staying inside for so long can drive you crazy. When I go outside, there are many different skies every day. The sky changes every day; it will never be the same as another. Like life, it is always changing, and no day is the same as another. Since my family goes on many walks, it has helped us get closer together. We play soccer and throw frisbees; we also run as a family. I now get to spend much more time with my baby sister, before I barely spent time with her. In some ways, quarantine is a good thing. It has helped with family bondage. This is why my family and I go on walks.

Empowerment and Resilience

Land-based learning empowers Indigenous and non-Indigenous, mainly immigrant communities, who strongly connect with the land and Land-based practice by reaffirming our self-determination and sovereignty. It helps counter-historical injustices and systemic marginalization faced by Indigenous peoples. Learning Land-based knowledge and practice helped us reclaim our agency over our cultural, social, and economic development. This, in turn, enhances their resilience, pride, and collective strength.

Intergenerational Transmission

Indigenous Land-based learning and practice facilitate the intergenerational transmission of knowledge, values, and skills. Indigenous Elders and Knowledge-keepers are vital in passing traditional teachings and practices to younger generations. Engaging in Land-based activities together, such as storytelling, walking, and ceremonies, knowledge and wisdom helped us ensure our responsibilities to be part of Indigenous Land and water rights movements. During the Covid-19 pandemic, while we learned stories from various Indigenous Elders

and Knowledge-keepers stories, we also tried to share our Land-based stories with our children. For instance, our children (authors 4) reflected in their reflective journals that

We heard many stories from my parents and grandparents regarding who we are and where we came from. During the war in his country, millions of people got killed and displaced from their ancestral land. My grandma that I did not get to see her, she became a widow with 6 children, and she did not have enough educational degrees to find a job. During the liberation war, my Dad's family got displaced. Many majorities of people grabbed my grandpa's land, house and other properties. My dad's family became homeless and they could not afford food, housing, education, and a safe social life even when the war stopped. At that time, most of the people were scared to get out of their house even to get food, because if they did get out, the Pakistani military would shoot them. Everyone was very panicked and traumatized, many people did not have food, clothes, shelter, or a job and students could not go to school, college or universities. At that time, there was no internet or online class facility. Innocent people were getting shot for no reason; children were getting shot too women were getting raped, kidnapped and killed. People did not have a normal life to live or grow. The liberation war continued for nine months. After hearing this story I realized that we are in a better situation during the COVID-19 lockdown here in Canada. Our parent's stories helped us a lot to be resilient during this difficult time.

At another reflection, our children (author-4) wrote how their parent's stories helped them during this difficult time.

In our parent home country [Bangladesh], there are common disasters such as floods and cyclones almost every year. Thousands of people die and lose their homes almost every year. Many people are directly affected by the disasters. My Dad family directly experienced severe floods. His Mom could not send him to school or give him housing, clothes, or food. The Bangladesh government could not provide enough facilities. My Dad's struggling life story is unique to us. His life story is helping me to understand the privileges that I am getting here in Canada, even during this COVID-19 pandemic. All these stories helped me to be strong during this COVID-19 lockdown, As I feel that we are privileged to live in Canada and that we have access to the internet and many survival facilities such as food, good housing, water, electricity and transportation.

Learning Land-based stories helped us become resilient during this COVID-19 lockdown. These stories also helped me learn reconnection, relationship, relearning, relevance, and respect. We learned how to reconnect, build relationships, relearn, make relevance, and respect nature, animals, and humans. For instance, learning from Indigenous Elder Land-based stories, one of our daughters (author-3) reflected that.

I learned from the First Nations Elders that our relatives are the air, the sun, water, plants, insects, and rain. We all, as humans and non-humans, are interconnected and interdependent on each other. We need to take care of each other; we have responsibility for each other. For instance, an Elder told us that bee has many roles in our everyday lives; without bees, we may not have food, which we depend on.

She also reflection how learning relational stories from Indigenous Elders and Knowledge-keepers helped them to understand spiritual meanings, connections,

I learned from the First Nations Elders that spirituality is to respect all of our relationships around us. According to Elders, spirituality is living together with humans and non-humans. In spirituality, everything is connected and interdependent. For example, the land is our mother, it gives us everything, including the food we eat, the water we drink, the air we breathe, and so on. In spirituality, we do not own the land, the land owns us.

Cultural and Social

Land-based stories from Indigenous Elders and Knowledge-keepers helped to understand that cultural and social aspects refer to who we are, where we came from, and where we need to go. Who we are is our practices and our land-based knowledge. It refers to coming to our land and family

and finding our identity. Where we came from is the land we are from, our culture, and our social practices. Music, dance, and art activities helped our family to be resilient during this difficult time. Our daughter (author-3) wrote.

COVID-19 does not make me stop my extracurricular activities. I am keeping myself resilient during the COVID-19 pandemic by dancing, singing and playing musical instruments. I do many types of dance, but during this pandemic, I had to stop learning physical dance at dance schools. These dances are ballet, jazz, Indian classical Kathak, Bharatnatyam, Bangla folk, Russian, German and Indigenous POWWOW dance. I have lots of flexible time to practice dances these days. Why I do these dances during this quarantine so I can stay active, happy, hopeful and won't forget the things I learned since I was three years old. It gives us the inner strength to calm down.

She also explained how her music activities helped her to overcome stressful situations,

In addition to dance, I did many musical activities, including singing, playing the piano, French horn, trumpet and Indian harmonium. Why we do this because it is therapeutic for our mind and body. We are not feeling depressed or bored and lonely. Dance and music have helped me to have more energy, positivity, and joyful times. How we are continuing everything is online and getting tremendous support from our parents at home. COVID-19 has taught us different meanings of dance and music.

Cross-cultural Activities

Both reading and writing became therapeutic for our family. Prarthona Datta (author-3) explained why reading and writing have been therapeutic for her because it helps her relax her mind. Writing and reading make her feel happy and good every day. For instance, she wrote, "COVID-19 has given me lots of free time to write and read. I am maintaining my regular journal and writing about COVID-19 so that the next generation can learn about what happened to people during this pandemic.

Art activities helped our family in many to cope with Covid-19 challenges. As Prarthoa Datta reflected in her daily journal reflection

During this quarantine, I have painted a painting, the theme was to protect the environment and COVID-19 and awareness of COVID-19 Doing art during this COVID-19 pandemic is therapeutic. Doing art is a productive way to spend your time. Art makes me feel relaxed and calm. I chose to do artwork to tell people to help reduce the spread of COVID-19 during this time; we all need to support each other as a community.

One of the best things when going outside is breathing in the fresh air. After staying in for so long, going outside in the fresh air feels great. We could feel the cool breeze whooshing past us when we went outside. The air makes me feel fresh and happy. Breathing fresh air is an amazing thing after staying inside for so long. Prarthona Datta (author-3) expressed that

Since COVID-19 has us all in quarantine, my family and I have gone on many land-walk. We go to the countryside most of the time. We often go to the countryside to escape the city and other people. Sometimes on the way, we see different birds like Canadian geese, ravens, crows, seagulls and pelicans; sometimes, we also see wild dogs and deer. Since the weather is getting warmer, we see more of them often. Roadside animals are a lot of fun to be around.

Therefore, our resilience is to support each other by sharing stress collectively. We often carry the stress of relatives in our bodies, so we do not need to carry our stresses alone. Through connecting this way, we thrive in the best of times and survive in the worst of times. Sharing stories collectively also means we may experience increased feelings of fear, worry, anger, shame and other challenging emotions. We can lean into our cultural strengths for support, knowing we have a long history of resilience. We have traditions and practices that ground us in the present and keep us well – spiritually, mentally, physically and emotionally. We have many cultural strengths to draw upon to stay connected and keep well, even while we practise social distancing.

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169 المعجم الحساني الجغرافي، أداة لحفظ الثقافة المجالية المبدعة لدى الإنسان الصحراوي

ذ. عبد العزيز فعرس [1]

ملخص

تهدف هذه الدراسة الى جمع المادة المعجمية الخاصة بالألفاظ والمصطلحات التي يستعملها الإنسان الصحراوي الحساني في علاقته مع محيطه الجغرافي والبيئي، وفق فهمه وتعريفه إياها.

وقد تم اعتماد عدة أدوات علمية لجمع المادة المعجمية، من بينها المقابلات الفردية والجماعية والملاحظة المستقاة من الزيارات الميدانية بمعية بعض المستجوبين، ناهيك عن شبكة لمسح متون مجموعة مصادر ومراجع والتحقق منها خلال العمل الميداني.

وقد خلصت الدراسة الى أن المعجم الحسانية يحمل تراثا ثقافيا غنيا ومعارف تقليدية مبدعة اكتسبها الانسان الصحراوي من الاحتكاك اليومي بالوسط الطبيعي الجد حساس الذي يعتبر المصدر الرئيسي لهذه المعارف الجغرافية البيئية، مما يتحتم علينا تسجيل هذا التراث الحساني الثقافي المعجمي وتوثيقه قبل أن نتحسر على ضياعه.

كلمات المفاتيح: المعجم الحساني الجغرافي، الثقافة المجالية المبدعة، الإنسان الصحراوي.

Dictionnaire géographique Hassani, un outil pour préserver la culture spatiale créative de l'homme du Sahara

Résumé

Cette étude vise à recueillir la matière lexicale des mots et des termes utilisés par l'homme du Sahara «Hasani» dans sa relation avec son environnement géographique, selon sa compréhension et sa définition de ceux-ci.

Plusieurs outils scientifiques ont été adoptés pour collecter la matière lexicale, y compris des entretiens individuels et collectifs et des observations de visites de terrain avec certaines des personnes interrogées, sans oublier une grille pour examiner le contenu d'un ensemble de sources et de références et les vérifier lors de travaux de terrain.

L'étude a conclu que le lexique Hassaniya est porteur d'un riche patrimoine culturel et de connaissances traditionnelles créatives acquises par l'homme du Sahara au contact quotidien avec le milieu naturel très sensible, qui est la principale source de ces connaissances géographiques et environnementales. Par conséquent, il est impératif que nous enregistrions et documentions cet héritage culturel hassani, lexical, avant de déplorer sa perte.

Mots-clés: Dictionnaire géographique Hassani, culture spatiale créative, homme du Sahara.

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Hassani Geographical Dictionary, a Tool to Preserve the Creative Spatial Culture of Sahara Man

Abstract

This study aims to collect the lexical material of the words and terms used by the man of the Sahara "Hasani" in his relationship with his geographical environment, according to his understanding and his definition of these.

Several scientific tools have been adopted to collect the lexical material, including individual and collective interviews and observations of field visits with some of the interviewees, without forgetting a grid to examine the content of a set of sources and references and check them during field work.

The study concluded that the Hassaniya lexicon carries a rich cultural heritage and creative traditional knowledge acquired by the man of the Sahara in daily contact with the very sensitive natural environment, which is the main source of this geographical and environmental knowledge. . Therefore, it is imperative that we record and document this Hassani cultural heritage, lexical, before lamenting its loss.

Keywords: Hassani geographical dictionary, creative spatial culture, Sahara man.

مقدمة

يحتل المعجم مكانة متميزة عند جميع الأمم، خاصة حينما يتعلق الأمر بالرغبة في المحافظة على تراث يتعدى الحمولة اللغوية إلى الحمولة الثقافية وتعزيز الشعور بالهوية، كما هو الشأن بالنسبة للثروة المفاهيمية الجغرافية البيئية المتوارثة والتي تزخر بها مختلف المناطق الجغرافية داخل نفس البلد أو بين البلدان التي تجمعها قواسم مشتركة كاللغة والهوية، وينطبق هذا الكلام على سياقات جغرافية شبيهة بالمجالات الصحراوية الغنية بتراثها المعجمي الحساني الجغرافي البيئي.

وفضلاً عن الجوانب الأدبية، فإن اللهجة الحسانية تحمل تراثا علمياً قيماً خاصة في علوم البيئة، الجغرافيا، المناخ والنبات، الفلك والطبوغرافيا، حيث تحمل الحسانية تصنيفا تفصيليا لجميع المظاهر البيئية والتضاريسية الصحراوية، وهذا راجع الى الإدراك المجالي الكبير عند الإنسان الصحراوي الذي وجه سلوكاته للتناغم مع منظومته البيئية، سلوكات صديقة لبيئته، قائمة على ثقافة تدبير ندرة الموارد وليس تبديرها.

في هذا السياق يأتي هذا العمل ليسلط الضوء على هذا المشروع، الذي من خلاله سنبرز أهمية الثقافة المجالية المبدعة عند الإنسان الصحراوي من خلال اللسان الحساني، وذلك بهدف صيانتها وتثمينها.

1. أهداف الدراسة والمنهجية المتبعة:

تأتي مبادرتنا لجمع المادة المعجمية الخاصة بالألفاظ والمصطلحات التي يستعملها الإنسان الصحراوي الحساني في علاقته مع محيطه الجغرافي والبيئي، وفق فهمه وتعريفه إياها. ومن هذا المنطلق سنعتبره معجما وصفيا تحليليا في تعريفه للمفردات الحسانية ومقابلتها بنظيرتها العربية الفصحى.

فالهدف العام من هذا العمل حماية الحسانية من الانقراض عبر دراسة مفرداتها وتوثيقها وأرشفتها والعناية بالمصطلحات الجغرافية التراثية. عبر مسح وحصر القاموس الجغرافي المشترك بين اللغة العربية الفصيحة والحسانية. وهذا بدون شك سيساهم في حفظ الذاكرة البيئية ورد الاعتبار للثقافة الجغرافية الحسانية وسيمكن الأجيال المتعاقبة من فهم الحسانية وتراثها الفكري والعلمي والحضاري. كما سيفيد الباحثين والمخططين في دراسة الظواهر البيئية السوسيو حضارية في هذه المجالات، عبر توفير قاعدة بيانات لغوية تفيد الباحثين والمخططين، مؤلفي الكتب المدرسية ومعدي البرامج الإعلامية لتقديم مواد تناسب متطلبات ساكنة هذه الأقاليم.

1.1. التقنيات التي تم اعتمادها في جمع المادة المعجمية هي كالتالي:

- جمع المفردات الحسانية المشتتة من مختلف المراجع والمصادر التي اهتمت بمجال وثقافة الصحراء (ارجع الى لائحة المراجع والمصادر).

- المقابلات الفردية والجماعية: فالمستجوبون هم عبارة عن إخباريين ورواة من أهالي المنطقة بالجنوب المغربي ممن يشهد لهم بدرايتهم ومعرفتهم الكبيرة بالثقافة الحسانية.
- الملاحظة المستقاة من الزيارات الميدانية بمعية بعض المستجوبين.
- مسح للمتون المبحوث عنها والتحقق منها خلال العمل الميداني في مجالات مختلفة من الصحراء سواء بمنطقة وادي نون أو وادي الساقية الحمراء ثم بوادي الذهب. مع الإشارة إلى أن الإحاطة بكامل المفردات الحسانية في كافة أنحاء المجال البيضاني هو أحد المستحيلات. لذا فهذا الانجاز هو مجرد لبنة أولى سيجد لاحقا من يطوره توسعا وتمحيصا.

2.1. الضبط والتدقيق اللغوي:

وذلك عن طريق العمليات التالية: الاختيار، الانتقاء وتقويم المادة المجمعة، التحقق من المصادر، والحسم في الروايات المتعددة واختيار الأكثر تداولا بين الرواة، تم التدقيق اللغوي في كل مفردة للوقوف على معناها الحقيقي ومختلف الشروحات الواردة فيها. لذا كان من الضروري الاعتماد على معاجم متخصصة في كل الحقول المعرفية المعتمدة (الجغرافيا، البيئة، الجيولوجيا، الجيومرفلوجيا، البيولوجيا، المناخ...) والبحث عن مقابل كل مفردة باللغة العربية. لكن كثيرا ما كنت أجدني عاجزا عن إيجاد ما يقابل المفردة بالعربية الفصحى بسبب عدم وجود أو عدم الاهتداء إلى المرادف المناسب، مما اضطرني أحيانا إلى وضع شروحات مبسطة مقابل المعنى الحقيقي للمفردة، دون المساس بجوهر معناها، متحاشيا الدخول في التفاصيل، وذلك من باب تسليط الضوء عليها وإبراز أوجه معانيها، خاصة أن بعض المفردات الحسانية لها عدة استعمالات.

وإذا كنا قد عانينا كثيرا من صعوبة توحيد المفاهيم والدلالات في الكثير من الكلام الحساني في الوقت الذي كنا فيه ميدانيا أمام سيل جارف من المفردات التي وجب تكييف شكلها حسب نمط تنفرد به عند الدلالة والتدقيق في مقابلاتها العربية، فإن غياب قواعد إملائية متبعة لكتابة هذه اللهجة لا يخلوا من كونه إحدى الإشكاليات الكبرى التي صادفناها في إنجاز هذا العمل، لذا فإننا التزمنا بكتابة الكلمات الحسانية كما تلفظ.

2. اللهجة الحسانية وتأثرها بالخصائص الجغرافية و البيئية

1.2. اللهجة الحسانية: مقاربة تاريخية و سوسيو جغرافية

في علم اللغة، اللهجة "هي مجموعة من الصفات اللغوية تنتمي إلى بيئة خاصة تعتبر جزءا من بيئة أوسع وأشمل تضم عدة لهجات تشترك جميعا في مجموعة من الصفات اللغوية والعادات الكلامية وهو ما اصطلح على تسميته لغة"(إبراهيم أنيس،2003، ص15)، و بالتالي فاللهجة هي شكل محلي للغة المشتركة، وهي أنعكاس لخصائص جغرافية وأثنية وتاريخية تشكل معاً شخصية مميزة لمجموعة بشرية.

و تعتبر الحسانية لهجة مشتقة من العربية التي كانت تتحدثها قبائل بني حسان المعقلية الذين سيطروا على أغلب صحاري موريتانيا وجنوب المغرب وجنوب غرب الجزائر بدءا من القرن 14 الميلادي(فعراس عبد العزيز، 2020، ص 99) وتوغلوا في مالي و النيجر(خريطة 01). فهي من أفصح اللهجات العربية، وذلك بحكم العزلة التي ظلت قبائل بني حسان العربية تعيش فيها في أعماق الصحراء الكبرى. فمادام الاستعمار الفرنسي والاسباني لم يعمر طويلا والدولة العثمانية لم تصل إلى المغرب و موريتانيا، فإن التأثيرات الخارجية قليلة في اللهجة العربية. وإذا استثنينا تعابير أمازيغية وأخرى افريقية فإن اللهجة الحسانية تعتبر من أقرب اللهجات المعاصرة إلى اللغة العربية الفصحى، وذلك رغم تواجد أكثر من نبرة نطق داخل اللهجة الحسانية لأن الفرق بينها هو كيفية النطق أي اللهيج.

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي. ص15.

تتميز اللهجة الحسانية بغناها المثير بالأنماط التعبيرية الشفاهية المتنوعة، ففي مجتمع الصحراء الذي تقل فيه الكتابة ووسائلها، تصبح التعابير الشفهية والصور اللغوية هي وسيلة التواصل الناقلة للتجارب والحافظة للذاكرة الشعبية. فهي تضم كما كبيرا من المفاهيم الأمثال والحكم التي تتميز بارتباطها بالإنسان والأرض، ونستطيع أن نتلمس نمط العيش والرؤى من خلال انعكاس البيئة الصحراوية الإجتماعية والطبيعية في ثناياها.

2.2. البيئة الصحراوية والانعكاس على البناء الجسدي واللغوي للإنسان الصحراوي:

معانقة الإنسان للبيئة ونحت الطبيعة للبنية النفسية والاجتماعية للإنسان، جدلية تاريخية وسوسيولوجية قديمة أخفق فيها الإنسان أحياناً واستطاع تشكيل ثنائية متجانسة و"رائعة" يحكمها الذهاب والإيّاب بين الطرفين في كثير من الأحيان، فالإنسان جزء من الطبيعة وطبيعته النفس-اجتماعية قابلة للتكيّف مع الطبيعة. وتحتل المجتمعات الصحراوية مواقع نموذجية في هذا الموضوع.

إن الصحراء القاحلة، والطقس الحار الجاف، وندرة المياه والموارد الطبيعية؛ عوامل دفعت البدو الحسانيين إلى الاعتماد على الإمكانات المتاحة لديهم أياً كانت للبقاء على قيد الحياة. وعلى الرغم من ذلك، فقد تميزت حياتهم بالبساطة وتعاملوا مع البيئة المحيطة بهم باحترام، حيث تفننوا في خلق استراتيجيات تتوخى اختراق الجغرافية (ناجيه،2016، ص2) .

فمجال الصحراء وتوابعه من نمط العيش المعتمد على شح الموارد له انعكاس إيجابي على البناء الجسماني والعقلي للمجموعات القبلية القاطنة في هذه المجالات، حيث يشير ابن خلدون في مقدمته المشهورة أن "هؤلاء الفاقدين للحبوب والأدم من أهل القفار أحسن في جسومهم وأخلاقهم من أهل التلول المنغمسين في العيش فألوانهم أصفى وأبدانهم أنقى وأشكالهم أتم وأحسن وأخلاقهم أبعد من الانحراف وأذهانهم أثقب في المعارف والإدراكات هذا تشهد له التجربة في كل جيل منهم" (ابن خلدون، 1992، ص87).

يتضح من خلال ما أورده ابن خلدون أن بدو الصحراء يمتلكون، بفعل ارتباطهم الوثيق بمجالهم الطبيعي ذي الخصائص المميزة، مجموعة من الخصائص الجسمية والذهنية التي تميزهم عن غيرهم، مما يكرس استمرارية هذه الخصائص عبر قافلة الحمل الثقافي بين الأجيال. فمجالهم الجغرافي الصحراوي يكسبهم ثقافة و سلوكات مجالية و بيئية تتراكم مع توالي الأجيال داخل المجتمعات القبلية.

إذن فالبدو الحسانيين تعلموا في مدرسة المجال الذي كانوا يعيشون فيه، فأكسبهم ثقافة ومهارات مكنتهم من إنتاج مفاهيم ومقولات وأفكار كبرى نابعة من فهم عميق لحساسية منظومتهم البيئية وإدراك كبير لمجالهم الجغرافي.

3. الثقافة المجالية عند الإنسان الصحراوي من خلال اللسان الحساني.

يقول نيتشة "لاتصدق أي فكرة لم تولد في الهواء الطلق أثناء التحرك بحرية"، فالأفكار الطازجة هي وحدها تلك التي تولد خارج حدود الجدران، حيث الأفق الممتد، وحيث الجسد يسير فتتدفق معه الأفكار في حيوية وانتعاش. الأفكار تنام في السكون وتنحشر في الأماكن الضيقة لكنها سرعان ما تنشط وتتحرر عندما تحركها القدمان في خلوات الطبيعة.

فالصحراء بخصوصيتها الطبيعية تكسب الإنسان شساعة المخيلة وبعد الرؤى وإدارة الوضعيات بشكل ملفت، فهو يتعمق في تفاصيل الأشياء، ليمتلك معرفة مجالية مدققة لمورفولوجية المكان، مما يستدعي القول بأن إنسان الصحراء يصل إلى مرحلة تجعل منه إنسانا مدركا لحساسية الوسط، ومبتكرا ومسهلا لتطوير الذاكرة المجالية عبر بوابة العمل الميداني والاحتكاك اليومي بالمجال، وهي المحصلة التي وصل إليها روبير كلارك Robert clark,1980, p23 في أبحاثه حول وجود الإنسان على وجه الأرض(ناجيه،2016، ص2). وعندما نستحضر العمل الميداني فإننا نورد مجموعة من الممارسات وأولها حركته الدؤوبة المسماة بالترحال المؤدية إلى ضبط المجالات وضبط المسالك من حيث وعورتها أو ملاءمتها، والتعامل مع جبرية المناخ من خلال وضع استراتيجيات للتحرك والتنقل في فترات معلومة ومدروسة بحثا عن الموارد المائية والكلأ.

1.3. قدرة بدو الصحراء على تحديد الاتجاهات

كانت القبائل الصحراوية دائمة الترحال، وغالبا ما تقطع مئات الكيلومترات في الصحراء دون أية وسيلة لتحديد الاتجاهات، فقد كانت تعتمد أكثر على وسيلتي الشمس والنجوم، فلم يكن البدو يستخدمون أية وسيلة لتحديد الاتجاهات باستثناء شروق الشمس وغروبها لتحديد جهتي الشرق والغرب، والنجوم لتحديد جهة الشمال. كما أسهمت منحدرات الكثبان الرملية التي تكونت بفعل الرياح السائدة في زيادة قدرة البدو على تحديد الاتجاهات.

وقد عرف عن البدو، أنهم كانوا خبراء في اقتفاء الأثر ويستطيعون التمييز بين آثار أقدام البشر والحيوانات على الرمال، وتحديد ما إذا كان هذا الأثر لرجل، أو طفل، أو امرأة، أو فتاة، أو أي نوع من الحيوانات.

شكل 1: أسماء الاتجاهات الجغرافية بالحسانية
المصدر : فعراس(2016) المعجم الحساني الجغرافي البيئي. ص61

«وبالفعل، فسكان الساحل في غرب الصحراء يطلقون على أنفسهم كذلك اسم " أوْلاَدْ لَمَزْنَ "، إذ السحابة المحملة بالماء هي " الأم" المحسنة للرحل الذين عليهم كذلك أن يتطلعوا إلى السماء، لأنهم يقتبسون منها مفاهيم مفيدة جدا لمعرفة الاتجاه في منظر ذي رتابة يضرب بها المثل... وذلك بهدف تحديد معايير الاتجاه الأساسية، فإنهم ينظرون إلى السماء. فالسماء الغائمة تدل على أمل المطر، بينما السماء الخالية من السحب ليلا تعني مرشدا لتحديد المكان الذي يوجد فيه الفرد بالضبط..." (كاروبروخا،2015 ص:103).

2.3. إدراك كبير للأشكال التضاريسية:

نجد أن اللهجة الحسانية تحمل تصنيفا تفصيليا لجميع المظاهر التضاريسية الصحراوية، ويكفي هنا أن نشير إلى أن اصطلاحات مثل: لَغْرَادْ، لَعْلاَبْ، اذْرَاغْ، عرْجْ، لعَكلَة، عْكَيْلَة، اذْرَيَّغْ، آشْوَيْرْ، البَطْحَة، اعْلَيْبْ، لعْظَمْ، اعَتْعَاتْ... كلها وصف للأشكال المرتبطة بالتراكمات الرملية (فعراس،2016، ص10)، غير أن الصحراوي يفهم منها معنى دقيقا من حيث الشكل والحجم وحتى المواد المكونة له أحيانا.

الأشكال المرتبطة بالهضاب والسهول (بالحسانية)

الشكل	المعنى
لَحْمَادَة	هضبة صحراوية جرداء تنتسب بنيتها الى " سانكلينال "تيندوف، وهي تغطي المجال الممتد بين وادي درعة ووادي الساقية الحمراء.
سهب	كلمة فصيحة: السهب، وهو عبارة عن سهل غريني يدل على تغطية وتراكم للمواد الدقيقة التي حملتها المياه من بعد. وهو بمثابة مجال منبسط يتميز بسيادة أعشاب قصيرة، كما انه مجال مناسب لنشاط رعي الماشية لكونه يخلو من الحصى. ومن أهمه سهب الحرشة.
الطَّرْحَة	الأرض المنبسطة.
اظَّهَرْ	الحافات النهائية للهضاب، حيث تظهر على شكل أجراف تطل منها الهضاب على الأراضي المنبسطة.
عرْجْ	عرق، وجمعه عروق، ومعناه : سطوح هضبية شاسعة مغطاة بالرمال. وهذا النوع من التشكيلات بالغ القدم في التكوين، ويغلب عليه التشكيل الرملي وتذرية الرياح.
الرَّج	رق، وهو مفرد رقوق، وهي سطوح هضبية مغطاة بالحصى التي مصدرها نزول عمودي للمواد بفعل تعرية انتقائية مصدرها السيل الغشائي أو تذرية الرياح.
آفْطُوطْ	مشتق من كلمة الفطط وتعني الانبساط، وافطوط هوعبارة عن ارض منبسطة تتخللها مستنقعات وسبخات وتربتها نسبيا صالحة للزراعة.
اظْلُوغْ	النجود: ما أَشرف من الأَرض وارتفع واستوى وصلب.
أسرفة	وهي أراض منبسطة مغطاة بالحصى تتخللها بعض الكثبان الرملية الصغيرة، ونباتات ليفية مشتتة إلى درجة يكاد ينعدم فيها الغطاء النباتي.
لمعادر	سهول غرينية تدل على تغطية وتراكم للمواد الدقيقة والادباق التي حملتها المياه من بعد. وهذه الميزة تكسبها غنى من حيث الأتربة التي يحصل استغلالها فلاحيا إثر تساقط الأمطار.
الْخَطْ	مكان منبسط يشغل مجال مسيل سطحي، أراضي صالحة للزراعة يكون شكلها طولي وعرضها يصل تقريبا 50 مترا.

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي.

الأشكال المرتبطة بالمرتفعات(بالحسانية)

الشكل	المعنى
آدْرَارْ (بترقيق الراء)	مصدره امازيغي ويعني المرتفع، وهو يطلق على مناطق هضبية في اقصى الجنوب بمنطقة تيرس مثلا ادرار صطف
آزْوَيْلِيقْ	قمة شاهقة يصعب صعودها، وغالبا تسبب في الانزلاقات
آنكَيم	المرتفع الرملي الكبير الذي يشرف على مجال واسع منبسط
بَانِي	الجبل والمرتفع الكبير
لَكْدِي	جمع كدية، وهي عبارة عن اراضي مرتفعة
كَـارَة	تل شاهد
كُوَيْرَة	تصغير لكلمة كَـارَة، وتعني تل شاهد صغير
سْطَيْلَة	يطلق على التلة التي قمتها مقببة
اسْطَيْلَات	تلال تتميز بقممها المقببة
اظْلُوعْ	النجود: ما أَشْرَفَ من الأَرضِ وارتَفَعَ واسْتَوَى وصَلُب، وفي ذلك تشبيه بضلوع الانسان أو الحيوان
الزَّمْلَة	تشبة في شكلها التل الصغير أو الربوة
كدية	ارض مرتفعة
ادْرَيْكَاتْ	ثلال شاهدة، ربوة ضيقة ومحدودة
الْعَكَبَة	حافة شديدة الانحدار
كَلْبْ (بتفخيم الكاف)	تل شاهد، يشبه في شكله القلب
لكْلَابْ (بتفخيم الكاف)	جمع كَلْبْ تلال شاهدة تشبه في شكلها القلب
كَلْيَبَاتْ	جمع تصغير لكَلْبْ وهو التل الشاهد الذي يشبه في شكله القلب

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي.

الاشكال المرتبطة بالتراكمات الرملية(بالحسانية)

المعنى	الشكل
نبْكَة	الكلمة الفصيحة المرادفة لها: النبخة، وهي أصغر تراكم رملي، يستغل وجود الحواجز كالنبات ليتطور خلفها بأحجام مختلفة
انْبَيْكة	تصغير لكلمة " نبكة" وهي النبخة الصغيرة
لَعْلاَبْ	جمع " علْبْ " ويعني: الارض المرتفعة، وغالبا تكون عبارة عن كثبان رملية مرتفعة ومتحركة
آشْوَيْرْ	الكثيب الرملي المنفرد
ابَانُوطَه	مشتقة من المصطلح العربي الفصيح "البثنة " وهي الأرض السهلة اللينة والرملة الناعمة التي تغوص فيها الارجل
ابَانُوطَه	مشتقة من المصطلح العربي الفصيح "البثنة " وهي الأرض السهلة اللينة والرملة الناعمة التي تغوص فيها الارجل
اعَثْعَاثْ	يقابله بالعربية الفصحى "البثنة " وهي الأرض السهلة اللينة والرملة الناعمة التي تغوص فيها الارجل
اثْرَابْ لْبَيْضَة	منطقة رملية
آنكْيم	المرتفع الرملي الكبير الذي يشرف على مجال واسع منبسط
الدَّهْسْ	أرض لينة تغوص فيها الاقدام
آزْكْيَّهْ	المرتفع الرملي الشاهق الذي يستعصي على الصعود
اذَّرَاعْ	الدراع الرملي، وهو عبارة عن كثبان رملية طولية وتراكمات رملية ممدودة بشكل طولي لمسافات طويلة كما هو الحال بالنسبة للدراع الرملي الكبير، الممر الرملي الموازي للساحل الذي ينطلق من شمال الطرفاية ويمر غرب مدينة العيون متوغلا في اقصى الجنوب
اذْرَيَّعْ	تصغير لكلمة "اذَّرَاعْ"، ويعني دراع رملي من حجم صغير
لعْظَمْ	عبارة عن ربوة، مرتفع رملي صغير تكسوه الحجارة
علْبْ	الارض المرتفعة، دراع رملي، وجمعها " لَعْلاَبْ"، ويعني كذلك عرق رملي غليظ ممتد الى مسافات بعيدة، وهو ثابت ومن اهمها: علب الكبش وعلب ام الدويات
البَطْحَة	الرمال
لَعْلاَبْ	جمع " علْبْ " ويعني: الارض المرتفعة، وغالبا تكون عبارة عن كثبان رملية مرتفعة ومتحركة
العطف	مرتفع رملي صغير تكسوه الحجارة
أُووزَّن	مرتفع رملي صغير تكسوه الحجارة
عرْكْ	عرق، وجمعه عروق، ومعناه: سطوح هضبية شاسعة مغطاة بالرمال. وهذا النوع من التشكيلات بالغ القدم في التكوين، ويغلب عليه التشكيل الرملي وتذرية الرياح.
لَغْرَادْ	جمع غرد، وهي عبارة عن تلال رملية وكثبان رملية في شكل نجمة، تنشأ نتيجة هبوب الرياح من اتجاهات مختلفة، وبالتالي فهي تصبح مصدرا للرمال التي تتكون منها الكثبان الهلالية والكثبان الطولية. ومن اهم هذه الانواع الغرد لحمر

المعنى	الشكل
اعْلَيْبْ	تصغير لكلمة علْبْ، وهو عبارة عن عرق رملي صغير الحجم
لعَكلَة	كثبان رملية متراكمة، كما تطلق الكلمة على المكان اللينة تربته خصوصا عندما يمتد على طول ازيد من 200 متر
عْكَيْلَة	تصغير لكلمة " لعَكلَة " وهي كثبان رملية متراكمة، كما تطلق الكلمة على المكان اللينة تربته خصوصا عندما يمتد على طول ازيد من 200 متر
أرَاكْنْ النَّيْرَبْ	كتلة من الترسبات الرملية الصلبة عالقة بجدوع الاشجار، تظهر كالهودج على ظهر الدابة
السَّافِي	ما تثيره الرياح من الاتربة والرمال

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي.

أشكال مرفولوجية مرتبطة بالأودية

الشكل	المعنى
لَخْنَاقْ (بتفخيم الخاء)	جمع خَنْكَة، مشتق من الخانق وهي شعب ضيقة في الجبل وفي سفوح الكدى بسبب تعمق الجريان
أكماد	شريط محادي للواد، وهو عبارة عن درجة أو مستوى مشرف على المجرى (كلمة متداولة بمنطقة وادنون)
أساكا	شريط محادي للواد، وهو عبارة عن درجة أو مستوى مشرف على المجرى (كلمة متداولة بمنطقة وادنون)
الفم	الجزء الاخير من الواد بعد اختراقه للمرتفع، ويطلق كذلك على مصب الواد
الحامول	جريان غشائي يعم سطحا منبسطا، ما لبث أن تحول إلى صفة السطح الطبوغرافي
لمعادر	سهول غرينية تدل على تغطية وتراكم للمواد الدقيقة والادباق التي حملتها المياه من بعد. وهذه الميزة تكسبها غنى من حيث الاتربة التي يحصل استغلالها فلاحيا إثر تساقط الامطار
آزْرِي الواد	جانب الواد وظفتيه
إجَرَانْ	جمع أجَارْ، وهو اخدود عميق يتركه السيل الجارف
أجَارْ	اخدود عميق يتركه السيل الجارف
فم الواد	مصب الواد، دلتا
الرَّكْبَة	الفج، مثلا نجد منطقة الرَّكْبَة بتغمرت بكليميم توجد في منبسط عبارة عن فتحة وفجوة بين مرتفعين، وذلك تشبيها بركبة الانسان.

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي.

3.3. المعرفة المجالية في البحث عن المياه زمن الترحال

يلعب الماء دورا مهما في حياة الإنسان مهما كانت طبيعة المكان الذي يقيم فيه ومهما كانت طبيعة هذه الإقامة، لكن المجال الصحراوي الذي تميزت ساكنته بخبرتها التاريخية في البحث عن المياه، في مجتمع بدوي يحمل الماء عنده معاني خاصة، لأن وجوده يعني إعطاءهم القدرة على تحمل ظروف الحياة القاسية في الصحراء، والإستقرار فيها، أما عدم وجوده فإنه يعني الترحال للبحث عنه.

-المؤشرات الميدانية

كان يسهل على الإنسان الصحراوي معرفة المناطق والأماكن التي كان يوجد فيها الماء عندما تهطل الأمطار، وعند إنعدامها يمكن أن يعثر على "عْكلة" أو "اخْليجْ" التي هي عبارة عن حفر أو آبار صغيرة تدعى محليا " اخْسَيَّات" تصل مترا ومترين تكون بالقرب من الأودية التي لم تجف بشكل نهائي، أو "تِلْمْسِي" وهي أقل عمقا وأصغر من العكلة(فعراس عبد العزيز، 2018، ص13). وقد يلجأ هذا الإنسان أحيانا الى مصب واد مغطى بالرمال، فيحفر بالقرب منه لأنه عادة ما يكون الماء تحت الرمل وتحت الصخور "الصْفي" ، وأحيانا أخرى يلج مكانا فيه صخور كبيرة مقعرة بها شَقوق يساعد شكلها على الحفاظ على الماء، لمدة طويلة، قد تصل ثلاثة أشهر أو أربعة.

-التجربة الفردية

من المعروف أن رجل الصحراء الذي يمتلك ثقافة مجالية واسعة، يعرف الوسط و وحداته الجغرافية أكثر من أي طبوغرافي، حيث يمكنه تحديد بدقة تشعبات وترشيحات الينابيع، والمياه التي تكون شبكات سطحية أو باطنية، ويستطيع كذلك أن يدرك المدى الذي تصله المياه في العمق بتتبع إندساسات الطبقة الكثيبة من الأرض، أو شم حفنة رمل، أو تذوق التراب بعد حفر الطبقة الظاهرة من الأرض، فحاسة الشم كانت تدل الباحث عن الماء على وجود تربة مبللة وعلى وجود الماء.

تقول إحدى المبحوثات باللهجة الحسانية"كان الصحراوي يْشْم نَبْع المَاء وْيَعْرَف عن ذاكْ لْبْلَد فيهْ الماء من خلال التْرَاب"(زهرة فعراس، 2015، ص: 92).كذلك كان الجمل يفعل، يشم رائحة الثرى ويدور على ذلك المكان ويضرب برجليه عليه، فيعي صاحبه أن بالمكان ماء فيبدأ بالحفر. إضافة إلى وجود تشكيلات نباتية تسمى محليا "الكرزيم" و"الطرفة" و"السْمَار" التي تنتشر عادة بالقرب من الوديان، فتكون دليل الباحث عن الماء.

4.3. اختيار موضع المسكن" الخيام "يعكس الذكاء الجغرافي للإنسان الصحراوي

ما من شك في أن الصحراء شكلت دوما تحديا صارخا للإنسان، بما تتضمنه تفاصيل الحياة اليومية فيها من تحديات جمة لعل أبرزها الطقس الذي لا يكاد يستقر عل حال، رغم ذلك فالإنسان الصحراوي استطاع قهر الصحراء وجعلها طوع أمره في حله وترحاله، ولعل ابرز العناصر التي ساهمت في تذليل الصعاب أمام هذا الإنسان الصحراوي شيئين اثنين :

الجمل والخيمة، فالجمل ظل يطوي المسافات غير آبه بالعطش والجوع ولا بتعاقب الليل والنهار، أما الخيمة فأضحت رديفة الاستقرار الذي يسعى إليه أهل الصحراء منذ الأزمنة الغابرة، و هي المسكن المتكيف مع قساوة البيئة الصحراوية و مع طبيعة النظام الاجتماعي، فرغم بساطة شكلها إلا أن نسجها ليس بالأمر الهين وهي تصنع في الغالب من شعر الماعز الذي يمنع تسرب المياه في الفترات الممطرة ، و يقي من حرارة الصيف القاسية.

وتتعدد أشكال وأنواع الخيمة لكن أبرزها تلك المصممة على شكل مثلث، وهذا التصميم ليس اعتباطيا فهو يقيها الاستسلام أمام الزوابع الرملية وهطول الأمطار، بيد أن السمة الأبرز للخيمة هي شكلها الانسيابي ومرونتها في الحل والترحال فقد لا يستغرق نصبها بضع دقائق، و يتم ذلك في الغالب بعيدا عن سافلة الوادي و مجراه. و لحماية الخيمة من خطر السيول الجارفة يتم إنشاء حواجز من التراب والحجر في الأماكن المواجهة لها، بل حتى في الحواشي الداخلية للخيام وهذه العملية يطلق عليها بالحسانية " إوني" من هنا جاءت المقولة الشعبية الحسانية «وني سابكَ ما جاك السيل».

أما واجهة الخيام فتختلف حسب المناطق الجغرافي، ففي بعض المناطق تكون في اتجاه الشمال «مكَافية» لأن الرياح «التلية» الآتية من الشمال تكون في الغالب ضعيفة، أما في بعض المناطق الاخرى فنجدها تتخذ اتجاه الجنوب «گبلة».

النبات و علاقته بتجمع و تشتت السكن " الخيام "

ففي فترات الجفاف الصعبة عادة ما يكون هناك ميول إلى انقسام مجموعات الرحل، فنجد المخيمات تنتشر، و أفرادا من العائلة نفسها يعيشون على بعد عشرات و عشرات الكيلومترات بعضهم عن بعض. وعلى العكس من ذلك، عندما يكون العشب وافرا فإن التكتلات تتجمع فتصير كبيرة.

توزيع موضع الماشية بعد رجوعها من المرعى في علاقة بالمسكن " الخيمة:

بعد رجوع الراعي بالماشية من المرعى، فإنه يموضعها على الشكل التالي:

- النوق الحلوب على مقربة من الخيمة.
- الى جانبها، و أبعد منها بقليل، النوق الحديثة الوضع.
- و ابعد منها أكثر، النوق الحوامل و الذكور المخصية.
- أ ما رؤوس الماعز فتبقى خلف الخيمة و إن كانت قريبة منها.
- تبقى خلف الخيمة كذلك و إن كان أبعد شيئا ما رؤوس الغنم، إذ هي معروفة أكثر عن الماعز بذعرها.
- في حين أن صغار الماعز و الشياه تبقى مربوطة.

وتربط رؤوس الشياه عادة من أرجلها لأنها تمارس قوة كبيرة، أما الماعز فتربط من رأسها. أذا كان عددها قليلا، فإنها تربط في مدخل الخيمة و ذلك بواسطة حبل به عقد تدعى " ربح". أما إن كانت هناك خيمتان في آن واحد، إحداهما للأب و الأخرى للابن، فإن الجمال تربط إلى جانب خيمة الأب، بينما تربط الماعز إلى جانب خيمة الإبن" (كاروبروخا 2015 ص: 146) .

5.3. قياس المسافات عند اهل الصحراء

إن البدو لا يتقيدون بحدود جغرافية، فحيثما يوجد الماء والكلأ يشدون الرحال الية في قوافل جماعية أو فردية. ووسيلة النقل لديهم سفينة الصحراء الأبل.

في هذه الرحلات يكابدون الكثير من المصاعب والمتاعب، لأنهم أحياناً يقطعون مسافات بعيدة مشياً على الأقدام. تحمل الأمتعة الأثقال والناس القصر على ظهور الأبل، وتكون بداية الرحيل أو الظعن وقت الصباح، والملتقى بين أفراد الأسرة الواحدة وقت المبيت في مكان ضرب موعده سابقاً. وهكذا يكون تخطيط سير الرحلة حتى يصلوا المكان المقرر للسكن، وفيه يضعون رحالهم به لفترة تطول أو تقصر غير محددة بمدة زمنية معلومة. وهكذا تستمر حياتهم في تنقل وترحال دائمين، كما وأنهم ينتقلون في فصل الشتاء إلى الأماكن التي تتوفر بها الأشجار بكثرة وقاية وحماية لهم ولحيواناتهم من نزلات البرد الشديد وتقلبات الرياح القارسة. أما في فصل الصيف فيرحلون إلى الأماكن التي يتواجد فيها الظل والماء. ويسافر البعض الآخر في الصحراء للقيام برعي الماشية والأبل.

قياس المسافات عند اهل الصحراء

قياس المسافات الطويلة	مَرْوَحْ	وحدة قياس المسافات الطويلة اعتمادا على المسافة التي يقطعها جمل عادي في يوم كامل منذ أن يصبح الصباح إلى أن يسدل الليل ستاره، وقد تبلغ هذه المسافة 40 كلمترا. فحسب مقابلة اجراها خوليو كاروبروخا مع سيدي محمد البشير فإن هذا الاخير يصرح انه تنقل من افني الى الطرفاية على متن جمله بخطى عادية، واستمرت هذه الرحلة التي غطت 300 كيلومترا 12 يوما.
	مُكِيلْ	المسافة التي يمكن ان يقطعها جمل في نصف يوم اعتمادا على المشي العادي دون هرولة.
	مُكِيلْ لْحَامِي	مسافة أصعب واطول من مسافة " مُكِيلْ "
	مَسْتَدْبِي	مسافة اطول ترغم المتنقل على الانطلاق بعد منتصف النهار للاستفادة من ساعات الليل للتقدم في اراضي ساخنة الجو ولتفادي قطاع الطرق. فيتم المبيت في منتصف الطريق، على اساس الانطلاق في الصباح الباكر.
قياس المسافات القصيرة	شَوْفَتْ إبِلْ	المسافة التي يمكن أن يرى فيها الانسان جملا عن بعد في الصحراء بوضوح، وقد تصل كيلومترين.
	شَوْفَتْ أغْنَمْ	المسافة التي يمكن أن يرى فيها الانسان رأس ماعز عن بعد في الصحراء بوضوح، وقد تصل كيلومترا واحدا.
	جَبْدَه	ما نقطعه من مسافة في ثلثي اليوم
	الشَّدْحَة	الخطوة التي تعادل متر، وهي وحدة لقياس المسافات.

المصدر: فعراس(2016) المعجم الحساني، الجغرافي البيئي.

خاتمة:

يظهر مما سبق أن المعجم الحسانية يحمل تراثا ثقافيا غنيا ومعارف تقليدية مبدعة اكتسبها الانسان الصحراوي من مدرسة المجال وعبر الاحتكاك اليومي بالوسط الطبيعي الجد حساس الذي يعتبر المصدر الرئيسي لهذه المعارف الجغرافية البيئية، وعبرها استطاع أن يكتسب قدرة عالية في التكيف والتأقلم مع الظروف البيئية القاسية ويمتلك مستويات رفيعة في الإدراك المجالي الذي سيوجه سلوكه البيئي والجغرافي ليتناغم مع طبيعة الوسط الجغرافي.

ويبدو أنه من المؤسف في مصير اللهجة الحسانية، وهي التي حملت هذا الموروث الثقافي البيئي الجغرافي المبدع الممتد لمئات السنين، أنها لهجة شفاهية قلما تكتب، مما يعني أن الموروث المنقول عبرها معرض للزوال بزوال حامليه حيث أصبح التواصل بين الأجيال أقل مما كان عليه. مما يدفع إلى التفكير الجاد في ضرورة تسجيل هذا التراث الحساني الثقافي المعجمي وتوثيقه قبل أن نتحسر على ضياعه.

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- Robert clark(1980), Naisssance de l’homme, édition du seuil .

276 Repositioning Environmental Education Organizations' Approach to Environmental Disasters

Abstract

Promoting cultural values and diversity can support sustainable solutions that help societies mitigate and adapt to environmental challenges. Traditional knowledge is not only limited to addressing today's catastrophes but also provides a context-informed approach to conserving resources. Indigenous knowledge (IK) is a collection of skills, beliefs, and practices passed down from generation to generation within a community through storytelling, dance, and cultural practices. Utilization of IK is sustainable because it facilitates inter-generational links informed by the lived conditions of a community.

Organizations working on environmental education should create an avenue for communities to identify and share the IK they have acquired through direct contact with the environment. Compared to what they are recognized for, the rural communities have more power, networks, and knowledge systems, including adaptive skills, as they have relied on traditional ecological knowledge to adapt and prepare for environmental changes for centuries. Environmental education organizations must recognize that the current pace of environmental and social change necessitates diverse and innovative thought processes.

The preservation and passing down of indigenous values and knowledge have undergone challenges, ranging from colonialism to exploitation. One of colonialism's targets was education; through expansionist policies, colonists destroyed the validity of indigenous cultures and values and replaced them with modernity, undermining traditional ways of knowing and understanding the environment. Non-western knowledge was labelled as unscientific and superstitious information devoid of logic and technicality. This viewpoint, supported in part by the writings of anthropologists, led to the devaluation of traditional knowledge.

Appreciating diverse cultural values is critical for understanding and addressing our complex 21st century planetary challenges, as no one solution will address all challenges. Indigenous knowledge is not a new approach to dealing with environmental disasters; instead, it offers a wealth of naturally sustainable traditional practices, techniques, and wisdom. Tapping into IK can contribute to providing a comprehensive understanding of current challenges and opportunities by encompassing social, cultural, and spiritual aspects.

Introduction

The task of this conceptual paper is to contribute to the ongoing discourse on repositioning Environmental Education Organizations' (EEOs) approach to environmental disasters by suggesting the integration of indigenous knowledge (IK) into the sector. The study explores the assumption that Western EEOs fear that integrating IK will require a total redesign of their present programs. Therefore, Western scientists marginalize IK instead of incorporating it as a complementary strategy to reduce environmental disasters. The assumption originates from the fact that colonialists once disparaged and viewed IK as unscientific and superstitious (ICIMOD, 2007).

Some scholars believe that an exploration of the conceptual structure of IK will reveal that IK is static and unchanging (Ogungbure, 2013). In this paper, we reject such a view by using practical examples of indigenous knowledge being dynamic and adaptive in addressing environmental disasters. Indigenous knowledge systems are closely entwined with their environments and lands, evolving over time to accommodate changes. They are embodied knowledge that evolves and changes based on observations and experiences with the natural environment. Hence, the assumptions of IK being static perpetuate the marginalization of indigenous perspectives and hinder the development of comprehensive, culturally-informed disaster management strategies that could benefit from both indigenous and Western scientific knowledge.

The side-lining of IK in informing disaster preparedness strategies has had a great human and capital cost. Over the past 50 years, an average of 115

people has been killed and $220 million in daily losses due to environmental disasters (UNFCCC, 2023). The risk of environmental catastrophes remains high, and vulnerability to people and property increases due to marginalization in government and scientific efforts to integrate IK into global EEO programs (Shaw, 2008).

Conceptual Questions

- The study was guided by the following questions:
- Why should EEOs be repositioned with IK?
- How can EEOs be repositioned with IK?

Methodology

This is a conceptual paper on the integration of IK in EEO programs and what purpose it serves for addressing environmental disasters and enhancing sustainable development. The study utilized inductive reasoning to conduct a systematic search across academic databases, focusing on peer-reviewed articles using relevant keywords like "Indigenous knowledge integration with Western environmental science" and "Why should environmental knowledge be repositioned?" "Local knowledge as a tool for change," "Indigenous and local knowledge in environmental management," and "Cultural and spiritual values of indigenous people."

Conceptual Context

The uncertainty surrounding the impacts of the Anthropocene and climate change is significantly shaping how EEOs respond to environmental crises. The Intergovernmental Panel on Climate Change (IPCC) reports that with just 1.1°C of global warming, climate change is causing widespread disruptions (Levin *et al.*, 2022). In response, Western science has offered vital data and insights into addressing its impacts. The Western science dichotomy includes knowledge that was derived through formal research or educational settings (Weaver, 2023). It has been institutionalized for policies and research institutions because of how it is studied, but Western science is insufficient on its own. Examining bottom-up strategies impacted by IK is recommended. The past failure of EEOs' climate change programs shows that Western concepts and techniques may not always align with the cultural context of many nations, necessitating the use of contextual traditional knowledge in environmental education (Nawrotzki, R. J., & Kadatska, P., 2010). As the World Meteorological Organization (WMO) Secretary-General, Prof. Celeste Saulo recently tweeted, "The developing and least developed world has enormous capacities and opportunities to lead in climate change" (World Meteorological Organization, n.d.). Disaster-affected individuals from developed and developing countries play a crucial role in disaster preparedness and mitigation, yet their knowledge is often overlooked by international environmental agencies and national governments. These failed interventions from EEOs underscore the need to promote insights from developing countries for climate change management and adaptation.

"The developing and least developed world has enormous capacities and opportunities to lead in climate change." Prof. Celeste Saulo, World Meteorological Organization (WMO) Secretary-General.

Indigenous ecological knowledge was formed by societies through long histories of interaction with their natural surroundings. It is defined as a collection of ecological skills, beliefs, and practices passed down from generation to generation within a community through storytelling, dance, and cultural practices (United Nations, 2019). IK, or traditional knowledge, and local knowledge are defined based on two assumptions: how knowledge is mobilized and its relationship with Western science (Whyte, 2013). The knowledge system is a crucial resource that provides cultural resources and essential building blocks for problem-solving and solutions. It is wholly influenced by lived experiences and has continuously evolved through local problem-solving techniques. Traditional epistemologies have thrived despite the colonial onslaught of Western imperialism. The devastation of colonialism has shaped the shared, but different, experiences of indigenous people. From the natural environment that enabled collective wellbeing to the cultural ecological knowledge, colonialism has disrupted and fragmented the ways of dealing with environmental issues. As Edward (1989) stated from his observation, Western-controlled research

used by EEOs perpetuates imbalances and hinders local knowledge advancement, hindering progress towards global development (Weaver, 2023). The primary limitation of IK advancement in colonial regions was the absence of specific theory-building procedures and infrastructure. Ill-informed strategies and interventions in climate-related areas have exacerbated communities' vulnerabilities to climate change impacts, especially in developing countries.

Western science is characterized by analytical and reductionist methods, contrasting with traditional knowledge's holistic approach. It is positivist, objective, and quantitative, unlike traditional knowledge's subjective and qualitative nature (Mazzocchi, 2006). People's worldviews can significantly influence their interpretation of individual knowledge systems. Despite using different approaches, both IK and Western EEO strategies are grounded in empirical observation and experimentation (Weaver, 2023). Both knowledge systems are influenced by the context in which they were acquired, making it crucial to recognize these harmonies for bridging the gap and promoting holistic climate change solutions.

Why should EEOs be Repositioned with IK?

Cultural diversity is crucial for fostering social resilience and sustainable development. Leveraging diverse knowledge systems can facilitate sustainable programs at local and global scales, making sustainability a pan-human endeavour and moving beyond a Western science-program interface. Integrating IK into disaster management approaches is crucial for promoting sustainability and enhancing resilience against climate change challenges. It creates an avenue for local people to address present environmental issues using their traditional methods. Indigenous knowledge complements Western scientific methods by offering unique perspectives and strategies. For example, during the December 2004 tsunami that hit the Indian Ocean, over 200,000 people lost their lives. However, the Moken people of the Surin Islands in Thailand, utilizing their indigenous ecological knowledge, predicted the ocean's unusual retreat from the island shore, interpreting it as a warning to evacuate their village despite never having encountered a tsunami before. Although their village was destroyed by the tsunami, no lives were lost (UNESCO, 2015). Their local insights into environmental disasters, in combination with national intervention, prevented life casualties. This shows that rural communities have primary contextual insights in responding to climate change impacts.

How can EEOs be Repositioned with IK?

Different cultures have developed traditional mechanisms to address environmental issues. These traditions make up an important part of their identity and shape their interaction with the outside world. Acknowledging and respecting this integral part of their belief system can establish an avenue for partnership in managing climate change impacts. Leveraging dialogues can foster partnership and establish a platform for mutual understanding where perspectives can be valued and ideas can be generated to solve pressing climate change issues. A dialogue can foster the creation of sustainability concepts, which are crucial for fostering societal cohabitation among individuals and social groups. For example, during the Anishinaabe First Nations land management and planning process, the knowledge keepers of Pimachiowin Aki First Nations collaborated with scientists through dialogue to integrate their knowledge into traditional area plans. These dialogues ensured that the community's voice was heard and documented, fostering a deeper understanding between the two groups (Panorama, n.d.). The world is not static; hence, dialogues for integration can take place to incorporate the unknown and otherness (Mazzocchi, 2006). Exploring the reality of where knowledge is developed can aid in integrating IK to solve intricate environmental issues.

Integration Approaches

Knowledge integration, from the perspective of epistemological pluralism, acknowledges and accommodates various ways of knowing in climate change adaptation programs. The 2030 Sustainable Development Goals (SDGs) provide an avenue

to integrate indigenous and local knowledge into climate change disaster management programs (United Nations, 2023). The agenda aims to foster collaboration, ensuring that no one is left behind. There are various approaches to integrating IK and EEO's Western science since they are both context-centered.

- For local, national, and international environmental disaster management strategies, community-based monitoring and information systems (CBMIS) are essential. They offer both quantitative and qualitative information about local conditions. As a result, socialization, the creation and sharing of knowledge, and data and information accessibility are promoted (UNESCO, 2016).
- Young people should be supported in collaborating with indigenous and local knowledge holders and Western disaster experts through dialogues and educational initiatives.
- Foster self-governance and autonomy to boost the validity of IK amongst local people. Such an approach can empower traditional people to maintain control of their wisdom and cultural practices. The participatory approach fosters openness and avenues for knowledge sharing and integration by strengthening the bond between the governed and governing bodies (Local Self-Government: Powers, Roles | StudySmarter, n.d.). This enhances Indigenous peoples' chances to assert their rights.
- Promote knowledge co-production as a collaborative partnership between Western scientists and Indigenous people. Knowledge co-production utilizes a more interactive arrangement and follows the principles of pluralism and context dependency for knowledge co-production (Weaver, 2023).

Tengo *et al.* (2017) present a framework for knowledge co-production based on two examples: the Plan of Action on Customary Sustainable Use of Biodiversity under the Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) thematic assessment of pollinators, pollination, and food production. This integration framework involves five distinct and important steps.

- Mobilization: articulating shared knowledge.
- Translation: facilitating mutual understanding of shared knowledge.
- Negotiation: assessing convergence, divergence, and conflicts across knowledge contributions.
- Synthesis: shaping common knowledge that maintains each system's integrity.
- Apply: usable knowledge to inform decision-making for all actors at different scales.

It is crucial to participate meaningfully at every stage of integration. The integration of IK into Western scientific knowledge may face challenges due to the lower scientific culture of developing nations, emphasizing the need for building on trust and respect as further integration measures are explored.

Concluding Insights and Implications

Despite the study's assumption, it is critical to understand that integrating IK can improve present disaster management strategies rather than necessitating a complete change. Western scientific knowledge is a dominant force in developed societies, but it is important that EEOs integrate other valid knowledge systems that exist. Even in the midst of advanced technologies and abundant data, the risks and vulnerability of environmental disasters are increasing. Environmental disasters continue to overwhelm current response capabilities.

Addressing these disaster issues and strengthening resilience requires the integration of a multi-faceted approach involving IK. To ensure equitable and empowering knowledge-sharing processes, it is crucial to focus on collaborative design and delivery, involving trust-building and mutual understanding of shared environmental challenges, to avoid harm to vulnerable communities. Traditional people from the multi-hazard context have low-cost disaster prevention measures; hence, EEOs have to create an avenue for reconceptualization. A bottom-up approach using local practices as a base for EEOs' programs is urgently needed.

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447 Naming Our Forest: Cultural Preservation in Environmental Communication

"We are grateful for your dedication to this project; fortunately, it was entrusted to you." This sentiment, expressed by an indigenous partner, affirmed our belief that with heartfelt effort, we can not only complete tasks but excel at them.

The authority for forest management in Taiwan lies under the Forestry and Nature Conservation Agency, entities classify forest types based on their functions and establish laws for management. However, management still faces challenges. One of the main issues is that the public doesn't fully grasp the importance of protection forests. People, driven by development needs, often request management relaxation through their representatives.

To address this, the Chiayi Branch of FNC. Agency collaborated with B Cop. FriendlySeed to reach the public through environmental education and communication, helping them understand and acknowledge the significance of protected forests. Naming the forests is one way to communicate the importance of protection forests and bridge the gap between the public and the forest.

The Story Begins Like This...

For several years, B Cop. FriendlySeed have been collaborating with the Chiayi Branch of the Forestry Bureau to promote the public-private partnership in managing protection forests. Our cooperation spans a wide range, including assisting with overall strategic planning, promoting education and advocacy for protection forests, deepening local communication, and establishing corporate collaboration channels. One interesting task was naming the protection forests.

Protection forests have been established since the Japanese colonial period to enhance the safety of residents and public facilities, protect specific water sources, and preserve ecological environments. In the past, these forests were managed by numbered codes for convenience, which created a sense of detachment among the public. To enhance public understanding and recognition of the value of protection forests, the Forestry Bureau began collaborating with nearby communities to name these forests, receiving positive feedback.

This year, B Cop. FriendlySeed work team were assigned the task of naming Protection Forest No. 1915 near the Saviki Tribe in Alishan. We felt a bit nervous because past experiences taught us that there are significant cultural and cognitive differences between Han people and indigenous partners. We had to carefully consider every detail, engaging in extensive dialogues to minimize potential misunderstandings due to cultural differences.

"Respect"

"Respect" is the core spirit of our work. Naming a forest might seem like a good marketing opportunity, where we could promote it through online voting and encourage participation with a lottery. This approach would not only complete the task but also help promote the concept of protection forests for the Chiayi Branch, killing two birds with one stone.

But we couldn't Do It This Way

To the public, a protection forest might be just a "forest of importance," without a clear idea of its location or stories. However, for residents, this forest could be a childhood companion, a source of cooking fuel, a place to find food, or an ancestral homeland. It holds deep survival and emotional ties with the residents, and thus, only those who truly live there should name it.

After discussions with the Chiayi Branch, we contacted the village chief of the Saviki Tribe and made a special trip to explain our hope that the tribal residents could name the protection forest. The chief agreed and arranged for us to meet with tribal elders and experienced hunters. We initially thought there might be several names for the different mountain areas of the forest. From a data collection perspective, we would gather these names and hold a community meeting for residents to vote on the most representative name.

However, the development was completely different from our expectations...

"Communication"

During our second visit to the tribe, the former chief, now a township representative, arranged for six tribal elders and experienced hunters to meet us, including the chair of the tribal council. Through discussions, we learned that this protection forest was their hunting ground, and they had specific names for each area. Thankfully, one team member was proficient in Google Earth. We marked the overall forest area, and the elders and hunters pointed out the names of various areas, with translations provided by the township representative and community development association members.

In addition to naming each area, the elders shared many interesting stories, such as someone being chased by a wild boar on a certain slope, a forest filled with a plant " Common Aspidistra," a stream with many shrimp, and ancestral homes in specific areas.

We spent the morning drawing and recording most of the protection forest's area names and listening to fascinating forest stories. Some places were so old that even the elders had forgotten their names, prompting one elder to call his 90-year-old uncle for confirmation.

After recording the information, the community development association members expressed how valuable these records were, containing places they had only heard of but never visited. We shared the complete records with them and taught them how to use Google Earth, enabling them to update the data and help preserve and pass on their culture.

The tribal elders then told us that no further community meeting was needed for voting. The chair of the tribal council was highly respected and could decide the forest's name. He decided on " Danaiku (Valley of Forgetfulness) Protection Forest."

Just when we thought we had accomplished the task, the tribal council chair earnestly proposed that Forest No. 1915 was not only used by the Saviki Tribe but also by the neighboring Lijia Tribe. The Saviki Tribe could name only the side of the forest near their village, and he hoped we could communicate with the Chiayi Branch to include the Lijia Tribe in the naming process, resulting in two names for the forest.

"Recognition"

Introduced by the Saviki Tribe, we hurried over the mountains to visit the Lijia Tribe's village chief. After understanding the project, he enthusiastically took on the task of communicating with the tribal elders. After their discussions, they proposed naming the forest " C'oc'osʉ Protection Forest (Land of Camphor Trees)." They also agreed with the Saviki Tribe's idea that each tribe could name the side of the forest near their village, and asked for our help in communicating with the Chiayi Branch.

The Chiayi Branch, after understanding the situation, agreed with the tribes' proposal and brought the matter to the Tsou Resource Co-management Meeting. Eventually, in the presence of all the tribes, it was decided that Protection Forest No. 1915 would be named "Dana'i Valley Protection Forest" and " C'oc'osʉ Protection Forest," becoming the first protection forest in Taiwan with two names. This handling of the matter, truly respecting indigenous culture, also gained recognition from the Forestry Bureau.

Every detail in environmental education reflects the environmental and worldviews of its practitioners. The B Corp, FriendlySeeds team members meticulously consider each task, analyze the stakeholders and subsequent impacts, and engage in extensive communication. This is because the scope of environmental education influences respect, communication, and overall recognition among all units and individuals in every aspect.

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Knowledge from Below in the Venetian Lagoon: Traditional Indigenous Knowledge on Water Environments as Innovative Sustainable Solution to the Challenges of Modernity

Rita Vianello (1)

Abstract

In the European Western vision, aquatic spaces are perceived as extraneous to humans and mostly dangerous. However, water environments are special, rich spaces necessitating peculiar knowledge to be profitably habitable by humans. Among the many complex human-environment-nature entanglements, in Upper Adriatic Sea, local fishermen perceive water as domestic areas and have developed special knowledge "from below" that brings attention to waters and seabed. The paper intends to investigate if and how the improvement of the Knowledge from Below can contribute to developing sustainable solutions in fishing sector.

Full Paper

1. Water Perceptions

This paper is based on anthropological research with Upper Adriatic Sea fishing communities, especially from lagoons. By bringing the voices to local communities and fishermen, the focus of the essay is to underline the value of "knowledge from below" as a possible solution to the sustainable management of delicate water ecosystems.

The specific case of the research work on the water dimension and traditional ecological knowledge in the Venetian Lagoon can be read as an example of auto-ethnography. I was born in Venice, and my experience of scholarship itself becomes an object and part of the analysis in which my individual engagement with the specific local socio-cultural and political context is analyzed. It is an approach to research and writing that seeks to describe and systematically analyze personal experience to understand cultural experience. As a method, autoethnography is both process and product at the same time. Moreover, I speak the local dialect, and as a Venetian, it is easier to be accepted by fishermen, even if initially they find it strange that a scholar is interested in their knowledge. In this way, I discovered a rich world of parallel knowledge no less complex than the official one.

In the European Western vision, the aquatic space is generally perceived as a flat and homogeneous surface extraneous to humans and mostly dangerous. Blue spaces have often been perceived by humans as foreign and dangerous terra nullius (or rather, aqua nullius) in which the mainland legitimizes its sovereignty over the sea. This awe is strongly felt when water assumes its most violent dimension, transforming itself into catastrophic floods (Galtarossa and Genovese, 2016; Hidiroglou, 2007). Inside this cultural and historical perception, our relationship with water has suffered from a vision that we can define as 'terracentric'. Aquatic spaces are ultimately the 'other' space par excellence (Vianello 2023, 126). As Mathur and da Cunha (2014) report, people are inclined to experience water on the other side of a line that allegedly separates it from land. However, maritime and fishing communities teach us new approaches. Local people, and primarily fishermen, contest the mainstream approach to reefs. They teach us that water environments are special spaces necessitating peculiar adaptive knowledge to be profitably habitable by humans. Among the many complex human-environment-nature entanglements (Inglold 2015), in aquatic places, local people developed a great variety of types of fishing techniques, special tools for sailing, and specific knowledge that creates domestication processes. Fishermen perceive water spaces as extensions of their inhabited mainland and

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bridges between dry lands. Water takes on the dimension of a well-known domestic place. In fact, fishermen know water spaces through detailed three-dimensional mental maps, which include in-depth knowledge of what lies beneath the surface. The acquisition of knowledge takes place thanks to a network of interactions built with the aquatic environment: the human components and the non-human ones that coexist in the water. It is the "knowledge from below". This term wants to highlight the literal knowledge of the experiences, observations, and mental maps created by fishermen of the seabed and reefs with their non-human components. However, it must also be understood metaphorically because today it is important to value a form of knowledge that has historically been marginalized by modern science.

It is a kind of knowledge that mostly derives from the individual experience accumulated during the practice and repetition of work. This knowledge is usually seen as 'traditional', i.e. as something that always repeats itself in the same way. Anthropological studies have found that tradition is not something which is immutable over time. Actually, even tradition changes, undergoing small adaptations and contaminations. However, in the past, innovations within tradition manifested themselves slowly. In the past, such innovations were a long process, and this made them difficult to observe and detect, but they existed (Dei 2018). Today, the evolution within tradition is becoming faster because of the challenges of modernity. The fixed point is that traditional knowledge is unique because it is related to a peculiar environment. Traditional knowledge is always 'local' knowledge. Unfortunately, this great treasure, which has allowed a territory to be exploited in a sustainable way for centuries, has been generally ignored by institutional science.

Today, the gap concerning local knowledge on water is starting to be filled thanks to recent theoretical debates. One of these is the hydrophilic turn developed by the geography of health. It critically examines the relationships between water, health, and well-being. In contrast to the widespread hydrophobic vision, the focus of hydrophilia is on the aspects of water which are simultaneously effective, life-enhancing, and health-enabling (Foley *et al.*, 2019). The new term hydrophilia emphasizes the attraction of aquatic environments for humans as compared to other environments without the presence of visible water surfaces (Vallerani 2019, p. 59). In light of recent literature, Philip Hayward has proposed the new socio-cultural concept of aquapelago where water is seen as an element that unites communities and cultures (2012). As Krause reports, it is time to correct a vision stimulated by a 'terrestrial angle' widespread in our cultures because a water or terrestrial point of view shifts people's points of reference around. To correct our terrestrial angle, he suggests the concept of hydro-perspectivism, that is when we look at terrestrial life from a watery point of view (Krause 2019, 93-101). It is time to become aware that water is not an alien element, but it is part of our wide and extremely complex Earth ecosystem. And the fishermen's holistic vision that I call 'knowledge from below' can help us to rectify our terrestrial angle.

2. Indigenous Water Knowledge

Within the persistent reductive vision of water spaces, lagoons are generally neglected. The concept of 'aquatic space' is polysemic, and its interpretation is often elusive due to the problematic dimension of water for humans. Lagoons, in particular, are still poorly studied places because they are often assimilated with marine environments (Vianello 2023). Despite this, they are easily distinguished thanks to their own geomorphological characteristics and to the fact that unique cultural expressions have developed over time. Lagoons can be interpreted as a socio-natural hybrid systems because they are the result of complex environmental processes involving a variety of human and non-human actions (Cavallo, Vallerani & Visentin, 2021).

There are numerous lagoons in the rich system of rivers, deltas, and estuaries that characterize the coastal strips of the regions of Veneto and Friuli, in north-eastern Italy. In these water areas, inhabitants obtained food mainly through fishing. There is no legal or customary ownership for access to the aquatic territory and only the practice of fishing makes it possible to acquire a right of use, which in turn can only be exercised if one possesses the

necessary knowledge. Fishing can be defined as a form of domestication that allows communities to prove their own special knowledge and skills. These special skills are very refined as the water environment is not visually tangible. Fishing is a form of domestication that allows communities their own special skill sets, which are productive, cultural, and social at the same time. Fishing is a set of resource acquisition practices, similar to hunting but more refined, as the marine environment, with its seabed and the plant life and animal species is not visually perceptible (Hewes 1948). Compared to terrestrial game, fish do not leave recognizable traces on the surface of the sea. To identify its presence, fishermen need to turn to a whole set of signs and knowledge belonging exclusively to the aquatic world. For these reasons, fishermen in the Upper Adriatic lagoons have developed a complex set of technical and naturalistic knowledge over the years, especially concerning the morphology of the submerged territory, that is of exclusive local and aquatic relevance. In order to practice fishing, special means of transport, specific equipment, and, above all, particular knowledge are necessary. Knowing where the fish are found, when they are found, and how to catch them becomes a fundamental factor for successful fishing. Meteorological knowledge is also important to understand the behavior of fish in relation to variations in weather, while environmental knowledge regarding the morphology of the marine territory is particularly useful for identifying and recognizing the habitats of the species being captured (Vianello 2018). Furthermore, they also have their own relevance for orientation purposes. In the past, before the introduction of modern technologies, in-depth knowledge of morphology appears to have been one of the most important elements for a fisherman to be able to orient himself among uniform water spaces. The peculiar fluidity and uniformity of water make it difficult to find points of reference. In addition, lagoons are a very particular environment as they are subject to the alternation of tides, which transform the landscape from a uniform body of water to a maze of tortuous canals winding through extensive dry areas.

The unpredictable nature of catches has made the knowledge of fish essential. Knowledge of fish is wide and regards notably their appearance, in order to be able to identify them among many, information on their reproduction, seasonal migrations, habitat, and the foods they prefer. Once fishermen have acquired these skills, they are combined with environmental and morphological knowledge. That means fishermen are able to reach and recognize the favorite habitat of a particular species. Knowledge is related to local language too. Fish and water places need given names that are not always translatable. Naming aquatic places also helps the domestication process of the territory. For example, in the Venetian lagoon, it is common to hear fishermen talk about baréne, a type of islet which is only submerged during the highest tides; vèlme, areas that emerge during accentuated low tides; and ghèbi, very small canals. Sometimes fishermen make interesting strings of conceptual associations in words and images using the human body in reference to the lagoon's denomination. The lagoon as a whole is also identified by fishermen as 'the uterus of the sea' when they wish to highlight that it is the privileged reproductive area of many aquatic species (Vianello 2023). Another example is about the lagoon's canals. The seabed of the lagoon is crossed by a complex network of canals that start from the three inlets that connect the waters of the sea with those of the lagoon. As the channels move towards the more internal areas, their width and depth become less and less accentuated. Fishermen equate this network of channels with the venous system of the human body which allows blood to pass from large arteries down to the smallest capillaries. This confirms what has been reported by Strang (2004) in her study on water. She writes that humans share the same models as cognitive starting points that occur in every sphere of experience, including the aquatic sphere.

3 . Indigenous Local Knowledge and New Technologies

In the Venetian lagoon, it is possible to observe the indigenous local in-depth knowledge of water, particularly regarding flood problems. In Venice, while scientists debate the causes of the recent increase in floods, fishermen provide their explanations. They connect human interventions in the environment with the exceptional tide phenomenon. Fishermen have experienced the serious consequences of the excavation of the

Petroli Canal in 1969. The Petroli Canal is an artificial channel, 15 metres deep, that was dug to allow oil tankers to reach the Marghera petrochemical refineries directly through the Malamocco inlet. Fishermen remember how the new canal raised the average water level throughout the southern lagoon. The excavation of the canal made it impossible to practice some local fishing techniques that, therefore, have been definitively abandoned. For example, the increase in the water level submerged purse seine nets completely, even during low tide, making it no longer possible to catch fish with them. For local communities, this example offered a further warning about the dangers resulting from the alteration of the lagoon's equilibrium. In their opinion, digging new deep channels involves a redistribution and an increase in water flow. It is interesting that they reported the same effect on the lagoon as a result of the construction of the so-called Mose system, the mobile dams' system against floods. But the institutions ignored their warning, and now new different currents are spreading throughout the lagoon (Vianello 2021).

Nowadays it is reductive to think that fishermen do not use any modern technology in favor of traditional knowledge and tools. They also have access to modern forms of technology, such as sonars, GPS, depth sounders, satellite imagery, and the new generations tend to mix the old traditions with the new, generally on utilitarian bases. That is, if something new gives them advantages in terms of time, effort, or money, it is accepted. However, the knowledge from older generations is always held in high regard. Their knowledge, which is commonly defined as traditional because it has been used for a long time and for many generations, is being modified or integrated with completely new ones. Today, this capacity for adaptation has allowed them to carry out profitable activities despite environmental challenges. Nowadays, global climate change is affecting the intangible part of knowledge, causing quick changes, adaptations, and contaminations. Small-scale fishing is going through a phase of crisis worldwide also due to industrial overfishing. For these reasons, new knowledge and skills are becoming fundamental to be competitive.

It is the case of the new oyster-farming initiative in the Scardovari lagoon, an area located southwards from Venetian lagoon. It illustrates a righteous case of entanglement between modern forms of technology and traditional knowledge. Here, a young mussel-farmer named Alessio started breeding oysters by combining his knowledge of mollusks with today's new technologies. He is the first to have successfully started this kind of breeding in the north Adriatic Sea[1]. Oyster farming was almost unknown in Italy because of unsuitable tidal cycles. Thanks to new technology, this man, together with an expert French oyster-farmer, created a sustainable mechanical system to simulate the diving and surfacing that oysters need to grow. The system is powered by solar panels and controlled with a mobile application. It's a new kind of farming that couldn't exist without traditional knowledge; it is the "knowledge from below" that suggests what is better to do and allows fishermen to act successfully. Without the experience, daily observations, and the knowledge from the older generations, nothing would be possible.

One more case is taken from Chioggia, a town in the south of the Venetian lagoon[2]. A fisherman from the new generation, thanks to a depth sounder system and a laptop that he always takes with him onboard, created a map of an irregular, but rich, seabed area, a sort of submerged mountain so-called *tegnùe*[3]. This is a difficult area to exploit because the nets get entangled. Moreover, it is a protected natural area where fishing is forbidden. The new seabed map allows him to do illegal fishing without having any problems with the tools. The new detailed seabed map is shared only with the family. It is a secret for everyone else, as is typical in the fishing world. This fisherman keeps using local ecological knowledge to know the habits of fish, when to find them, and

1 Interview with Alessio, 21 October 2023.

2 Interview with Mario, 15 July 2019.

3 *Tegnùe* are underwater formations characterized by rocks and irregular cavities, similar to coral reefs. They are widespread in the Upper Adriatic Sea and their origin is still uncertain. Fishermen's legends tell of ancient cities submerged by tsunamis. What is certain is that these are environments rich in life and biodiversity.

so on. This example can be perceived as a negative one of the integration between new technology and traditional knowledge. Still, it is a demonstration of how local knowledge allows fishermen to identify the fishiest places, which are now exploitable thanks to the new technologies available.

Conclusions

Knowledge is always linked to the environment. For this reason, traditional indigenous knowledge has to be understood as local knowledge. Local knowledge, developed by the inhabitants over the centuries, has allowed the exploitation of resources present in specific territories. For centuries, sometimes millennia, populations have exploited the local resources in a sustainable way, guaranteeing their regeneration. Enhancing them can help develop innovative policies to recover the environment through sustainable actions. We must never forget that the environment is also our environment, and we are part of it, of that complex entanglement between human and non-human components that indigenous have learned to know and respect for a long time.

All this is even more important and urgent for aquatic places. In a situation of worldwide crisis in the fishing sector, the value of 'knowledge from below' can contribute to actively involving communities in protecting cultural and natural heritage. Indigenous knowledge can be a possible solution to sustainable management of delicate watery ecosystems. The entanglement between human and non-human that small-scale fishermen developed thanks to local ecological knowledge can generate sustainable patterns - a concept that should be understood as including socio-cultural, economic, and natural dimensions – and foster environmentally friendly new activities and promote good practices.

Perhaps this is not a definitive solution to the challenges of modernity, or a barrier to the spread of industrial fishing, but it is a small step towards the conscious exploitation of marine resources. We must remember that maintaining a good environmental balance is equivalent to maintaining a good economic balance as well. For these reasons, we need to promote positive examples of constructive dialogues between different knowledge systems and improve cooperation with local communities.

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THE DIMENSIONS THEME 02

Aesthetics Ethics and Emotional Dimensions - The Role of Art and Design in EE

Theme Background: Art has a unique ability to help us visualize and connect with the intricate patterns inherent in living systems and the natural world. Children, in particular, possess a natural inclination to recognize and express the essence of nature through artistic expression. Beyond conventional learning about plants and animals, art offers a means of experiential engagement, fostering a deeper, emotional connection to the environment. The integration of EE and ESD into art challenges students to see and relate to the natural world in profound ways. Similarly, design thinking emerges as an innovative tool for addressing complex systemic sustainability challenges, providing a creative approach to problem-solving and fostering ethical and empathetic responses to environmental issues.

Theme Objectives: "Aesthetics, Ethics, and Emotional Dimensions: The Role of Art and Design in EE," aims to:

- Highlight growing knowledge and sensitivity to the environment and environmental challenges through the lens of art and design.
- Showcase innovative proposals that incorporate art and design activities as critical elements of the EE and ESD experience, demonstrating the potential for creative expression to foster environmental understanding and action.

Theme Focus:

- Personal journeys of artists and educators in integrating environmental themes into their work.
- The role of art in fostering a sense of environmental responsibility and stewardship.
- Creative approaches to using art and design to communicate complex environmental concepts.
- Curriculum designs that incorporate art and design as essential components of environmental education.
- The role of artistic expression in fostering problem-solving and critical thinking skills.
- Art and design activities that promote empathy and ethical responses to environmental issues.

Theme Outcomes: Learn how art and design contribute in developing essential skills for identifying and addressing environmental challenges, including problem-solving, critical thinking, and empathy.

Theme Conclusions: The thematic track on "Aesthetics, Ethics, and Emotional Dimensions: The Role of Art and Design in EE" aligns with the overarching goal of WEEC 2024, which is to "Connect People, Create Tomorrow."

It underscores the transformative potential of art and design in enhancing environmental education, fostering emotional connections to nature, and promoting ethical and empathetic responses to environmental challenges.

THE DIMENSIONS THEME 02

Aesthetics Ethics and Emotional Dimensions - The Role of Art and Design in EE

Proceedings

ID	TITLE	PRESENTER	FORMAT
191	The Fresh Press Enterprise: A Sustainable Action Project for Paper Production at Zayed University Using Locally Sourced Agricultural Waste	Tina Sleiman, Eric Benson, Fatme Al Anouti	Pecha kucha

191

The Fresh Press Enterprise: A Sustainable Action Project for Paper Production at Zayed University Using Locally Sourced Agricultural Waste

Tina Sleiman[(1)], *Eric Benson*[(2)], *Fatme Al Anouti* [(3)]

Abstract

At the University of Illinois, Eric Benson utilized innovative approaches in design education through Fresh Press Paper. Based on this initiative, Fresh Press Emirates seeks to utilize local agricultural waste for specialty paper production. Environmental education was integrated in graphic design pedagogy At Zayed University in Fall 2023 through students' engagement in: (1) researching papermaking materials and processes with a visit to a paper mill, (2) designing visual narratives that respond to environmental issues, and (3) devising a plan to brand and promote Fresh Press Emirates.

Full Paper

Introduction

The United Arab Emirates (UAE) consume large quantities of paper (Khaleej Times, 2011), and this consumption was paralleled with the establishment of numerous paper mills (Paper Arabia, 2022). However, most mills make bleached, coated, wood-based paper from virgin pulp, severely impacting the environment. Brian Dougherty and Celery Design Collaborative suggest that because "the paper industry is responsible for 40 percent of all industrial deforestation worldwide [...] agricultural residue, or agri-pulp, is perhaps the most promising fiber source because it [...] makes the most of a waste material and doesn't require dedicated agricultural land" (2008). At the University of Illinois, Eric Benson has embedded responsible environmental practices in his innovative approaches to art and design education. Benson and a team of papermakers, farmers, artists, designers, students, architects, and material science engineers collaborate at Fresh Press Paper, a studio running in parallel to a sustainable student farm to make paper out of agri-pulp.

Fresh Press Emirates explores the potential of building a small-scale model of sustainable specialty paper production at Zayed University (ZU), utilizing local agricultural waste material as fibers to make paper that would serve art and design students and practitioners.

In this paper, we address the integration of environmental education in graphic design pedagogy at ZU through three aspects: (1) research and observation, (2) visual communication design, and (3) branding. At first, students were engaged in researching about existing paper production facilities. Provided with an exclusive visit to the largest regional paper mill specialized in paper for printing and writing, students learned about materials, processes, and paper grades. As a second stage, students designed visual communication material that responded to issues encountered. Students synthesized their readings and observations into narratives that ended with a call to action, ultimately reversing their role from student to potential educator. The third stage consisted of devising, along with students, a plan to brand and promote Fresh Press Emirates, starting by defining its goals, and then designing a bilingual logo, writing professional business letters, and creating a visual proposal.

1. Research and Observation

The first tasks students were engaged in consisted of researching about paper production facilities in the UAE (including a curricular visit to the largest regional paper mill specializing in paper for printing

(1) Zayed University
(2) University of Illinois at Urbana-Champaign
(3) Zayed University

and writing), learning key terminology related to sustainability, and engaging in readings and discussions on responsible graphic design.

The Paper Industry Technical Association lists ten paper mills located in the UAE. Among them, six manufacture tissue paper; two (Union Paper Mill based in Abu Dhabi in Dubai, and Arabia Kraft Paper based in Umm Al Quwain) specialize in packaging including core boards, linerboards, flutes, and Kraft paper for bags; one is listed as a factory producing handmade paper (Ar Ragi paper, that appears to be no longer available); and one, Ittihad Paper Mill located in the industrial area in Abu Dhabi, specializes in printing and writing. The latter, established in 2020, is currently the largest mill of its kind in the region, producing 1600 meters of paper per minute, and catering to local, regional, and international clients.

In September 2023, Ittihad Paper Mill (IPM) Operations Director Rabih El Assadi organized an exclusive tour for senior graphic design students enrolled in the AGD 453 Graphic Design IV course at ZU, in response to a request by the course instructor. The generous three-hour tour consisted of 1) a thorough presentation on the company's team, clientele, and the materials it utilizes, and its efforts in matter of sustainability; 2) a walking tour of factory grounds where students observed the water filtration units and paper stacks reading for shipment, 3) a guided visit to the industrial machinery room where students viewed the working machines after a safety induction, 4) an explanation of the stages of paper production and preview of automated software that tracked the production in the control room; and concluded with 5) an examination of resulting paper at the lab where students learned about paper types and quality analysis.

Holistically, visiting students learned from the plant manager at IPM that five components are essential to make paper: pulp and filler, water, energy, people, and market. Students' takeaways from the trip were revealed in their notes and in-class discussions, where they presented to their peers their understanding of materials utilized to make paper, stages in the papermaking process, and various approaches to sustainability.

In parallel to the field trip to IPM, extensive round-table discussions occurred in the classroom. To start, the instructor shared the Mohawk Loop Sustainability Glossary (that was distributed at the New Contexts/New Practices AIGA Design Educators conference in 2010). Each student picked a card from the deck and read the definition of the key term. The meaning was then discussed as a group. Learned terminology included the much-used term of 'sustainability'; labels such as 'totally chlorine free' vs. 'processed chlorine free', 'post-consumer waste' vs. 'pre-consumer waste', 'recycled" vs. "recyclable'; and processes such as 'deinking', 'upcycling', 'optimization', and 'life cycle assessment'.

Students were assigned readings from two essential resources: Brian Dougherty and Celery Design Collaborative's Green Graphic Design, as well as Eric Benson and Yvette Perullo's Design to Renourish. Students' takeaways, documented in their journals, included the following statements from the Green Graphic Design book:

> "Through their work, graphic designers have a significant impact on the world by influencing their audience's perceptions and actions. While Designers often focus on HOW to communicate, they should also consider WHAT to communicate."
>
> "Dougherty believes that graphic designers are at a crossroads and that their choices in the coming years will have a significant impact on the future of the planet. He advises graphic designers to embrace sustainability, creativity, and innovation."
>
> "The impact of graphic design can be significant, from the sources used to produce printed materials to the energy used to power digital devices."
>
> "Design activism involves designers choosing clients that align with their values, and promoting practices that benefit society and the environment."

Student Mariam Al Hammadi was fully engaged in the class assignments. Her takeaways from the Design to Renourish book and the Re-nourish website are outlined hereafter:

"Re-nourish developed standards for evaluating the ecological impact of design projects. The standards cover materials, production, energy, process, and end-of-life. They recommend that designers and vendors prioritize ethical practices, which include minimizing waste and using renewable materials."

"Defining sustainability in graphic design can be challenging due to unclear guidelines."

"Greenwashing is common, where companies make misleading environmental claims."

"Selecting paper involves considering factors like source, manufacturing, and impact."

"Selecting digital or print depends on factors such as energy source and material."

"Responsibility goes beyond materials to consider impact on people and the economy."

"Case studies in the book illustrate diverse approaches to sustainable graphic design."

It is evident from the above comments that students could see the link between graphic design decisions (from selecting paper types, to communicating particular messages) and their impact on the environment. Throughout discussions that spread over several class sessions for a few weeks, students regularly acknowledged that most of the information they were learning was new to them, even though they were seniors in their final year of study.

2. Visual Communication Design

Students then synthesized their readings and observations into visual narratives.

Once they synthesized the information grasped from the sources above (and additional recommended readings), students were asked to design a recursive card (based on the model made by Kelli Anderson initially designed by Jeff Rutzky) that addressed an environmental issue of their choice related to the sourcing, use, or discarding of paper; that would be addressed to youth. They were tasked to address an issue, propose a feasible solution, and end with a straightforward call to action. The noteworthy deliverables of ten students from the course are discussed below.

Students shed the light on aspects to keep in mind when utilizing paper, starting with the selection of paper stocks. H.S. asked the question: "Where do papers come from?" After explaining that they are a mix of fiber and water, she explained the advantages of selecting recycled paper in saving energy and water, reducing landfill waste, and setting a good example to others. She ended with the statement "choose paper wisely" along with a QR code that links to the *EcoPaper Database* featured on the website of Canopy, a forest conservation organization. Alya Al Beshr's topic focused on cutting down individual paper waste through maximizing the coverage of each sheet of paper (by utilizing both sides and filling as much space as possible before switching to a new sheet), and through borrowing books from libraries or buying used books whenever possible. F.N. addressed the dangers of plastic added to paper through lamination, M.S. discussed harmful dioxins present in bleached paper, while A.M. focused on adhesive residues in paper and how they complicate the recycling process. Maryam Al Nuaimi explained the papermaking process, with a warning on the harmful effects of wood-based papermaking (deforestation, pollution, climate change), and a reminder that utilizing recycled paper (or reused paper) can substantially reduce air pollutants and the quantity of raw materials (including water) utilized in processing. Reem Sumaida focused on the end-of-life of paper, addressing three scenarios of where the held piece of paper can be taken: to the landfill (where toxins are released in the environment), or to be reused (which extends the life of materials and cuts down on carbon emissions), or to be recycled (that conserves energy, water, and landfill space). As a proposed call to action, she cited three initiatives available in the UAE: *Planet Green, Yes Full Circle, and the Washmen Recyclers*. FQ presented the concept "turning news into blooms" by explaining the benefits of utilizing newspaper mulch in the garden as learnt from gardener Peter Richards. S.H. explored the link between fabric, paper, and clothing stating that "sustainability will never go out of fashion". She started with a mention of

Kamiko historic paper garments from Japan, and ended with a link to a page listing brands that utilize recycled materials to make new products, coupled with her statement "next time you are looking for a new piece of clothing, take a moment to consider the impact it will have on the planet."

Maryam Al Hammadi's approach was utterly inspired by the trip to the paper mill and the fact that paper jams occur, for the most part, from the paper quality rather than the printer. Her statement was thus:

> "It all starts with the pulp, if it's not properly refined and blended with filler, you will encounter paper jams. Here comes the role of a paper engineer. Paper engineers shape the future of responsible printing and design by ensuring high-quality paper production".

As a result, Maryam's call to action was to encourage youth to explore material science engineering as a career option, something she discovered upon meeting Finnish paper engineer Mika Viertola at IPM and learning about his education and thirty years of experience in the field.

The latter shows a direct link between theoretical (readings) and practice-based (field-trip) education, informing the student's choice of the message she chose to deliver in her design work. In other words, as the student suggested the study of paper science to tackle the crisis, she saw the direct link between environmental education and its potential impact. Furthermore, in all the above, students were involved in crafting messages, and then presenting them visually through an interactive paper-based format. In this way, their role shifted from students to potential educators on art and design sustainability, while acknowledging the ecological impact of the kind of paper selected for any project.

For some students, the project was a success in terms of the messages delivered, the visual aesthetics, and the accuracy and craftsmanship in printing. Several students, however, struggled with synthesizing the information into a direct message that contained a succinct call for action. Others had a clear message, but their work needed visual improvement in the use of typography, graphics, or structuring the visual space. Still, the main struggle for most was in printing. Due to the complexity of the recursive card, and after several attempts by the instructor to generate a correct template, there were still issues encountered with aligning double-sided printing, which resulted in wasted sheets of paper. The issue was ultimately resolved, but to avoid additional paper waste, some cards were not reprinted. For the future, additional planning from the instructor's side is needed, with additional class sessions set aside for printing.

3. Branding and Promotion

As a final step in the course, students were involved in branding Fresh Press Emirates, and writing professional letters to potential partners and clients.

Guided by NESTA's Creative Enterprise DIY Toolkit, students used the evidence planning sheet and theory of change sheet as an initial exercise to trigger class discussions that resulted in defining Fresh Press Emirates' role: to cultivate an appreciation of paper and revive traditional papermaking by making and providing local, unbleached, specialty paper from organic agricultural residue for various art and design uses.

From this point, each student proposed a bilingual logo. The selected logo showed a visual connection to University of Illinois' Fresh Press Paper logo (in terms of using the circular shape and typographic choices), with a changed color from red to maroon to reflect Zayed University's signature color. The logo incorporated open hands to represent the cultural relevance of hands in the Emirates (reminiscent of henna and falconry), as well as to symbolize the three key words that form the slogan: Harvest, Make, Give: harvesting agricultural-waste, making paper by hand, and giving back to the earth.

The instructor then asked each student to select a potential client from a list, in order to practice writing professional business letters. The list included local businesses that would utilize specialty paper, such as local art studios, design agencies, printing companies, nurseries, academic institutions, and government institutions. Students started by reading their target audience's vision and mission, researching about why and how they

would utilize the company's product (handmade paper), and filling in the DIY target group worksheet. They then wrote their letters. All students started their letters by introducing Fresh Press Emirates' vision and mission, and ended them by proposing possible means of collaboration. In the body of the letter, students used different approaches. Some described the sourcing the materials, and others the papermaking process; some focused on the environmental impact, and others on the cultural relevance and locality with reference to the year 2023 as the Year of Sustainability in the UAE (as declared by the country's president).

For each of the above, the instructor utilized the studio approach of one-to-one meeting and direct feedback, to help students improve their outcomes. At each subsequent class session, students showed a revised version of the work where they incorporated recommendations. As a final step in the course, each student consolidated her proposal through a visual presentation. Presentations varied in terms of quality of the content and design. Some excelled, while others were challenged with the task of incorporating a large amount of information.

Conclusion and Next Steps

At the beginning of the course, students explored professional graphic design practices and case studies of design for social issues. Following a field trip to a local paper mill, assigned readings, and in-class discussions; each student designed a visual narrative, learned about business models, wrote a professional business letter, designed a bilingual logo and created relevant social media posts to promote Fresh Press Emirates. All such activities reflected the learning by practice approach which we embraced throughout the project. However, in student surveys (completed by 8 out of 14 students), some respondents felt restricted with the overarching focus on sustainability, as evident in the following reflections on their learning experience in the course:

> "the course is very focused on sustainability, which i dont think contributed to learning about graphic design. as a senior i was hoping to learn more advanced skills about softwares."

> "didn't learn a lot just learnt about sustainability."

Rather than seeing it as a holistic approach in graphic design, they felt that their learning revolved around on one topic and that as such learning other aspects was minimal. This perception could partially be resulting from the fact that design responsibility was little addressed in earlier courses. On another note, the student who designed the selected logo for Fresh Press Emirates stated in an email (personal communication, 11 March 2024):

> "I want to express my heartfelt gratitude for granting me the opportunity to design the Fresh Press Emirates logo. It has been an incredible experience working on such a meaningful project. I am thrilled to hear that the logo has been implemented on Fresh Press's Instagram account as well. It's truly rewarding to see my work being appreciated and utilized by such a reputable platform. I am excited to continue contributing to the success of Fresh Press in any way I can."

When reflecting upon the course, in the comment box, one student commented that the course was not very helpful while another wrote: "Very helpful and useful". These statements reflect the mixed opinions of students and the perceived relevance and importance of the integration of sustainability in their graphic design learning.

Interestingly, the most remarkable observation was that of the student who made the direct link between environmental education and paper engineering, utilizing her role as a graphic designer to communicate a message inspired by her trip to the paper mill. A few months later, that same student was among the first design students to contact the organizers to volunteer at WEEC 2024.

The pedagogical approaches mentioned in this paper centered on graphic design students' engagement in the learning process. The upcoming steps would involve science students characterizing fiber properties of local agri-waste using the electron microscope. Ultimately, the project would culminate in the research team setting up the papermaking studio to make specialty paper, and testing it with art and design projects.

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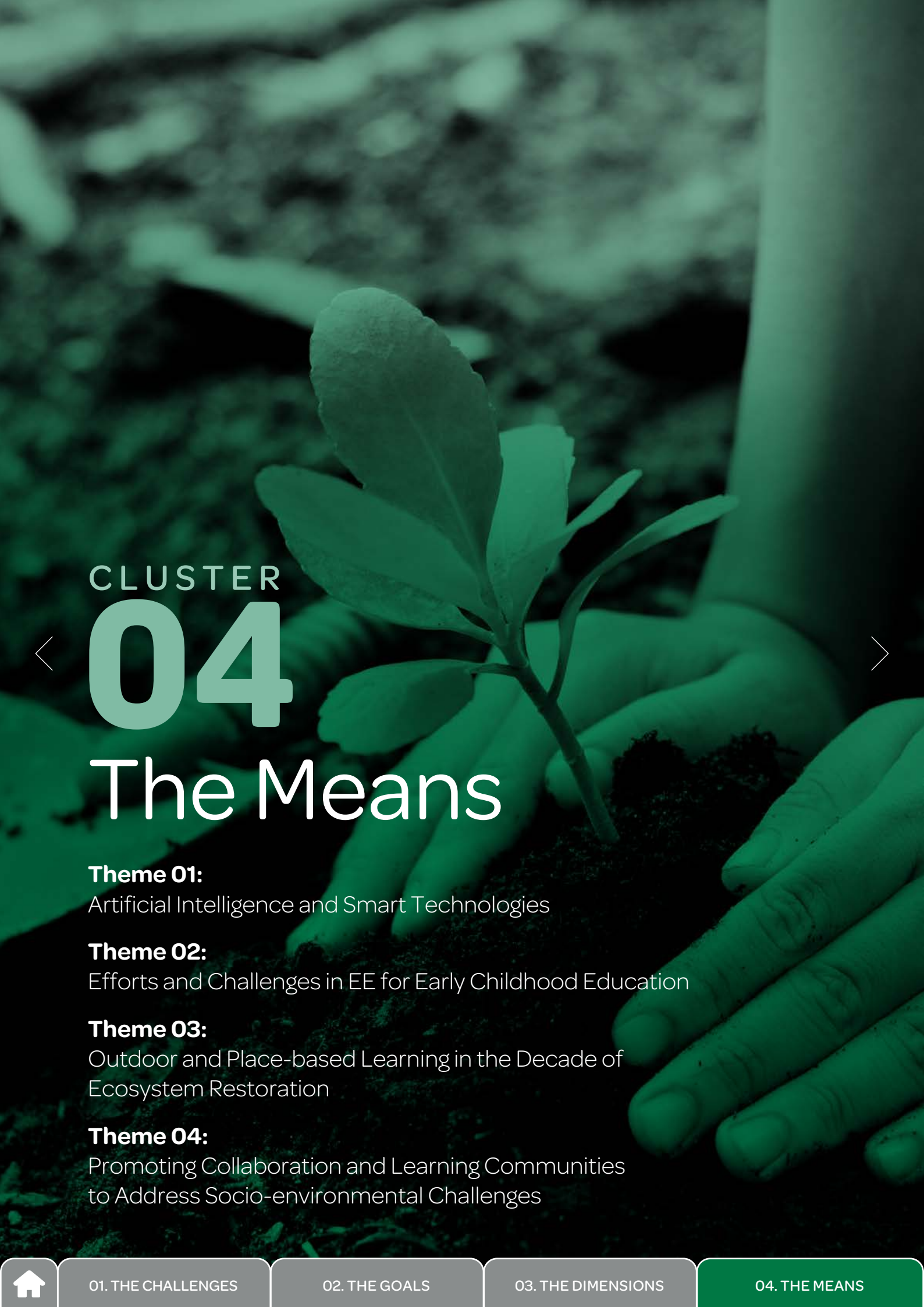

CLUSTER

04

The Means

Theme 01:
Artificial Intelligence and Smart Technologies

Theme 02:
Efforts and Challenges in EE for Early Childhood Education

Theme 03:
Outdoor and Place-based Learning in the Decade of Ecosystem Restoration

Theme 04:
Promoting Collaboration and Learning Communities to Address Socio-environmental Challenges

THE MEANS THEME 01

Artificial Intelligence and Smart Technologies

Theme Background:

In the digital age, smart technologies and Artificial Intelligence (AI) have become integral tools in education, revolutionizing the learning process for students of all ages. These technologies offer a wide range of transformative possibilities, supporting learners and educators alike in acquiring knowledge and fostering engagement. In the field of EE and ESD, smart technologies hold tremendous potential for raising environmental awareness, promoting sustainable development, and enhancing ecological understanding.

Smart technologies, including AI and virtual reality, enable interactive and immersive learning experiences, making environmental activities more engaging and impactful.

Theme Objectives:

The theme, "Artificial Intelligence and Smart Technologies in Environmental Education," aims to:

- Examine the opportunities and challenges presented by AI, virtual reality, and smart technologies in the context of environmental education. What are the advantages, and how can obstacles be overcome?
- The need to leverage Geospatial Technologies in EE and ESD and their role in enhancing environmental understanding and engagement.
- Smart technologies in citizen science initiatives and their contribution to EE and ESD.
- Role of smart technology in providing inclusive access to EE and ESD for students with special needs.

Theme Focus:

- Innovative uses of AI and smart technologies in environmental education.
- Strategies for harnessing smart technologies to enhance learning outcomes.
- Geospatial tools and their impact on environmental understanding.
- Engaging citizens in environmental research using smart technologies.
- Environmental and ethical considerations related to the production and disposal of smart devices.
- The potential for personalized and adaptive learning experiences through AI.
- The role of AI in data-driven decision-making for environmental sustainability.
- Assistive technologies and tools for special needs students in EE and ESD.

Theme Outcomes:

The pivotal role that Artificial Intelligence and Smart Technologies in connecting people to the environment, natural resources, and ecological issues, paving the way for informed decision-making and environmentally responsible behaviours.

Theme Conclusions:

The thematic track on "Artificial Intelligence and Smart Technologies in Environmental Education" aligns with the overarching goal of WEEC 2024, which is to "Connect People, Create Tomorrow."

Together, we can explore innovative approaches, share best practices, and address the opportunities and challenges presented by AI and smart technologies in the pursuit of a sustainable and resilient future.

THE MEANS THEME 01

Artificial Intelligence and Smart Technologies

Proceedings

ID	TITLE	PRESENTER	FORMAT
106	Conceptualización de un Sistema de Información Geográfica (SIG) para la Educación Ambiental en Bogotá D.C. (2002-2021)	Carolina Infante Osorio	Oral communication

106

Conceptualización De Un Sistema De Información Geográfica (Sig) Para La Educación Ambiental (Ea) En Bogotá, Colombia (2002-2021)

Carolina Infante Osorio[(1)], *Claudia Shirley Ramírez Cuetia*[(2)], *Jennifer Lizeth Romero Pérez* [(3)]

Resumen

Se elaboró la etapa de conceptualización de un SIG aplicado a la Educación Ambiental en Bogotá, con el fin de identificar atributos que integren y relacionar la información sobre los tipos de EA ejecutados en la ciudad capital en el periodo de tiempo entre el año 2002 y 2021. La investigación se dividió en tres fases principales: evaluación de necesidades, requerimientos tecnológicos y diseño conceptual. Se destaca que los SIG y la EA son temas poco conocidos por los ciudadanos de Bogotá, por lo tanto, se requiere de una herramienta de fácil acceso y sin restricción de uso que permita un acercamiento de los usuarios a una información confiable.

Problema de Investigación

Se evidencian diversos estudios en el tema de Educación Ambiental en el Distrito Capital de Colombia. Sin embargo, los actores trabajan de forma desarticulada, dificultando la visualización de la información y la continuidad de proyectos. Esto genera un problema interinstitucional y un manejo ineficiente de las zonas ambientales de Bogotá, puesto que se pueden presentar investigaciones con el mismo objetivo o proyectos sin objetivos definidos, principalmente por la falta de antecedentes y de un registro de información pertinente que permita realizar seguimiento y control a las evidencias en Educación Ambiental.

En la Especialización en Educación y Gestión Ambiental de la Universidad Distrital se ha venido desarrollando un SIG llamado SEEGA-UD, en donde se diseñó y elaboró una herramienta que sistematizara las experiencias en Educación Ambiental en la ciudad de Bogotá dentro del período 2002 al 2016 (Tamayo & León, 2017). Esta herramienta SIG permitió la aplicación de un modelo entidad-relación, en donde se ubica espacialmente diferentes experiencias en Educación Ambiental en la ciudad, junto con la descripción de sus atributos básicos. Posteriormente, se realizó como complemento una conceptualización de la herramienta SIG para el análisis de los PRAE (Proyectos Ambientales Escolares), con el fin de implementar una información más provechosa y completa para la sistematización de esta estrategia de políticas ambientales (Munevar & Turriago, 2018).

Con la implementación de un modelo conceptual con base en los componentes de Educación Ambiental, se propone complementar el SIG para que permitirá integrar y relacionar los datos para facilitar la organización, análisis y visualización de la información de los tipos de Educación Ambiental recopilados en la ciudad capital, y así obtener una articulación entre actores interesados y la continuidad de proyectos ya iniciados (Manzanares & Quintana, 2019).

Pregunta de Investigación

¿Cuáles son los atributos pertinentes necesarios en el diseño de un sistema de información geográfica para la Educación Ambiental en Bogotá D.C. en el periodo comprendido entre el 2002 y 2021?

Metodología

El alcance del proyecto es realizar la etapa de conceptualización de la herramienta SEEGA-UD según el esquema metodológico de un SIG de Guevara (1992), como base para estudios posteriores dedicados al estudio piloto, estandarización, instalación del sistema, aplicaciones de programación, entrenamiento, SIG en uso, y entendimiento y control (Figura 1).

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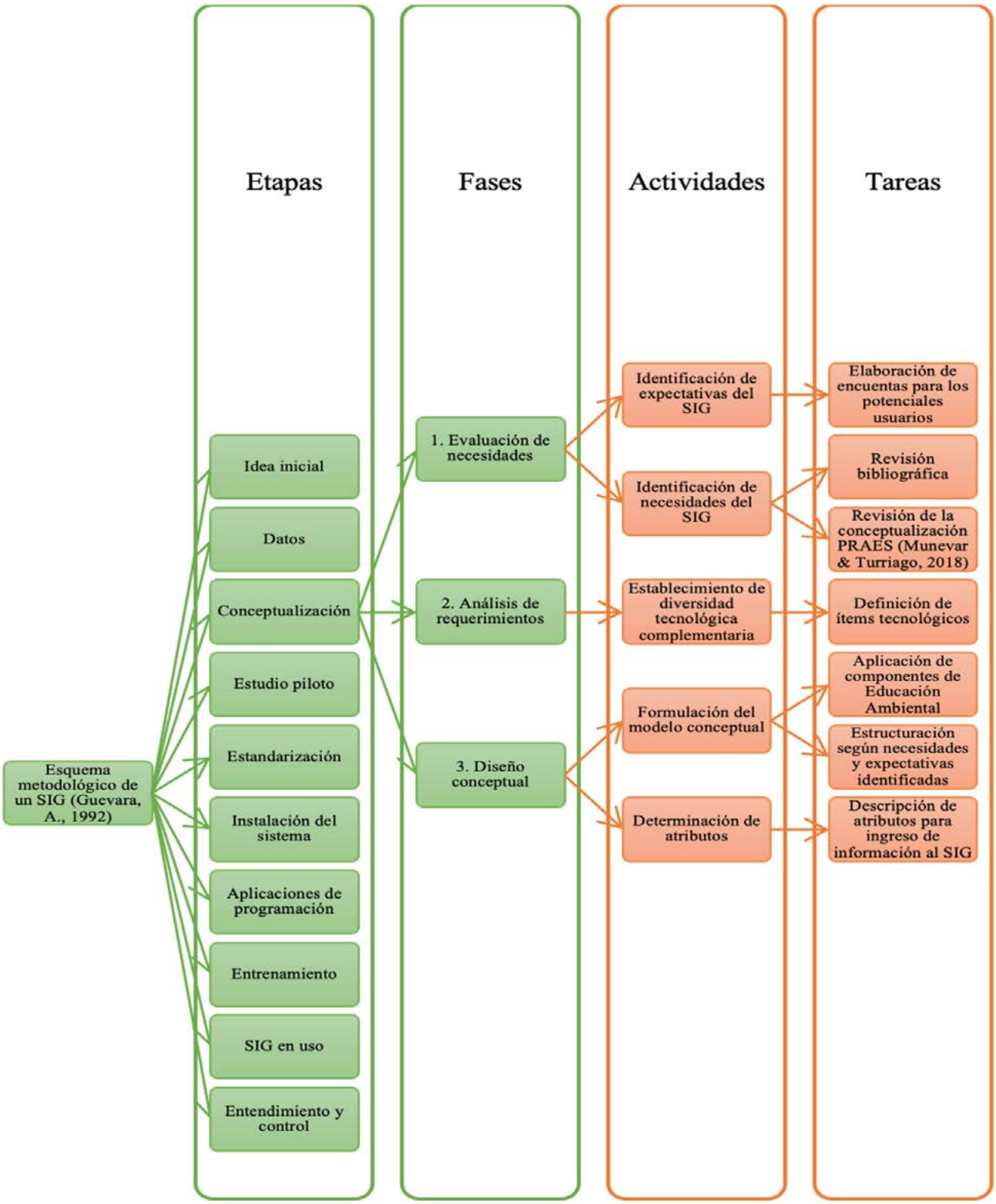

Figura 1: Diagrama de flujo del diseño metodológico del proyecto modelo conceptual SIG

1. Evaluación de necesidades

Establecimiento de expectativas y necesidades de la herramienta SIG, según los intereses de los potenciales usuarios y los requisitos para la toma de decisiones. La identificación de expectativas se realizó mediante encuestas dirigidas a potenciales usuarios, mientras que la identificación de necesidades se basó en revisión bibliográfica y revisión de la conceptualización PRAES de Munevar & Turriago (2018).

2. Análisis de requerimientos

Definición de los componentes tecnológicos necesarios para la satisfacción de necesidades asociadas a la herramienta SIG, mediante revisión bibliográfica.

3. Diseño conceptual

Elaboración del modelo conceptual propuesto para la implementación de atributos aplicados a la Educación Ambiental. Este se realiza aplicando los componentes de Educación Ambiental propuestos por Zamudio (2015), además de estructurarse según las necesidades identificadas.

Resultados

1. Evaluación de necesidades

a. Identificación de expectativas del SIG

Se procede a analizar los resultados obtenidos de la encuesta "EXPECTATIVAS DEL USUARIO SIG" aplicada a 150 usuarios potenciales (Figura 2).

La información recolectada representa a un grupo de usuarios que desconoce en gran mayoría tanto los SIG (41,3%) como la información de Educación Ambiental (74%) en la ciudad en la que viven. Por lo tanto, se hace necesario y pertinente el diseño de una herramienta que permita facilitar la información y el acceso a esta, logrando la participación activa de más actores, la continuidad de proyectos realizados, la articulación de grupos sociales e instituciones, y la posterior evaluación de la Educación Ambiental en Bogotá.

La mayor expectativa del SIG fue conocer y localizar los proyectos ambientales realizados en la ciudad con fin informativo como primer paso para la toma de decisiones.

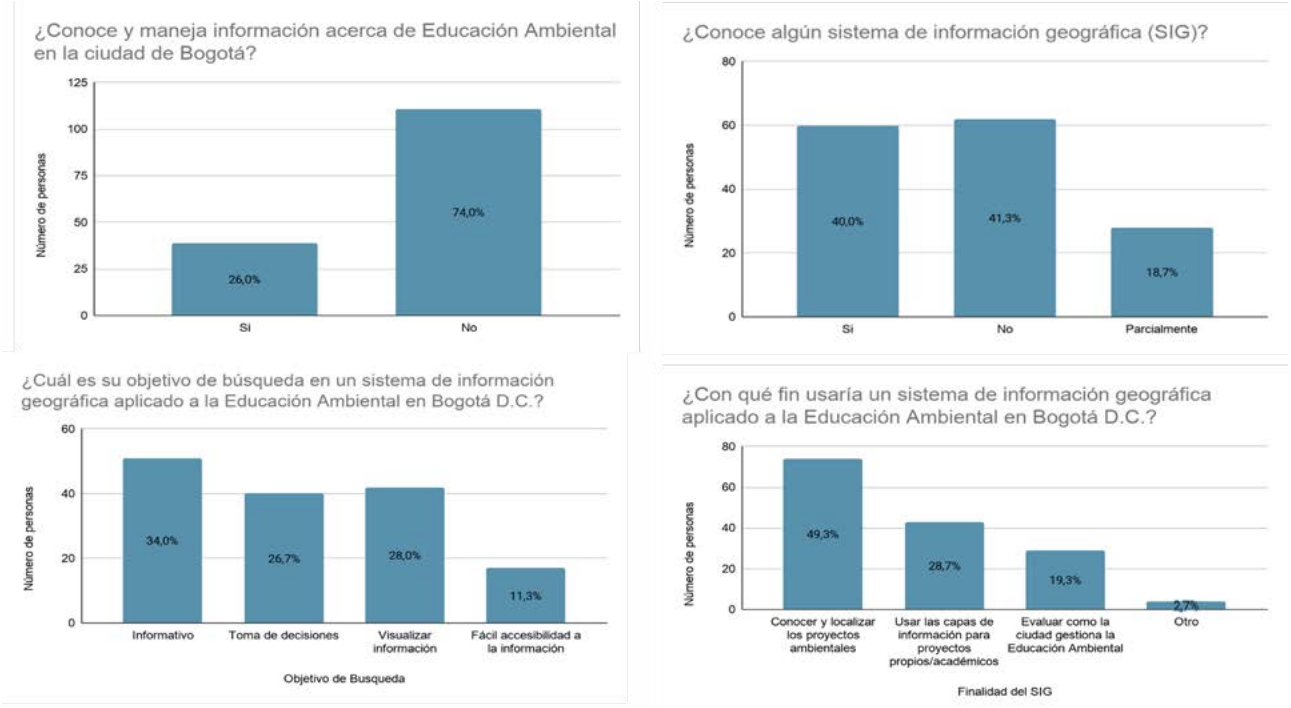

Figura 2: Estadística de resultados de algunas preguntas de la encuesta EXPECTATIVAS DEL USUARIO SIG

Los potenciales usuarios son personas del sector académico que están empezando a conocer esta herramienta geográfica para la visualización y manejo de información,

b. Identificación de necesidades del SIG

Se requiere de un software libre para dar acceso a la comunidad a utilizar, analizar y visualizar la información sobre los tipos de Educación Ambiental en la ciudad (Ambuila & Davila, 2020).

El modelo desarrollado por las autoras Munevar y Turriago (2018) está compuesto por tres componentes de la Educación Ambiental, los cuales se identificaron por medio de la lectura de 4 políticas públicas de Colombia (Metodología desarrollada por el Jardín Botánico, Decreto 1743 de 1994, PPDEA y PPNEA) (Figura 3).

2. Análisis de requerimientos

Los SIG son una combinación de elementos físicos (hardware), digitales (software y datos) y humanos (usuarios). Es por ello que los requerimientos tecnológicos (hardware y software) varían según el tipo de usuario al que va dirigido el SIG. Teniendo en cuenta lo anterior, la propuesta SIG aplicada a la Educación Ambiental en Bogotá D.C. está enfocada a usuarios orientados a datos vectoriales, ya que estos pueden editar, procesar, analizar y visualizar la información geográfica con base en capas geométricas de puntos, líneas y polígonos (Santos, 2020).

Los archivos de datos vectoriales usualmente necesitan requisitos de hardware menores que los datos de teledetección y programación SIG, en cuanto a nivel de almacenamiento, gráfico y procesamiento Pucha *et al.* (2017). En cuanto al sistema operativo (software) se pueden tener como destacados Windows, Linux y Mac, esto depende de la experiencia de cada usuario, de sus necesidades y gustos al usarlo (Estévez, 2019).

3. Diseño conceptual

a. Formulación inicial del modelo conceptual

A continuación se definirán los ítems utilizados para el modelo conceptual propuesto:

- Componentes: Son una serie de elementos que dan fundamento a cualquier acción de Educación Ambiental

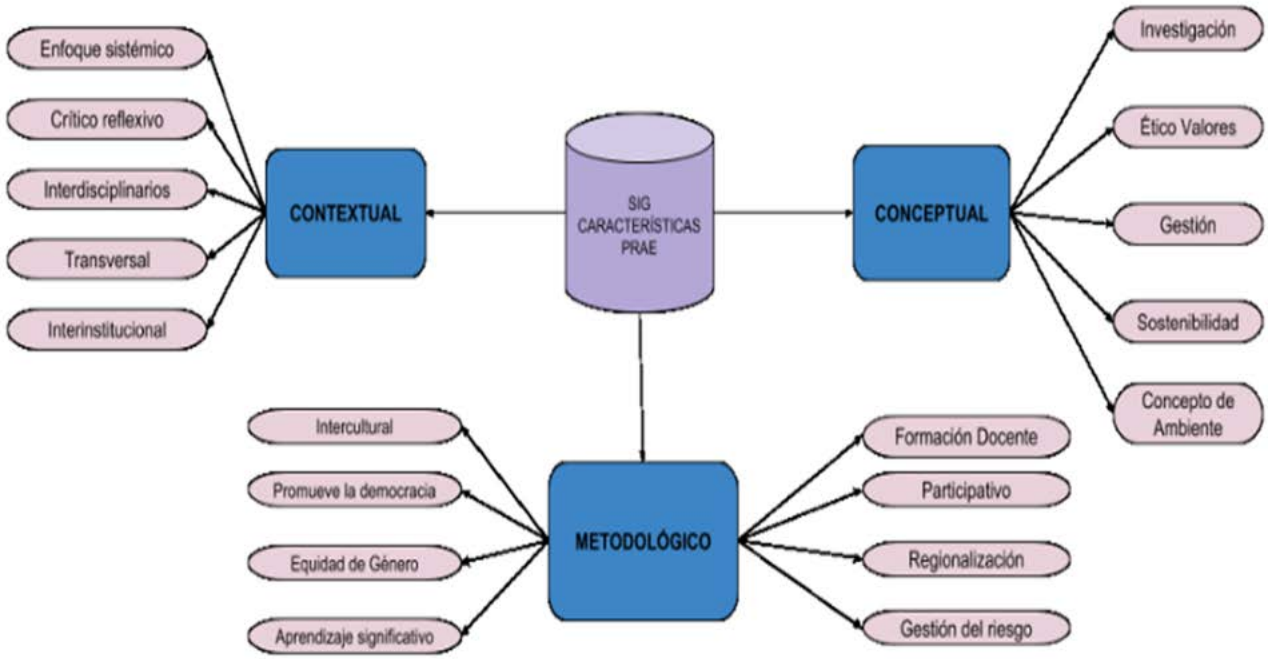

Figura 3: Modelo conceptual SIG PRAE (Munevar & Turriago, 2018)

- Características: Cada elemento que integran los componentes.
- Criterios: Características ingresadas al SIG para definir los atributos.

Los componentes y características de la EA empleados para el diseño del modelo conceptual se obtienen del análisis de la autora Zamudio (2015), los cuales se ilustran en la Figura 4.

b. Aplicación de componentes de Educación Ambiental

En la Figura 5 se observa el análisis de frecuencias de las características de la EA en 20 documentos elegidos aleatoriamente de cada tipo de Educación Ambiental desarrollados en Bogotá entre los años 2002 al 2021.

Según la aplicación de componentes de Educación Ambiental realizada se logró conocer sobre qué componentes hay información en los documentos de los tipos de EA ejecutados en la ciudad de Bogotá, resultando como características de más fácil obtención el concepto de ambiente, la relación ambiente-desarrollo, las situaciones ambientales y las políticas ambientales; caso contrario a características como cosmovisiones, aproximación, teorías empleadas, diálogo de saberes, conocimiento, enfoque privilegiado, éticas ambientales, enfoque ético-político y enfoque axiológico; de las cuales no se obtuvo información alguna.

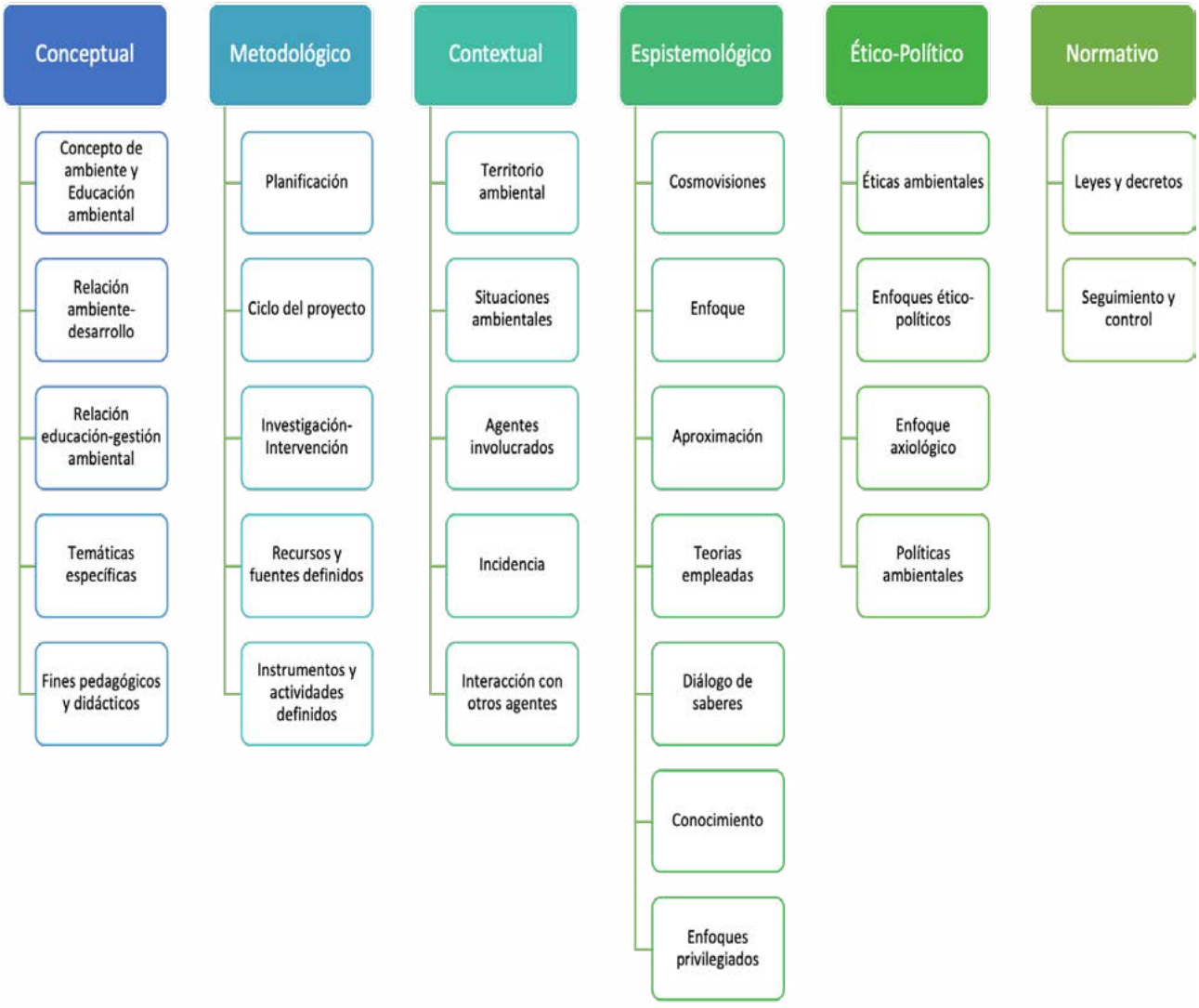

Figura 4: Componentes y características de la Educación Ambiental (Zamudio, 2015)

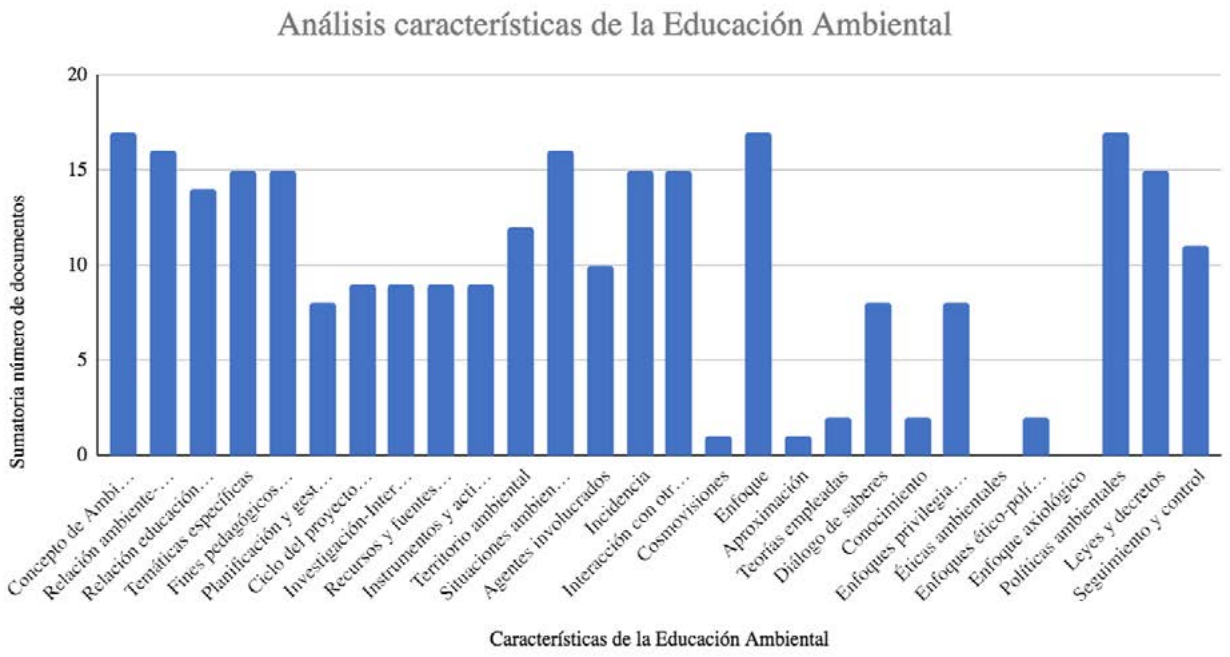

Figura 5: Análisis de frecuencias de las características de la Educación Ambiental en documentos desarrollados en Bogotá entre 2002 y 2021

c. Estructuración según necesidades y expectativas identificadas

De acuerdo con la estructuración según necesidades y expectativas identificadas se destacan características como recursos y fuentes definidas, instrumentos y actividades definidas, territorio ambiental, situaciones ambientales, agentes involucrados, incidencia, interacción con otros agentes, cosmovisiones, diálogo de saberes, conocimiento, políticas ambientales y seguimiento y control; a diferencia de características como relación ambiente-desarrollo, ciclo del proyecto, teorías empleadas, éticas ambientales, enfoque ético-político y enfoque axiológico, las cuales no se emplearon directamente para cumplir las necesidades y expectativas analizadas.

d. Formulación final del modelo conceptual

Como resultado se genera el modelo conceptual presentado en la Figura 6, incluyendo las características que predominan en los dos análisis anteriores más cosmovisiones, aproximación, diálogo de saberes y conocimiento, pues a pesar de no haber información disponible en los documentos estudiados, son características necesarias para cumplir con las necesidades y expectativas de un SIG participativo e integral que permita un estudio interpretativo de la Educación Ambiental en la ciudad. Características como ciclo del proyecto, teorías empleadas, enfoque privilegiado, éticas ambientales, enfoque ético-político y enfoque axiológico, no se incluyeron dentro del modelo pues no es información de fácil acceso y análisis en los documentos, además de no ser de gran relevancia para el fin de la herramienta y los potenciales usuarios identificados. En la figura también se pueden observar características con asterisco (*) el cual representa características destacadas en los análisis realizados anteriormente, y algunas con dos asteriscos (**) los cuales representan las características que generan información esencial y que requieren de mayor participación en los atributos del SIG.

e. Determinación de atributos

Elaborado el modelo se procede a determinar los atributos para la herramienta SIG aplicada a la Educación Ambiental en Bogotá, en donde se genera la Tabla 1.

Figura 6: Modelo conceptual propuesto para la herramienta SIG aplicado a la Educación Ambiental en Bogotá

Tabla 1: Ejemplo de algunos atributos seleccionados

Tipo de atributo	Nombre	Descripción
Contextual	Nombre_ proyecto	Nombre del proyecto en mayúscula
	Localidad	Nombre de la localidad donde se realiza el proyecto en mayúscula
	Agentes_ involucrados	Nombre de la institución o responsables del proyecto en mayúscula y separados por coma (,), primero el apellido y luego el nombre.
Metodoloógico	Gestión_cascada	¿Presenta una gestión en cascada? SI/NO
	Antecedentes	¿Hay proyectos precedentes en el territorio intervenido? SI/NO
Conceptual	Concepto_ ambiente	Concepto de ambiente empleado para la realización del proyecto
Epistemológico	Cosmovisiones	Nombre de cosmovisión observada en el proyecto en mayúscula, NA si no aplica
Ético-político	Política	¿Qué política ambiental pública rige el proyecto? en mayúscula
	Principios	¿El proyecto cumple con los principios de la política pública? SI/ NO/PARCIALMENTE
Normativo	Leyes_decretos	¿Qué leyes y decretos rigen el proyecto? en mayúscula y separados por coma (,)

Conclusiones

El uso de las encuestas en la investigación permitió conocer el estado actual de la Educación Ambiental y los SIG en la ciudad de Bogotá, pues el 74% de los encuestados no conocen ni manejan información sobre EA y el 41.3% no tienen conocimiento de esta herramienta, reflejando que las estrategias de las políticas públicas ambientales no se están ejecutando eficazmente.

Los potenciales usuarios son ciudadanos y académicos con poca experiencia y conocimiento tanto de los sistemas de información geográfica como de la Educación Ambiental de la ciudad, por lo tanto, el SIG se diseña con un propósito informativo y de fácil acceso y uso.

La propuesta SIG aplicada a la Educación Ambiental en Bogotá D.C. está enfocada a usuarios orientados a datos vectoriales, requiriendo así de un hardware no especializado, de un software de libre acceso y sin condiciones de uso, y de una estructura organizacional distribuida a través de la organización.

Por medio del estudio de los documentos de cada tipo de Educación Ambiental se determinó que la profundización en el tema es vaga en la ciudad, pues la mayoría de estos solo presentan información referente a componentes contextuales y conceptuales, desconociendo información de carácter interpretativo pertenecientes a los componentes epistemológicos y ético-políticos.

El modelo se elaboró teniendo en cuenta los 6 componentes de la Educación Ambiental, pues estos permiten una información integral sobre EA en Bogotá, siendo los componentes conceptual, metodológico y contextual los que generan información base del tipo de EA y los componentes epistemológico, ético-político y normativo los que producen información que permite un ambiente participativo y de inclusión, interdisciplinariedad, y conocer la relación de estos con las políticas públicas y las diferentes leyes.

Se propone que la herramienta sea online y que se provea el acceso por medio de un link público, esto para garantizar el involucramiento de todos los usuarios, pues en este estudio no se tuvo participación de grupos comunitarios o representantes sociales, siendo ellos parte importante de las estrategias de las políticas públicas como la elaboración de PROCEDAS.

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THE MEANS THEME 02

Efforts and Challenges in EE for Early Childhood Education

Theme Background:

Early childhood is a critical phase for shaping an individual's character, behaviours, and beliefs. Extensive psychological and educational research underscores the significance of this period in a child's development.

This theme focuses on the essential pillars of Early Childhood Education, encompassing educators, curricula, the impact of technology, and tools/materials used in the learning environment. These elements collectively contribute to the educational journey of young children, nurturing their capabilities, fostering engagement in communities, and preparing them for a sustainable future.

Theme Objectives:

The theme, "Efforts and Challenges in EE for Early Childhood Education," aims to:

- Discuss educational programmes and approaches that enhance environmental education in early childhood, focusing on the need for alignment with recent studies and emerging learning methods.
- Explore the tools and materials essential for creating hands-on learning experiences and fostering outdoor education spaces that stimulate children's thoughts, expand their knowledge, and enhance their skills.

Theme Focus:

- Strategies for integrating environmental education into early childhood curriculum.
- Teacher training and professional development in environmental education.
- Innovative curricular frameworks for ECE that incorporate environmental themes.
- Experiences and best practices in engaging young children with nature and sustainability.
- Designing child-friendly learning spaces that foster creativity and environmental stewardship.
- Strategies for adapting EE and ESD curricula and activities for diverse learners.

Theme Outcomes:

Stress the critical role of educators and practitioners as role models in shaping early childhood education, emphasizing their influence on students' environmental awareness and engagement within school, family, and society.

Theme Conclusions:

The thematic track on "Efforts and Challenges in EE for Early Childhood Education" aligns with the broader mission of WEEC 2024 by highlighting the pivotal role of early childhood education in fostering environmental awareness and sustainability.

Together, we can explore effective strategies, share best practices, and address the challenges of nurturing environmentally conscious and engaged young learners, setting the foundation for a more sustainable future .

THE MEANS THEME 02

Efforts and Challenges in EE for Early Childhood Education

Proceedings

ID	TITLE	PRESENTER	FORMAT
089	Una Inmersión En La Memoria: El Nacimiento De La Escuela Levino Cândido	Edilene Barbosa Pinto	Oral communication
341	The Climate Change and Early Childhood Development Nexus a Case Study of Eswatini	Novuyo Nkomo	Oral communication
392	La Realidad De Las Escuelas Y La Nueva Forma De Hacer Educación En Afogados Da Ingazeira-Pe, Brasil	Edilene Barbosa Pinto	Oral communication
571	Development of a tool towards enhancing early childhood education in schools and at homes providing basic environmental knowledge using artificial intelligence technology	Sabine Saad, Rayan Mourtada, Jinane Mounsef	Oral communication
645	منهج السنة النبوية في غرس وتنمية قيم التربية البيئية وأثره على الأطفال	Mahmoud Mohamed Ali	Oral communication
726	Awareness and Sustainability. An Action-research on Early Childhood Educators and Parents in the Municipality of Rome	Chiara Minischetti	Oral communication
629	ممارسات التربية البيئية في التراث العربي والإسلامي: "تحول حضاري نموذجي"	Mahmoud Mohamed Ali	Oral communication

089 Una Inmersión En La Memoria: El Nacimiento De La Escuela Levino Cândido

Janirza C. da Rocha Lima [1]

Resumen

Investigación realizada con el objetivo de producir una cartografía de la memoria de las instituciones escolares del semiárido nororiental y de los sujetos de esas escuelas, con foco en las dimensiones de las prácticas pedagógicas y de gestión y sus transformaciones. El municipio de Afogados da Ingazeira fue elegido para el estudio inicial y la Escuela Municipal Levino Cândido fue el foco en la producción de este análisis.

En Brasil, los proyectos de memoria institucional surgen como reacción a las acusaciones de que somos un país sin memoria, donde el olvido es la fosa común donde reposan episodios y personajes, actores y acciones. Por ello, la comunidad intelectual emprende la tarea de preservar la memoria, deteniendo el olvido (NORA, 1993).

Es en el afán de buscar sus orígenes lo que mueve a distintos actores sociales en la recuperación de memorias particulares. Así, se consagran "lugares de memoria", que conviven en tres dimensiones: material, funcional y simbólica. En ese entretejido, los "lugares de la memoria" se caracterizan como un movimiento que articula Memoria e Historia, pues busca intencionalmente conservar las huellas, impidiendo la acción del olvido.

Dentro de estas formulaciones teóricas, encaja nuestra búsqueda por comprender la memoria institucional de la educación en municipios ubicados en el semiárido brasileño, en especial el municipio de Afogados da Ingazeira-PE.

Con el impedimento de realizar la investigación etnográfica, se optó por trabajar con documentos oficiales y/o institucionales. Se realizó un exhaustivo levantamiento bibliográfico sobre el tema.

Dos niveles guiaron el análisis de datos. En un primer nivel de análisis se tomaron los acervos documentales como indicadores de la memoria de la educación en el municipio y con ello plasmamos la dimensión cuantitativa. En un segundo nivel, se intentó mapear los temas privilegiados en los documentos mencionados y las posibles conexiones que tejen su acervo teórico-investigativo allí presente. Es una investigación que aborda la memoria institucional de la educación, de forma etnográfica y documental.

La escuela es pues sus muros imaginarios, su arquitectura, sus sujetos, personajes de una historia inconclusa pero en constante construcción.

Por otro lado, la escuela almacena gran parte de la memoria social como resultado de su cotidianidad y su temporalidad. A través de las memorias de docentes y estudiantes representa el momento de todo aprendizaje, como normas, transmisión de valores, uniformes, caminos recorridos hacia el mismo, juegos y desafíos, experiencias con el grupo, material didáctico utilizado y otros hechos que cobran sentido en relación social con la vida cotidiana de estos protagonistas escolares. Esto muestra que como lugar de memoria es a la vez simbólico y material. Los lugares, los edificios, los uniformes y los objetos sólo cobran pleno significado a partir de las relaciones sociales que se dan en la vida cotidiana.

En Brasil, los proyectos de memoria institucional surgen como reacción a las acusaciones de que somos un país sin memoria, donde el olvido es la fosa común donde reposan episodios y personajes, actores y acciones. Por ello, la comunidad intelectual emprende la tarea de preservar la memoria, deteniendo el olvido (NORA, 1993).

Esto se puede observar tanto en Universidades como en Centros de Investigación donde se forman grupos de investigadores a partir de la temática de investigación de las fuentes documentales,

Palabras clave: memoria institucional; semiárido; educación contextualizada

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tales como: el Núcleo de Historia Oral de la Universidad Federal de Pernambuco, el Núcleo de Documentación e Información Histórica Regional - NDHIR de la Universidad Federal de Paraíba, Núcleo de Documentación y Cultura de la Universidad Federal de Ceará, Centro de Memoria Unicamp, Centro de Investigación y Documentación de Historia Contemporánea de Brasil - Cpdoc de la Fundación Getúlio Vargas y de la Fundación Joaquim Nabuco, Centro de Documentación y Estudios de la Historia Brasileña Rodrigo de Mello Franco de Andrade - Cehibra.

Por lo anterior, el estudio de la memoria como posibilidad de vestigio, de registro que se hace y se rehace en la riqueza de la experiencia humana ha sido objeto de interés en la discusión historiográfica en un intento de crear campos documentales a partir de su registro. . Esto sucede porque la memoria es vista tanto en su carácter selectivo -al privilegiar ciertos registros- como en su carácter de creación -porque puede ser producida con objetivos bien definidos.

Es en el afán de buscar sus orígenes lo que mueve a distintos actores sociales en la recuperación de memorias particulares. Así, se consagran los "lugares de la memoria", que conviven en tres dimensiones: material, funcional y simbólica. En ese entretejido, los "lugares de la memoria" se caracterizan como un movimiento que articula Memoria e Historia, pues busca intencionalmente conservar las huellas, impidiendo la acción del olvido.

Es dentro de estas formulaciones teóricas que se inscribe nuestra búsqueda por comprender la memoria institucional de la educación en municipios ubicados en el semiárido brasileño, en especial el municipio de Afogados da Ingazeira-PE.

El objetivo principal de la investigación fue producir una cartografía de la memoria de las instituciones escolares del semiárido nororiental y de los sujetos de esas escuelas, con foco en las dimensiones de las prácticas pedagógicas y de gestión y sus transformaciones.

El proyecto de investigación abarcó 5 (cinco) municipios distribuidos de la siguiente manera: Curaça y Casa Nova, en Bahía y Cabrobó, Santa Maria da Boa Vista y Afogados da Ingazeira, en Pernambuco.

La pandemia de Covid 19 llega a Brasil en marzo de 2020. A raíz de los hechos, el alcance de la investigación tuvo que ser redimensionado. La opción fue elegir el municipio de Afogados da Ingazeira como estudio inicial. El programa de investigación se vio afectado y el trabajo de campo se vio muy afectado.

Con el impedimento de realizar la investigación etnográfica, se optó por trabajar con documentos oficiales y/o institucionales. Y se realizó un exhaustivo levantamiento bibliográfico sobre el tema. La trayectoria metodológica de la investigación se basó en el método cuantitativo y cualitativo para cumplir con los objetivos propuestos para la Escuela Municipal Levino Cândido en la aldea de Carapuça, en el municipio de Afogados da Ingazeira.

Dos niveles guiaron el análisis de datos. En un primer nivel de análisis se tomaron los acervos documentales como indicadores de la memoria de la educación en el municipio y con ello plasmamos la dimensión cuantitativa. En un segundo nivel, se intentó mapear los temas privilegiados en los documentos mencionados y las posibles conexiones que tejen su acervo teórico-investigativo allí presente. A la luz de la advertencia de VENTORIN, comprender cómo se manifiesta [una] producción no es hacer un diagnóstico definitivo ni proponer soluciones a partir de ella, sino buscar sus significados y su movimiento interno (2005 p. 56). Es una investigación que aborda la memoria institucional de la educación, de forma etnográfica y documental.

En el silencio de la escuela se construye la memoria...

Las escuelas almacenan gran parte de la memoria social como resultado de su cotidianidad y temporalidad. El conocimiento del universo escolar posibilita comprender las instituciones escolares más allá de sus finalidades (docentes) específicas, percibiéndolas como territorios de lento aprendizaje del mundo exterior, o sea, una educación más allá del aula, educación para la vida .

La trayectoria de vida de una institución escolar también permite seguir toda la constitución de un proceso educativo y un clima cultural fechado y localizado. Tienen una identidad propia, llena de historicidad, que permite construir, sistematizar y reescribir el itinerario de vida de una institución (y de las personas vinculadas a ella), en su multidimensionalidad.

Hace 73 años nació la unidad escolar Levino Cândido. En ese contexto, la Escuela Municipal Levino Cândido, locus de investigación, con su edificio modelo FNDE, sirve como documento de hechos pasados que refleja valores, ya que aún conserva el nombre del donante del terreno escolar - Levino Cândido.

Imagem 4: Do trabalho Projeto de Intervivência Pedagógica apresentado no Seminário Socializando Vivências. Foto de Levino Cândido.

Volvamos a las páginas del tiempo... Corría el año 1949. Llegaron a Carapuça dos familias propietarias de tierras, una de las cuales era el Sr. Levino Cándido. Dona un terreno para la construcción de una escuela en el pueblo de Carapuça. La escuela lleva el nombre de su benefactor: Grupo Escolar Mínimo Levino Cândido.

A lo largo de los años, las inversiones se realizaron a través de la acción de los alcaldes: José Rodrigues de Brito, que construyó la escuela y João Alves Filho al realizar la primera reforma en 1964. y bajo la dirección del Dr. Orisvaldo Inácio da Silva (1992) realizó la segunda reforma del edificio con ampliación.

En un principio, las limitaciones de las instalaciones físicas y la falta de equipamiento en el edificio dificultaron realizar una mejor labor pedagógica, sin embargo, no imposibilitaron que la dedicación de tantos educadores diera sus frutos.

La escuela tuvo como primera maestra a Maria José do Nascimento (Zeza) que enseñó a aproximadamente 20 alumnos. Las dificultades fueron muchas, pero este educador vino de la sede del municipio de Afogados da Ingazeira con el objetivo de llevar educación formal a niños y jóvenes, hijos e hijas de agricultores.

Los maestros comenzaron a venir de la ciudad en 1975. Por las condiciones de acceso al pueblo, el camino era el cauce del arroyo a Queimada Grande y el transporte en un principio era animal.Se ubica la nueva escuela. Los maestros se quedaron en el pueblo toda la semana y regresaron a sus hogares el fin de semana en un Jeep. Con el tiempo, muchos maestros se casaron y se establecieron en el pueblo. Hoy la Casa de Apoyo estuvo cerrada.

La profesora Nininha enseñó de 1977 a 1984 y se casó con un chico de Carapuça, permaneciendo enseñando en el pueblo. Según un entrevistado, ella era muy estricta y castigaba a los alumnos, porque había un remo.

Consta que en 1988 había dos turnos en la escuela y en cada turno había más de 60 alumnos en el salón de clases.

Un hecho llamativo fue la elevación de la escuela a la categoría de Enseñanza Básica de 5º a 8º grado, en 1991, bajo la gestión del alcalde Orisvaldo Inácio da Silva y la secretaria de Educación Lúcia Maria Queiroz Campos, que en ese año inscribieron 70 alumnos en dos clases de 5to grado.

En el pasado, la propia escuela resolvía problemas disciplinarios, tales como: daños a la propiedad y frecuentes peleas entre estudiantes. Incluso hubo expulsiones de estudiantes. No había dirección en la escuela. Esta posición se crea en 1992.

Cabe señalar que el proceso democrático para la elección de los directores de la escuela Levino Cândido comenzó en 2010 y continúa hasta el día de hoy.

La escuela pasó a tener la modalidad de 5º grado y en 2003 comenzó el proceso de nucleación absorbiendo las escuelas de las siguientes comunidades que estaban cerrando sus actividades: Portásio, Inveja, Serrote, Leitão da Carapuça, Encruzilhada.

En 2011, la Escuela ganó el PDE INTERATIVO con fondos por el valor de R$ 33.000,00. Los recursos recibidos se aplicaron en los años 2012/2013, para mejorar la estructura física y la calidad de la enseñanza y el aprendizaje.

En 2012, la Escuela estaba contemplada con los programas PDDE CAMPO por valor de R$ 15.000,00 que fueron invertidos en la estructura física y calidad de la enseñanza. Ese mismo año, recibió un recurso de R$ 10.000,00 para estructuración accesible, que fue aplicado.

En 2013, la Escuela ganó el Programa Más Educación con un presupuesto de R$ 24.660,00. Los fondos recibidos se destinaron a la compra de material didáctico y pago de monitores para talleres en el macro campo: Cultura, Educación Artística y Patrimonial, Deporte y Ocio, Agroecología y Seguimiento Pedagógico.

En 2014, la Escuela ganó el Programa Atleta en la Escuela con un valor de R$ 1.288,00 que se invirtió en la compra de insumos utilizados por los alumnos en la práctica del atletismo en la Escuela.

La única fuente de recursos con la que cuenta la escuela es un convenio firmado con el Fondo Nacional de Fomento de la Educación (FNDE) a través del Programa Dinero Directo a la Escuela, con la creación de la Unidad Ejecutora con una transferencia anual de recursos para aplicación en la adquisición de Material consumible.

El 5 de julio de 2015 fue inaugurado el nuevo edificio de la Escuela Municipal Levino Cândido. La nueva escuela fue construida con recursos del FNDE en colaboración con el gobierno municipal de Afogados da Ingazeira a partir de un proyecto presentado por la Secretaría Municipal de Educación.

Prédio da antiga escola

Foto: Edilene B. Pinto

Prédio da antiga escola

Foto do acervo da pesquisa

Escola Municipal Levino Cândido

La escuela está compuesta por 11 profesionales de la educación distribuidos de la siguiente manera: 9 (nueve) tienen una especialización, 1 (uno) tiene un título de maestro y el otro tiene un título, organizados de la siguiente manera:

2 (dos) docentes de Educación Infantil

3 (tres) docentes para los Primeros Años

6 (seis) docentes para los Años Finales

Un dato interesante a mencionar fue obtenido de conversaciones informales en la sala de profesores: una alumna de la ex escuela Levino Cândido, hoy es maestra de jardín de infantes y profesora de

Matemáticas de la ex escuela y, después de 19 años sin enseñar en Carapuça, vuelve a la nueva escuela. Y hay más: las familias que se mudaron a la sede del municipio no inscriben a sus hijos en las escuelas de la ciudad y se quedan estudiando en la escuela Levino Cândido.

El piso de la escuela... Levino Cândido

Podemos decir que el espacio no es neutral. Trae consigo huellas de relaciones sociales entre personas, símbolos, signos, lenguajes y discursos que muestran su producto cultural. Esto es lo que vemos en la escuela-espacio, la construcción de relaciones a través del uso del espacio.

Pensar este espacio es verlo como un escenario de relaciones e intereses individuales que se entrecruzan a partir de las relaciones que se establecen entre directivos, docentes, estudiantes y la comunidad escolar en su conjunto. Al ser considerada como una construcción social y cultural que expresa y refleja, más allá de su materialidad, determinados discursos, según Frago & Escolano (2001).

Se reafirma aquí que la estructura construida externa e interna inscribe un poco de la historia y constitución de los valores sociales, culturales, religiosos y políticos de una época. en palabras de DAYRELL (1997), el espacio arquitectónico de la escuela expresa una determinada concepción educativa (p. 147).

La escuela tiene su materialización tanto en la arquitectura interna como externa, lo que nos hace pensar que la construcción del espacio se debe a los diversos signos e impresiones de la sociedad y del propio ambiente escolar.

Esta concepción va más allá de mostrar, materializar y visibilizar funciones culturales y pedagógicas. También está presente en las metodologías que se utilizan en la escuela, como ocurre con la metodología Montessoriana que organiza la clase teniendo en cuenta el espacio y el material que utiliza el niño.

Los espacios existentes en una escuela tienen importancia no sólo como espacios físicos distribuidos en un edificio, sino y, principalmente, por lo que posibilita como herramienta educativa. Es indispensable convertirlos en ambientes que promuevan y revelen el aprendizaje, entre ellos podemos mencionar: paredes, fachadas, aulas, patio, baños, cafetería, laboratorios. Lo importante es ofrecer un ambiente acogedor, organizado, limpio y agradable para todos los asistentes. Así como necesitan comunicar la propuesta pedagógica, lo que están aprendiendo los estudiantes y cómo los docentes están desarrollando dichas propuestas de trabajo contenidas en el Proyecto Político Pedagógico (PPP) de la Escuela. Por lo tanto, se cree que este conjunto de acciones mejora la convivencia, la interacción y la armonía entre toda la comunidad escolar.

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The Climate Change and Early Childhood Care and Development Nexus: A Case of Eswatini

Novuyo Nkomo (1)

Abstract

Alive to the fact that while early childhood care and development (ECCD) is a critical time in the ultimate development of young people and aware that there is a dearth of research studies on the implications of climate change on the ECCD, this study sought to unpack and appreciate these in the context of the low-income development country, the Kingdom of Eswatini. The study used a participatory approach centred around variations of the interview method that extracted relevant data from ECCD practitioners from two National Care Points (NCPs) in the Manzini region of the Kingdom. Key informant interviews (KIIs) with Ministry of Education and Training officials and focus group discussions (FGDs) with ECCD learners, parents and teachers constituted the qualitative means data were collected and subsequently analysed to generate findings. Among some of the major findings of the study was the fact that there is an awareness of the increasing challenges occasioned by climate change by Eswatini ECCD practitioners, particularly as the Kingdom is largely rural and dependent on agriculture. It further emerged that ECCD learners are vulnerable to the effects of extreme weather phenomena including flooding, heat waves and famine due to their age-vulnerability matrix which means they cannot negotiate their way on their own. The study also found that damage to learning infrastructure because of weather extremities continues to compromise ECCD learners' access to ECCD service and this does not augur well for their futures. Finally, the study found that the learners' psycho-social development is understood as under-cut with negative impacts on the Kingdom's farming heritage as it means diminished access to nutrition to the children most in need of it to have a solid basis for growth.

1.0 Introduction

Climate change is one of the most pressing global challenges of our time, with far-reaching implications for the environment, society, and future generations. In addressing climate change, early childhood education plays a critical role in shaping the attitudes, knowledge, and behaviours of young children toward sustainability (Shulla, *et al.* 2020). By incorporating climate change education into early childhood curricula, we can promote environmental awareness, develop a sense of responsibility towards the planet, and foster sustainable practices from a young age.

It is concerning that despite being more vulnerable, children have been largely ignored when it comes to exploring the impact of climate change on their development and well-being. However, a study conducted by Lam (2007) did identify a clear connection between health risks associated with global warming and younger students in the ECCD realm. This highlights the urgent need for further research in this area to ensure that the most vulnerable members of our society are protected from the negative effects of climate change. The study, for instance, found that there was an increasing number of ECCD learners being treated for fever and gastroenteritis at hospital emergency rooms (ERs) because of their age-related inability to regulate their bodies during extreme temperatures (ibid).

Keywords: Early Childhood Care and Development, climate change, accessibility, climate adaptation

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Abbreviations:

ECCD : Early Childhood Care and Development.
ECCE : Early Childhood Care and Education.
ECD : Early Childhood Development.
ERs : Emergency Rooms.
FBOs : Faith-Based Organizations.
FGDs : Focus Group Discussions.
NCPs : Neighbourhood Care Points.
NGOs : Non-Governmental Organizations.

Undoubtedly, climate change is one of the most persistent and pressing problems that the world is currently grappling with, (Bhatasara, and Nyamwanza, 2018). It has far-reaching implications for the sustainable development of all nations and has been aptly dubbed a "super wicked problem" by experts. Fernandez, Thi, and Shaw, (2014), postulate the effects of climate change as being extensive and unprecedented, ranging from rising sea levels and catastrophic flooding to changing weather patterns that pose a threat to food security. In light of these alarming findings, I conducted a qualitative participatory study to investigate how Eswatini manages climate change and how it affects issues related to early childhood care and development (ECCD).

2.0 Understanding the Impact of Climate Change on ECCD Services

As the world continues to grapple with the climate change crisis, there is increasing concern over the future of children born in this era. Dora (2020) notes that children born in the 2020s are likely to live until 2100, when - based on the current trajectory of greenhouse gas emissions – temperatures will have risen by up to 4ºC, in the same vein, Collins *et al.*(2013) add that rising sea levels will have flooded coastal areas, and extreme weather will have dramatically affected agricultural production and water scarcity. Over the coming years, therefore, children are most likely to grow up in an environment of worsening vulnerability posing a threat to their lives, welfare, and well-being. It, therefore, follows that the early childhood development (ECD) agenda will need to increasingly pay more attention towards the effects of climate change on children in early development, (Davis, 2007). This is more so in developing countries where resilience to climate shocks is weak and there are inadequate resourcing and response frameworks against climate change in general, (Dhiman, Pahwa, Dillon, and Dash, 2010). Zimbabwe and Eswatini present cases in point, (World Bank, 2021) where in both cases for instance, climate change-induced rainfall pattern extremes (droughts and floods) have been shown to negatively affect agricultural production, food security, water management, the integrity of infrastructure and public health, with women and children bearing the worst brunt (Maundeni, 2013).

Parents play a crucial role in their child's development, starting from the home environment. Parents who received an education during their childhood are more likely to prepare their children for school, whereas those who did not receive an education may struggle to do so. It's difficult for children who are not ready for school to adjust, and they often end up dropping out. The success of primary education and lifelong learning depends on the implementation of early childhood and community development (ECCD) Roy, Dev, Sheheli, and Education, 2019). The importance of the early years in creating sustainable societies is increasingly recognized in global development frameworks. Therefore, high-quality early childhood education is essential, and programmes are credited with having a positive impact on the child, family, and societal outcomes. The Constitution of the Kingdom of Eswatini recognizes education as a basic human right by stating that every Swazi child has the right to free education in public schools. Stakeholders are recognizing and promoting the fact that education can leverage significant improvements in the lives of children as the present and future generations. Whilst, education benefits the individual child, it can also serve as an important tool for the development and empowerment of the child.

A strong motivation for Eswatini to invest in integrated ECCD is that a significant proportion of children have a poor start in life and, thus are unable to attend preschool education and the country experiences high rates of grade repetition in primary schools, thus, speculated Bisschoff and Botha (2015). Research from around the world has shown that a child's early experiences have a profound impact on a nation's ability to develop its human capital. The success of this development is largely dependent on the possession of highly developed human and capital abilities. According to Marope (2010), investing in children provides a better return on investment than investing in adults with poor skill levels. Against this backdrop, ECCD in the Kingdom of Eswatini is offered in pre-schools, Neighbourhood Care Points (NCPs), Ka Gogo Centres, as well as in day/home-based care centres (World Bank, 2011). These are usually funded by communities, faith-based organizations (FBOs), nongovernmental organizations (NGOs),

and private individuals. Most preschool centres are incapable of facilitating teaching learning and care for children. Pre-school teachers and caregivers often do not have the adequate skills and knowledge required to teach and care for young children or facilitate their development (Gita and Israel, 2010).

ECCD, which is an integral part of the education and development of the child, is not widely accessible or affordable to most families and children in Eswatini (Government of Swaziland, 2009). This is despite the observation by Goodman and Altus (2009) that the early years are the most crucial years to introduce education for sustainable development, thereby instilling values that are aligned with care and stewardship for the planet. This is especially pertinent to the extent that the world is characterized by instability, complexity, rapid change, and high inequality (IPCC, 2007 and Jafino *et al.* 2020), coupled with climate change and loss of biodiversity, resource depletion and unsustainable consumption.

Innumerable challenges face the education of young children; amidst many are poor quality teacher development, low levels of parental involvement, as well a poor learning environment, (Stein, and Stein, 2021). As indicated earlier, there have been no major developments in the ECCD landscape, thus, quality remains a problem, echoes Tabi (2013). Though there are centres that operate in a first-world environment, others survive under conditions that no child should find themselves in; they lack learning resources and physical learning and playing space amongst many challenges, and these are integral to ECCD, (Bhatasara, and Nyamwanza, 2018).

Climate change has a serious impact on Eswatini's early childhood service delivery, and it needs to be addressed urgently stated Dube and others. According to the literature, several potential effects of climate change might hinder Eswatini's early children programs' accessibility and reach, (Chevallier, 2010). These effects may include more frequent droughts and erratic precipitation patterns, which might lead to food shortages and a lack of healthy food for young children, (Maddison, 2006). Furthermore, extreme weather events like heat waves and floods can damage transportation networks and infrastructure, which can create difficulties for families in need of early childhood programs argued Duenas and Ochoa, (2016). Notwithstanding the vulnerability of children, few studies have investigated how climate change affects child development and well-being in the Kingdom of Eswatini.

3.0 Theoretical Framework Informing the Study

The research is informed by a social-constructivism theory. Social constructivists such as Lev Vygotsky, and Jerome Brunner, among others, argue that an individual's mind is in a state of continuous development. Vygotsky's major research interests involved associating thinking and the development of language learning in young children (Crain, 2009). According to Shaw (2006), the sociocultural strategy for understanding cognitive growth in the early years was the brainchild of Vygotsky. According to Vygotsky, a developing child is influenced by both their social and physical environment (Lloyd & Fernyhough, 1999). Hence, Allahyar and Nazari (2012) highlight the significance of considering biological aspects in relation to their social context, rather than solely focusing on them, in the training of ECCD specialist instructors.

It happens through the social interactions that children have, as they explore the new world they come across while striving to make sense of it. It is through social stimulation that the sharpness of intellectual faculties is honed. These are the reasons why young children, in what experts have characterized as the informal curriculum, usually pick up values and norms that are consistent with those of the society in which they grow up. The environment in which a person is exposed, be it physical or otherwise, influences how that person relates to it.

4.0 Research Gaps

What is however not clear is the direct effects of the various climate-change-induced extremities on ECCE-specific indicators, such as the children's:

- access to adequate and quality food, nutrition, and health services

- access to adequate water and sanitation facilities
- access to safe learning environments (looking at road and bridge infrastructure access to integrity of schooling infrastructure)

Further, there is a need to analyse the extent to which climate change coping mechanisms pay any consideration to mitigating impacts on children, on matters such as:

- Rehabilitation of damaged school infrastructure
- Promotion of resilient and climate-smart agriculture at the household level
- Supporting supplementary feeding for ECCE children
- Provision of psycho-social support targeting children where there have been severe impacts of climate change-induced hazards affecting households

It is imperative to examine national response frameworks to determine whether Early Childhood Care and Education (ECCE) should be considered as a significant component of a larger plan to mitigate climate change. Furthermore, to reinforce the case for economic models that prioritize early childhood development, it is crucial to obtain improved data on the connections between ECCE and sustainable climate policy. This is especially critical as the world is currently engaged in discussions regarding a sustainable and affordable post-COVID-19 economic recovery, opines, Attali, (2020).

4.1 Effects of Climate Change on Early Childhood Services

4.1 1. Effects on Food Security and Nutritional Vulnerabilities

A widespread and overwhelming impact of climate change in Africa is food insecurity, with predictions of frequent emergencies, (Gray and Mueller, 2011). A strong link exists between climate change-induced weather conditions and uncertainty of food provisions due to the changes in growing seasons, interpolated with increased droughts and floods that destroy food crops. When compared with adults, children are physically more susceptible to the direct effects of extreme heat, drought, and natural disasters, it is within this broad purview that (Lam, 2007 and Davies, 2007), opine that climate change's indirect effects can also derail children's developmental trajectories, for instance, through conflict, vector-borne diseases, economic dislocation, under-nutrition, or migration—making it harder for them to reach their full potential, (Dhiman *et al.*, 2010).

4.1.2 Effects on Education

In the wake of natural disasters, young children who cannot relocate far from their homes are severely impacted, particularly when it comes to education. The infrastructure supporting education is often damaged, causing education systems to collapse entirely. School buildings, as well as the water, sewage, and electricity systems, may sustain damage, and resources may become limited. This according to a UNICEF report paper, can turn schools into physically dangerous locations, and it may take a significant amount of time to rebuild them, causing instruction to stop completely, (UNICEF. (2013). In times of disaster, schools may also be commandeered as a refuge for communities displaced by the catastrophe, similar to how they are frequently used for military operations during times of conflict. Due to a lack of infrastructure, governments may offer internally displaced children schooling outside of the official system in response to disasters.

A UN climate report underscored how the dire climate crisis is indisputably and irrevocably caused by humans, and that there is a need to act now to alleviate the global crisis, (Gray & Wise, 2016). There is an urgent and largely unacknowledged education crisis that starts in the early years, consequently, the climate change crisis in early childhood does not affect people equally. The gaps in the early years of life are more pronounced across income and race, (Mishra, 2019). Three in four children from moderate and high-income families are estimated to be kindergarten-ready, compared with less than half of children from low-income backgrounds. Climate change is one of the most significant threats to our economy, society and environment and it is likely to have implications for current and future generations if left unaddressed.

4.1.3 Effects on Health

Potential connections also exist between climate change and early child development through extreme weather events, droughts, floods, forest fires, heat, changes in vector-borne and infectious diseases, and changes in access to food and water, (Lam, 2007). Air pollution, which affects children's cognitive and physical development, is an especially notable link with climate change. It has many of the same sources as greenhouse gases, but it can be more easily measured by citizens and used for local accountability. Potential connections also exist between climate change and early child development through extreme weather events, droughts, floods, forest fires, heat, changes in vector-borne and infectious diseases, and changes in access to food and water.

5.0 Study Objectives

In the context of this study, the research had the following objectives:

- To assess how climate change-induced extreme weather patterns affect access to ECCD learning centres.
- To establish the effects of climate change-induced food security on food and nutritional requirements for ECCD learners.
- To assess the gap between current provision and access and the international and national targets of full access to quality ECCD, especially by the most vulnerable children.
- To draw lessons and best practices from the country cases that have adequately responded to support policy response in developing countries such as Eswatini.

6.0 Methodology

This research was conducted by utilizing a mixed-methods participatory action research approach that appropriately combined elements of qualitative and quantitative approaches. For example, this involved the use of qualitative and quantitative viewpoints, data collection and analysis as well as inference techniques (Johnson *et al.*, 2014). This was done for breadth and depth of understanding and verification. In the same vein, Creswell defines a mixed-methods participatory action approach as a methodology which involves the mixture of qualitative and quantitative approaches in many phases in the research process of a single study (Creswell, 2014). This means each of the methodologies complements the other. A qualitative study was conducted to explore and understand the nature of the phenomenon of interest, (Merriam, 1998). The phenomenon of interest in this instance refers to the climate change and Early Childhood Development nexus as in the case of Eswatini which is likely to have implications for current and future generations if left unaddressed. The qualitative study was conducted on a smaller sample of caregivers and other participants which include health care and welfare professionals, and ECCD practitioners.

6.1 Research Design

A research design is perceived as varied plans of enquiry contained in the different approaches, while it is understood by Eriksson and Kovalainen, (2016) as selected based on the nature of the problem or issue being addressed, the researcher's encounters and the target group of the study. On that note, this study was conducted in two NCPs, all located in the Manzini Region, following a multiple case study research design. The primary data were gathered through (6) key informant interviews (KIIs) with (2 ECCD teachers based in the NCPs, 2 parents working/assisting at the NCPs and 2 Ministry of Education and Training responsible for ECCD). The KIIs sessions generally sought participants' views about the effects of climate change on the provision of accessibility to ECCD services in Eswatini. Key informants were interviewed at their workplaces. A trained officer conducted the interview and captured all the responses and comments made by each interviewee. Interviewees were further asked to follow-up questions for probing and elaboration. The interview schedule was used because it allowed the researcher to probe and get clarity from the responses. Secondary data such as attendance records, local and national NCP reports and Ministry of Education and Training data were analysed as part of the research process.

On the other hand, the study conducted (2) focus group discussions (FGDs) and each discussion was made up of (6 participants) (that included 2

Table 1: Study participants

	Study participants	Frequency
1	ECCD Teachers	4
2	Ministry of Education and Training Officials	4
3	ECCD students' parents/caregivers	4
4	ECCD students with parental consent	4
	Totals	**12**

Source: Developed by the author

community members who work with children at the NCPs, 2 ECCD teachers/caregivers and 2 Ministry of Education and Training responsible for the ECCD programme). More conveniently, Flick (2014) state that focus groups provide another means of acquiring information where participants are given opportunities to describe and present their perspective on the issue discussed. In this study, this method proved convenient as well as inspiring as it not only allowed for the simultaneous collection of information from many people but facilitated an exchange of ideas and thoughts amongst the participants as well as with the researchers. This resulted in data collected having richness and interrogated richness individual interviews lacked.

A sample of (6 interviewed, 6 FGDs participants) was extracted from the two NCPs for this study. The sample was largely selected using purposive considerations around participants' proximity to the issues under review, availability as well as willingness to participate. The study participants were disaggregated as shown in the table above.

6.2 Research Method

An adjustable tool used for collecting data as it enables multi-sensory processes to be employed was used as the semi-structured interview schedule used to collect data from the key informants individually. Notwithstanding the fact that circumstances where interviews are used as data-gathering instruments vary from context to context, the most common understanding is that there is a considerable rate of information exchange between the researcher and the respondents (Cohen *et al.*, 2011) and the exercise with the key informants proved this to be true. Data was collected holistically through semi-structured interviews with parents, caregivers and children attending the selected NCPs. It needs to be emphasised that the children who participated did so with the express permission of their parents and/or caregivers as they cannot proffer informed consent. Additional respondents were officials from the Ministry of Education and Training.

7.0 Research Findings and Discussions

This section discusses the findings in line with the objectives of the study. It also recommends strategies that can be used for the successful mitigation of challenges faced by communities because of climate change in Eswatini. Though McMillan and Schumacher, (2010), confirm that data is portrayed as being chaotic, vague, and laborious, data analysis involves organising and bringing order and meaning to masses of gathered data. When compared with adults, children are substantially more susceptible to the discernible effects of climate change in extreme heat, drought, or other natural calamities. Conversely, climate change's indirect effects can also disrupt children's developmental trajectories, for instance, through economic disturbances, under-nutrition and

food challenges, health issues and many others, making it harder for young children to reach their full potential.

7.1 Effects of Extreme Weather Patterns on Access to ECCD Services by Young Children

Young children in Eswatini are very vulnerable and particularly suffer high rates of death, and inequality because of climate change, Calow, Bonsor, and Jones, (2011) observed that those situated in rural setups are the most affected; they lack access to safe water and adequate and proper sanitation, food, housing, education facilities and health care centres. There are significant implications in their childhood development. The sentiments are shared by most participants in different centres. Lack or shortage of resources was cited by the participants across all the research sites, they all commented and expressed challenges learners encounter in both material and human form. Depleted resources due either to too many rains or lack of adequate rains leave young ECCD children in much-comprised positions. A participant in a rural NCP located in Manzini region categorically expressed the concerns, saying:

> When it rains a lot, some children are unable to attend school, because they need to cross the river. The inconsistency in the food supply has reduced the numbers. We have two classrooms, but we only use one class. It is difficult to care for many when the resources are very limited. We told those who are more than six years old not to come to the centre. The poor attendance results in less firewood even when the food is available. Children bring firewood to school every day which is used to prepare the meals.

The climate changes in the climatic conditions do affect children's schooling outcomes in many indirect ways. The extreme weather conditions experienced in Eswatini impact children's education during early life as well as later years in shaping outcomes in child health and nutrition. Participants attributed the failure of children to attend the NCPs to the resultant climate change-induced unpredictable weather patterns. Participant NCP CO2 noted that the availability of food in the centre sustains children in the centre because parents send children to the NCP both for learning and feeding purposes.

7.2 Effects of Extreme Weather Patterns on Infrastructure at ECCE Learning Centres

In the case of Eswatini, the effects of climate change on young children should be tackled from a wider dimensional view due to the extensive developmental pressures that affect the nation, (Marope, 2010). Specifically, economic shocks and stresses, poverty and inequality, issues of high HIV/AIDS cases, as well as management of scarce natural resources each interact with climate change challenges. The participant expressed concerns about the impact on children and said...

> ...there was too much rainfall; the roof was destroyed by the storms. Nothing has been done so far. We reported at our offices, but nothing has been done. The caregivers who prepare food were left without shelter. They cook in the open space

> ...the infrastructure at the centre was damaged by the heavy rains and hail- storms, meaning there was hardly any learning taking place. Most of our teaching and learning aids were affected by the rainfall as the building roof was damaged. The roof has visible holes due to the storm...

Positively, early childhood educators in Eswatini acknowledge, understand, recognise, and try to address the challenges that climate change poses; they do develop climate-specific experiences with children in different NCP centres to address needs related to food, energy, weather, and water. However, their efforts need to be complemented for higher yields to be realized: Participants lamented the financial constraints in mitigating the challenges and had this to say...

> ...we have a vegetable garden, but we always get very little food due to the unpredicted weather patterns. We grow vegetables but most of the time, we get very little due to lack of water. There is a water project that we use in the community but sometimes the pump does not work due to the low level of water.

7.3 Effects of Food Security on Food and Nutritional Requirements for ECCE Learners

According to McSweeney, New, and Lizanco, (2007), evidently, a decline in food production and a rise in food prices will aggravate the rate of malnutrition and stunting, in young children. Agricultural production that is reduced due to droughts, heat, or floods negatively affects the nutrition of young children. Diallo, Donkor, and Owusu (2020), furthermore add that a threat to children's health is inevitable as adverse effects of food supply shortages that occur in low-income countries may spread yonder hunger and malnutrition.

Participant NCPT 1 shared the viewpoint that:

> Households that depend on agricultural output, suffer losses to income and food security caused by severe droughts or heat waves. They may not have enough money to pay school fees or may pull their children out of school to help earn additional income. During severe droughts, girls may miss school because they must travel longer distances to collect water or may be married off at an early age, which often coincides with dropping out of school. In addition, entire families may migrate in search of food, water, and employment, pulling their kids out of school.

Notably, not investing in early childhood has consequences for their future, for example, children who attend high-quality early childhood programs benefit well into their adult years. The same cannot be said about children affected by climate change impacts. Participant MCNCPT concurs:

> When it rains a lot, some children are unable to attend school, because they need to cross the river. The inconsistency in the food supply has reduced the numbers. We have two classrooms, but we only use one class. It is difficult to care for many when the resources are very limited. We told those who are more than six years old not to come to the centre.

Malnutrition has significant effects on child development. The chances of children becoming malnourished increase with frequent exposure to disasters such as the slow onset of droughts and rapid onset floods, (UN, 2010). Closely tied to the conditions are the levels of households which may be impacted by climate change effects leading to the loss of livelihoods, and the inability to provide children with nutritious diets. Shortages of food can be triggered by reduced rainfall, flooding and other extreme weather changes that may affect agricultural outputs. A participant at another centre bemoaned the scarcity of appropriate food resources: She said...

> The area is naturally dry of late. We grow crops but the yields are very poor. Children have nothing to eat both at home and at the centre. We also cook the little that is available to keep them going. The numbers are increasing at the feeding centre. They come after school to feed for the evening.

Participant MCNCPT had to add that:

> This area used to have flowing rivers, but they have since dried up. Crops are no longer growing properly. People used to practise farming and they would sell for additional living costs. But now very little food is produced and ECCD centres like this one depend on sponsorship as parents cannot afford to contribute to the upkeep of the centre. The lack of food limits the number of children coming.

Early childhood development and climate change are interconnected in many ways with mutual benefits. An observation by Westwood *et al.*(2011) was that climate change poses a threat to the achievement of crucial development goals, such as the Millennium Development Goals, as well as sustainable development. Additionally, development pressures often exacerbate the impacts of climate change. People do not usually respond directly to climate change. Instead, climate change indirectly affects households through other development-related processes, such as food price increases, disease outbreaks, and conflicts over natural resource management. Another participant pointed out the effects of climate change, she highlighted how they used to adequately feed all the children at the centre, but then their sponsors

reduced the food quantities delivered though they still feed the children. She said...

> We used to prepare two meals for the poverty-stricken children to take home for dinner. We now provide one meal...

A clear indication of the dire need for intervention for young children. The results of this study unequivocally demonstrate that climate change can cause food shortages and reduced availability of nutrient-dense foods, leading to significant impacts on the physical and cognitive development of young children. This finding is consistent with a previous study conducted in South Africa, which concluded that rising temperatures make children particularly susceptible to natural calamities such as droughts and floods, which can have a devastating effect on their living conditions, (Stein, and Stein, 2021). Furthermore, climate change can exacerbate environmental pollution and result in house demolitions, further compounding the negative impacts on children, (Duenas, and Ochoa, 2016).

7.4 Climate Change-induced Hazards Affect the Living Conditions and Welfare of Children

Young children react disproportionately to the impact of climate change. Their vulnerability is multidimensional in nature as it is fundamentally shaped by the physical, social, and emotional changes that take place over the progression of childhood.

> ...many children are affected a lot by staying at home without going to school. Staying at home without your parents and even when they return, they do not fulfil your needs. Our children have stunted growth and the illness affects those taking care of the children. Some children have even lost people who were supportive of their livelihoods.

Climatic conditions can impact schooling outcomes in several different ways. In the most direct sense, extreme weather events such as tropical cyclones may destroy or damage school buildings, or schools may be used to shelter people who have been displaced from their homes. This leaves children temporarily unable to attend school, and some children may never return to their studies.

> Another sticking challenge is that some children reside across the community and must cross the river to reach school. When the river is flooded, they miss school. They cannot cross the river because they are small. They are unable to follow the stipulated curriculum due to lack of facilities leading to school... when the weather looks bad, we send them back home early when there is thunder... They miss lessons.

Extreme weather conditions may result in schools and childcare centres being destroyed or damaged or may just be shut down for an extended period. Khady (2007) expounds that in the city of St Louis in Senegal, which is prone to frequent flooding, schools take in flood victims, with several families sharing each classroom, and the school year is effectively reduced to a few months each year.

7.5 Climate Change-induced Hazards on the Physical and Psychological Well-being of ECCE Children in Eswatini

Extreme high temperatures anticipated under climate change may particularly be harmful to growing children. Calow *et al.*(2011) affirm that children are more susceptible to heat due to their physiological features, and also because they behave and react differently as compared to adults. Children's experiences, especially in the early years impact and affect their development, substantially in the ECCD phase. The experiences in the environment have the longest influence, (ibid).

The educational landscape of today's world is undergoing radical transformation with many changes that have been accelerated by pandemics and natural disasters. Currie and Deschênes (2016) point out that, compared with adults, children are physically more vulnerable to the direct effects of extreme heat, drought, and natural disasters. Climate change's indirect effects can also derail children's developmental trajectories, for example, through conflict, diseases, economic dislocation, undernutrition, or migration. This makes it harder for them to reach their full potential.

> ...when there is no school children have nothing to eat. The homes are without food. Some families are very poor. The lack of food at the centre is a problem because we are not sure when they will deliver. Sometimes the waiting can last for three months. So, children miss lessons for that period...

Sentiments of the participant at the NCP1, revealing the hardships children encounter at one of the centres. From this perspective, a positive reaction to changing climate and development pressures is required from all stakeholders as well as efforts and good coordination across multiple levels of governance, stretching from households and community, embracing municipal and provincial, to national and international levels. The outcome of such interactions will effectively remotely influence the transmission of climate change effects to children and households at the local level.

8.0 Lessons and Good Practices are Drawn from Support Policy Responses in Eswatini

Experiencing a natural disaster can destroy a family's home and sources of income, food, and clean water, leading to stress and limiting resources available for pregnant women and young children. Exposure to extreme weather events like these in early life impacts children during critical periods of development, potentially leaving them at an educational disadvantage compared to those who experienced more favourable climatic conditions. Food security has affected most families. They are now depending on buying but most people are not employed. The shortage of water is vast as the boreholes have also dried up.

Compared with adults, children are physically more vulnerable to the direct effects of extreme heat, drought, and natural disasters. Climate change's indirect effects can also derail children's developmental trajectories, for example, through conflict, diseases, economic dislocation, under-nutrition, or migration—making it harder for them to reach their full potential.

It is crucial to pay attention to the vulnerability of children under five years old, who are already more susceptible to poverty and hunger. This will help mitigate the impact of climate change on their access to social support networks. We need sustainable strategies that address this issue and aim to improve the current situation while also considering the well-being of future generations. These strategies should focus on promoting physical and environmental wellness, supporting full development, and preserving ecological and environmental values. By addressing the problems of food insecurity, malnutrition, and global warming, we can reduce poverty and new-born malnutrition sustainably and in harmony with the environment.

9.0 Recommendations

- Achieving net zero is necessary to mitigate the worst impacts of climate change in Eswatini. The world over there is an increase in the impacts of climate change, such as flooding, rising temperatures, and lack of food.
- For early childhood learners, education-based is practical experience through recycling and waste reduction programs or vegetable gardens are likely to be most impactful, nutritional gardens would be helpful.
- The range of resources available online aimed at educating the community about climate change would come in handy if educators can use these resources to arm children with knowledge, empowering them to make their own choices to create change.
- The greatest impacts of climate change are often felt by rural communities, which are already affected by droughts and flooding, thus climate change heightens the social and economic problems created by these disasters. It is recommended that education and awareness campaigns help Eswatini rural communities prepare and plan for disaster recovery and build resilience within communities to support affected children
- Remote rural communities are particularly vulnerable to climate change effects. With guidance from community elders and nurturing a child's needs can promote the creation of longer-term solutions that may contribute to mitigating the environmental and social impacts from climate change that arise in rural communities.

10.0 Concluding Remarks

The impact of climate change seriously hampers access to early childhood development for children in Eswatini. The absence of an early childhood education system leaves children ill-prepared to cope with climate change-related natural disasters. This could result in a lack of benefits for both themselves and their communities, and in the worst-case scenario, they may exacerbate the challenges associated with disaster risk reduction. The understanding of the impacts of climate change has significantly expanded, leading many stakeholders to develop innovative strategies to reduce its effects. Climate change is affecting daily life in Eswatini and across Africa, particularly in terms of access to Early Childhood Development programs. Several factors contribute to the issue of unequal access to ECD services for most children. This study highlighted that providing young children with a strong foundation in life is in the best interest of our nation and that young children are crucial to our nation's future, and it is our responsibility to provide them with the necessary services.

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392 La Realidad De Las Escuelas Y La Nueva Forma De Brindar Educación En Afogados En Ingazeira-Pe, Brasil

Edilene B. Pinto (1)

Resumen

Investigación que tiene como objetivo identificar la realidad de las escuelas de Afogados da Ingazeira-PE, a partir de los Indicadores de Calidad de la Educación, con foco en la práctica y evaluación pedagógica, el acceso y la permanencia de los estudiantes en la escuela y el ambiente físico escolar. El municipio se ubica en una región donde se busca implementar una propuesta educativa orientada a la convivencia con la región. También se realizó Formación Continua en Educación Contextualizada para la convivencia con el Semiárido con docentes, coordinadores pedagógicos y directivos escolares, que actuaron en Educación Básica en escuelas rurales y comunidades quilombolas de la red de educación pública.

La idea inicial era realizar la investigación en cinco municipios de la región semiárida brasileña, pero la pandemia de Covid-19 impactó la planificación del trabajo de campo, lo que llevó a un estudio de caso en el municipio de Afogados da Ingazeira-PE. Por tanto, fue necesario rediseñar el proyecto original.

El Municipio ya había mostrado interés en la propuesta de Educación Contextualizada para la Convivencia con el Semiárido (ECSAB), cuando participó del premio Reto Municipal Innovador en Educación, impulsado por Fundaj en 2017, presentando un proyecto a partir de esta propuesta educativa. Este fue el factor relevante a la hora de elegir el municipio.

Además, la Fundación Joaquim Nabuco (Fundaj) contó con una propuesta de Formación Continua en Educación Contextualizada para la Convivencia con el Semiárido, formateada con la Coordinación General de Políticas de Educación Rural del Ministerio de Educación (MEC) y miembros de la Red de Educación del Semiárido Brasileño. (Resab), que estaba incluida en el proyecto.

Esta formación consta de un curso de 160 horas estructuradas en cuatro Módulos de 40 horas, abarcando los siguientes temas:

Módulo 1 : El Semiárido brasileño.

Módulo 2: Historia y principios de la Educación y la realidad del Semiárido brasileño.

Módulo 3: Currículo y prácticas pedagógicas contextualizadas.

Módulo 4: Proyecto de intervención local.

Foto Edilene B. Pinto – Material entregado durante la Capacitación.

Palabras clave: Educación contextualizada; convivencia con el semiárido; calidad de educación; práctica pedagógica; Semiárido

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El Curso se realizó de forma remota y tuvo una duración de 25 días con clases en horario de mañana, tarde y noche, predominando los turnos de mañana y tarde. El trabajo pedagógico se realizó en dos momentos articulados: un momento sincrónico y un momento asincrónico. Siguiendo los procedimientos de las clases online expositivas y dialogadas, basadas en lecturas de textos y documentales; celebración de foros de discusión en el entorno en línea; estudios dirigidos (individuales o grupales); realizar investigaciones de campo o bibliográficas; seminarios temáticos y sistematización de artículos con posibilidad de presentación en eventos académicos y/o posterior publicación.

Como propuesta metodológica, el curso constó de encuentros modulares de capacitación fundamentados en los principios de la Educación Contextualizada para la Convivencia con el Semiárido, así como aspectos didáctico-pedagógicos que tuvieron como objetivo contribuir a la formación y calificación de la práctica pedagógica. La estructura del trabajo formativo fue diseñada para propiciar la articulación entre la teoría y la práctica vivida por profesores y educadores en su actividad pedagógica diaria en el aula.

Foto Edilene Pinto – El alcalde de Afogados da Ingazeira da la bienvenida a los estudiantes del Seminario de Finalización de Formación. Mayo/2022.

Las actividades se realizaron con el objetivo de construir un proceso participativo y dialógico, en la construcción de conocimientos sobre el currículo contextualizado, con el fin de construir un trabajo de articulación entre escuela y comunidad en el ámbito de la Educación Contextualizada para la Convivencia con el Semiárido. El curso concluyó con un seminario donde los participantes presentaron los resultados del aprendizaje adquirido durante la formación.

Participaron de esta capacitación profesores, coordinadores pedagógicos y/o gestores de escuelas municipales de Afogados da Ingazeira-PE, que actúan en Educación Básica en escuelas rurales de la red de educación pública y fueron seleccionados por la Secretaría Municipal de Educación.

Para desarrollar la investigación sobre la realidad de las escuelas del municipio, se decidió aplicar, vía correo electrónico, un cuestionario semiestructurado con 66 preguntas a los participantes de la Capacitación, ya que la pandemia de Covid-19 restringió el trabajo de campo. De la investigación participaron profesores y/o coordinadores pedagógicos y/o directores escolares de 15 (quince) escuelas rurales de Afogados da Ingazeira-PE.

El análisis de la realidad de las escuelas se basó en algunos indicadores de Calidad de la Educación, a partir de la definición de las siguientes dimensiones que guiaron la reflexión sobre la calidad de las escuelas en esta investigación: a) práctica pedagógica y evaluación; b) Acceso y permanencia de los estudiantes en la escuela y c) Ambiente físico escolar. Y en la dimensión "Práctica y evaluación pedagógica", con énfasis en ECSAB.

Los docentes que participaron en la Capacitación fueron exclusivamente de escuelas rurales y la información aquí presentada se referirá a estas escuelas. Si bien la propuesta del curso fue ofrecida a docentes, coordinadores pedagógicos y/o directivos de escuelas que actuaban en Educación Básica en escuelas urbanas y rurales de la red de educación pública, fue opción de la Secretaría de Educación Municipal priorizar a docentes de

escuelas del campo, como el municipio estaba trabajando en la redacción de su política municipal de agroecología.

La información obtenida fue analizada junto con las observacione s realizadas en el diario de campo de los viajes realizados por el equipo de investigación al municipio.

Foto Edilene B. Pinto - Libros Conociendo el Semiárido Vols. 1 y 2 (para Profesor)

escuelas del campo, como el municipio estaba trabajando en la redacción de su política municipal de agroecología.

La información obtenida fue analizada junto con las observacione s realizadas en el diario de campo de los viajes realizados por el equipo de investigación al municipio.

La mayoría de las escuelas encuestadas cuentan con un proyecto político-pedagógico (PPP) y el proyecto pedagógico es conocido por todos en la comunidad escolar (personal, padres y estudiantes). Sin embargo, algunos docentes informaron que en algunas de estas escuelas, aunque cuentan con el PPP, el documento no es conocido por todos en la comunidad escolar.

En cuanto a la contextualización, casi la totalidad de los docentes encuestados conocían o habían oído hablar de Educación Contextualizada para la Convivencia con el Semiárido. Para la mayoría de ellos, la convivencia con la región semiárida forma parte del día a día escolar en todos los proyectos docentes. Y en la producción de nuevos conocimientos a partir de la idea de contextualización, se señaló que encuentran dificultades, principalmente, con los equipos, el material didáctico-pedagógico y con su formación.

Para la práctica pedagógica se utilizan otros espacios además del aula, como el patio de la escuela, los alrededores de la escuela, la casa del campesino y otros espacios de la comunidad rural. En estos espacios se realizan círculos de lectura, presentaciones, juegos, visitas, clases de campo, observaciones, grabaciones, picnics literarios, entre otros. Y el uso de estos espacios quedó constatado durante el seminario de clausura del curso, cuando los docentes del curso presentaron sus trabajos a partir de sus prácticas pedagógicas.

En casi todas las escuelas encuestadas, los estudiantes con discapacidad reciben asistencia educativa especializada.

Foto del trabajo presentado por los participantes del curso en el Seminario de clausura de la Formación Continua en Educación Contextualizada para la Convivencia con el Semiárido. Mayo/2022).- Escuela Municipal São Paulo, Picnic Literario/2019.

En cuanto a las evaluaciones, todas las escuelas encuestadas utilizan diferentes actividades para evaluar a los estudiantes, como observación, seguimiento y registro continuo, pruebas, trabajos y seminarios. Además, los estudiantes son informados sobre los resultados de su desempeño.

Para "acceso y retención de estudiantes en la escuela" se utilizaron dos indicadores: "Atención especial a estudiantes ausentes" y "Atención especial a estudiantes con algunas brechas de aprendizaje". Así, en todas las escuelas, cuando los estudiantes no asisten, los docentes entrevistados informaron que intentan averiguar el motivo de la ausencia, contactando a los padres el mismo día. Y en cuanto a la brecha de aprendizaje, además de identificar el problema, la mayoría de las instituciones escolares superan esta dificultad con lecciones extra, grupos de refuerzo y clases extra.

En cuanto al "ambiente físico escolar", los ítems abordados en la investigación fueron: "instalaciones físicas", "mobiliario", "recursos didácticos" y "alimentación". Y para su análisis se utilizaron los tres indicadores:

Suficiencia: disponibilidad de material, espacio o equipo cuando sea necesario.

Calidad: idoneidad del material para la práctica pedagógica, buenas condiciones de uso, conservación, organización, belleza, etc.

Buen uso: valorización y uso eficiente y flexible de todo lo que se tiene.

Foto Edilene B. Pinto - Patio interno de la Escuela Municipal Levino Cândido. julio/2022

Dicho esto, la investigación mostró que casi todas las escuelas tienen suficientes aulas y baños para el número de estudiantes. Sin embargo, para algunos, aunque los baños son suficientes, no son accesibles ni adecuados para el uso de todos, in cluidos los niños pequeños y las personas con discapacidad. Sin embargo, están "limpias y en buen estado, con papel higiénico y jabón". Las aulas son "hermosas, ventiladas, luminosas y alegres".

Foto Edilene B. Pinto - Sala de lectura de la Escuela Municipal Levino Cândido. julio/2022.

Las salas y/o rincones de lectura están presentes en casi todas las unidades escolares encuestadas y cuentan con un conjunto organizado, un ambiente agradable, ventilado, luminoso y hermoso. Y cualquiera puede tener acceso, es decir estudiante, docente, empleado y/o padres de familia.

Aún en cuanto al espacio físico de la escuela, la mayoría cuenta con patio escolar y vías de acceso a las aulas para estudiantes con algún tipo de discapacidad. Sin embargo, la mayoría de los patios escolares no cuentan con juguetes adecuados a las edades de los alumnos, ni cuentan con un laboratorio de computación o espacio para la enseñanza o la práctica de deportes.

En cuanto al mobiliario, en general, hay mesas y sillas disponibles adecuadas a las diferentes edades de los alumnos y se encuentran en buen estado. Y cuando se rompen, se reutilizan rápidamente, según los docentes encuestados.

Todas las escuelas encuestadas están conectadas a Internet. Sin embargo, en algunos de ellos la conexión a internet no permite realizar búsquedas con rapidez y, en la mayoría, el uso de internet no se produce al menos una vez por semana.

En el ítem "alimentos", el tema tratado fue el agua. En todos los colegios hay filtros o algún tipo de tratamiento de agua que hace que el agua potable esté al alcance de todos. Y los filtros o bebederos se encuentran en buen estado. Y en todos ellos se realizan actividades con los estudiantes sobre el consumo adecuado de agua.

Foto del trabajo presentado por el profesor. Estudiante del Seminario Socializando Vivências.Mayo/2022. Estudiantes de la Escola Santa Helena que visitan la Comunidad de Queimadas abastecen bien.

Considerando las informaciones proporcionadas por los docentes investigados y con base en los indicadores de calidad de la Educación trabajados, se concluyó que las escuelas del campamento de Afogados da Ingazeira atienden la cuestión de la calidad de la Educación en algunos ítems. Sin embargo, en otros, como el acceso a internet, material didáctico contextualizado y formación continua; es necesario invertir para mejorarlo. Máxime cuando el objetivo es implementar una política de Educación Contextualizada para la Convivencia con el Semiárido, señalada por la gestión municipal.

En Brasil no existe un estándar para una escuela de calidad. Por ello, se crearon los Indicadores de Calidad Educativa , con el objetivo de contribuir a la evaluación y mejora de la calidad escolar.

En esta investigación, a través de estos indicadores de calidad en la Educación, buscamos conocer la realidad de las escuelas de Afogados da Ingazeira, municipio de una región que históricamente sufre los efectos del clima y donde se ha intentado implementar una propuesta educativa orientada a la convivencia. con las adversidades de esta región.

Los trabajos realizados generaron buenos resultados para el municipio, como la revisión/ reelaboración del Proyecto Político Pedagógico (PPP) de las Escuelas; promover la discusión sobre el desarrollo de lineamientos curriculares contextualizados desde una perspectiva de convivencia con el semiárido; el fortalecimiento del proceso de elaboración de los Lineamientos Municipales de Educación Contextualizada para la Convivencia con el Semiárido para el municipio, que conducirán a la Elaboración de la Política Municipal de Educación Contextualizada para la Convivencia con el Semiárido de Afogados da Ingazeira.

Con base en este trabajo, se puede decir que Afogados da Ingazeira es un municipio prometedor en la implementación de una política educativa basada en la convivencia con la región Semiárida. Esta afirmación se evidencia en el desempeño positivo de los participantes del curso, observado durante la capacitación realizada, y también en la intención expresada por sus directivos en los diversos momentos en que se reunieron con el equipo de investigación, y/o en su participación en diversos eventos públicos, de realizar Educación Contextualizada para la Convivencia con el Semiárido, una política municipal de Educación en el municipio de Afogados da Ingazeira.

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Development of a Tool towards Enhancing Early Childhood Education in Schools and at Homes Providing Basic Environmental Knowledge Using Artificial Intelligence Technology

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Abstract

This paper introduces "Little Green Hero" (LGH), a pioneering mobile and web application designed to cultivate environmental awareness among children from toddlers to 8 years old. Utilizing artificial intelligence (AI), LGH offers an innovative learning approach that effectively engages young learners in environmental topics. By integrating AI, LGH provides a dynamic and adaptive learning environment that gently introduces complex environmental issues, ensuring that children understand without feeling overwhelmed or anxious. This preliminary model demonstrates the application's efficacy in engaging children and fostering early environmental consciousness, showcasing AI's potential to revolutionize educational experiences in critical areas like environmental education.

1. Introduction

The integration of artificial intelligence (AI) into educational tools has ushered in a new era of innovative learning approaches. Little Green Hero (LGH), an inventive mobile and web application that harnesses the power of AI to promote environmental awareness among children aged toddler to 8 years. As much as the on-time vaccination throughout early childhood is essential in providing immunity before children are exposed to potentially life-threatening diseases, environmental education (EE) should be provided at early stage of human life, immunizing therefore a whole generation's behavior against human harming impact on the environment. The proposed application highlights the significance of EE and introduces how LGH tactfully navigates the complex terrain of environmental topics, fostering understanding without inducing fear or anxiety.

2. Objectives

The goals of the LGH program align seamlessly with the theme's emphasis on innovative educational approaches to environmental awareness more particularly to ESD for SDGs. The use of AI technology amplifies the program's aim of providing personalized, engaging, and age-appropriate EE to young children.

3. Early Childhood Environmental Education Challenges

Environmental consciousness is a critical facet of contemporary society, and its cultivation from an early age holds transformative potential. Education can have a massive impact on shaping a brighter sustainable future for people and societies. Environmental education represents "an approach, a philosophy, a tool, and a profession [1] with the aim of creating an environmentally literate citizenry well-suited to address environment and resource sustainability issues [2]. Environmental education has a lifelong impact [3]. The earlier children are introduced to reflecting and asking questions about the environment and the impacts of human activities on it, the better they can begin to develop an attitude of care for the environment. However, educating young minds about environmental complexities necessitates an approach that balances imparting knowledge with ensuring that children feel empowered, curious, and unburdened by ecological concerns. The central challenge lies in explaining intricate concepts like climate change,

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energy efficiency, sufficiency, renewable energy, waste management, and others in ways that are both informative and relatable. LGH addresses this challenge by employing AI to create a dynamic and interactive learning experience. Through games and educational videos, the application takes children on an engaging journey where they learn about these topics with the assistance of a friendly AI-driven character who facilitates learning by interacting, giving feedback, and providing context-sensitive information.

4. Methodology

"It is perhaps obvious that all children need these basic elements to lead a healthy life: a healthy environment to live in, clean air to breathe, water to drink and food to eat... However, climate change could undermine all of these fundamental rights... There is perhaps no greater threat to the rights of the next generation of children than this" as per Henrietta H. Fore, Executive Director of UNICEF.

It is not enough to tell people what to do in order to preserve the environment. Children must understand the rationale and the interconnectedness of humans and nature. They need to know their "Environmental Rights", such as the right to inherit a Healthy and Sustainable Environment, and the right to food, water, shelter and education. They also need to know that climate change is going to affect the exercising and enjoyment of these rights. The issue of climate change, energy, waste, pollution, and environment is too complex for a young child's ability to comprehend. Addressing this subject by insisting on the dangers' risks frightening a child will make him live with "ecoanxiety". Therefore, it is essential to avoid being alarmist when talking about the environment to a child.

Through engaging and easy-to-understand resources, LGH will make young children understand these abstract concepts with the best ways to bring them closer to nature, by involving them in ecological actions within their community, by using the resources of daily life and carrying out other activities such as those explained in the next section.

The milestone of LGH begins, as the figure 1 shows, with a welcoming message where the user can select the language (currently English, French and Arabic). At this stage, the user is considered a grown-up (parent of school teacher) and he/she has to choose between the home or school mode (respectively). After creating the general account, the kid (2nd user) can create his own specific account, choose his preferable character who will guide him and play with through his learning journey. Going directly to the home page, a welcome video will introduce the concept to the kids in the best way and directing him/her to choose to start in one of the topics as per figure 2. At the end of each game the child will understand how much he/she is closer to protecting Earth through specific/funny Earth Saving indicators and will be awarded after finalizing every chapter in order to become the Little Green Hero.

Figure 1: LGH Roadmap

Figure 2: LGH Home page

Figure 3. LGH Covered topics

5. LGH Topics

Environmental conditions across the globe continue to deteriorate at an alarming pace due to a complex web of social-ecological challenges including, but not limited to, climate change, air and water pollution, ocean acidification, land degradation, and biodiversity loss [4]. Many note that protecting and restoring the global environment will require transformative changes in human behaviors related to production and consumption, reflecting on individual choices as well as collective action on a larger scale and culturally mediated [5] (Mastrángelo *et al.*, 2019; UN Environment, 2019). The environmental topics covered by LGH are listed as per the figure below and the specific objectives of each are presented in the figure 3:

- Climate Change: As climate change threatens to disrupt life on Earth, rising temperatures, shifting weather patterns, floods, desertification and habitat loss are causing .... But there is still time to act. Children should be aware on the actions they can take in their daily life to reduce their carbon footprint, protect their environment, and conserve Earth for generations to come. In this topic of LGH, a child can start his/her journey with learning the difference between climate and weather. Through different games and informative videos, he/she can better understand the environment where he/she lives and what is the weather today. The kid needs to choose from a list of graphics, for example, what he can see from his/her window. Depending on what he/she chose, a simulation will be done

to know what is the weather today. As for the climate, depending on the country's entry data, a simulation can be done to know what is the climate? The several usages will be an indicator that there are lots of the item chosen (lots of cars, bldgs., trees, flowers....). A simulation will be done to estimate the environment surrounding the kid house. It can be optionally repeated or skipped by the kid. Other games help the users to learn about climate change causes and effects including but not limited to "The main different climate zones existing around the world, specifications of each and to end that this climate might change in the same place in years", "What is the greenhouse effect?", "Who are greenhouse gases?", "Where do they come from?", "What are the consequences of global warming?", "Heat in the city","1 degree plus effect" ... They should also learn about the small actions they can take in their daily life to mitigate climate change and to adapt to it.; "What are we doing to fight climate change?", "What role can they play?".

- Energy: Energy is life. It allows living beings to grow, breathe, move and reproduce. To develop, human societies have, over time, used various forms of energy: muscular (human and animal), water, wind, wood, sun, atom, oil. Through informative videos and games, energy will be firstly defined including but not limited to energy resources, energy transfer and transformation, energy consumption, renewables and non-renewables, food and energy, energy storage, the pyramid of energy (conservation, efficiency, renewable), energy needs and how to use it wisely, and the world energy transition conception. "Where does this energy come from", "What are the impacts of our energy consumption?", "Energy is everywhere in our lives, how to conserve it?", "Energy stars, or the energy efficiency"; "Renewable energies: the next generation"; "The golden rules for reducing our consumption energy".
- Waste: Knowing how waste from their daily consumption at school and at home is managed and understanding the importance of waste management is crucial to be introduced to early childhood. This topic in LGH can teach through several challenging games "How to fight food waste?", "The simple gestures in kitchen"; "The expiration dates: FIFO concept"; "Let's consume differently"; "let's consume smartly". It offers some ideas for more responsible consumption: reducing waste at source at home, at school, in the restaurants and especially while shopping. Reducing waste is taking action against waste that is overflowing and polluting land, rivers, seas, and oceans. Children should be aware how to reuse and extend the lifespan of products; how to throw away less; How to recycle waste; What is waste prevention; Better use, repair and reuse; The other side of their look (the clothes they wear have environmental and social impacts; discover the 7 keys to limit them)...
- Pollution: Explaining to children what environmental pollution including air, soil, and water pollution will help them better understand how natural systems work and how to take care of them so that they do not deteriorate, for example how they can move differently (on foot or by bike to school).
- Environment: It is essential to teach children about the delicate balance of the environment so that they know how they can help improve their environment. Children will learn about "The polar bear, the ice floe is melting"; "Oxygen is essential"; "What is sustainable food?"; "Sustainable development, why?"; "Go sustainable, it works!"; "The 7 families of the hidden life of soils". Forests are the terrestrial environment that concentrates the greatest number of life forms and species. Forests play an essential role in water, carbon and oxygen cycles. They help to create, enrich and protect the soil. Hundreds of millions of people earn their livelihood from it. They are also the source of a large part of our medicines. For centuries, people have exploited forests, their resources and their territories in order to meet their needs. Indeed, deforestation and the degradation of forest ecosystems weigh both on collective living conditions and on climate change.

6. AI Features and Benefits

The current prototype of our app is designed to engage children in an interactive learning environment focused on environmental topics. Upon starting the app, it prompts the child to input necessary information, allowing for a personalized learning experience. The child can then select from various environmental themes to explore through games. If a child answers a question incorrectly, the app not only shows the correct answer but also presents a similar question to reinforce learning. Upon achieving full accuracy in responses, the app unlocks the next level, progressively challenging the child.

The experience offered by LGH is grounded in AI's adaptability. LGH tailors the learning experience to the child's age, comprehension level, and pace of learning. As the child interacts with the AI character and progresses through different levels, the AI adapts its responses and content delivery to ensure a personalized and enriching experience so that the child remains engaged, fostering a sustained interest in environmental topics. Furthermore, the program encourages outdoor exploration and engagement with the environment, complementing the AI-facilitated lessons. By instilling a love for nature, LGH aims to inspire a generation of environmentally conscious individuals who are motivated to safeguard their surroundings.

The AI Algorithm Features can be described as the following:

- Answer Accuracy: It tracks how correctly children answer game questions.
- Response Time: It measures the time taken to respond, indicating engagement and difficulty level.
- Child Feedback: It integrates children's input for personalized game experiences.

Building Personal profiles can be built in the application through:

- Data-Driven History: Each session records the child's gaming profile.
- Learning & Preferences: AI analyzes historical data to understand learning patterns.

In LGH, AI learning and adaptation can be applied through continuous learning – as AI evolves with each child's interactions to better understand their abilities – and game selection by choosing games based on skill level, interests, and educational value.

The benefits of this conception are in customizing gaming experiences to individual learning styles (tailored learning paths), and in keeping games challenging and fun, maximizing educational benefit (enhanced engagement) while ensuring inclusion of children with special needs.

7. Conclusion and Perspective

LGH presents a promising avenue for delivering impactful EE to young children. It is foreseen to include all the other SDGs in next steps. By employing AI-driven interactions, LGH makes learning about complex environmental topics accessible, engaging, and enjoyable. This approach not only imparts knowledge but also empowers children to understand their role in environmental preservation. As AI continues to redefine educational paradigms, LGH stands as an exemplar of how technology can foster a generation of environmentally aware individuals.

Our future development plan includes integrating AI to enhance the app's functionality. Specifically, we aim to implement machine learning algorithms that can analyze the child's interaction patterns with the app. This AI integration will allow for adaptive learning features that adjust game difficulty and content dynamically based on the child's performance, ensuring optimal engagement and educational benefit. Additionally, LLM techniques will be employed to improve the app's ability to understand and respond to open-ended user inputs, making the interactive experience more intuitive and educational. This AI-driven approach will provide a more tailored educational experience that adjusts in real-time to the learning pace and preferences of each child.

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منهج السنة النبوية في غرس وتنمية قيم التربية البيئية وأثره على الأطفال

محمود محمد علي [1]

يشتمل البحث على:

1. أولا: التمهيد: - مفهوم التربية البيئية وأهمية التركيز على تربية النشء وتعليم الصغار في ضوء السنة النبوية
2. ثانيا: محاور البحث:
   - 1. سمات المنهج النبوي في التربية البيئية
   - 2. أهم أساليب السنة النبوية في تربية الأطفال
   - 3. ممارسات السنة النبوية في غرس قيم التربية البيئية وأثره على الأطفال
3. ثالثا: خاتمة واهم التوصيات
4. رابعا: مصادر البحث

ملخص البحث:

لطالما حرصت السنة النبوية على غرس قيم التربية البيئية في نفوس الأطفال، ويعد ذلك نموذجا رائعا يمكننا إسقاطه على واقعنا الحالي، والتوصية بتفعيل ذلك في المدارس ومراكز تحفيظ القرآن وجميع المؤسسات التربوية بعد دراسة سبل تحقيق ذلك

إن تعليم الأطفال على القيم والمبادئ قضية كبرى لطالما شغلت المفكرين والمربين والأدباء والعقلاء، وكل أدلى فيها بدلوه، غير أن معين الهدي المحمدي يظل أعذبها موردا، حيث إنه ينتهج في ذلك "التعليم بالقدوة"، وهو أسلوب رائع ومنهج قويم، لأن الطفل يعتمد في تعلمه على المحاكاة والتقليد، فكل أفعاله صلى الله عليه وسلم كانت بمثابة مرجعية للأطفال وللشباب، أيضا كان له أسلوب فريد في رياضة الأطفال، "حديث يا عمير ما فعل النغير" نموذجا.

والمتأمل في أحاديثه الشريفة يرى كيف استخدم صلى الله عليه وسلم مصطلحات وألفاظ بيئية تحبب الناس في بيئاتهم وتصنع علاقة قوية بين الإنسان والبيئة، فقد سبق بذلك وتفرد صلى الله عليه وسلم، على سبيل المثال لا الحصر بحديث النخلة:

عن عبد الله بن عمر أن رسول الله صلى الله عليه وسلم قال: «إن من الشجر شجرة لا يسقط ورقها، وهي مثل المسلم، حدثوني ما هي؟» فوقع الناس في شجر البادية، ووقع في نفسي أنها النخلة، قال عبد الله: فاستحييت، فقالوا: يا رسول الله، أخبرنا بها؟ فقال رسول الله صلى الله عليه وسلم: «هي النخلة» قال عبد الله: فحدثت أبي بما وقع في نفسي، فقال: «لأن تكون قلتها أحب إليّ من أن يكون لي كذا وكذا» (متفق عليه).

وفي حديث شريف آخر نجده -صلى الله عليه وسلم – يربط الإنسان ربطا شديدا بتربة الأرض التي يعيش عليها، بل ويعلمه أن يسترقي بها من المرض، فهل يقدم عاقل بعد ذلك على تلويث تربة يستشفي بها!

إن مبدأ الرقابة التي تسعى إليها التربية البيئية العالمية، يبدو جليا في أحاديثه الشريفة، يقول صلى الله عليه وسلم: "مثل القائم على حدود الله والواقع فيها كمثل قوم استهموا على سفينة فأصاب بعضهم أعلاها وأصاب بعضهم أسفلها فكان الذين في أسفلها إذا استقوا من الماء مروا على من فوقهم فقالوا لو أنا خرقنا في نصيبنا خرقا ولم نؤذ من فوقنا، فإن تركوهم وما أرادوا هلكوا وهلكوا جميعا وإن أخذوا على أيديهم نجوا ونجوا جميعا" رواه البخاري.

لأن الكل لا يسلم حتى يسلم الجزء وأن المشكلة إن حَلّت لا تميز بين الفاعل وغيره تبنت دولة الإمارات العربية المتحدة هذا الدور الرائد في نشر السلام والعلم ومحاولة التوفيق بين الشعوب فأدنت القريب من البعيد وألفت بين الميؤوس والمأمول، وقد جاء هذا نتيجة للفهم الوسطي المعتدل للنصوص الدينية وسعيا لتطبيق منهج السنة النبوية الشريفة وبخاصة من خلال غرس وتنمية القيم البيئية الإسلامية،

وهي "مجموعة الأحكام المعيارية المنبثقة من الأصول الإسلامية، التي تكون بمثابة موجهات لسلوك الإنسان تجاه البيئة، وتمكنه من تحقيق وظيفة الخلافة في الأرض"، وهي:

قيم المحافظة، وقيم الاستغلال بمفهوم التوسط والاعتدال، وقيم التكيف والاعتقاد، وقيم الجمال.

حيث حثت الشريعة الإسلامية على أهمية الحفاظ على البيئة في العديد من الآيات الكريمة ومنها:" كُلوا وَاشْرَبُوا من رِّزْقِ اللّه وَلَا تَعْثَوْا في الْأَرْضِ مُفْسِدِينَ"(البقرة:60)، كما أنها نهت صراحةً عن الفساد بكل أنواعه وأحجامه، وحذرّت من كونه مخالفة لشرع الله تعالى.

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(1) باحث الماجستير بكلية أصول الدين – قسم الحديث وعلومه – جامعة الأزهر – مصر
مدرس وواعظ وإمام بالأزهر الشريف
معلم التربية الإسلامية للناطقين بالعربية – مؤسسة جيمس – دبي

كما أن الإسلام ركزً على قانون التوازن، فعند وقوع أي ضرر على عنصر من عناصر البيئة فإنه بذلك يؤدي إلى خللٍ في التوازن واضطراب يهدد البيئة وما تشمله.

واهتمت السنة النبوية اهتماما بالغا بالتشجير والزراعة، وفي ذلك يقول الرسول صلى اللّه عليه سلم: "مَا مِنْ مُسْلِمٍ يَغْرِسُ غَرْسًا، أَوْ يَزْرَعُ زَرْعًا، فَيَأْكُلُ مِنْهُ طَيْرٌ أَوْ إِنْسَانٌ أَوْ بَهِيمَةٌ، إِلَّا كَانَ لَهُ بِهِ صَدَقَةٌ".

ومن جهة أخرى دعا الإسلام الحنيف إلى المحافظة على الكائنات الحية وعدم التعرض لها بالأذى، يقول صلى اللّه عليه وسلم:" دَخَلَت امْرَأَةُ النَّارَ فِي هِرَّة رَبَطَتْهَا، فَلَمْ تُطْعِمْهَا، وَلَمْ تَدَعْهَا تَأْكُلُ مِنْ خَشَاشِ الْأَرْضِ".

إن تمام التربية أن ننشئ أطفالنا على قيم الرحمة والحكمة والوسطية والمحبة والإحسان لكل الخلق وبالأخص الأرض التي نحيا عليها ومنها، يقول تعالى:

"وَلَا تُفْسِدُوا فِي الْأَرْضِ بَعْدَ إِصْلَاحِهَا وَادْعُوهُ خَوْفًا وَطَمَعًا إِنَّ رَحْمَتَ اللَّهِ قَرِيبٌ مِّنَ الْمُحْسِنِينَ"

أولا: التمهيد

مفهوم التربية البيئية وأهمية التركيز على تربية النشء وتعليم الصغار في ضوء السنة النبوية

التربية البيئية مفهوم شامل يهدف إلى تعزيز الوعي بالبيئة وحمايتها، وتعزيز السلوكيات المستدامة والمسؤولة تجاه البيئة. تعتبر التربية البيئية جزءًا أساسيًا من التنمية المستدامة، حيث تسعى إلى تحقيق توازن بين احتياجات الأجيال الحالية والأجيال القادمة.

في ضوء السنة النبوية، نجد أن النبي محمد صلى اللّه عليه وسلم كان يولي اهتماما كبيرا بحماية البيئة والحفاظ عليها. فقد كان يوصي بعدم إسراف في الماء حتى عندما كان يتوضأ، وكان يحث على زراعة الأشجار والحفاظ على الغابات. كما كان يحث على حماية الحيوانات والتعامل الحسن معها.

تركيز التربية البيئية على تربية النشء وتعليم الصغار يعتبر أمرًا بالغ الأهمية، حيث يمثلون المستقبل والأمل في بناء عالم أفضل وأكثر استدامة. من خلال تعليمهم قيم حماية البيئة والاستدامة، يمكن تشكيل جيل مسؤول يسعى للحفاظ على البيئة وتحسينها.

ثانيا: محاور البحث

المحور الأول: سمات المنهج النبوي في التربية البيئية

يتسم المنهج النبوي بالشمولية حيث يتفرد بالجمع بين الجانب المادي والجانب المعنوي في توازن دقيق، ويرتكز على الأسس والمبادئ الآتية:

1. الرحمة ومظهرها الرفق

- يقول تعالى: "وما ارسلناك الا رحمة للعالمين" (الأنبياء:107)

- وفي السنة النبوية الشريفة:

* عن أبي هريرة رضي اللّه عنه أن النبي صلى اللّه عليه وسلم قال: "إن اللّه رفيق يحب الرفق، ويعطي على الرفق ما لا يعطي على العنف، وما لا يعطى على ما سواه" (رواه مسلم).

* عن عائشة رضي اللّه عنها أن النبي صلى اللّه عليه وسلم قال: «إن الرفق لا يكون في شيء إلا زانه، ولا ينزع من شيء إلا شانه». (رواه مسلم).

* الحديث المسلسل بالأولية: "الرَّاحِمُونَ يَرْحَمُهُمُ الرَّحْمَنُ تَبَارَكَ وَتَعَالَى، ارْحَمُوا مَنْ فِي الْأَرْضِ يَرْحَمْكُمْ مَنْ فِي السَّمَاءِ" (أخرجه أبو داود والترمذي من حديث عبد اللّه بن عمرو).

هذه الأحاديث وغيرها كثير تظهر الرعاية التامة والعناية الكاملة التي كان يظهرها النبي محمد صلى اللّه عليه وسلم عامة، وللبيئة بكل مواردها الطبيعية وأنواعها بوجه خاص، وكان يحث على التقدير والرفق في التعامل مع الأشياء المحيطة به، حتى الجمادات. كان يألف الأشياء وتألفهُ، فكان يُسمِّي ناقَته ومَحكَلته وسيفه، والكوب الذي يشرب فيه. وينظر إلى الجبل ويقول جبل أحد يحبنا ونحبه

نماذج من رفقه صلى اللّه عليه وسلم بالحيوان والطير:

- عن سهيل بن الحنظلية قال: "مَرَّ رسول اللّه صلى اللّه عليه وسلم ببعير قد لحق ظهره ببطنه، فقال: اتقوا اللّه في هذه البهائم المعجمَة فاركبوها صالحة، وكلوها صالحة". (المعجمة التي لا تنطق) [أخرجه أبو داود].

- وعن عبد اللّه بن مسعود رضي اللّه عنه قال: "كنا مع رسول اللّه صلى اللّه عليه وسلم في سفر، فانطلق لحاجته، فرأينا (حُمّرة) معها فرخان، فأخذنا فرخيها، فجاءت الحمّرة، فجعلت تُعرِّشُ، فلما جاء رسول اللّه صلى اللّه عليه وسلم قال: مَن فجع هذه بولدها؟ رُدُّوا ولدها إليها، ورأى قرية نمل قد أحرقناها، فقال: مَن أحرق هذه؟ قلنا: نحن قال: لا ينبغي أن يُعذِّب بالنار إلا رب النار"؛ [رواه أبو داود وأحمد]. (الحمَّرة: طائر يشبه العصفور) (تُعرِّش: ترفرف)

- كان صلى اللّه عليه وسلم يُصغي للهرة الإناء، فتشرب ثم يتوضأ بفضلها" (يُصغي: يميل) [صحيح: رواه الطبراني].

أما رحمته صلى اللّه عليه وسلم بالأطفال فلا يمكن أن نحصيها في هذه الورقات، ونذكر منها على سبيل المثال لا الحصر:

كان النبي صلى اللّه عليه وسلم يتعامل مع الأطفال برقة ورفق، وكان يظهر لهم الحنان والمحبة. قال النبي صلى اللّه عليه وسلم: "مَنْ لاَ يَرْحَمْ لاَ يُرْحَم"، مما يعكس الأهمية التي أولاها للرحمة في تعامله مع الأطفال.

وفي الحديث الشريف: "ليس منا من لم يرحم صغيرنا، ويوقر كبيرنا" (رواه أبو داود والترمذي من حديث أنس بن مالك وعبد اللّه بن عمرو، وفي راوية "ويعرف حق كبيرنا").

وقد ضرب النبي صلى اللّه عليه وسلم أصدق مثال للرحمة والعناية بالأطفال في أجمل صورها على الإطلاق في حديث العصفور: " يا عمير، ما صنع النغير"،

عن أنس بن مالك رضي اللّه عنه قال: "إن كان النبيُّ لَيُخالطُنا، حتى يقولَ لأخٍ لي صغير: يا أبا عُمَيرُ! ما فعل النُّغَيرُ" (صحيح الأدب المفرد)

إنه أسلوب فريد في رياضة الأطفال، ونموذج لرحمة خاصة قل أن ينتبه إليها أحد نرى فيه كيف أن النبي كنّاه بأبي عمير، فهو يرجو له أن يتزوج وينجب ولدا يسميه أبا عمير. يداعبه ويعلمه ويربيه بكليمات قليلة تحمل أعظم المعاني وأجل القيم في الرحمة والرفق.

وقد اعترض أحد المستشرقين على هذا الحديث قائلا: ما بال أصحاب محمد ينقلون عنه الغث والسمين!؟

فنشط لذلك أحد علماء المسلمين فألف رسالة جمع فيها فوائد هذا الحديث وما يؤخذ منه.

2. الحكمة والتأسيس لمبدأ الرقابة والمسئولية

إن الفساد بجميع أنواعه، بما فيه الفساد البيئي والذي يشمل التلوث الصناعي، الإضرار بالبيئة، والتهور وسوء إدارة الموارد الطبيعية مكروه من اللّه سبحانه وتعالى.

يقول اللّه تعالى في القرآن الكريم:

"ويسعون في الأرض فساداً واللّه لا يحب المفسدين" – سورة المائدة، آية – 64

"ولا تفسدوا في الأرض بعد إصلاحها ذلكم خير لكم إن كنتم مؤمنين" – سورة الأعراف، آية – 85

ولا تبغ الفساد في الأرض إن اللّه لا يحب المفسدين" – سورة القصص، آية – 77

لقد نظم الإسلام العلاقة بين الفرد والجماعة فالفرد لا يمكن أن يكون بمعزل عن الآخرين إنما هو جزء من كل، فهو مسؤول عن نفسه ومجتمعه الإنساني، ثم إن مقتضى المسئولية التنبيه وإيقاف أي إساءة للبيئة لأن تدهور النظام البيئي يهدد البشرية جمعاء سواء الذين أسهموا في أذية البيئة أو الذين لم يسهموا.

وفي السنة النبوية الشريفة: يقول الرسول صلى اللّه عليه وسلم: "مثل القائم على حدود اللّه والواقع فيها كمثل قوم استهموا على سفينة فأصاب بعضهم أعلاها وأصاب بعضهم أسفلها فكان الذين في أسفلها إذا استقوا من الماء مروا على من فوقهم فقالوا لو أنا خرقنا في نصيبنا خرقا ولم نؤذ من فوقنا، فإن تركوهم وما أرادوا هلكوا وهلكوا جميعا وإن أخذوا على أيديهم نجوا ونجوا جميعا"، رواه البخاري.

وبهذا يتحقق مبدأ الرقابة التي تسعى إليها التربية البيئية العالمية.

وعليه، فإن الحفاظ على البيئة يعتبر واجبا دينيا وكذلك التزاما مجتمعيا، وليس مسألة اختيارية. إن استغلال أي من الموارد الطبيعية يدرج تحت بند المساءلة، والحفاظ على تلك الموارد أمانة.

3. الاستخلاف والتأسيس لمبدأ الرعاية

لقد تجاوزت التعاليم الإسلامية مبدأ الرقابة الذي يعد الغاية القصوى للتربية البيئية العالمية نحو الاستدامة البيئية وهو ما يعرف بمفهوم "الوصاية"، كون الإنسان يعتبر الخليفة أو "الراعي" حيث يمكنه الانتفاع بما خلق اللّه من خيرات دون إسراف أو تبذير لأنها ليست خاصة به وحده بل للمجتمع وللأجيال القادمة.

فيجب عليه اتخاذ جميع الخطوات والتدابير اللازمة لضمان حفظ وصيانة تلك الموارد والتأكد من تمريرها إلى الأجيال اللاحقة بأفضل شكل ممكن. لذا اعتبر الإسلام أن الإنسان هو خادم للطبيعة ويجب أن يتعايش بانسجام مع كافة المخلوقات الأخرى. فمن واجب الجميع احترام البيئة ورعايتها والحفاظ عليها.

يقول تعالى في سورة البقرة: "وَإِذْ قَالَ رَبُّكَ لِلْمَلَٰٓئِكَةِ إِنِّى جَاعِلٌ فِى ٱلْأَرْضِ خَلِيفَةً" (الآية 30)، ويقول عز من قائل: "وسَخَّرَ لَكُم مَّا فِي السَّمَاوَاتِ وَمَا فِي الْأَرْضِ جَمِيعًا مِّنْهُ ۚ إِنَّ فِي ذَٰلِكَ لَآيَاتٍ لِّقَوْمٍ يَتَفَكَّرُونَ" (الجاثية:13)، فالإنسان مستخلف في الكون، مستأمن عليه،

"هُوَ أَنْشَأَكُمْ مِنَ الْأَرْضِ وَاسْتَعْمَرَكُمْ فِيهَا" (هود: 61)

قال ابن كثير في تفسيره: أَيْ: جَعَلَكُمْ فِيهَا عُمَّارا تُعَمِّرُونَهَا وَتَسْتَغِلُّونَهَا

وقال الطاهر بن عاشور: وَمَعْنَى الْإِعْمَارِ أَنَّهُمْ جَعَلُوا الْأَرْضَ عَامِرَةً بِالْبِنَاءِ وَالْغَرْسِ وَالزَّرْعِ لِأَنَّ ذَلِكَ يُعَدُّ تَعْمِيرًا لِلْأَرْضِ حَتَّى

سُمِّيَ الْحَرْثُ عِمَارَةً لِأَنَّ الْمَقْصُودَ مِنْهُ عَمْرُ الْأَرْضِ.

قال إمام الدعاة الشيخ الشعراوي: {وَاسْتَعْمَرَكُمْ}" وساعة ترى الألف والسين والتاء فاعلم أنها للطلب، وهكذا يكون معنى كلمة «استعمر» هو طلب التعمير. {وَاسْتَعْمَرَكُمْ فِيهَا} أي: طلب منكم عمارتها،

وهذا يتطلب أمرين اثنين: أن يبقي الناس الأمر الصالح على صلاحه، أو يزيدوه صلاحاً"

وهذا أسمى غايات التربية البيئية على الإطلاق!

الكل مسؤول، والكل راع، كما في الحديث الشريف:

"كلُّكم راعٍ وكلُّكم مسؤولٌ عن رعيتِه فالأميرُ الذي على الناسِ راعٍ عليهم وهو مسؤولٌ عنهم والرجلُ راعٍ على أهلِ بيتِه وهو مسؤولٌ عنهم والمرأةُ راعيةٌ على بيتِ بعلِها وولدِه وهي مسؤولةٌ عنهم وعبدُ الرجلِ راعٍ على بيتِ سيدِه وهو مسؤولٌ عنهُ ألا فكلُّكم راعٍ وكلُّكم مسؤولٌ عن رعيتِه" (أخرجه البخاري، ومسلم، وأبو داود، والترمذي، والنسائي في السنن الكبرى، وأحمد).

4. الإحسان وذروته المحبة وتعزيز الخير

قال رسول الله صلى الله عليه وسلم: "لا يؤمن أحدكم حتى يحب لأخيه ما يحب لنفسه" (صحيح البخاري، من حديث أنس بن مالك)

وقال "..... وخير الناس أنفعهم للناس" الحديث (من حديث جابر بن عبد الله، رواه الطبراني في الأوسط)

والأمر واضح جلي: كيف ندعي محبة أولادنا ثم نورثهم الكوكب وقد أصبح أشبه بسلة مهملات كبيرة؟!

"تقولون إنكم تحبون أبناءكم أكثر من أي شيء آخر، ومع ذلك تسرقون مستقبلهم أمام أعينهم جهارا نهارا"[1]

5. الوسطية ومظهرها الاعتدال

التوسط والاعتدال: لفظان متقاربان في المعنى، ويراد بهما فعل المطلوب والمأذون فيه من غير إفراط ولا تفريط، وكل من الإفراط والتفريط انحراف وميل عن الجادة والصواب.

وقد نَهَى اللَّهُ عَزَّ وَجَلَّ عن التَّبْذِيرِ وَالإِسْرَافِ؛ فَقَالَ سُبْحَانَهُ: {وَكُلُوا وَاشْرَبُوا وَلَا تُسْرِفُوا إِنَّهُ لَا يُحِبُّ الْمُسْرِفِينَ} [الأعراف: 31]

وفي السنة النبوية الشريفة يروى أن النَّبِيَّ صَلَّى اللَّهُ عليه وسلَّمَ مرَّ بسَعدٍ وَهوَ يتوضَّأُ، فقالَ: ما هذا السَّرَفُ يا سَعدُ؟ قالَ: أفي الوضوءِ سَرفٌ، قالَ: نعَم، وإن كنتَ على نَهرٍ جارٍ."

فَالْمَاءُ نِعْمَةٌ رَبَّانِيَّةٌ، لابد أن يَشْتَرِكُ الْجَمِيعُ فِي الْمُحَافَظَةِ عَلَيْهِ، وَذَلِكَ بِتَرْشِيدِ اسْتِخْدَامِهِ فِي كَافَّةِ صُوَرِ اسْتِعْمَالِهِ فِي حَيَاتِنَا الْيَوْمِيَّةِ، حَتَّى فِي الْوُضُوءِ وَالَّذِي هُوَ شَرْطٌ لِصِحَّةِ الصَّلَاةِ يَجِبُ الِاقْتِصَادُ فِي الْمَاءِ.

وقد ورد أن النَّبِيَّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ كان يَغْتَسِلُ بِالصَّاعِ وَيَتَوَضَّأُ بِالْمُدِّ[2]، وَقَدْ نَهَى الشَّرْعُ الإسلامي عَنِ الإِسْرَافِ فِي الْمَاءِ مَهْمَا كَثُرَ، وَإِنْ كَانَ لِعِبَادَةٍ، حِفَاظًا عَلَى اسْتِدَامَتِهِ. فَيَجِبُ نَشْرُ الْوَعْيِ بَيْنَ النَّاسِ بِعَدَمِ الْإِسْرَافِ وَيَجِبُ تَرْبِيَةُ الصِّغَارِ عَلَى ذَلِكَ بِالْقُدْوَةِ وَالتَّعَوُّدِ الإِيجَابِي.

ضوابط استغلال البيئة

- اعتماد منهج الوسطية والاعتدال في استغلال خيرات البيئة والاستفادة من ثرواتها.
- الدعوة إلى المحافظة على التوازن البيئي من خلال التخطيط المحكم وحسن التدبير، قال تعالى: (قَالَ تَزْرَعُونَ سَبْعَ سِنِينَ دَأَبًا فَمَا حَصَدتُّمْ فَذَرُوهُ فِي سُنبُلِهِ إِلَّا قَلِيلًا مِّمَّا تَأْكُلُونَ).
- النهي عن الفساد والخراب كالتلوث، قال تعالى: (وَلَا تُفْسِدُوا فِي الْأَرْضِ بَعْدَ إِصْلَاحِهَا).
- تحريم الإسراف والتبذير لأنه استنزاف لخيرات البيئة، قال تعالى: (وَلَا تُبَذِّرْ تَبْذِيرًا).
- تحقيق التوازن بين مصلحة الأجيال الحاضرة والأجيال المقبلة لتفعيل "التنمية المستدامة".

المحور الثاني:
أهم أساليب السنة النبوية في تربية الأطفال

الْأَوْلَادُ هِبَةٌ مِنَ اللَّهِ لِلْإِنْسَانِ، تَسُرُّ الْفُؤَادَ مُشَاهَدَتُهُمْ، وَتَقَرُّ الْعَيْنُ بِرُؤْيَتِهِمْ، وَتَبْتَهِجُ النُّفُوسُ بِمُحَادَثَتِهِمْ. وَالْمُتَتَبِّعُ لِسِيرَةِ رَسُولِ اللَّهِ -صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ- وَحَدِيثِهِ الشَّرِيفِ، يَجِدُ جَانِبًا مُهِمًّا مِنْ جَوَانِبِ الِاقْتِدَاءِ بِهِ -عَلَيْهِ الصَّلَاةُ وَالسَّلَامُ-، أَلَا وَهُوَ أَسَالِيبُهُ الْفَذَّةُ فِي تَرْبِيَةِ الْأَطْفَالِ، ومن أبرزها:

1. التربية بالأسوة والمحاكاة:

إن تعليم الأطفال على القيم والمبادئ قضية كبرى لطالما شغلت المفكرين والمربين والأدباء والعقلاء، وكل أدلى فيها بدلوه، غير أن معين الهدي المحمدي يظل أعذبها موردا، حيث إنه كان ينتهج في ذلك "التعليم بالقدوة"، وهو أسلوب رائع ومنهج قويم، فالطفل يعتمد في تعلمه على المحاكاة والتقليد، وكل أفعاله صلى الله عليه وسلم هي

[1] غريتا ثانبيرغ، ناشطة في مجال المناخ، ومؤسسة "الإضراب المدرسي من أجل المناخ"

[2] رواه البخاري ومسلم من حديث أنس بن مالك رضي الله عنه

بمثابة مرجعية للأطفال وللشباب،

2. الحفاظ على الفطرة:

فقد جاء في السنة النبوية الشريفة أن "كل مولود يولد على الفطرة"[3]، فواجب على الآباء والقائمين على تربية الأطفال الحفاظ على هذه الفطرة نقية سليمة، وفي ذلك الضمان الكافي لاستمرار حب الجمال والخير في نفسية الطفل وسلوكه والنفور من القبح والفساد والإيذاء لأي من المخلوقات.

3. التربية بالحكاية

كان النبي صلى اللّه عليه وسلم يستخدم القصص والأمثلة لتوجيه الأطفال نحو القيم الصحيحة والسلوك الحسن. وتحمل قصص الأنبياء والأحاديث الشريفة عبرًا تربوية يمكن استخدامها للتأثير الإيجابي في سلوك الأطفال. والقرآن الكريم يذكر قصص الأنبياء والأمم السابقة "لقد كان في قصصهم عبرة"[4]

ومما يدل على استخدامه – صلى اللّه عليه وسلم - لهذا الأسلوب الرائع قوله "لقد كان فيمن قبلكم" في أحاديث كثيرة.

4. الاهتمام والتوجه بالعناية والرعاية للصغار

حديث النغير السابق ذكره مثالا، ولا شك أن العناية بالأطفال والتقرب منهم ومداعبة حيواناتهم الأليفة المحببة إليهم من أكثر الأساليب التربوية تأثيرا في نفوسهم. وفيه ربط للصغار بحب الكائنات كلها والعطف عليها والاهتمام بها، وذلك من أرقى أساليب التربية البيئية قديما وحديثا ومن أقصر الطرق وأكثرها عبقرية لغرس قيم التربية البيئية في الأطفال فيما يعرف "بالتعلم باللعب" (Learn through play)[5]

5. التربية "بضرب الأمثال" والتصوير:

كما ورد عن أبي موسى الأشعري رضي اللّه عنه عن النبي صلى اللّه عليه وسلم قال: «مَثَلُ المؤمن الذي يقرأ القرآن مَثَلُ الأُتْرُجَّة: ريحها طيب وطعمها طيب، ومَثَل المؤمن الذي لا يقرأ القرآن كمَثَل التمرة: لا ريح لها وطعمها حُلْوٌ، وَمَثَل المنافق الذي يقرأ القرآن كمثل الريحانَة: ريحها طيب وطعمها مُرٌّ، وَمَثَل المنافق الذي لا يقرأ القرآن كمثل الحَنْظَلَة: ليس لها ريح وطعمها مُرٌّ». (متفق عليه)

وكذلك حديث النخلة المشهور:

فقد استخدم النبي صلى اللّه عليه وسلم مصطلحات وألفاظ بيئية تحبب الناس في بيئاتهم وتصنع علاقة قوية بين الإنسان والبيئية:

عن عبد اللّه بن عمر أن رسول اللّه صلى اللّه عليه وسلم قال:

«إن من الشجر شجرة لا يسقط ورقها، وهي مثل المسلم، حدثوني ما هي؟» فوقع الناس في شجر البادية، ووقع في نفسي أنها النخلة، قال عبد اللّه: فاستحييت، فقالوا: يا رسول اللّه، أخبرنا بها؟ فقال رسول اللّه صلى اللّه عليه وسلم: «هي النخلة» قال عبد اللّه: فحدثت أبي بما وقع في نفسي، فقال: «لأن تكون قلتها أحب إلي من أن يكون لي كذا وكذا» (متفق عليه).

وكل ذلك في إطار تربوي متفرد، مثل التعليم والتربية بواسطة التصوير أو ما يسمى حاليا بالخرائط الذهنية كما جاء في الحديث:

عن عبد اللّه بن مسعود قال :"خطَّ رسولُ اللّه صلَّى اللّه عليه وسلَّمَ خطًا بيده ثم قال : هذا سبيلُ اللّه مستقيمًا، وخطَّ خطوطًا عن يمينه وشماله، ثم قال : هذه السبلُ ليس منها سبيلٌ إلا عليه شيطانٌ يدعو إليه، ثم قرأ : وَأَنَّ هَذَا صِرَاطِي مُسْتَقِيمًا فَاتَّبِعُوهُ وَلَا تَتَّبِعُوا السُّبُلَ فَتَفَرَّقَ بِكُمْ عَنْ سَبِيلِهِ" (أخرجه أحمد والنسائي في السنن الكبرى)

6. التحفيز والتشجيع

كان النبي صلى اللّه عليه وسلم يشجع الأطفال على الأعمال الصالحة ويثني عليهم عند أداء الخير. ونحن في حاجة إلى هذا الأسلوب الراقي في غرس القيم التربوية لأنه يساهم في بناء الثقة بالنفس لدى الأطفال وتعزيز رغبتهم في القيام بالأعمال الصالحة.

فإذا أراد تعديل سلوك وتقويمه قال: "ما بال أقوام.." وهو ما يعرف بالأسلوب غير المباشر في التربية.

7. وأهم ما يميز هذه الأساليب التربوية ويعين عليها التحلي بالصبر:

فقد كان النبي صلى اللّه عليه وسلم يظهر الصبر والتحلي بالهدوء في التعامل مع الأطفال. ولا شك أن الصبر يلعب دورًا هامًا في بناء العلاقة مع الأطفال وفهم احتياجاتهم وتوجيههم بشكل فعال.

يقول أنس بن مالك رضي اللّه عنه: "خَدَمتُ النَّبيَّ صلَّى اللّه عليه وسلَّم عَشرَ سِنينَ، فما أمَرَني بأمرٍ فتوانيتُ عنه أو ضيَّعتُه، فلامَني، فإنْ لامني أحدٌ من أهل بيتِه إلَّا قال: دعُوه، فلو قُدِّرَ -أو قال: لو قُضِيَ- أن يكونَ كان" (أخرجه البخاري ومسلم)

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[3] أخرجه البخاري ومسلم من حديث أبي هريرة رضي اللّه عنه

[4] سورة يوسف: الآية 111

[5] "التعلم باللعب يتعاظم أثره عندما يشارك الكبار الصغار في عالمهم بدلا من محاولة الكبار السيطرة على الصغار بالأوامر. فالفارق كبير بين المشاركة والسيطرة" المصدر: من كتاب "أينشتاين لم يعرف البطاقات التعليمية" لكاثي هيرش باسيك و روبرتا جولينكوف،
Einstein Never Used Flash Cards, Kathy Hirsh-Pasek, Roberta Michnick Golinkoff, Rodale, Inc., ISBN 978-0-08-023383-3

وفي رواية له يقول: "خدمتُ النبيَّ صلَّى اللهُ عليهِ وسلَّم عشرَ سنينَ ، فما قال لي أُفٍّ قطُّ ، وما قال لي لشيءٍ لِمَ أفعلْهُ : ألا كنتَ فعلتَه ؟ ولا لشيءٍ فعلتُه : لِمَ فعلتَه ؟"

ومما تقدم يمكن القول إن منهج النبي صلى اللّه عليه وسلم في تربية الأطفال كان مستندًا إلى الحكمة، والرفق، والتوجيه الصحيح واتخاذ هذه القيم والأساليب منهجًا متوازنًا يساعد في بناء شخصيات قوية ومستقرة.

المحور الثالث: ممارسات السنة النبوية في غرس قيم التربية البيئية وأثرها على الأطفال

1. الحفاظ على نظافة البيئة

- حديث "الطهور شطر الإيمان..."[6] يدل على أهمية النظافة في الإسلام.
- والطهارة في المنهج النبوي ظاهرة حسية وباطنة معنوية: عن أبي هريرة - رضي اللّه عنه - أن رسول اللّه - صلى اللّه عليه وسلم - قال: "أرأيتم لو أن نهرًا بباب أحدكم يغتسل منه كل يوم خمس مرات، هل يبقى من درنه شيء؟"، قالوا: لا يبقى من درنه شيء، قال: "فذلك مثل الصلوات الخمس؛ يمحو اللّه بهن الخطايا"؛ (متفق عليه).
- ويجب تعليم الأطفال أهمية النظافة والحفاظ على البيئة النظيفة من هذا المدخل التربوي القيمي مع الاهتمام بطهارة القلب كما نهتم بطهارة الجسم.
- وحديث " اتَّقوا الملاعنَ الثلاثة البَرازَ في الموارد وقارعةِ الطَّريقِ والظِّلِّ"[7] من أعظم التوجيهات للحفاظ على البيئة والصحة العامة والعناية بالآخرين.

2. حماية البيئة وعدم الإضرار بها

- حديث "لا ضرر ولا ضرار"[8] حديث مشهور، من جوامع كلم النبي صلى اللّه عليه وسلم، يمثل قاعدة الإسلام في الشرائع وقواعد الأخلاق والتعامل بين الخلق، وهي دفع الضرر عنهم بمختلف أنواعه ومظاهره، فالضرر محرم وإزالة الضرر واجبة، والضرر لا يُزال بالضرر.
- ويؤخذ منه توجيه الأطفال لاتخاذ خطوات إيجابية للحفاظ على البيئة وعدم اتلافها وكف الضرر عنها.

3. التعلم من الطبيعة

- حديث "تفكروا في خلق اللّه..."[9] وغيره فيه الأمر بالنظر في الكون واستخدام الطبيعة كمصدر للتعلم والتأمل.
- ويدلنا استخدام هذا المفهوم في تعزيز فهم الأطفال لجمال وقيمة الطبيعة والاستدلال على إبداع الخالق.

4. ربط الإنسان بتربة الأرض التي يعيش عليها بل ويعلمه أن يسترقي بها[10] من المرض، فهل يقدم عاقل بعد ذلك على تلويث تربة يستشفي بها!

كما كان النبي صلى اللّه عليه وسلم يربط الإنسان بسائر الكائنات أيضا بإعلامه أنها تستغفر له إذا علّم الناس الخير، قال -صلى اللّه عليه وسلم: "إنَّ اللّه عزَّ وجلَّ وملائكتَهُ، وأهلَ السمواتِ والأرضِ، حتى النملةَ في جُحْرِها، وحتى الحوتَ ، ليُصَلُّونَ على معلِّمِ الناسِ الخيرَ" (رواه الترمذي).

5. الاستدامة والمحافظة على الموارد:

أولى النبي صلى اللّه عليه وسلم أهمية كبيرة للزراعة المستدامة للأراضي وكيفية تعامل الإنسان مع الحيوانات والحفاظ على المصادر الطبيعية وحماية البيئة البرية. إن من أقواله -صلى اللّه عليه وسلم بشأن الاستدامة البيئية:

ما رواه أنس رضي اللّه عنه عن النبي صلى اللّه عليه وسلم: "ما من مسلم يغرس غرسا أو يزرع زرعا فيأكل منه إنسان أو بهيمة إلا كان له به صدقة". (أخرجه البخاري)

وقال أبو أيوب الأنصاري رضي اللّه عنه عن النبي صلى اللّه عليه وسلم: "ما من رجل يغرس غرسا إلا كتب اللّه له من الأجر قدر ما يخرج من ثمر ذلك الغرس"(أخرجه أحمد في مسنده).

كما نهى – صلى اللّه عليه وسلم -عن قطع الأشجار وتدمير المحاصيل حتى في أوقات الحرب.[11]

وليس أدل على الحرص على التنمية المستدامة من هذا التوجيه النبوي الذي لم أجد له نظيرا:

"إذا قامت الساعة وفي يد أحدكم فسيلة، فإن استَطاعَ ألا تَقومَ حتَّى يغرِسَها فلْيغرِسْها".[12]

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6 رواه أبو مالك الحارث بن عاصم الأشعري رضي اللّه عنه وأخرجه مسلم

7 رواه معاذ بن جبل رضي اللّه عنه، وأخرجه أبو داود

8 رواه مالك في الموطأ، والحاكم في المستدرك وغيرهما

9 خَرَجَ ابْنُ ماجَهْ، وأبُو الشَّيْخِ، عَن ابْنِ عَبّاسٍ قالَ: «مَرَّ النَّبِيُّ صلى اللّه عليه وسلم عَلى قَوْمٍ يَتَفَكَّرُونَ في اللَّهِ، فَقالَ: «تَفَكَّرُوا في الخَلْقِ ولا تَتَفَكَّرُوا في الخالِقِ؛ فَإنَّكم لا تَقْدِرُونَهُ»

10 رواه أبو داود وغيره. وعن عائشة رضي اللّه عنها قالت: " كان رسول اللّه صلى اللّه عليه وسلم يقول للمريض" بسم اللّه، تربة أرضنا بريقة بعضنا يشفى سقيمنا بإذن ربنا " متفق عليه، واللفظ للبخاري.

11 في مسند أحمد من حديث ثوبان أنه صلى اللّه عليه وسلم قال: من قتل صغيراً أو كبيراً أو أحرق نخلاً أو قطع شجرة مثمرة...لم يرجع كفافا، وكان صلى اللّه عليه وسلم يوصي أمراء جيوشه فيقول: ... ولا تقطعوا نخلا ولا شجرة ولا تهدموا بناء". وكذلك في وصية أبي بكر رضي اللّه عنه كما في مسنده.

12 صحيح الأدب المفرد من حديث أنس بن مالك

6. التوجيهات النبوية بعدم إتلاف الطبيعة أو إيذاء الحيوانات، مما يعكس حرص النبي محمد صلى اللّه عليه وسلم على احترام البيئة والكائنات الحية:

ومن جهة أخرى دعا الإسلام الحنيف إلى المحافظة على الكائنات الحية وعدم التعرض لها بالأذى، يقول صلى اللّه عليه وسلم: "دَخَلَت امْرَأَةُ النَّارَ في هِرَّة رَبَطَتْهَا، فَلَمْ تُطْعِمْهَا، وَلَمْ تَدَعْهَا تَأْكُلُ مِنْ خَشَاشِ الأَرْضِ".[13]

في حين سقى رجل كلبا فغفر اللّه له، فعَنْ أبي هُريرةَ رضي اللّه عنه أنَّ رسولَ اللّه صلَّى اللّه عليه وسلَّم قال: «بينما رجلٌ يمشي بطريقٍ اشتدَّ عليه العطشُ، فوجد بئرًا، فنزل فيها فشَربَ، ثم خرج فإذا كلبٌ يلهثُ، يأكلُ الثَّرَى من العَطشِ، فقال الرَّجلُ: لقد بلَغَ هذا الكلبُ من العطشِ مثلَ الذي كان قد بلَغَ منِّي، فنزل البئرَ فملأ خُفَّه ماءً، ثم أمْسكَه بفِيه، حتَّى رَقَى فسَقَى الكلبَ، فشَكَرَ له، فغَفَرَ له» قالوا: يا رسولَ اللّه إنَّ لنا في البهائمِ أجرًا؟ فقال: «في كلِّ كبدٍ رطبةٍ أجرٌ» (متفق عليه).

7. كان النبي صلى اللّه عليه وسلم يغرس الأشجار بيده:

كما جاء في حديث سيدنا سلمان الفارسي رضي اللّه عنه وقصة مكاتبته:

ذكر البخاري رحمه اللّه حديث سلمان كما ذكره ابن إسحاق، وغرس رسول اللّه صلى اللّه عليه وسلم ثلاثمائة نخلة بيده الشريفة، فعاشت كلها.

وما دعوة النبي الكريم صلى اللّه عليه وسلم إلى غرس الأشجار والنباتات إلا تربية بيئية تدعو لنظافة البيئة وخلوها من الملوثات من خلال زيادة مساحة الغطاء النباتي الناتج للأكسجين والمنقح الجو من ثاني أكسيد الكربون وغيره مما لا حاجة للبيئة به شيئا.

8. الحفاظ على الموارد المائية: وقد سبق بيانه

9. الحث على ترشيد الاستهلاك والتقليل من الطعام:

"ما ملأ ابنُ آدمَ وعاءً شرًا من بطنه حسْبُ ابن آدمَ أُكلاتٌ يُقمْنَ صلبَه فإن كان لا محالةَ فثُلثٌ لطعامِه وثلثٌ لشرابِه وثلثٌ لنَفَسِه".[14]

10. التنبؤ بمستقبل الحياة على الأرض ومنه يتبين خطورة التغيرات المناخية وضرورة المحافظة على البيئة ورعايتها:

فقد أنبأنا رسول اللّه – صلى اللّه عليه وسلم- أن أرض العرب ستعود مروجا خضراء كما كانت، وفيه دليل على تغير المناخ بين الجفاف والمطر وتغير البيئة بين التصحر والإنبات.[15]

كما حدّثنا عن انحسار الفرات عن جبلٍ من الذهب في آخر الزمان كما رواه أبو هريرة رضي اللّه عنه، أن رسول اللّه -صلى اللّه عليه وسلم- قال: "يوشك الفرات أن يحسر عن كنز من ذهب، فمن حضره فلا يأخذ منه شيئًا" (متفق عليه).

ثالثا: خاتمة وبعض التوصيات

- إضافة مادة التربية البيئية للمناهج الدراسية
- اقتراح عمل بعض الأنشطة الخاصة بالبيئة مثل:
  - الزراعة والعناية بالنباتات في حديقة المدرسة أو المركز التعليمي
  - توفير المصادر العلمية اللازمة مع مراعاة الفئات العمرية كالكتب والمراجع
  - المشاركة في عمل مسرحيات وعروض تقديمية عن البيئة ضمن النشاط المدرسي

في ختامنا لهذا الموضوع المهم، نجد أن دراسة التربية البيئية في حديث النبي محمد صلى اللّه عليه وسلم تعتبر أمرًا ذا أهمية كبيرة في الوقت الحالي، حيث تساهم في توجيهنا نحو الحفاظ على البيئة والاهتمام بها. إن تأصيل هذا الموضوع في السنة النبوية يعزز من أهمية اتباع هذه القيم والمبادئ في حياتنا اليومية.

بناءً على ذلك، نوصي بضرورة تشجيع الدراسات والأبحاث التي تركز على تربية الأطفال بمفهوم الحفاظ على البيئة والتوجيهات النبوية المتعلقة بهذا الموضوع. كما يجب دمج هذه القيم والمبادئ في مناهج التعليم والتربية للأطفال، سواء في المدارس أو في المجتمعات.

علاوة على ذلك، يجب أن يكون للمربين بكل فئاتهم دور فعال في نشر هذه القيم والتوجيهات النبوية بشكل مستمر ومؤثر. ويمكن أن يساهم ذلك في بناء جيل مسلم يحترم البيئة ويعتبر الحفاظ عليها واجبًا دينيًا.

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[13] ي الصحيحين من حديث ابن عمر رضي اللّه عنهما

[14] رواه المقدام بن معدي كرب، وأخرجه الترمذي، والنسائي في السنن الكبرى، وابن ماجه، وأحمد واللفظ له

[15] عن أبي هريرة رضي اللّه عنه قال: قال النبي صلى اللّه عليه وسلم: "لا تَقُومُ السَّاعَةُ حتَّى يَكْثُرَ المالُ ويَفِيضَ، حتَّى يَخْرُجَ الرَّجُلُ بزَكاةِ مالِهِ فلا يَجِدُ أحَدًا يَقْبَلُها منه، وحتَّى تَعُودَ أرْضُ العَرَبِ مُرُوجًا وأنْهارًا. (أخرجه مسلم في صحيحه)

رابعا: مصادر البحث

- القرآن الكريم
- الكتب الستة – صحيح السنة النبوية الشريفة
- المكتبة الالكترونية : جوامع الكلم والمكتبة الشاملة
- الجامع الصحيح للإمام السيوطي
- مسند الإمام أحمد
- نهج البلاغة للإمام علي بن أبي طالب-
- تفسير ابن كثير
- السيرة -لابن هشام الأنصاري
- مقدمة ابن خلدون - طبعة دار الفكر
- المؤتمر العالمي الأول في التربية البيئية -تبليسي/ جورجيا -الاتحاد السوفيتي سابقا عام 1977
- نحو طاقة خضراء، العلم والإيمان للدكتور مصطفى محمود
- التوازن البيئي بين العلم والإيمان، د. أحمد عبد العزيز مليجي

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Awareness and Sustainability. An Action-research on Early Childhood Educators and Parents in the Municipality of Rome

Chiara Minischetti[1]

Abstract

Early childhood education provides a crucial foundation for building a sustainable society. The objectives of this action-research, as part of the PNRR doctoral research path, are being defined and implemented; they concern the investigation of the sensitivity of educators and parents towards environmental sustainability and ecological transition. By analyzing the perceptions and practices related to sustainability, the study aims to identify the levers for fostering a deep cultural shift. Preliminary findings highlight both challenges and opportunities in promoting sustainability education in early childhood, emphasizing the importance of a systemic and inclusive approach.

1. Introduction

In today's rapidly changing society, issues related to sustainability and environmental education have become more urgent than ever (Rifkin, 2022). Despite the fact that awareness of this emergency is increasing internationally and nationally (Official Journal European Union, 2022; MIUR, 2017; United Nations, 2015; United Nations, 1987), these issues have not yet permeated the daily habits of the population. In fact, the mere dissemination of information through the main channels of mass culture often fails to translate into habits or concrete actions on the part of citizens.

"A feeling of hope emerges that could bring our species back to a new beginning and offer it another chance to rewrite the future" (Rifkin, 2022, p. 170). To translate this hope into sustainable practices, It is necessary that environmental sustainability education be present from early childhood education and care, and that educators share the goal of educating youth and adults to be environmentally responsible (NAAEE, 2016).

The following is a brief perspective on environmental sustainability education in early childhood, analyzing the role of educators, families and the entire educational community in preschool education. Therefore, we will try to analyze the following in the proposed order: education for environmental sustainability in early childhood - the doctoral research project (research demand and objectives) - methodology and tools - first considerations - conclusions.

1. Early Childhood Environmental Education

The fourth Sustainable Development Goal of the 2030 Agenda aims to "ensure inclusive and quality education, equitable and promote lifelong learning opportunities for all" (United Nations, 2015). Therefore, education of all levels must contribute to the creation of a more sustainable world, as specified by sub-goal 4.7, which aims to guarantee learners of all ages the knowledge and skills necessary to promote sustainable development.

Within this framework, environmental education for early childhood (henceforth ECEE) is fundamental. By promoting the values of sustainability and environmental awareness from the earliest years of life, ECEE lays the foundations for future generations to adopt sustainable and nature-friendly lifestyles. From preschool age, it is important to offer the possibility of understanding and valuing the natural world and interacting with it. These opportunities help to develop a sense of curiosity and wonder in children up to the age of 6 (Carson, 2024) and teach them to act in favor of sustainability, both individually and collectively (Official Journal European Union, 2022).

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Even though individual centers for early childhood education and care are becoming increasingly active in relation to emerging ecological issues (such as the climate crisis and biodiversity), sustainability would seem not to be a systemic feature of preschool education yet (Official Journal European Union, 2022; Collins *et al.*, 2023). Early childhood educators often do not feel prepared to address ecological issues and to foster a positive approach to environmental topics (Official Journal European Union, 2022). The key determinant to successfully implement education for environmental sustainability is educator competence (Collins *et al.*, 2023). Educators themselves recognize that they need targeted support to integrate the principles of green transition into their educational practices. It is important to recognize that education for environmental sustainability should not be approached as a separate subject, but rather as holistic, interdisciplinary knowledge. In this way, *"children are not taught about sustainability but rather learn to become sustainable"* (Collins *et al.*, 2023, p. 2).

As first educators of children, families and parents, have a great influence on the future of children, conditioning their attitudes, values, behaviors, habits and skills; consequently, they also play a key role in education for sustainable development (Yan *et al.*, 2008).

The contribution of the educating community, which includes educators, families and the wider community, is indispensable (Aluffi Pentini, 2021). These actors play a crucial role in creating an environment where sustainable practices are not only taught, but also modeled and reinforced. By involving families in the educational process, the principles of sustainability are consistently reinforced at home, fostering the development of sustainable habits in children.

2. Action Research

This article is based on ongoing action-research that forms part of the author's doctoral path, funded by the National Recovery and Resilience Plan[1] (PNRR). The hypothesis for this research emerged from an analysis of the European Recommendation (Official Journal European Union, 2022), international directives (United Nations, 2015), and a thorough review of current scientific literature. The hypothesis suggests that it is scientifically relevant to investigate the role of early childhood educational services in promoting environmental sustainability. This led to the formulation of the central research question for the project:

What role do early childhood educational services currently play, and what potential do they have in the future, in promoting ecological awareness, adopting sustainable lifestyles, and influencing consumer habits within the families of young children?

This action-research primarily focuses on analyzing the environmental awareness of early childhood educators and parents. A deep understanding of sustainability issues is considered a crucial starting point for driving behavioral change and fostering a sustainable lifestyle.

The specific objectives of this action-research are as follows:

- To assess the sensitivity to sustainability issues and education for sustainable development through questionnaires administered to preschool teachers and parents, with a focus on analyzing environmental awareness and the adoption of sustainable practices.
- To leverage the existing potential of the preschool educational system and its community.
- To systematize actions addressing emerging sustainability issues, with early childhood educators, preschool teachers, and families serving as key agents in these efforts.

In the following section, the structure, administration, and preliminary findings of the questionnaires will be discussed in detail.

3. Methodology

The working methodology is oriented towards action research, considered one of the most effective tools for understanding and addressing

[1] Presidenza del Consiglio (2021), *Piano Nazionale Ripresa e Resilienza Italia Domani.*

the specific focus areas of this project: environmental sustainability, sustainable transition, and the pedagogical models underpinning them (Marescotti, 2000). Action research is particularly suitable for this project because it allows for an initial exploration of the complexity of these issues, followed by participatory engagement.

During this phase, the active involvement of research participants was crucial to promoting meaningful engagement (Montali, 2009). Consequently, the choice of action research as the methodological approach was driven by its strong connection to social issues, particularly those related to education. Moreover, its action-oriented nature makes it intuitively accessible and immediately applicable to the research participants themselves (Baldacci *et al.*, 2013).

To effectively gather comprehensive data and understand the perspectives of key stakeholders, a mixed-methods approach was employed, utilizing both quantitative and qualitative tools. Specifically, surveys including questionnaires and interviews were used to collect quantitative and qualitative data, respectively. Additionally, various activities such as laboratory sessions with children and parents, meetings with parents, and community meetings were conducted to provide further insights. In the following section, the design, administration, and preliminary findings of questionnaires will be discussed in detail.

4. Questionnaires: Design and Administration

The use of questionnaires was selected as a primary method for data collection; it aligns with the action-research methodology by providing structured and flexible insights form early childhood education protagonists.

Through the administration of questionnaires, the aim of this phase of research is to assess the sensitivity of both parents and educators to emerging issues of environmental sustainability and ecological transition. Additionally, the questionnaires seek to explore how they perceive their respective roles in addressing these matters.

Two distinct questionnaries were developed and administred: one is addressed to preschools teachers and coordinators, while the other is addressed to parents of children aged from birth to 6 years. Both questionnaires consist of 30 items, divided into six sections:

1. General information
2. Personal habits on differentiated waste
3. Personal opinion on sustainable activities with children
4. Personal opinion on preschool role in ecological transition
5. Advice of text and manuals
6. Agenda 2030

There is an additional section specifically addressed to preschools coordinators, which aim to analyze their unique perspectives. It took about 10 minutes to complete each questionnaire.

Both questionnaires were designed to be anonymous and were administered online, to facilitate easy access and to encourage participants to provide accurate information. They were primarily distributed within the Municipality of Rome; preschools coordinators and educators assisted in the dissemination process.

The questionnaires are still in the process of being administered, so only a few preliminary observations can be made at this stage. These initial findings will be presented and discussed in the following section.

5. Preliminary Considerations

The analysis of the data is still in its early stages, as the questionnaires are still being administered and the data collection phase remains active.

A significant challenge encountered during this phase has been the difficulty in receiving responses from educational institutions. Only a few number of schools have shown willingness to participate in the research. In contrast, parents have been more responsive, contributing approximately twice as many responses as educators and coordinators. This disparity highlights a potential

gap in engagement between these two groups, which may require further attention.

Additionally, the early analysis suggests a notable difficulty in fostering cooperation between preschools and city institutions, such as universities. This lack of collaboration presents a barrier to the effective implementation of sustainable practices in early childhood education.

6. Conclusions and Future Analysis

Sustainability education requires more than just the transmission of concepts; it must involve the adoption of a sustainable lifestyle. Early childhood education is a crucial starting point for promoting environmental awareness and sustainable habits. The involvement of early childhood educators, families and the entire educational community is essential to the development of sustainable practices from preschool age.

This action research underlines the importance of collective commitment to promoting environmental sustainability. Achieving sustainable actions necessitates ecological awareness, which forms the foundation for any meaningful change in behavior. This awareness begins with the educators themselves, as *"training should first and foremost raise educators' awareness about sustainable development, and the role that early childhood education could play in promoting it"* (Yan *et al.*, 2008).

Through the analysis of the data collected via the questionnaires, this research aims to assess the current level of environmental awareness among parents and educators, as well as to identify areas where further efforts are needed. The expected outcomes include insights into the effectiveness of current educational practices in fostering sustainable behaviors and the identification of potential gaps that need to be addressed.

This research opens up several avenues for further investigation, particularly regarding the in-depth analysis of the collected data, which remains a crucial step for drawing more definitive conclusions. Future studies could expand on these findings, exploring how different educational strategies might better support the integration of sustainability into early childhood education.

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ممارسات التربية البيئية في التراث العربي والإسلامي: "تحول حضاري نموذجي"

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يشتمل البحث على:

- أولا: التمهيد: – مفهوم التربية البيئية ونشأة علوم البيئة
- ثانيا: محاور البحث:
  - 1. أسس ومبادئ التربية البيئية العالمية
  - 2. أسس ومبادئ التربية البيئية في ضوء الكتاب والسنة
  - 3. نماذج من علماء العرب والمسلمين واسهاماتهم في مجال التربية البيئية
  - 4. خطر التلوث البيئي ومنهج الشريعة الإسلامية في مواجهة الأخطار البيئية من خلال المؤسسات
  - 5. أهم المصنفات العربية في علوم البيئة والتربية البيئية
- ثالثا: خاتمة وبعض التوصيات
- رابعا: مصادر البحث

أولا: التمهيد:

مفهوم التربية البيئية ونشأة علوم البيئة:

تشير التّربية البيئيّة أو كما يُطلق عليها التّعليم البيئيّ إلى الجهود المنظّمة التي تعمل على توعية البشر من أجل تعديل سلوكهم نحو الحفاظ على البيئة الشاملة بمواردها مختلفة، وكيفيّة تمكين العنصر البشريّ من إدارة سلوكه في النّظام البيئيّ بهدف العيش بطريقة مستدامة، وضبط التعامل مع مقدرات البيئة في مسار صحيح يحول دون حدوث مشكلات بيئية، ويعمل على حل المشكلات القائمة والحد من أخطارها.

نشأة علوم البيئة:

إن هذا المفهوم واسع وشامل لجميع المؤثرات والأطر التي تحيط بالإنسان والتي تتضمن العوامل الطبيعية والاجتماعية والثقافية وغيرها التي تؤثر على الأفراد والجماعات.

والحاجة التي دعت إلى نشأة هذا العلم هي وضع أو رسم إطار عام لتحديد العلاقة والتفاعل والتأثير والتأثر بين الانسان وكل المخلوقات الحية مع محيطها الذي تعيش فيه، وتنظيم عملية استفادة هذه الكائنات الحية في محيطها في سبيل نموها وتطويرها، ولما كانت هذه العوامل والمؤثرات متعددة ومتجددة ومتنوعة دعت الحاجة إلى دراستها وهذا ما اصطلح عليه بعلم البيئة.

وذهب البعض من الباحثين إلى أن علم البيئة وإن لم يكن له هذه البحوث والتعاريف في القرون الماضية لكن لا بد من القول بأن الاهتمام بالبيئة المحيطة بالبشر قديم قدم الإنسان نفسه، فالإنسان لا ينفك عن الاحتياج إلى بيئته والتفاعل معها.

ثانيا: محاور البحث:

1. أسس ومبادئ التربية البيئية العالمية

من خلال استقراء العديد من الدراسات البيئية السابقة والوقوف على أهم توصيات مؤتمرات البيئة الدولية نجد أن المشتغلين بهذا العلم يرون أن له مبادئ حددوها، من أهمها ما يلي:

1. مراعاة أن تكون التّربية البيئيّة مستمرّةً مدى الحياة فيما يطلق عليه بالانجليزية: (Continuous Environmental Education)
2. التأكيد على أهميّة التعاون المحليّ والقوميّ والدوليّ في تفادي المشاكل البيئيّة وحلّها.
3. تمكين متعلّمي التّربية البيئيّة؛ ليكون لهم دورا في تخطيط خبراتهم التعليمية، وإتاحة الفرصة لهم لاتّخاذ القرارات وقبول نتائجها.
4. المساهمة في اكتشاف المشاكل البيئيّة وأسبابها الحقيقيّة.
5. التأكيد على التفكير العلمي الدّقيق، والمهارة في إيجاد حلول المشاكل البيئيّة المعقدة.

2. أسس ومبادئ التربية البيئية في ضوء الكتاب والسنة

والآن نعيد قراءة هذه المباديء في ضوء الكتاب والسنة:

1. مراعاة أن تكون التّربية البيئيّة مستمرّةً مدى الحياة:

يقول اللّه تعالى: (وَلاَ تفْسِدوا فِي الأَرْضِ بَعْدَ إِصْلاحِهَا وَادْعوه خَوْفاً وَطَمَعاً إِنَّ رَحْمتَ اللَّهِ قَرِيب مِّنَ المحْسِنِينَ) [1]

(1) باحث الماجستير بكلية أصول الدين – قسم الحديث وعلومه – جامعة الأزهر – مصر
مدرس وواعظ وإمام بالأزهر الشريف
معلم التربية الإسلامية للناطقين بالعربية – مؤسسة جيمس – دبي

(2) أستاذ الحديث وعلومه المساعد بكلية أصول الدين جامعة الأزهر بأسيوط

(3) أستاذ مساعد البيئة المائية بشعبة علوم البحار والأسماك قسم علم الحيوان كلية العلوم جامعة الأزهر بأسيوط

[1] سورة الأعراف: الآية 56

- تحث هذه الآية الكريمة على الابتعاد عن تلويث الأرض وعدم إفسادها وتدعو لاحترامها.
- كما يجب علينا أيضًا أن نحافظ على مواردها حتى نستفيد بها بشكل جيد ولوقت كبير.

وفي الحديث الشريف عن معاذ بن جبل رضي اللّه عنه قال: إن رسول اللّه صلى اللّه عليه وسلم قال: "اتّقوا المَلاعنَ الثلاثة: البُرازَ في الموارِدِ وقارعةَ الطريقِ والظِّلِّ". (أخرجه أبو داود في سننه)

- يأمرنا رسول اللّه صلى اللّه عليه وسلم في حديثه الشريف بعدم قضاء الحاجة في الطرق التي يسلكها الأشخاص بشكل يومي أو الأماكن التي يجلسون بها.
- والتي قد تؤدي إلى تلوث البيئة بشكل كبير بالإضافة إلى أنها قد تعود بالضرر على الإنسان والبيئة.

2. التأكيد على أهميّة التعاون المحليّ والقوميّ والدوليّ في تفادي المشاكل البيئيّة وحلّها

يقول تعالى: "وَتَعَاوَنُوا عَلَى البِرِّ وَالتَّقْوَى وَلاَ تَعَاوَنُوا عَلَى الإِثْمِ وَالْعُدْوَانِ وَاتَّقُوا اللَّهَ إِنَّ اللَّهَ شَدِيدُ العِقَابِ"[2]

- تشير هذه الآية إلى العلاقة القوية التي تجمع بين أفراد المجتمع والبيئة.
- فيجب عليهم أن يحرصوا كل الحرص وأن يتعاونوا على البر ولا شك أن الحفاظ على البيئة وحمايتها من خطر التلوث من أرقى أبواب البر والعكس صحيح.
- كما يتوعد اللّه سبحانه وتعالى بالعذاب الشديد كل آثم ومعتد، وهل بعد تلويث البيئة التي نعيش فيها ونأكل منها نحن وأولادنا والاعتداء عليها إثم.

ويقول النبي صلى اللّه عليه وسلم: " يد اللّه مع الجماعة" (رواه الترمذي من حديث ابن عباس)

3. تمكين متعلّمي التّربية البيئيّة؛ ليكون لهم دورا في تخطيط خبراتهم التعليمية، وإتاحة الفرصة لهم لاتّخاذ القرارات وقبول نتائجها

يقول تعالى: وَمَا كَانَ ٱلْمُؤْمِنُونَ لِيَنفِرُواْ كَآفَّةً ۚ فَلَوْلَا نَفَرَ مِن كُلِّ فِرْقَةٍ مِّنْهُمْ طَآئِفَةٌ لِّيَتَفَقَّهُواْ فِى ٱلدِّينِ وَلِيُنذِرُواْ قَوْمَهُمْ إِذَا رَجَعُوٓاْ إِلَيْهِمْ لَعَلَّهُمْ يَحْذَرُونَ" [3]

وعن أبي هريرة رضي اللّه عنه قال: قال رسول اللّه صلى اللّه عليه وسلم: "من سلك طريقاً يلتمس فيه علماً سهل اللّه له به طريقاً إلى الجنة" (رواه مسلم في صحيحه).

- المساهمة في اكتشاف المشاكل البيئيّة وأسبابها الحقيقيّة&

5. و التأكيد على التفكير الدّقيق، والمهارة في إيجاد حلول المشاكل البيئيّة المعقدة

يقول تعالى: "قُلْ سِيرُوا فِي الْأَرْضِ فَانظُرُوا كَيْفَ بَدَأَ الْخَلْقَ ۚ ثُمَّ اللَّهُ يُنشِئُ النَّشْأَةَ الْآخِرَةَ ۚ إِنَّ اللَّهَ عَلَىٰ كُلِّ شَيْءٍ قَدِيرٌ"[4]

ويقول النبي صلى اللّه عليه وسلم:"لكل داء دواء، فإذا أصيب دواء الداء برئ بإذن اللّه عزّ وجل "(رواه مسلم)

وفي قول النبي صلى اللّه عليه وسلم حث على البحث و طلب ذلك الدواء والتفتيش عنه.

وبما اننا لسنا بمنأى عن الدين الإسلامي الحنيف، فكل ما نطلبه ونرجوه وكل ما سنطلبه وسنرجوه موجود بين دفتي القرآن الكريم ومجلدات السنة النبوية المطهرة واجتهادات العلماء جزاهم اللّه خيرا، وقد أثر عن الإمام عليّ -كرم اللّه وجهه- قوله وهو يصف شمولية الإسلام: "فيه شفاء المستشفي، وكفاية المكتفي" [5]

3. خطر التلوث البيئي ومنهج الشريعة الإسلامية في مواجهة الأخطار البيئية:

لايخفى على شريف علمكم أن التلوث في يومنا هذا أشد خطورة في أبعاده المؤثرة واتساع نطاقه الجغرافي ليشمل الكرة الأرضية كلها فالإنسان يعمل ليل نهار في تدمير الكرة الأرضية دون أن يكون هناك أي اعتبارات لصوت الصحة والإبقاء على الحياة كما خلقها اللّه عز وجل بدون أي ملوثات حتى يتمتع بكل ما علي الأرض. [6]

إن القاعدة المنطقية تقرر أنه لا يسلم الكل حتى يسلم الجزء من أجل ذلك نظم الإسلام العلاقة بين الفرد والجماعة فالفرد لايمكن أن يكون بمعزل عن الآخرين إنما هو جزء من كل إنه مسؤول عن نفسه ومجتمعه الإنساني ثم إن مقتضى المسؤلية التنبيه وإيقاف أي إساءة للبيئة لأن تدهور النظام البيئي يهدد البشرية جمعاء سواء الذين أسهموا في أذية البيئة أو الذين لم يسهموا، يقول الرسول صلى اللّه عليه وسلم: "مثل القائم على حدود اللّه والواقع فيها كمثل قوم استهموا على سفينة فأصاب بعضهم أعلاها وأصاب بعضهم أسفلها فكان الذين في أسفلها إذا استقوا من الماء مروا على من فوقهم فقالوا لو أنا خرقنا في نصيبنا خرقا ولم نؤذ من فوقنا، فإن تركوهم وما أرادوا

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[2] سورة المائدة: الآية 2
[3] سورة التوبة: الآية 122
[4] سورة العنكبوت: الآية 20
[5] نهج البلاغة، الخطبة 108
[6] د. أحمد عبد العزيز مليجي، كتاب التوازن البيئي بين العلم والإيمان ص18 - 19

هلكوا وهلكوا جميعا وإن أخذوا على أيديهم نجوا ونجوا جميعا" رواه البخاري.

وبهذا يتحقق مبدأ الرقابة التي تسعى إليها التربية البيئية العالمية [7]

يقول تعالى: "ولو اتبع الحق أهواءهم لفسدت السموات والأرض ومن فيهن" [8] ،ومن هنا جاءت الشريعة الإسلامية عاصمة للإنسان من اتباع الهوى والميول إلى شهوات نفسه الأمارة بالسوء، فكان لزاما على الإنسان أن يشكر الله ويحمده على ما سخره له من روعة وجمال بيئته المتزنة ويحسن استخدامها واستغلالها لمصلحته ومصلحة البشرية جمعاء دون تدمير ولا تلويث ولا إفساد كما استخلفه الله عليها فهي أمانة بين يديه وتحت تصرفه.[9]

ولما كان موضوع هذا البحث "جهود العلماء العرب والمسلمين في التربية البيئية" فإنه يتعين أن تكون البداية من عند معلم الناس الخير، رسول الإنسانية صلى الله عليه وسلم، فكل جهد دونه قابل للنقد والدراسة والخطأ.

والمتأمل في أحاديثه المؤنسة يرى كيف استخدم صلى الله عليه وسلم مصطلحات وألفاظ بيئية تحبب الناس في بيئاتهم وتصنع علاقة قوية بين الإنسان والبيئية، فقد سبق بذلك وتفرد صلى الله عليه وسلم، على سبيل المثال لا الحصر بحديث النخلة:

عن عبد الله بن عمر أن رسول الله صلى الله عليه وسلم قال: «إن من الشجر شجرة لا يسقط ورقها، وهي مثل المسلم، حدثوني ما هي؟» فوقع الناس في شجر البادية، ووقع في نفسي أنها النخلة، قال عبد الله: فاستحييت، فقالوا: يا رسول الله، أخبرنا بها؟ فقال رسول الله صلى الله عليه وسلم: «هي النخلة» قال عبد الله: فحدثت أبي بما وقع في نفسي، فقال: «لأن تكون قلتها أحب إلي من أن يكون لي كذا وكذا» (متفق عليه).

وفي وجه الشبه بين المؤمن والنخلة اجتهد بعض أهل العلم فخلصوا إلى ما ملخصه: كثرة خيرها ودوام ظلها وطيب ثمارها لايزال يؤكل منه حتى ييبس ويتخذ منه منافع كثيرة

وفي حديث شريف آخر نجده -صلى الله عليه وسلم – يربط الإنسان ربطا شديدا بتربة الأرض التي يعيش عليها بل ويعلمه أن يسترقي بها من المرض، فهل يقدم عاقل بعد ذلك على تلويث تربة يستشفي بها!

وعن عائشة رضي الله عنها قالت : " كان رسول الله صلى الله عليه وسلم يقول للمريض" بسم الله، تربة أرضنا بريقة بعضنا يشفى سقيمنا بإذن ربنا " (متفق عليه، واللفظ للبخاري) .

وصفة ذلك كما قال الإمام النووي رحمه الله : " أنه أخذ من ريق نفسه على إصبعه السبابة، ثم وضعها على التراب فعلق به شيء منه، ثم مسح به الموضع العليل أو الجريح قائلاً الكلام المذكور في حالة المسح "ا.هـ

ولأن الماء سر الحياة وحابيها -كما أطلق عليه المصريون القدماء - فلطالما تحدثت عنه السنة النبوية المطهرة حيث حذرت من الإسراف فيه ونهت عن تلويثه وإفساده، وها هو معلم الخير ينادي على أمته في شخص سعد بن أبي وقاص رضي الله عنه ناهيا إياه: "لاتسرف في الماء ولو كنت على نهر جار" (رواه الإمام أحمد في مسنده).

والنهي عن الإسراف يتبعه نهي عن تلويث المياه من باب أولى يقول النبي صلى الله عليه وسلم:"لايبولن أحدكم في الماء الدائم الذي لايجري ثم يغتسل فيه" (أخرجه البخاري من حديث أبي هريرة).

وقد نهينا عن ذلك لأنه يقتضي تلوث الماء بالنجاسة والأمراض التي قد يحملها البول فتضر كل من استعمل الماء.

اللمحة الفائتة تعد من الأساليب الوقائية، فكيف وإن عم البلاء ووقع بالبيئة مكروه؟

إن رسول الله صلى الله عليه وسلم ألف بين الميؤوس والمأمول في حديث الفرار من المجذوم:

من حديث أبي هريرة رضي الله عنه قال: قال رسول الله صلى الله عليه وسلم: "لا عدوى ولا طيرة ولا هامة ولا صفر، وفر من المجذوم كما تفر من الأسد"، (أخرجه البخاري بسنده في الصحيح).

وفي حين أنه ثبت عنه من حديث جابر أنه أكل مع المجذوم في قصعة واحدة وقال له: "كل بسم الله ثقة بالله وتوكلا عليه" (رواه الترمذي في سننه).

قد يبدو في هذا تعارض، لكن هيهات هيهات فلا تعارض بين النص الصريح والعقل الصحيح وإن بدا ذلك فالوهم في فهم الفاهم، يقول الدكتور محمد علي البار في شرح هذه الأحاديث: يبين النبي للعرب كافة وللناس كلها أن العدوى وحدها أو الميكروب وحده ليس هو السبب في حصول المرض وأن هناك أسبابا أخرى بيد الله سبحانه وتعالى إن شاء صرفها وإن شاء جمعها فكان المرض وكانت العدوى،لذلك

[7] المصدر السابق ص 212

[8] سورة المؤمنون: الآية 71

[9] المصدر السابق ص15

لما استفهم الأعرابي من رسول اللّه صلى اللّه عليه ولم: "فما بال الإبل تكون في الرمل أنها الضباء فيجيء البعير الأجرب يدخل فيها فيجرب بها كلها؟ فأجابه: فمن أعدى الأول". (أخرجه البخاري في صحيحه من حديث أبي هريرة).

وبعد أن صحح العقائد صلى اللّه عليه وسلم أعطاهم النصائح البيئية التربوية والطبية ليفتح بذلك باب قبول النصح والوصايا والتنبيهات الصحية من الأمراض السارية من أهل الاختصاص يقول: "لايورد ممرض على مصح" (رواه البخاري من حديث أبي هريرة)،

يقول القسطلاني أي لا يدخل المريض على الأصحاء لكى لاينقل المرض إليهم.

ولم يكتف صلى اللّه عليه وسلم بمنع المريض من الاختلاط بالأصحاء وإنما يأمر الأصحاء أيضا بعدم الاختلاط بالمريض المصاب بمرض معد حتى يصبح غير ناقل للمرض إليهم فيقول: "إن من القرف التلف" (أخرجه أبو داود والبيهقي في السنن)، والقرف هو مقارفة المريض أي ملامسته والاحتكاك به، والتلف الهلاك أي العدوى.

وجاءه وفد من البادية يبايعونه وبينهم رجل مجذوم فأمر أن يرجع وقد بايعه عن بعد صلى الله عليه وسلم احترازا، ومن أقواله: "كلم المجذوم وبينك وبينه قدر رمح أو رمحين، وتحديد هذه المسافة بين الصحيح والمريض خشية العدوى هي نفس المسافة التي نشترطها اليوم بين أسرة المستشفيات [10]

وقد أسس صلى اللّه عليه وسلم لمفهوم الحجر الصحي عند تفشي الوباء والطاعون في الحديث الذي يرويه ابن حجر العسقلاني في فتح الباري عن أم المؤمنين عائشة رضي اللّه عنها قالت: "قلتُ يا رسولَ اللّه فما الطاعونُ ؟ قال غُدَّةٌ كغُدَّةِ الإبلِ ، المقيمُ فيها كالشَهيدِ والفارُّ منها كالفارِّ منَ الزحفِ" (فتح الباري 10/198، وإسناده حسن).

إن منع رسول اللّه صلى اللّه عليه وسلم لأهل البلدة المصابة بالوباء من الانتقال عنها تشريع رائع ومعجزة علمية ظهرت حقيقتها اليوم بعد مضي أكثر من أربعة عشر قرنا من الزمان وكما جاء الوعيد مرعبا: "كالفار من الزحف" جاء الترغيب حاثا أشد الحث على الإقامة والصبر يقول: "والمقيم فيه كالشهيد والصابر فيه كالصابر في الزحف".

إن هذه التعاليم التي جاءت في أحاديث المصطفى صلى اللّه عليه وسلم حول الحجر الصحي لا تختلف عن أحدث التعاليم العلمية في وقتنا الحاضر.

وللإمام الغزالي حجة الإسلام قول جدير بالذكر عن حقيقة حامل الميكروب وفترة الحضانة، يقول: "إن الهواء في البلدة المصابة بالوباء لا يضر من حيث ملاقاته ظاهر البدن بل من حيث دوام الاستنشاق فيصل إلى القلب وإلى الرئة فيؤثر في الباطن ولا يظهر على الظاهر إلا بعد التأثير في الباطن، فالخارج من البلد يقع به الوباء لا يخلص غالبا مما استحكم به." [11]

العناية بالبيئة من خلال التعاليم والأحكام الإسلامية ومؤسسات الدولة:

لقد استقى علماء المسلمين من المعين النبوي الشريف العلوم كلها واثمر ذلك ونما في بيئاتهم وبنوا مؤسسات الدولة عليه:

أ. مؤسسة الخلافة: حيث رأينا الخلفاء يعتنون بأمر البيئة بأنفسهم وبولاتهم وبأعوانهم، كما رأينا عمر بن الخطاب يحث أحد ولاته على غرس الشجر في أرضه ويشاركه بيده في الغرس ورأيناه يوصي بالرفق بالحيوان ورأيناه يشجع على إحياء الموات وكذلك رأى علي رضي اللّه عن الجميع في أرض الخراب بالكوفة

ب مؤسسة القضاء: حيث يستطيع القاضي أن يحكم بالتعزير على كل من أساء للبيئة

ج مؤسسة الحسبة: وكان لها دور كبير في الإشراف والإرشاد والرقابة والتأديب وكانت تتدخل في كثير من الأمور الاجتماعية والاقتصادية والأخلاقية.

د مؤسسة الوقف الخيري: وهي مؤسسة تقوم على أساس الصدقة الجارية الدائمة بأن يحبس الإنسان الأصل المالي ويسبل ثمرته وأن يجعلها موقوفة على الخيرات وسد الثغرات في حياة الناس حتى رأينا من خيار الناس من ينشئ وقفا للكلاب الضالة.

ه مؤسسة الزكاة: وقد قامت الزكاة بدورها في معالجة مشكلات الفقراء والمساكين والغارمين وأبناء السبيل من أصحاب الحاجات،

ومن المعلوم أن مشكلة الأعداء الثلاثة الفقر والمرض والجهل تعد من أعوص المشكلات التي تعيق رعاية البيئة والإحسان إليها. [12]

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[10] كتاب البيئة والأوبية في التراث الطبي العربي الإسلامي ص21\22 للدكتور محمود الحاج قاسم محمد\ نقل جزء عن الفنجري أحمد شوقي \ كتاب الطب الوقائي الإسلامي\ ص 36\ الهيئة المصرية العامة للكتاب 1985

[11] د. محمد علي البار: "العدوى بين الطب وحديث المصطفى" – دار الشروق، جدة 1977 ص 76.

[12] كتاب مسالك الشريعة الإسلامية في تحصيل مقصد حفظ البيئة ص30 – دكتور سمير محمد جمعة عواوده

ونرى الفقه المالكي يمنع الضرر الناتج عن مخلفات دور الدبغ والأفران:

حيث يمنع الفقه الإسلامي عامة والفقه المالكي خاصة الضرر الناتج عن مخلفات دور المدابغ والأفران والحمامات،

وكذلك يمنع الفقه الإسلامي تلوث الهواء بالنفايات واصطبلات الدواب والضرر الناتج عن المشاريع المجاورة للعمران ويجعل دور مؤسسة الحسبة دور رقابي في رقابة الملوثات الهوائية،

هذا ويوصي الفقه الإسلامي بتنمية الأراضي بالتشجير تنمية للبيئة وحفاظا عليها وذلك من خلال النوازل الفقهية بهدف حمايتها لما لها من آثار كبيرة تعود على الإنسان وباقي الكائنات الأخرى بالخير العميم.

كذلك اهتم الفقه الإسلامي اهتماما كبيرا بالمحافظة على التوازن البيئي والحكامة الجيدة للموارد الطبيعية بغرض الحفاظ على الرأسمال البيئي قال تعالى: " والأرض مددناها وألقينا فيها رواسي وأنبتنا فيها من كل شيء موزون".[13]

يضاف إلى ذلك أن مؤسسة الحسبة من الناحية العلمية استطاعت أن تسبق في كثير من جوانبها ما تنادي به المنتديات العلمية الحالية للحفاظ على البيئة من التلوث رغم قلة الإمكانيات بالنسبة لمؤسسة الحسبة وهذا دليل صادق يؤكد على مدى اهتمام الفقه الإسلامي بالمحافظة على البيئة داء ودواء.[14]

4. نماذج من علماء العرب والمسلمين وإسهاماتهم في مجال التربية البيئية وعلوم البيئة:

أولا:من باب الإنصاف العلمي، فان العلماء العرب استفادوا من ترجمة علوم اليونان والهند والفرس وغيرهم فى ميدان النبات والحيوان لكنهم درسوها وطوروا الكثير من النظريات والآراء العملية البحتة والتطبيقية ووضعوا إسهامات عديدة فى علم الحيوان والنبات والبيئة وأرسوا قواعد هذه العلوم للحضارة الغربية الحديثة.

فعندما برز الاسلام في الجزيرة العربية لم يكن بمنأى عن هذا الواقع،

إن الثقافة والحضارة التي أنتجها الدين الاسلامي أبرزت مجموعة من العلماء والباحثين الذين استقوا معارفهم وعلومهم من الإسلام فاستكملوا ما جاءت به الحضارات السابقة وساهموا في كل العلوم ومنها علم البيئة، وكان عصر الحضارة الاسلامية مشرقا في علم الحيوان والنبات والبيئة وسائر العلوم الاخرى.

ثانيا: لقد استند علماء العرب والمسلمين على الجربة أو التجريب والدراسات الميدانية في هذا الحقل لذا نرى أنهم أرسوا أيضا قواعد البحث العلمى فى مثل هذه العلوم، وهذا غاية ما يقوم به العلماء المعاصرين (Empirical Sciences) في العلوم الامبريقية/ التجريبية القائمة على الرصد والتجريب.

ثالثا: إنهم لم يفصلوا بين علم الحيوان وعلم النبات ولم يفصلوا كذلك بين الكثير من العلوم المرتبطة بها كالجيولوجيا والصيدلة والطب وعلم المناخ والتربة والزراعة، وذلك لإدراكهم بالعلاقة الوثيقة بين الحيوان والنبات والعناصر غير الحية وكيفية الاستفادة من العناصر الحية وغير الحية فى الجانب التطبيقي.

رابعا: إن عصر الحضارة الاسلامية لم يكن مظلما فى علوم الحيوان والنبات والبيئة وسائر العلوم الأخرى كما يدعى بعض علماء الغرب بل كان مشرقا جدا وكيف ذلك وقد ترجمت وطبعت الكتب التي نحن بصدد ذكرها عدة مرات وما زالت تستخدم كمراجع مهمة فى الجامعات الاوروبية والغربية.

ولأن الإسهامات التى قدمها العرب والمسلمون في مجال التربية البيئية وعلوم البيئة كثيرة ويصعب حصرها سنوردها فيما يلى بناء على تعاقبها الزمني، على سبيل المثال لا الحصر:

الأصمعى:

لقد درس الاصمعى بعض أصناف الحيوانات البرية والبحرية والأليفة والمتوحشة وقد أسهب فى دراسة بيولوجية الخيل والإبل.

الجاحظ:

وقد كان الجاحظ يلاحق الحيوان فى بيئته فيصف سلوكه ويتحدث عن بيولوجيته ويعد الجاحظ اول من تحدث عن أسس المكافحة الحيوية حين قال فى كتابة الحيوان : فعملت أن الصواب فى جمع الذباب مع البعوض فإن الذباب يفنيه . هذا المفهوم البيئى له أهمية كمحاولة للسيطرة على الكائنات الحية الضارة بدلا من استعمال المبيدات والمواد الكيميائية التى تلوث البيئة. وقد كان الجاحظ ينظر إلى الحيوان عند ولادته فيتحدث عن نشأته وموطنه وكيفية تربيته لصغاره وإطعامهم، وكان يراقب تأثر الحيوان بالحر والبرد والشمس والظل، وكذلك يتحدث عن علاقته مع الإنسان وحقيقة هذا هو ما يفعله علماء البيئة المعاصرين.

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[13] سورة الحجر : الآية 19

[14] بحث مقدم لمؤتمر القانون والبيئة المنعقدة في الفترة من 23، 24 ابريل 2018 بكلية الحقوق جامعة طنطا للدكتور أحمد محمود عبدالعال علي العوضي مدرس المدخل لدراسة الفقه الإسلامي بكلية القانون جامعة عمر المختار سابقا.

وقد ذكر الجاحظ في كتاب الحيوان ما نصه: "لا تنكر أن يفسد الهواء في ناحية من النواحي فيفسد ماؤهم وتفسد تربتهم."

أبو حنيفة الدينورى

وقد أبدع ابو حنيفة الدينورى فى كتابه النبات فى تصنيف النباتات وشرح بيئتها وأماكن وجودها وقدر قيمتها الاقتصادية.

ابن جلجل

أما ابن جلجل فقد ركز على بيئة الحشائش والأعشاب واستخداماتها فى علم الصيدلة والطب.

ابن سينا

أما ابن سينا فى كتابه الشفاء فقد درس الحيوانات المائية والبرمائية وعنى بالحيوانات المائية التى قسمها إلى لجية وشطية وقسم الشطية الى طينية وصخرية .

وتحدث ابن سينا أيضا فيما يسمى اليوم بعلم بيئة المتحجرات حيث استخدم الأحافير البحرية استخداما صحيحا للدلالة على أن أجزاء من الارض كان يغمرها البحر فى سالف الأزمان .

وقد درس ابن سينا بيئة بعض النباتات الطبية وركز على مواطن النباتات من حيث التربة التى تنمو فيها سواء أكانت مالحة أو غير مالحة .

ابن البيطار

وقد اهتم ابن البيطار فى كتابه الجامع لمفردات الأدوية والأغذية فى دراسة النباتات وبيئتها. فقد فحص النباتات فى مختلف البلاد واهتم بوصف هذه النباتات وصفا دقيقا كمايفعل علماء التصنيف النباتى فى وقتنا الحاضر.

الفزيوني

أما الفزيونى فى كتابه عجائب المخلوقات وغرائب الموجودات فقد تحدث عن تأثير البيئة على الحيوان وتحدث عن العلاقات الطيبة والعدائية بين الحيوانات أو ما يعرف اليوم بالتدخلات الحيوية فيقول فى حيوان الببر: حيوان هنى، اقوى من الأسد، بينه وبين الأسد معاداة وإذا قصد الببر النمر فالأسد يعاون النمر وبين العقرب والببر مصادقة وربما اتخذ العقرب فى شعر الببر بيتا. ويقول فى موضوع البيئة الحيوانية فى كتابه آثار البلاد وأخبار العباد متحدثا عن الطيور: الصقر والبازي والعقاب لا تفرخ إلا على رءوس الجبال الشامخة... والبطوط وطيور الماء لا تفرخ إلا فى شطوط الأنهار...الخ

ابن خلدون:

ومن اهتمام علماء المسلمين بالبيئة ما ذكره ابن خلدون في العلاقة بين العوامل التاريخية وتفكك التربة في حديثه عن جزر البحرين قال: "مفرطة الحر منهالة الكثبان، يهب الرمل على منازلهم" (العبر ديوان المبتدأ والخبر الجزء الرابع صفحة 197 طبعة بيروت 1941).

لقد سبق ابن خلدون وابن رضوان أطباء وعلماء البيئة بعدة قرون في مسألة تلوث البيئة، فهذا ابن خلدون على الرغم من عدم كونه طبيبًا إلًا أنه أكد بأن الزحام والهرج هما سببين رئيسيين من أسباب سرعة انتقال الأمراض المعدية خصوصًا أمراض الرئة ويستعرض بإيجاز أسباب تلوث الهواء في المدن المزدحمة وأخطار ذلك على صحة الأفراد ويؤكد على ضرورة ترك الفراغات بين الأبنية للتهوية كطريقة للحيلولة دون تلوث الهواء أو للإقلال من التلوث.[15]

- أهم المصنفات العربية في علوم البيئة والتربية البيئية:

وفيما يلي نعرض بإيجاز أهم مصنفات علماء العرب والمسلمين في علوم البيئة والتربية البيئية،

ونبدأ ببعض مما وصلنا من المصنفات في علوم صحة البيئة، إذ ربما تبادر إلى الأذهان أن علم صحة البيئة من مفرزات الحياة المدنية الحديثة، غير أن ما وجد في هذا الباب في كتب التراث الطبي يشير إلى معرفة الأطباء العرب والمسلمين بالعلاقة بين صحة الإنسان العامة والأحوال البيئية وأنهم كانوا على دراية كاملة بأن صحة الإنسان كما تتعلق بعوامل داخلية خاصة ببدنه فإنها تتعلق بعوامل خارجية ترجع إلى عناصر البيئة العامة الطبيعية والبشرية والحضارية[16]، بل إنهم أسسوا لممارسات في الطب الوقائي مماثلة لما نجده اليوم حيث انطلقوا من أن حفظ توازن الأفراد مع البيئة المحيطة بهم هو الداعم لترقية الصحة والوقاية من الأمراض وأن النظام البيئي هو المصدر الأساسي للحياة.[17]

ومن هذه المصنفات:

- نعت الأسباب المولدة للوباء في مصر لأحمد بن إبراهيم ابن الجزار القيرواني الطبيب التونسي المتوفى 395
- بذل الماعون في فضل الطاعون لأحمد بن محمد بن علي بن حجر العسقلاني المتوفى 852
- رسالة في الحيلة في دفع المضار الأبدان في أرض مصر

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15 ابن خلدون، المقدمة، طبعة دار الفكر ص 293

16 علي إحسان محاسنة، البيئة والصحة العامة، الأردن – جامعة مؤتة، 1997، ص 68

17 زهير حلاج، الصحة العامة، اللاذقية – جامعة تشرين، ط1، 1981، ص 11

لعلي بن رضوان

- كتاب الإبل ، وكتاب الوحوش عن الحيوانات البرية، الأصمعي
- الحيوان للجاحظ
- المقدمة لابن خلدون
- القانون في الطب لابن سينا
- موسوعة الشفاء لابن سينا
- الأبخرة المصلحة للجو للكندي
- النبات لابي حنيفة الدينوري (توفي سنة 894م)
- في الطبيعيات وتأثير النشأة والبيئة على الكائنات الحية للمجريطي (950-1008م)
- الجامع لمفردات الادوية والاغذية لابن البيطار (1149-1197م).
- عجائب المخلوقات وغرائب الموجودات للقزويني (1208-1283م)

خاتمة وبعض التوصيات:

1. تمكين التربية البيئية في المدارس: بهدف معايشة الأطفال للمشكلات البيئية، وتنمية مهاراتهم التي تساعدهم على صيانة بيئتهم وتنمية مواردها، مع إكساب التلاميذ القيم والاتجاهات الإيجابية نحو حماية البيئة وتنميتها بقصد إعداد جيل واع ببيئته الطبيعية والاجتماعية والنفسية والثقافية وتعزيز الهوية الحضارية.
2. نشر التربية البيئية والوعي البيئي في بيئات العمل المختلفة محليا وعالميا بهدف توعية سكان العالم بالبيئة الكلية، وزيادة اهتمامهم بالمشكلات المتصلة بها، وتزويدهم بالمعلومات والاتجاهات والدوافع والمهارات التي تساعدهم فرادي وجماعات للعمل على حل المشكلات البيئية الحالية، ومنع ظهور مشكلات جديدة او على الأقل الحد من أخطارها.

الخاتمة

إن كل ما نبحث عنه موجود بالفعل... فهل من مشمر!

فكل ما نطلبه ونرجوه وكل ما سنطلبه وسنرجوه موجود بين دفتي القرآن الكريم، ومجلدات السنة النبوية المطهرة واجتهادات العلماء جزاهم الله خيرا،

وقد أثر عن الإمام عليّ -كرم الله وجهه- قوله وهو يصف شمولية الإسلام:

" فيه شفاء المستشفي، وكفاية المكتفي"

وختاما...

يقول الحق تبارك وتعالى في كتابه العزيز في سورة العنكبوت:

"أولَمْ يَكْفِهِمْ أَنَّا أَنزَلْنَا عَلَيْكَ الْكِتَابَ يُتْلَىٰ عَلَيْهِمْ إِنَّ فِي ذَٰلِكَ لَرَحْمَةً وَذِكْرَىٰ لِقَوْمٍ يُؤْمِنُونَ (51)".

المصادر

- القرآن الكريم
- الكتب الستة (المكتبة الالكترونية : جوامع الكلم والمكتبة الشاملة)
- الجامع الصحيح للإمام السيوطي
- نهج البلاغة للإمام علي بن أبي طالب-
- مقدمة ابن خلدون - طبعة دار الفكر
- المؤتمر العالمي الأول في التربية البيئية -تبليسي / جورجيا -الاتحاد السوفيتي سابقا عام 1977
- التوازن البيئي بين العلم والإيمان، د. أحمد عبد العزيز مليجي
- البيئة والأوبئة في التراث الطبي العربي الإسلامي للدكتور محمود الحاج قاسم محمد
- كتاب الطب الوقائي الإسلامي أحمد شوقي الفنجري
- د. محمد علي البار: "العدوى بين الطب وحديث المصطفى" - دار الشروق، جدة
- مسالك الشريعة الإسلامية في تحصيل مقصد حفظ البيئة - دكتور سمير محمد جمعة عواوده
- بحث مقدم لمؤتمر القانون والبيئة المنعقدة في الفترة من 23،24 ابريل 2018 بكلية الحقوق جامعة طنطا للدكتور أحمد محمود عبدالعال علي العوضي
- علي إحسان محاسنة، البيئة والصحة العامة، الأردن – جامعة مؤتة
- زهير حلاج، الصحة العامة، اللاذقية - جامعة تشرين

THE MEANS THEME 03

Outdoor and Place-based Learning in the Decade of Ecosystem Restoration

Theme Background: Connecting with the natural environment and its contextual significance plays a fundamental role in fostering a deep sense of connection among individuals and in creating a sustainable future. This core theme aligns with the central theme of WEEC 2024, which emphasises "Connecting People, Creating a Sustainable Tomorrow." In this context, the United Nations Decade on Ecosystem Restoration represents a global commitment to preventing, halting, and reversing the degradation of ecosystems through active participation by communities and individuals. As part of this commitment, there is a growing call for nature-based education and place-integrated experiences within the field of EE and ESD.

Theme Objectives: The theme, "Outdoor and Place-based Learning in the Decade of Ecosystem Restoration," seeks to:

- Showcase diverse examples of outdoor and place-based learning initiatives that connect individuals with nature and their surroundings.
- Explore the impact of outdoor EE and ESD on students' physical and mental well-being and examine how contact with nature contributes to holistic development.

Theme Focus:

- Innovative approaches to outdoor education and place-based learning.
- Successful programmes that engage students and communities with their local ecosystems.
- Strategies for incorporating outdoor learning into formal and non-formal education settings.
- Psychological and physical health benefits of outdoor education.

Theme Outcomes: An elaboration on nature-based or place-integrated learning experiences that have shown to yield a wide range of benefits, in the context, the United Nations Decade on Ecosystem Restoration through active participation by communities and individuals, including the development of personal and social competencies that are highly relevant in today's world.

Theme Conclusions: The thematic track on "Outdoor and Place-based Learning in the Decade of Ecosystem Restoration" aligns with the broader mission of WEEC 2024 by emphasising the critical role of outdoor and place-based education in connecting people with their environment and fostering a sustainable future. Educators, researchers, practitioners, and community leaders are encouraged to contribute their insights, experiences, and innovations to this important dialogue in Abu Dhabi.

Together, we can explore the transformative potential of outdoor and place-based learning and its capacity to empower individuals and communities to become stewards of the natural world and active participants in ecosystem restoration efforts.

THE MEANS THEME 03

Outdoor and Place-based Learning in the Decade of Ecosystem Restoration

Proceedings

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107 La caractérisation d'une ruelle verte comme patrimoine où déployer une éducation à l'inclusion

Mamadou Bhoye BAH (1)

La ruelle verte peut être considérée comme un terrain propice au déploiement d'une éducation à l'inclusion sociale. En raison de son intérêt pour la dynamique urbaine, ce type d'aménagement de proximité, de plus en plus présent sur le territoire montréalais, a fait l'objet d'une série de webdocumentaires intitulée *Vue de ruelle*[1]. Huit capsules vidéo, co-réalisées par des cinéastes québécois dans huit ruelles des arrondissements Le Sud-Ouest et Mercier– Hochelaga–Maisonneuve ont été réalisées et projetées dans le cadre des festivités du 375e anniversaire de la ville de Montréal. À partir de l'analyse de ces documents, d'une visite des sites et d'un ensemble d'entrevues auprès des acteurs, nous avons cherché à mieux comprendre les modes d'appropriation des ruelles par les résidents. Nous avons porté une attention particulière à la dimension inclusive de ces initiatives.

I. Mise en contexte

Pour la plupart, des villes ont été fondées sur des sites écologiques à l'embouchure des cours d'eau pour faciliter le transport des personnes et des marchandises. Peu à peu, l'occupation résidentielle et industrielle le long des rives a fait disparaître un grand nombre d'espèces végétales et animales. Cet appauvrissement de la biodiversité prive les résidents de plusieurs avantages liés à un environnement plus naturel. Dans un tel contexte, il faut reconnaître le rôle important joué par la ruelle verte au fil des ans dans le développement de nos villes. Plus intimes et plus calmes que les rues, les ruelles étaient autrefois un cadre idéal de rencontres entre voisins, une aire de jeux pour les enfants et un passage utilisé par certains marchands. Leur configuration et leur mode d'occupation a changé, mais elles conservent toujours leur fort potentiel de convivialité et leur aménagement favorise désormais un meilleur rapport à la nature.

Selon Robert (2014), dans le Montréal de la Nouvelle-France, les ruelles étaient à l'origine inexistantes, en raison de la faible densité du développement urbain. Elles sont apparues au cours du XIXe siècle, pour faciliter la livraison du bois de chauffage. Elles ont aussi servi d'accès aux écuries à l'arrière des maisons dans certains quartiers ouvriers (Ville de Montréal, 2014). C'est également à cette époque qu'est apparu le type bâti avec porte-cochère permettant d'accéder aux cours intérieures. La ruelle est ainsi devenue une « voie d'accès secondaire, publique ou privée, à l'usage des terrains riverains déjà desservis par une voie publique » (Ville de Montréal, 2014).

Au début du XXe siècle, pour faire face à la croissance urbaine, les promoteurs développèrent des modes de construction rapides, économiques et denses qui marqueront le paysage des quartiers. Afin de réduire les coûts et mettre à profit l'espace exigu, les portes-cochères furent graduellement remplacées par des passages en fond de cours, parallèles aux rues, à l'origine de la ruelle en forme de H.

La ruelle est donc une trace visible de la dualité des régimes français et anglais dans l'aménagement de la ville. Tandis que la porte-cochère et l'îlot rectangulaire relèvent de la tradition du régime français dans le mode de lotissement seigneurial (sans ruelle), la ruelle est un concept importé par les architectes britanniques à l'ère des grands industriels (Despaties, 2013 ; Marchal, 2013).

Après la disparition des premiers usages, les ruelles ont été intégrées dans les plans d'aménagement des nouveaux quartiers. Elles ont été en majorité bétonnées dans les années 1960-1970. Au début des années 1980, rapporte Gobeille (2014), pour prévenir les incendies, la Ville de Montréal a instauré le programme Opération Tournesol en subventionnant la démolition de 35 000 hangars.

(1) Enseignant chercheur

Puis, la Ville a décidé d'élargir son intervention à l'ensemble des ruelles et a créé le programme Place au soleil (Ville de Montréal, 2014). Après l'élimination des hangars, ce programme a permis de transformer les ruelles en petits parcs améliorant ainsi la qualité de vie des citoyens. Ainsi les ruelles ont été modifiées au fil du temps passant d'une présence de hangars sans verdure, à peu de hangars et plus de verdure. Toutefois, malgré l'enthousiasme de départ, le programme Place au soleil fut abandonné après l'aménagement de 58 ruelles, à cause des coûts élevés d'aménagement.

Sur le plan urbanistique, l'aménagement des ruelles n'a certes pas échappé à la vague contemporaine découlant de la prise de conscience des enjeux environnementaux. Le projet de ruelles vertes consiste à réaménager des ruelles laissées à l'abandon pour les rendre plus fréquentables, diminuer les îlots de chaleur et créer un sentiment d'appartenance au milieu de vie commun. Il vise à augmenter les surfaces perméables, à favoriser la socialisation, mais surtout, à mobiliser et engager les citoyens. Lieu de rencontre entre voisins, une ruelle verte c'est également un terrain de jeu idéal pour les enfants et un espace à verdir pour contribuer à mieux gérer les eaux pluviales et augmenter la biodiversité en ville. La ruelle verte peut prendre en effet des formes très différentes. Au-delà de la verdure, on y intègre souvent du mobilier comme des bancs et autres commodités fournis par l'écoquartier2, fabriqués ou achetés par les résidents. Dotées de deux ou quatre entrées, elles permettent à toutes les résidences d'un même quadrilatère de se rejoindre à l'arrière.

Les projets de ruelles vertes ont contribué et contribuent toujours à la déconstruction de l'espace physique en vue de mieux reconstruire un commun qui favorise l'interaction et l'implication des résidents. On peut lire dans les documents historiques de la ville de Montréal (2014) que la première « ruelle verte » proprement dite a officiellement vu le jour en 1997 dans l'arrondissement du Plateau-Mont-Royal avec l'aménagement du quadrilatère des rues Napoléon, Roy, Du Parc-Lafontaine et Mentana.

Or, la prise de conscience des citoyens pour le verdissement s'accroît et la création des ruelles semble de plus en plus « populaire ». Plus de 85 % des ruelles vertes actuelles ont vu le jour depuis 2010. En août 2011, la plus grande ruelle verte de Montréal fut inaugurée. Appelée « L'Échappée Belle » et délimitée par les rues Wurtele, Florian, De Rouen et Ontario, cette ruelle mesure 363 mètres de longueur, comporte 57 arbres indigènes, 163 arbustes et 159 végétaux vivaces (Robert, 2014).

En 2013, dans l'arrondissement Villeray–Saint-Michel–Parc-Extension, l'administration locale a approuvé une résolution appuyant les initiatives citoyennes pour utiliser les ruelles à des fins récréatives durant la période hivernale. Patinoires, glissades et pistes de ski de fond pourront désormais être aménagées. Ainsi les autorités de cet arrondissement ont permis l'aménagement de ruelles blanches (Corriveau, 2013).

De 1999 à 2016, les Éco-quartiers se sont impliqués dans près de 320 projets de ruelles vertes. Onze des dix-neuf arrondissements de Montréal possèdent au moins une ruelle verte, développée grâce à des citoyens mobilisés, en étroite collaboration avec les Écoquartiers. Au total, sur l'ensemble du territoire de l'île de Montréal, on compte 346 ruelles vertes. Après plus de dix ans d'existence, il a été possible de proposer des Parcours verts et actifs en vue de valoriser les ruelles vertes. Maintenant, grâce à l'application mobile gratuite Parcours verts et actifs, ces itinéraires permettent aux citoyens et visiteurs de se déplacer activement tout en découvrant les aspects historiques et culturels des ruelles. De nos jours, le programme des ruelles vertes est l'affaire des résidents et il est coordonné majoritairement par les Écoquartiers, tandis qu'une bonne partie du financement ainsi que la légitimité de la démarche relèvent des arrondissements.

Sur le plan culturel, la ruelle occupe une place primordiale dans la mémoire collective des Montréalais. Elle a accueilli les activités récréatives des enfants riverains et marqué leur imaginaire. Ces ruelles inspirent encore bon nombre d'artistes québécois fascinés par la culture populaire. Mais la dimension culturelle associée à la ruelle montréalaise réside surtout dans

> « l'expérience de cette arrière-scène de la ville, ouverte sur le quotidien des riverains et la mémoire des lieux » (Ville de Montréal, 2015). Les ruelles ont donc un riche passé, mais aussi un bel avenir (Gehl, 2012). Qu'il s'agisse d'actions de verdissement ou de simples aménagements ponctuels, les acteurs du milieu commencent à tirer profit de cet espace semi-public. En célébrant le foisonnement d'idées et de créativité qui s'y cache et en mettant en évidence le sentiment de fierté qu'ont les gens qui s'y investissent, nous croyons que la production Vue de ruelle (Pierre-Étienne, 2017) qui est né de l'intérêt commun de trois vidéastes et de celui du Regroupement des écoquartiers pourra inspirer et encourager les citoyens à créer de nouvelles ruelles vertes.

Cette série de webdocumentaires présente en effet huit projets de ruelles vertes, mettant en évidence le caractère unique de chacune d'elles. Or, près de quatre décennies après l'avènement des ruelles vertes et malgré la double pertinence écologique et sociale de ces aménagements de proximité, force est de reconnaitre que trop peu de recherches se penchent sur le recours aux ruelles comme contexte d'éducation communautaire (tel que dans le guide d'activités produit par Zachari, Caron et coll., 2017). C'est donc pour contribuer à combler cette lacune que nous avons choisi d'examiner la ruelle verte sous l'angle d'un patrimoine commun à s'approprier par des acteurs locaux, en portant une attention particulière à la dimension inclusive des projets et au potentiel éducatif qu'on y trouve.

II. Cadre conceptuel

Le cadre conceptuel de notre recherche s'articule autour de deux éléments : le mode d'appropriation de la ruelle et l'éducation à l'inclusion. L'analyse du mode d'appropriation de la ruelle s'appuie sur les travaux de Kelly (2014) tandis que pour l'éducation à l'inclusion, nous nous référons aux travaux de l'Organisation des Nations Unies pour l'éducation, la science et la culture (UNESCO, 2009) et du ministère de l'Éducation de la Saskatchewan (2017).

L'appropriation d'un endroit se fait avec la création d'une communauté capable de soutenir ses membres. Durant les années 1960, des chercheurs se sont penchés sur les « urban villages », supposant qu'il s'agissait là d'une nouvelle forme de communauté, surtout basée sur les villages « ethniques ». Dans notre cas, il s'agit plutôt de ramener cette idée à plus petite échelle, la ruelle. Des résidents peuvent éprouver un besoin de s'unir entre voisins, car, en plus de partager un territoire, plusieurs d'entre eux partagent aussi des modes de vie, empreints de valeurs. Ce sont surtout les résidents qui ont des enfants qui ressentent ce besoin de solidarité, évoquant des questions de sécurité et de socialisation.

Le fait de fréquenter et d'expérimenter un lieu est une condition essentielle pour se l'approprier. L'appropriation du lieu débute par un premier contact guidé par l'appréhension multisensorielle ou encore les relations de voisinage, les motivations des résidents et les enjeux associés au lieu. L'utilisation régulière de la ruelle favorise la construction de ce sentiment d'appartenance. « La confiance n'implique pas seulement de se sentir en sécurité. Être en confiance, c'est ressentir un sentiment de "chez soi" par la présence solidaire ou bienveillante de personnes familières » (De Sablet, 1991, p. 49). Pour cet auteur, les espaces publics comme les ruelles sont des lieux propices aux relations sociales.

Sous le double éclairage des travaux de Folco-Durand (2017), de Dardot et Laval (2014) et de ceux de Kelly (2014), l'inclusion favoriserait une meilleure compréhension et une plus grande acceptation de la diversité sociale et ethnoculturelle. Afin de répondre aux défis croissants que soulève cette diversité dans le « vivre-ensemble », plusieurs États et institutions ont adopté depuis les années 1990, des politiques et des programmes inclusifs dans différents secteurs (dont l'UNESCO, 2009 ; ministère de l'Éducation de l'Ontario, 2009). Le Québec ne fait pas exception à cet égard, notamment dans le secteur de l'éducation, où les développements en matière d'éducation inclusive sont jugés essentiels pour le développement d'une société plus accueillante et démocratique.

À l'échelle de la ruelle, le fait de pouvoir compter sur un groupe rend l'expérience urbaine plus humaine: *« Reconnaître qu'un lieu est la propriété d'un groupe ou qu'un groupe en possède*

l'usage de façon privilégiée, c'est lui accorder un caractère particulier aussi important que sa fonction » (UNESCO, 2009). Un milieu éducatif de type inclusif, à l'image d'une ruelle, devrait être un espace accueillant où l'on accepte les centres d'intérêt, les origines et le vécu de celui qui apprend.

L'approche inclusive vise donc à introduire un processus de transformation au sein des regroupements, associations ou institutions afin que tous les individus puissent y participer et y contribuer, en toute équité. Selon l'UNESCO (2009), cela suppose une réforme qui favorise la diversité : il s'agit là de l'une des principales stratégies permettant d'affronter la marginalisation et l'exclusion.

III. Choix méthodologiques

Pour mieux cerner les modes d'appropriation des ruelles par les résidents, la démarche privilégiée a été celle d'une recherche descriptive, interprétative et critique. En effet, cette étude s'intéresse non seulement au repérage et à la caractérisation des diverses configurations des ruelles vertes, mais elle se penche aussi sur le sens que les résidents accordent au mode d'appropriation de leur ruelle. De plus, dans une perspective critique, elle s'intéresse au processus d'inclusion de différents groupes sociaux dans de tels projets d'aménagement de proximité.

Deux principales stratégies complémentaires de collecte de données ont été privilégiées : l'entrevue et l'observation. Les participants aux entrevues ont été sélectionnés dans trois ruelles dont deux (Desnoyers/St-Jacques et Blake/Dominion) dans l'arrondissement Le Sud-Ouest (SO) et une (Desjardins/Pierre-De-Coubertin) dans Mercier–Hochelaga-Maisonneuve (MHM). Les critères de sélection ont été les suivants : tous les participants devaient habiter aux abords des ruelles en question ; leurs profils sociodémographiques devaient être variés ; ils devaient assister à toute la projection de Vue de ruelle.

C'est ainsi que des témoignages ont été recueillis auprès de dix répondants rencontrés immédiatement après la projection des web documentaires. Deux d'entre eux étaient de jeunes garçons québécois de 10 (MHM4) et 13 ans (SO6) ; une Canadienne retraitée, âgée de 74 ans (SO4) ; une Marocaine âgée de 47 ans (SO2), nouvellement arrivée au Québec ; une Algérienne de 32 ans (MHM2), établie à Montréal depuis dix ans ; une Canadienne « anglophone » de 38 ans (SO1), femme d'affaires ; une autre Québécoise de 45 ans (SO5), enseignante et trois autres Québécois de 29 (MHM1), 38 (MHM3) et 43 ans (SO3) dont les professions n'ont pas été précisées. Les répondants ont été volontaires.

Les entrevues auprès de ces dix répondants ont duré 30 minutes en moyenne par personne interrogée. Certaines entrevues ont toutefois été plus courtes, notamment avec les plus jeunes, soit 20 minutes, par manque de temps de la part des répondants ou en raison de la concision des réponses. Toutes les entrevues ont fait l'objet d'un enregistrement audio. Parallèlement à ces entrevues, nous avons procédé à l'étape de l'observation de projets de ruelle. Nous appuyant sur les balises méthodologiques de plusieurs auteurs (Postic et de Ketele, 1988 ; de Ketele, 1988; Norimatsu et Pigem, 2008 ; Gaudreau, 2011), nous avons constaté de visu ce qui se passe en visitant les ruelles en question et en visionnant les webdocumentaires présentant ces ruelles. Nous avons été attentifs à ce qu'il est convenu d'appeler des « récits de lieu »3 pour reprendre l'expression de Kelly (2014).

Dans le cas de cette recherche, au-delà de l'analyse des pratiques dans les ruelles, nous nous sommes intéressés au contexte, à l'« esprit d'aménagement » et à l'aménagement physique proprement dit de la ruelle verte tel que décrits par les acteurs. L'enregistrement audio des propos d'entrevue et la narration des capsules vidéo de la série Vue de ruelle ont été organisés en un corpus qui, transcrit en verbatim, a permis d'analyser les modes d'appropriation des ruelles qui ont été déployés par les résidents, en portant une attention particulière à leur dimension inclusive. Un premier découpage des verbatims a facilité l'identification des activités ou des interventions effectuées dans les ruelles.

Pour caractériser l'appropriation, il fallait d'abord identifier le type d'activité ou l'intervention telle que décrite par les répondants. La saisie des modes d'appropriation a nécessité ensuite

plusieurs visionnements des séquences vidéo et une analyse en profondeur des propos d'entrevue. Par la suite, les enjeux soulevés par le déploiement des activités dans les ruelles vertes ont été cernés à travers les données rassemblées. Une analyse transversale des modes d'appropriation des ruelles par les résidents et un examen des enjeux a enfin permis de dégager des pistes à retenir pour rendre les ruelles plus inclusives et pour concevoir des interventions éducatives à cet effet.

IV. Une diversité des projets de ruelle

Il existe plusieurs types de ruelles vertes dont les plus répandues s'étendent environ sur 300 mètres de long et 4 mètres de large. De façon générale, des bandes d'asphalte sont excavées de chaque côté des huit ruelles qui ont fait l'objet des projections. Des plantes indigènes et des arbustes y sont plantés. Par endroit, des plantes grimpantes sont cultivées et quelques grands arbres forment une sorte d'arche au-dessus de la voie, réduisant ainsi l'absorption de la chaleur du soleil par le bitume. Dans certaines ruelles vertes, on note l'existence de bancs de parc, de peintures murales et de composteurs. Dans de rares cas, les citoyens ont choisi de retirer complètement l'asphalte et d'y installer de la pelouse. Dans les cas où l'accès aux automobiles est interdit, l'arrondissement peut exiger que tous les riverains acceptent le projet, à 100 %. Il convient de signaler enfin l'établissement d'un centre, « Plaque tournante de la ruelle », qui n'est pas nécessairement son centre géographiquement parlant, mais un point de rencontre autour duquel gravitent les jeux des enfants.

Dans les paragraphes qui suivent, sont présentées les grandes lignes des huit courts webdocumentaires qui composent le projet Vue de ruelle (Pierre-Étienne, 2017) dont il importe de souligner le caractère artistique.

Ruelle verte Desnoyers : la vision du jardinier: Située à l'angle des rues Desnoyers et Saint-Jacques, cette ruelle met en vedette un résident de Saint-Henri et ex-jardinier pour la Ville de Montréal. Ce dernier s'amuse à apprendre les rudiments du métier à la « relève » du quartier. Inspirée des concepts de haie champêtre et de paysage comestible, la ruelle est maintenant remplie d'arbres fruitiers, de vivaces et de créativité.

Ruelle verte Desjardins: l'héritage : À l'inauguration de la ruelle Desjardins-Pie IX et l'Espace Vert Desjardins, il y avait des jeux d'animation portant sur des habitudes de vie responsables ainsi qu'une brouette maraichère intitulée marché mobile. Ce kiosque a permis à deux producteurs de fruits et légumes bios de faire découvrir leurs produits aux visiteurs.

Ruelle « jaune » Allard: rêver en couleur : Durant l'été 2017, dans le coin de Ville-Émard, un artiste éco-recycleur a mis sur pied un projet de ruelle jaune en l'occurrence la ruelle Allard. L'artiste a peint des barres jaunes et blanches ainsi que des pictogrammes représentant des enfants à vélo et des femmes enceintes afin de réduire la vitesse de circulation des voitures dans la ruelle. Il y a ajouté une touche de verdure, en plantant des fleurs dans des bacs en bois, accrochés en haut d'une clôture rétractable sur roulettes.

Ruelle verte French: Patates et gazon7: La ruelle verte French, à l'instar d'autres ruelles, a sa propre personnalité. En plus de contribuer à l'amélioration de la qualité de vie et à la lutte aux îlots de chaleur, c'est une oasis de verdure qui renforce les liens de bon voisinage et rehausse le sentiment de sécurité.

Ruelle verte Baldwin/Lebrun: Papillons et limonade : La ruelle verte Baldwin force l'admiration de plusieurs voisins, enfants et curieux. Elle comporte des bancs de bois, des boîtes à fleurs, des treillis de bois et des jeux colorés à même l'asphalte donnant une allure ludique à cet espace bordé de cours arrière. C'est justement pour revitaliser ce lieu symbolique que l'instigatrice du projet a décidé de se lancer dans cette aventure afin d'offrir un espace de jeu et un lieu agréable aux enfants du voisinage.

Ruelle verte Blake: Plate-bande joyeuse: La ruelle Blake, en plein cœur de la Petite Bourgogne, est aussi un bel exemple de cohabitation entre des personnes provenant de différents milieux. Le jardin communautaire bordé de fleurs rassemble les propriétaires des jolies maisons de la rue Coursol et les résidents des habitations à loyer modique (HLM) vivant à proximité.

Ruelle verte Yamaska : Nostalgie à Saint-Henri: La ruelle Yamaska, dans Saint-Henri, met de l'avant l'histoire d'un citoyen qui est né et a passé toute sa vie dans cette partie de l'arrondissement Le Sud-Ouest. Nostalgique des temps passés, où tout le monde se connaissait et prenait son temps, ce citoyen a voulu créer un lieu de rassemblement en organisant de petits événements comme des ventes-débarras.

Ruelle verte William-Bennett: La vie devant soi11: « La vie devant soi » est inspirée d'un roman qui raconte l'histoire d'un petit garçon arabe orphelin élevé par une dame juive, âgée et malade qui garde dans son appartement des enfants dont les mères travaillent ou ont disparu. C'est aussi un roman qui provoque constamment le rire et les larmes et qui porte en lui toutes les questions, tous les drames et tous les rêves du monde d'aujourd'hui. On a pu observer à travers cette capsule vidéo un récit fort intéressant sur l'enfance, l'espoir et l'insouciance.

V. Modes d'appropriation des ruelles dans un contexte inclusif

En réponse à la question « Comment les Montréalais s'approprient-ils leurs ruelles ? », voici ce qui émerge du discours des répondants en complément aux notes de visionnement des webdocumentaires. L'appropriation de la ruelle par les résidents se fait de différentes manières. Dans le cas de cette recherche, l'aménagement de la ruelle, notamment par les initiatives citoyennes, et son utilisation autant par les enfants que par les adultes sont les deux principaux modes qui permettent son appropriation.

> *Le plus souvent, l'appropriation de la ruelle commence par un certain aménagement par les gens qui y sont engagés. Souvenons-nous que la plupart des ruelles avaient été bétonnées dans les années 1960. On peut voir aussi en leur centre une rigole permettant l'écoulement de l'eau vers les bouches d'égout disposées à trois ou quatre endroits dans la ruelle. Les ruelles possèdent également, en grande majorité, des dos d'âne généralement placés au centre ainsi qu'aux extrémités de la ruelle. Plusieurs poteaux y soutiennent les fils électriques, les lignes téléphoniques, l'éclairage et les cordes à linge. À ce type d'aménagement classique, s'ajoutent des bancs et par endroit des bacs composteurs comme ce qu'on a pu observer dans la ruelle Desnoyers/Saint-Jacques.*

Par ailleurs, les rythmes de la ruelle nous ont permis de situer dans le temps la fréquentation de celle-ci. Cette fréquentation au fil des jours est fortement influencée par les heures de travail et d'école, ou de camps de jour organisés pendant l'été. Durant une même semaine, l'utilisation de la ruelle est plus importante en fin d'après-midi.

Il ressort de nos entretiens et observations que cette utilisation est associée à des jeux d'enfants, à des projections cinématographiques, à de la peinture sur le sol, à l'organisation des fêtes de voisins (ou fêtes de ruelles), etc. Les activités de jardinage, comme celle des plates-bandes joyeuses de la ruelle Blake, impliquent pour leur part l'occupation régulière par des résidents venus entretenir leurs plantations.

On observe que ce sont surtout les enfants qui utilisent la ruelle, dans la mesure où c'est leur aire de jeu. La ruelle demeure l'un des premiers lieux de socialisation facilement à leur portée. Les enfants y vaquent à différents jeux et loisirs dont les plus populaires sont la cachette, le ballon (basketball, soccer, ballon chasseur, etc.) et la bicyclette. D'autres jeux comme le badminton, les dessins à la craie, les courses, le hockey, le baseball, mais aussi les jeux de rôles, les « mauvais coups » et les discussions, ont été également observés dans les séquences vidéo et également mentionnés par les personnes interrogées.

Certains répondants soutiennent que leur principale motivation à fréquenter la ruelle est la possibilité de trouver une panoplie de jeux pour leurs enfants.

> Écoutez, c'est le bonheur, ça part des enfants. Les enfants sont là, ils veulent voir d'autres enfants, ça réunit les gens, les parents se rencontrent. En plus de toutes les petites activités qu'on organise, la soirée de films une fois par année par exemple, les enfants mangent ensemble. Ces enfants-là, quand ils vont devenir adultes, ce sont des moments qu'ils n'oublieront jamais (8e web documentaire).

SO4: Pour moi, ça a commencé avec mon fils qui allait souvent jouer dans la ruelle avec les p'tits voisins et ça en a fait un humain ouvert à la diversité et qui sent le besoin de cette diversité-là pour frapper son imagination, pour nourrir son intériorité, nourrir sa vie intérieure. Dans le même ordre d'idées, les préoccupations familiales constituent un autre élément qui plaide en faveur de cette utilisation.

SO2: Je veux que mes enfants grandissent là où il y a des arbres, des fleurs, de la verdure, etc. Je veux que mes enfants et moi, on trouve un bon endroit où relaxer. MHM3 : Comme vous le savez, se rencontrer avec les gens, ça favorise le partage et la communauté. Donc, c'est exactement l'inverse du monde individualiste qui rend les gens malheureux.

Évoquant des raisons de sécurité, les parents vont accompagner leurs enfants dans la ruelle. À cette occasion, des amitiés se tissent, les parents apprennent à se connaître et à se reconnaître entre eux, surtout lorsqu'ils vont chercher leurs enfants chez l'un ou chez l'autre. Cet extrait du 5e webdocumentaire permet de corroborer cette affirmation : *« La ruelle, c'est un peu comme un parc familial. De nos fenêtres, on le voit que nos enfants sont en sécurité, que nos enfants jouent bien ensemble ».*

Notons toutefois que certains répondants ont exprimé des réserves à l'égard des ruelles. Ainsi, l'une de nos répondantes estime que la ruelle peut parfois recéler des dangers : *« Dans la ruelle Blanchard, il y avait quelques dangers pour mon fils (des déchets partout, des chats de ruelles, du commerce de la drogue, bref de l'insécurité). Le fait que les gens se rencontrent pour s'entraider, pour surveiller le quartier et sécuriser la ruelle aussi, je trouve ça très important ».*

Ce sentiment d'insécurité pourrait n'être qu'un vieux souvenir des années 1980 car, de l'avis de la grande majorité de nos répondants, les gens se sentent en sécurité dans les ruelles. L'une des activités récurrentes des ruelles vertes est certes le jardinage comme en témoignent, entre autres, les webdocumentaires :

SO1: *Quand je passe par les ruelles le soir, je trouve ça le fun, je regarde. On y travaille, on fait du jardinage ici. Parfois aussi des barbecues. Ce qui attire ce sont les voisins. En plus, il y a la vue panoramique, comme moi j'occupe un appartement qui ouvre vers la ruelle.*

> **MHM3:** *L'appropriation des ruelles se fait via des potagers. On observe aussi que la présence d'animaux renforce l'expérience de la vie dans la ruelle. Parmi les activités de divertissement notamment pour les enfants, on mentionne des peintures murales et parfois des marquages qui sont faits au sol. Les 2e et 3 e webdocumentaires permettent de dégager fort bien la dimension artistique des gestes de création et de l'imaginaire. Comme l'atteste Delorme (2005, p. 24), « Les citoyens imaginent leur ville, ils la pensent selon leur conception personnelle et s'identifient à l'environnement qui est le leur. »*

MHM2: *À travers des activités organisées ensemble, il y a également les décorations murales et par terre et les peintures murales ou sur le sol.*

MHM4: *J'aime bien quand il y a des croquis et j'aime bien aussi quand il y a la peinture sur le sol. J'aimerais bien que ma ruelle ça soit une ruelle verte. Ensuite, j'aimerais bien dessiner, puis mettre un jardin, et puis de la peinture sur le sol.*

L'imaginaire de la ruelle se construit à même des éléments et des personnes qui s'y trouvent. Certains éléments matériels font partie d'un imaginaire collectif, comme les cordes à linge, les hangars et les clôtures. Chaque ruelle comporte son lot de personnages communs, dont des jeunes familles, des voisins qui ont un jardin dans leur cour, des enfants qui jouent dans la ruelle ou encore des amis ou ennemis des chats. (Kelly, 2014, p. 100)

Signalons que la toute première utilité de la ruelle et qui est toujours pratiquée est la circulation. Nous avons pu voir à travers les webdocumentaires que de nombreux citoyens empruntent les ruelles comme raccourcis pour se déplacer dans le quartier ou encore comme accès à une place de stationnement. Bien que la ruelle verte soit un terrain de jeux doublée d'une socialisation très marquée, elle est restée et reste toujours un lieu de passage, que ce soit en voiture, à bicyclette ou à pied. La coexistence de ces trois moyens de déplacement est également primordiale dans les relations de voisinage.

Parmi les activités organisées dans la ruelle, les fêtes (fête de la ruelle, fête des voisins) occupent une place de choix.

SO1: *Organiser la fête de ruelle ou encore les soirées cinéma, c'est une idée géniale.*

> ***SO3:*** *Ce qui est intéressant avec les fêtes dans les ruelles, c'est la dynamique, c'est le fait de s'éloigner de l'image que la majorité des gens peuvent avoir de la grande ville. Tu sais Montréal, c'est que du béton, les gens ne se parlent pas, les gens ne se connaissent pas. C'est tout le contraire là, on vient à la ruelle, les gens se parlent, se connaissent, on rit, les enfants profitent aussi. C'est quelque peu déconstruire les limites de l'imaginaire pour montrer ce que la ville peut être versus tout ce qu'on pouvait imaginer dans les années 90.*

À l'occasion desdites fêtes, les voisins sortent souvent des chaises, discutent et profitent en même temps pour partager soit un souper commun, des grignotines ou un barbecue. Ces fêtes peuvent atteindre une autre envergure lorsque par exemple un des résidents fait des ententes avec les commerces environnants pour avoir des commandites et faire tirer des prix parmi les voisins. Ces fêtes s'adressent aux enfants, à leurs parents et grands-parents, aux amoureux des ruelles vertes autant qu'aux curieux et aux passants.

Dans la ruelle verte Desjardins, les fêtes ont lieu depuis 2015 et à chaque fois, les voisins sortent des chaises, des grignotines ou du melon d'eau par exemple, en plus d'inviter les employés ayant travaillé avec eux pour la ruelle verte.

MHM2: On organise des fêtes de ruelle deux fois par été. On y fête aussi l'Halloween. Tous les voisins sont invités, même si c'est seulement un noyau de résidents qui s'impliquent à la fois dans l'organisation de l'événement et dans l'aménagement de la ruelle verte.

> Le visionnement de films est une autre forme d'activité festive organisée dans certaines ruelles. Les exemples mentionnés par certains répondants ont lieu une fois durant l'été. Pour ce faire, les voisins se procurent un projecteur, installent une toile ou un drap blanc pour faire la projection et apportent chaises ou des couvertures, ainsi que des bonbons pour les enfants. Dans la ruelle verte William-Bennett, SO5 fait partie du petit groupe de résidents qui se rassemblent pour organiser des soirées cinéma : « Il peut y avoir jusqu'à 50 personnes qui se déplacent pour venir s'installer au milieu de la ruelle, où se déroule la projection ». Dans la ruelle verte Desjardins, la projection de film, intégrée à la fête de la ruelle, ouvre sur une autre dimension.

MHM2: Dans nos fêtes de ruelles, on intègre la projection de films. On envisage même pour le futur d'organiser des repas communautaires, partager divers repas de diverses cultures (décrypter l'art culinaire en quelque sorte) autour d'une table et en même échanger un peu ce qu'on a vécu durant la journée, des choses qu'on peut discuter quand on est réuni.

> *Le fait d'utiliser régulièrement la ruelle favorise le développement d'un sentiment d'appartenance et d'une confiance en soi. « Être en confiance, c'est ressentir un sentiment de "chez soi" par la présence solidaire ou bienveillante de personnes familières ». Les ruelles sont donc des lieux propices aux relations sociales. Kelly (2014) fait remarquer à cet effet qu'à une époque où l'on tend à croire que la ville est un lieu où chacun est seul parmi les autres, la création de ruelles vertes nous montre le contraire.*

Témoins privilégiés de cette nouvelle tendance, les ruelles constituent un lieu de départ pour l'établissement de ce renouveau du mode de vie communautaire urbain. Ainsi, dans le cadre du 375e anniversaire de Montréal, les arrondissements Le Sud-Ouest et Mercier–Hochelaga-Maisonneuve ont été les hôtes de nombreuses activités socioculturelles organisées par les Éco-quartiers. Dans le cadre de ces manifestations, de nombreuses ruelles ont été investies, où rassemblement festif et mixité citoyenne ont été fortement encouragés.

Dans les ruelles vertes nous avons pu observer des échanges et interactions intenses entre voisins qui apprennent à se connaître au fil du temps. La relation de voisinage est d'autant plus importante

qu'elle semble s'effectuer plus facilement via le patrimoine commun qu'est la ruelle.

Selon les résidents, le verdissement a changé la vie de quartier. À ce propos, une résidente anonyme rencontrée près de la ruelle Desnoyers affirme ceci :

> C'est la rencontre des voisins, c'est la cohésion sociale. Tout le monde se parle, tout le monde s'entraide. C'est comme un petit village en plein cœur de Montréal. Beaucoup de gens ont choisi d'acheter ici parce qu'il y a la ruelle. Il n'est pas aisé d'expliquer les origines des premiers contacts qui ont amorcé les projets de ruelle. Certes, le fait que des voisins immédiats partagent l'arrière de leur cour est propice à l'interaction. Mais le partage de l'espace, les premiers contacts seraient surtout occasionnés par la présence des enfants ou par différents événements, comme le chat qui se fait adopter, tel que mentionné dans les webdocumentaires.

À la question « Quelles sont vos relations avec vos voisins ? », voici des extraits de réponse de deux répondants :

SO3: Certains voisins sont très engagés avec nous, car la ruelle a plusieurs vocations de sociabilité, vocation éducative notamment à cause des enfants; ça leur permet de savoir c'est quoi un poirier, un prunier, comment se développent les vivants dans la nature, etc. On n'a pas toujours accès à la forêt, mais quand on regarde ici, on est dedans.

SO4: En fait, plus les gens se parlent, plus nos quartiers seront agréables à vivre. C'est une très grande richesse ici la diversité. Je précise qu'ici, il y a beaucoup d'Indous, d'Asiatiques et de noirs. Un jour, un enfant venu de Sherbrooke que je j'ai amené avec moi pour jouer au parc m'a dit qu'il y avait beaucoup de gens bruns ici. C'est du monde bizarre. Je lui ai dit non ce sont des gens différents, c'est la diversité. C'est intéressant d'avoir toutes sortes de gens, toutes sortes de cultures. Il était fasciné de voir les gens. Un enfant qui est élevé dans un tel contexte, il entend de langues différentes aussi, tout cela est une richesse.

Il y a lieu de préciser toutefois que les rapports entre les voisins ne sont pas nécessairement des liens amicaux ; il peut s'agir simplement de relations de bon voisinage :

SO3: *«Juste connaître les gens qui sont autour de moi, peut-être apprendre un peu sur l'horticulture, parce que je cueille mes fraises à la ruelle, apprendre un peu comment entretenir mes plantules. »*

En tout état de cause, l'utilisation de la ruelle, parce qu'elle favorise la socialisation, devrait faciliter l'intégration et l'apprentissage. Pour certains répondants, le fait de fréquenter la ruelle leur a permis de se familiariser avec leur milieu d'accueil. C'est le cas de cette Algérienne installée au Canada depuis 10 ans qui dit avoir appris beaucoup de la culture d'accueil dans la ruelle :

MHM2: On a de bonnes relations avec nos voisins. On a planifié des choses tous les jeudis pour faire des activités ensemble et on essaye de faire profiter les enfants : les enfants jouent et nous les adultes on bouge un peu plus. On envisage même pour le futur d'organiser des repas communautaires, partager divers repas de diverses cultures. La ruelle nous a permis une ouverture l'un vers l'autre et des échanges sur beaucoup de sujets, notamment la culture et la religion, loin de l'image dénaturée qui est parfois véhiculée par les médias. Les gens sont ouverts et disponibles et il n'y a pas de préjugés.

Cet enthousiasme est toutefois nuancé par certaines inquiétudes chez des résidents anonymes venus assistés à la projection organisée le 25 août 2017 à la ruelle verte Blake :

> La voie publique doit garantir un accès aux propriétés en arrière-cour. Quand on fait une ruelle verte, on le fait de commun accord avec les propriétaires qui cèdent leur droit d'accès pour un véhicule. Alors il n'est pas dit qu'un nouvel occupant ne va pas remettre ça en cause. Dans ce cas-là, la ruelle représente une entrave éventuelle à la vente de leur propriété.

Voici également un extrait des propos de l'un de nos répondants :

MHM3: On se rend compte qu'à long terme, tout le monde pourrait faire ça. S'il n'y a pas de protection de la ruelle, n'importe quel propriétaire qui vend pourrait décider d'aménager un stationnement.

> Le débat n'est donc pas clos, car, en dépit des efforts déployés et des ressources investies par les citoyens et leurs partenaires, la réglementation de la Ville de Montréal ne permet pas à l'arrondissement d'intervenir, la ruelle étant définie comme une voie publique. Quel que soit son statut, la ruelle constitue certes un lieu de socialisation. Mais ne faudrait-il pas en profiter pour développer des projets éducatifs concernant l'éco-francisation et l'écocitoyenneté par exemple, qui offrent des belles perspectives d'éducation à l'inclusion.

En guise de conclusion

Deux voies d'appropriation des ruelles se dégagent de l'analyse des propos d'entrevue et des notes d'observation : l'aménagement et l'utilisation. En effet, l'aménagement de la ruelle, sous quelque forme, constitue le point de départ de son appropriation. Par la suite, la ruelle fait l'objet de diverses utilisations, du terrain de jeux à la socialisation en passant par des projections cinématographiques, du jardinage, de la peinture au sol, l'organisation des fêtes de ruelles, etc. Il convient d'affirmer également que des préoccupations de sécurité, notamment à l'égard des enfants, constituent l'un des éléments de motivation à utiliser la ruelle.

Réfléchir avec les acteurs locaux à leur expérience de « ruelle verte » est certes une occasion d'examiner le potentiel de celle-ci, entre autres la possibilité d'y intégrer des activités éducatives. Cette avenue reste à explorer et d'autres recherches pourraient être conduites afin de d'identifier des stratégies d'éducation à l'inclusion dans le cadre de projets communautaires ancrés dans un patrimoine commun inclusif, comme ceux des ruelles vertes. Pour relever un tel défi, il conviendra de travailler avec les acteurs locaux, porteurs de tels projets. À suivre !

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Notes

Vue de ruelle met en lumière les caractéristiques de différentes ruelles vertes. En général, ils'agit d'endroits aménagés pour recevoir des plantes vivaces, des arbres et arbustes, et où les plantes indigènes sont privilégiées; différents aménagements peuvent compléter les plantations : murales, nichoirs, composteurs, bacs de récupération d'eau de pluie. On y met aussi en évidence l'engagement des citoyens. Cette production vidéo incite d'abord à se laisser transporter par la projection de fresques lumineuses in situ ; suivent de courts webdocumentaires, puis un montage de photos d'archives qui permet de découvrir les ruelles au fil du temps - http:// www.ruellesvertesdemontreal.ca/vue-de-ruelle/

L'approche Éco-quartier, instauré par la Ville de Montréal en 1995, vise à promouvoir l'éco-civisme et à améliorer le cadre de vie des Montréalais par le biais d'actions environnementales réalisées par les citoyens eux-mêmes. Le Regroupement des éco-quartiers (REQ) représente les 19 éco-quartiers de la Ville de Montréal. Ces derniers sont à la base de nombreux projets de développement durable, d'implication citoyenne et d'éducation relative à l'environnement. Investis dans des projets allant du compostage à l'économie d'eau potable en passant par l'agriculture urbaine, le verdissement et la sensibilisation à l'agrile du frêne, les Éco-quartiers desservent à l'année 90 % de la population montréalaise répartie dans 14 des 19 arrondissements, soit près de 1,5 million de citoyens.

Roberge (1995, p. 15) fait référence à trois types de récits : récit de vie, récit de pratique et récitd'épisode. Le premier type est un témoignage mettant en vedette la personne qui le raconte et les grands événements de sa vie constituent la trame du récit. Le deuxième type de récit porte sur des informations spécifiques relatives à une pratique, une technique ou une activité. Enfin, le troisième concerne une période précise de la vie de l'informateur, souvent caractérisée par un âge ou un événement important. Ces types de récits permettent de connaître ce que les informateurs vivent ou ont vécu. Or dans cette recherche, nous nous intéressons à un autre type de récit, appelé « récit de lieu ».

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Résumé

Cet article traite de la ruelle verte comme un patrimoine à s'approprier et un terrain propice au déploiement d'une éducation à l'inclusion sociale. Les ruelles vertes, de plus en plus présentes sur le territoire montréalais, ont fait l'objet d'une série de webdocumentaires intitulée Vue de ruelle. À partir de l'analyse de ces documents, de visites des lieux et d'un ensemble d'entrevues avec les acteurs de divers projets de ruelle, nous avons mené une recherche descriptive, interprétative et critique visant à mieux saisir les modes d'appropriation des ruelles par les résidents. Deux principales voies d'appropriation se dégagent de l'analyse des propos d'entrevue et des notes d'observation: l'aménagement et l'utilisation. Nous avons également porté attention à la dimension inclusive des projets de ruelle à l'égard de la diversité sociale. Nous observons qu'il y a lieu de réfléchir avec les acteurs engagés afin d'examiner davantage la question du commun inclusif et d'envisager des activités éducatives à cet égard.

This article deals with the Green Lane as a common heritage to appropriate and a ground conducive to the deployment of an education for social inclusion. The green alleys, increasingly present in Montreal, have been the subject of a series of Web-documents entitled Alley View. Based on the analysis of these documents, site visits and a set of interviews with the actors of various alley projects, we conducted a descriptive, interpretative and critical search to better grasp the ways of appropriation of the alleys by the residents.

Two main ways of appropriation emerge from the analysis of the verbatim of interviews and our observation notes : planning/ development and use. We also paid attention to the inclusive dimension of alley projects with respect to social diversity. We observe that there is a need to reflect with the actors involved to further examine the issue of inclusiveness and to consider educational activities in this regard.

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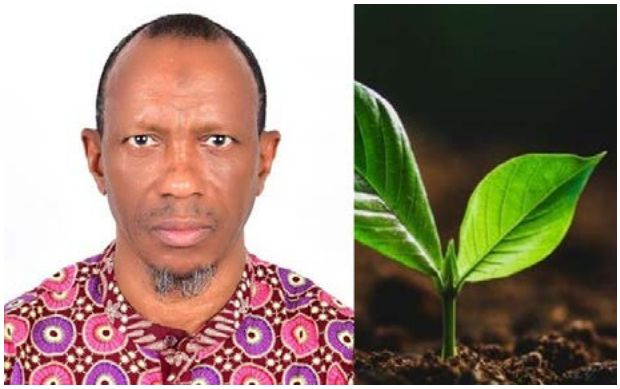
Mots-clés : ruelle verte, éducation à l'inclusion

Keywords : green Alley, inclusive education

Auteur



Mamadou Bhoye Bah

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Estudio piloto de salidas de campo basadas en el juego con estudiantes del Grado en Educación Primaria

Cinthia Pereira [(1)], *David Aguilera* [(2)], *Javier Carrillo-Rosúa* [(3)]

Resumen

Se presenta una propuesta de salida de campo fundamenta en el aprendizaje basado en juegos, dirigida a docentes en formación del Grado en Educación Primaria (GEP). Dos pruebas piloto se hicieron con 82 estudiantes de GEP de la Universidad de Granada y la Universidad de Barcelona, en dos Reservas de la Biosfera: Montseny y Sierra Nevada. Los resultados preliminares indican, por parte del alumnado, una mayor cohesión del grupo-clase, un mayor cuestionamiento sobre lo observado durante

Introducción

Álvarez-Piñeros *et al.* (2016) describen una salida de campo como una oportunidad de explorar y descubrir (o redescubrir) una realidad próxima o lejana por el alumnado. Se trata de un proceso donde el nombre de las «cosas» juega un papel esencial para poder observarlas, describirlas y explicarlas in situ, convirtiéndolas en objeto de investigación. Este acercamiento a la realidad pone al alumnado en contacto directo con la naturaleza, la cual podría ser observada y sentida desde diferentes perspectivas: del origen, de identidad, de conjunto y pertenencia y de necesidad.

La comunidad educativa es consciente del valor de las salidas de campo como un recurso didáctico para la educación científica, pero aún tienen poca presencia en los planes de estudio (Aguilera 2018). Una de las posibles causas de esta escasa presencia es la formación del profesorado. Así, es esencial invertir en su desarrollo profesional; facilitándoles el conocimiento pedagógico y las experiencias adecuadas que les capaciten, tanto a nivel procedimental como emocional, para organizar salidas de campo (Tal y Morag, 2009). En este sentido, es fundamental trabajar de una manera creativa con el alumnado para que estos disfruten de la experiencia mientras aprenden, y eso se podría lograr mediante un ambiente educativo lúdico (Plass *et al.*, 2020).

En coherencia con la contextualización realizada, esta propuesta piloto se basa en tres ejes principales:

- Aproximación de los maestros en formación a la naturaleza para que reconozcan su potencial didáctico, así como la oportunidad de ofrecer una educación consciente y conectada con el medio natural y su biodiversidad.
- Práctica de la enseñanza y aprendizaje de las ciencias experimentales en Reservas de la Biosfera (RB).
- Acercamiento al Aprendizaje Basado en Juegos (ABJ) en espacios naturales y con fines de educación científica.

Imagen 1. Esquema conceptual de las zonas y usos de una Reserva de la Biosfera.

Palabras clave: educación en la naturaleza, ciencias naturales, educación ambiental, educación experiencial

(1) Universidad de Barcelona
(2) Universidad de Granada
(3) Universidad de Granada

Contexto de las zonas de trabajo

Para realizar esta investigación educativa se utilizó la figura de protección de espacios naturales RB como un contexto socio ambiental. Las RB son áreas otorgadas por la UNESCO para la conservación de la diversidad biológica y cultural, donde se intenta lograr un equilibrio entre la protección de los ecosistemas, el desarrollo sostenible y la investigación (Imagen 1). De acuerdo con UNESCO, son considerados territorios excelentes para abordar los desafíos de la conservación biológica y cultural a nivel global, promoviendo la coexistencia armoniosa entre las comunidades locales y la naturaleza.

Imagen 2. Fotos de las zonas de trabajo en primavera.

Imagen 3. Fotos de las zonas de trabajo en invierno.

Las salidas de campo se desarrollaron en dos RB que tienen características en común como la proximidad a ciudades muy pobladas y universitarias como Barcelona y Granada. Además, estas tienen gran variedad de ecosistemas forestales y agrícolas. Las zonas de trabajo fueron la zona del Pla de la Calma, de la RB del Montseny y la zona de Cumbres Verdes en la RB de Sierra Nevada. En las imágenes 2 y 3 se muestran los diferentes paisajes de cada reserva en diferentes estaciones.

Metodología

Siguiendo una metodología de investigación basada en el diseño (Guisasola *et al.*, 2021), se diseñaron dos salidas de campo dirigidas al desarrollo profesional docente de maestros y maestras en formación. En este trabajo se describen los procedimientos de diseño de las dos pruebas piloto (Tabla 1), así como los resultados preliminares.

Ambas pruebas piloto se ejecutaron a partir de cuatro salidas de campo, dos en cada RB. La primera, considerada de reconocimiento, fue desarrollada por el profesorado universitario. Estos, que son expertos en diferentes disciplinas (ambientólogos, geólogos, biólogos, maestros, físicos y químicos), reconocieron el terreno y estudiaron las posibilidades didácticas del itinerario. A partir de esta diagnosis, se diseñaron las actividades de aprendizaje que fueron testadas en una segunda salida con los estudiantes.

En esta fase inicial del diseño ha participado profesorado y estudiantado de dos universidades españolas: la Universidad de Barcelona (UB) y la Universidad de Granada (UGR).

Tabla 1. Planificación de la investigación educativa

Salida de Campo RB Montseny	Salida de Campo RB Sierra Nevada
Lugar: Pla de la Calma	Lugar: Cumbres Verdes
FASE DE PREPARACION	
Años: 2022 y 2023	
Participantes: Profesorado universitario y de escuelas con formación en Biología, Geología, Física, Química y Educación. Ex-Alumnado del grado de Ed. Primaria	
I FASE DE INTERVENCIÓN	
Año: 2023	
Participantes: Profesorado universitario con formación en Biología, Geología, Física y Educación. Alumnado del grado de Ed. Primaria	
FASE DE ANÁLISIS DE RESULTADOS, ADAPTACIONES Y MEJORAS	
Año: 2024	
II FASE DE INTERVENCIÓN	
Año: 2025	

El perfil del alumnado que participó de las pruebas piloto son los descritos en la Tabla 2.

Tabla 2. Perfiles de los participantes de las dos pruebas piloto.

I FASE DE INTERVENCIÓN	
Salida de Campo RB Montseny	**Salida de Campo RB Sierra Nevada**
Participantes: **40 estudiantes**	Participantes: **42 estudiantes**
Doble Grado de Educación Primaria e Infantil	Grado de Educación Primaria
Asignatura: Aprendizaje y Enseñanza de las Ciencias Naturales	Asignatura: Didáctica de las Ciencias Experimentales
Curso: 2n año	Curso: 3r año
8 grupos de 5 personas	8 grupos de 5-6 personas
97,5% mujeres	77% mujeres
Profesores: Ambientóloga y Geóloga	Profesores: Ambientóloga, Física, Geólogo y Maestro
La salidas de campo estaban relacionadas con las asignaturas y contribuían para la nota pero la participación no fue de carácter obligatorio sino **voluntario.**	

Descripción de la salida de campo (prototipo inicial)

Se ha utilizado la metodología de Aprendizaje Basado en Juegos (ABJ) para incorporar elementos lúdicos en el proceso de aprendizaje durante las salidas de campo en las RB y así ser más interactivo y memorable para el alumnado. Se organizaron grupos de cinco personas para resolver retos sobre fauna, flora, paisaje y rocas (Tabla 3). Para superar estos retos, cada grupo tenía información detallada sobre el área y un conjunto de materiales e instrumentos para la medición y observación. El alumnado tenía autonomía para organizar su trabajo y su tiempo para resolver los retos con la orientación del profesorado acompañante.

La secuencia metodológica de las salidas de campo con el alumnado se dividió en tres fases: preparatoria, salida y reflexiva.

- Fase preparatoria: Lección magistral introductoria sobre biodiversidad, ecología, y características geológicas de las zonas de trabajo, en el marco de asignaturas sobre la didáctica de las ciencias experimentales.
- Fase salida de campo: Se llevaron a cabo diferentes acciones. (1) Dinámica para la presentación de los participantes y conectar con el medio natural; (2) explicación previa sobre el qué y cómo se trabajará en el campo; (3) formación de grupos y distribución de materiales; y (4) resolución de los retos planteados mediante una indagación guiada, invirtiendo un tiempo de acción aproximado de 5 horas (incluyendo una parada de 45min para comer).
- Fase reflexiva: Se realizó una reflexión en gran grupo sobre los retos abordados y los logros alcanzados por cada equipo de trabajo. Luego, revisaron su cuaderno de campo y respondieron a una encuesta de evaluación. Esta última de orientación cualitativa y dirigida a valorar las percepciones del alumnado sobre el aprendizaje alcanzado y la salida realizada.

La encuesta final se compone de siete preguntas abiertas sobre las capacidades de: observar la naturaleza; encontrar relaciones simbióticas en la naturaleza; cuestionar sobre lo investigado en el campo (pensamiento crítico); dibujar elementos naturales observados; meditar sobre los valores del trabajo cooperativo; valorar el interés por los temas trabados; y evaluar desde el punto de vista didáctico las fortalezas y las debilidades de la salida de campo.

Imagen 4. Alumnas recogiendo materiales para sus grupos de trabajo.

Los materiales que fueron distribuidos a los ocho grupos fueron: frascos de vidrio con ocho bolitas de un color; materiales de observación y medición; dos bolsitas con muestras de plantas; una bolsita con tres muestras de rocas; prismáticos; lupas; cepillo de dientes (para limpiar muestras de rocas); reactivos químicos (ácido clorhídrico en baja concentración) y guías. En la recogida de los materiales, el alumnado fue orientado a cuidar muy bien de todos los materiales (Imagen 4).

Para completar el juego, era necesario resolver las pistas (Imagen 5) sobre los cuatro siguientes desafíos en cinco horas (Tabla 3):

Tabla 3. Descripción de los cuatro retos del juego que los grupos habían de resolver durante la salida de campo.

Retos	Descripción
Flora	Identificar en el medio natural ocho plantas a partir de las pistas facilitadas en las bolsitas de tela codificadas (cada grupo tenía pistas diferentes).
Fauna	Registrar y describir, al menos, dos aves avistadas u oídas durante el itinerario.
Paisaje	Fotografiar y caracterizar dos paisajes diferentes, usando un marco de madera para centrar el análisis.
Rocas	Identificar en el medio natural cuatro rocas mediante la comparación de los fragmentos proporcionados.

Imagen 5. Fotos de las pistas e instrumentos del juego.

Imagen 6. Sistema de intercambio de bolitas entre los diferentes grupos.

Los desafíos estaban basados en Biología (observación de la flora y de las aves, sus colores, tamaños, estructuras y comportamientos), Geología (observación de las rocas, sus texturas, sus minerales y su reactividad con un ácido), y Paisaje (observación del medio natural, su composición, estructura y usos del suelo). Además, se establecieron una serie de condiciones para promover la interacción (Imagen 6):

1. Cooperación intergrupal esencial para resolver los retos, pues cada equipo tiene pistas diferentes.
2. La colaboración efectiva tiene el premio de una bolita de color.
3. Cada equipo debe conseguir ocho bolitas de colores diferentes.
4. La información a compartir ha de estar registrada en el cuaderno de campo, de lo contrario no es válida.
5. El profesorado presente cooperará en la resolución de los retos propuestos bajo la demanda de cada equipo.

En el siguiente mosaico (Imagen 7) se puede observar el trabajo de campo hecho por los diferentes grupos.

Imagen 7. Mosaico fotográfico del trabajo de campo hecho por el alumnado.

Resultados preliminares

- Capacidad de observación

Se observa encantamiento por la naturaleza y la observación detallada. A continuación, se muestran algunas declaraciones ilustrativas:

> *"Nunca me había parado a contemplarla [la naturaleza] de esa manera y he apreciado muchos sonidos, colores que me han trasmitido tranquilidad."*

> *"Cuando cierro los ojos escucho el aire moverse entre los árboles, algún insecto volador que pasa cerca de mí y las risas y voces de mis compañeros. Mi olfato percibe los olores de los días de lluvia previos a la excursión: tierra mojada, hierbas aromáticas... En mi piel noto el sol ocultarse bajo nubes no muy tupidas que avisan de que la lluvia está cerca. Por último, con los ojos abiertos veo vida y naturaleza: pájaros volar, mariposas revolotear, anélidos reptar y hormiguitas y mariquitas caminar, colores verdes y ocres y la primavera que en su esplendor revela flores en mucha de la vegetación."*

- Emerge una visión ecosistémica.

Los retos propuestos, así como las prácticas de observación e interacción, parecen facilitar al alumnado la comprensión de las relaciones que se establecen entre los elementos bióticos y abióticos en cualquier ecosistema.

> *"La polinización es una relación simbiótica entre las flores de las plantas y los polinizadores, como abejas, mariposas o pájaros, los polinizadores se alimentan del néctar y polen de las flores, obteniendo así una fuente de alimento. A su vez, al visitar diferentes flores, transportan el polen de una flor a otra, facilitando la reproducción de las plantas."*

> *"Pudimos observar en una roca, el musgo que se había formado en ella, de ahí surgían líquenes que pudimos apreciar allí mismo."*

- Cuestionar lo investigado (pensamiento crítico).

Se observa en general una gran capacidad para formular preguntas. Hay cuestionamientos de carácter didáctico, de carácter naturalístico y también de carácter social.

"¿Cómo podría llevar a mis alumnos al campo de manera que su distracción para realizar las tareas encomendadas fuera la mínima? ¿Qué forma es la más adecuada de realizar una salida de campo con mis alumnos? (metodología o tareas, actividades para proponer a los alumnos en la salida)"

"¿Cómo puede una planta activar un mecanismo de defensa tan eficaz para defenderse de algún insecto que ha querido atacarla? ¿Por qué cambia tan radicalmente el cielo de un momento a otro? Si Sierra Nevada se está levantando porque una placa tectónica se está ocultando bajo la otra, ¿se erosionará en la sierra más rápido de lo que se levanta?"

"¿Cómo puede la gente contaminar tanto un espacio tan bello? ¿Por qué mis compañeros no son capaces de pasear sin necesidad de escuchar música en un altavoz contaminando acústicamente y molestando a los que caminamos a su lado?"

- Dibujar elementos naturales observados.

Los dibujos hechos durante la salida de campo eran de carácter más sencillo (sin colores ni muchos detalles). Pero al dar tiempo al alumnado para mejorar los cuadernos, se observa una gran mejora cuanto a detalles artísticos y complementados con esquemas e información teórica (Imagen 8).

- Practicar los valores en un trabajo en grupo.

Se observa autoconsciencia sobre la práctica de valores y también respecto al comportamiento del grupo. Además, se percibe preocupación, como futuras maestras, en practicar los valores con sus futuros alumnos.

"Creo que he practicado en cierta medida los valores de respeto, empatía y ayuda mutua, pero siempre hay margen de mejora. Reconozco que a veces puedo ser más consciente de las necesidades y perspectivas de los demás, y es algo en lo que estoy trabajando activamente."

"Creo que los hemos practicado y estoy bastante orgullosa en general del comportamiento que adquirió el grupo a lo largo de la salida. Como futuros maestros me parece fundamental tener actitudes respetuosas y empáticas tanto unos con otros como con el medio y el profesorado."

- Interés por los temas trabajados.

Se observa un aumento del interés por saber más sobre la naturaleza habiendo experimentado este tipo de salida de campo. También se observa que ha aumentado el interés tanto de alumnas con interés intrínseco como las que no lo tenían.

"Gracias a la salida de campo, hace que aprecie aún más la naturaleza, aunque yo mismo este muy conectada con ella, de forma que genere

Imagen 8. Foto de un cuaderno de campo al final de la salida de campo (izquierda) y del cuaderno una semana después de la salida (derecha).

en mí una mayor voluntad a la hora de realizar este tipo de actividades."

"Si, he desarrollado mayor interés por la naturaleza después de realizar la salida en un entorno natural ya que la belleza del paisaje hace que me fije en la flora y en la fauna de ese lugar. Además he despertado un sentido de conexión, por lo que eso me motiva a la hora de aprender más sobre naturaleza."

"Siempre he tenido cierto interés por la naturaleza ya que nací en un pueblo en el cual la naturaleza es lo que más predomina. Sin embargo, he observado que la naturaleza es más interesante de lo que antes consideraba y me gustaría realizar más salidas en las que aprenda sobre ello, ya que es más motivador aprender de esta manera."

"Me parece que la observación directa es la mejor forma de aprender sobre ciencia. Las prácticas en el laboratorio son muy útiles, así como las prácticas STEM en el huerto de la universidad, pero creo que actividades como esta deben ser de carácter obligatorio."

Conclusiones

Se ha logrado, en cierta medida, una aproximación de los maestros en formación a la naturaleza para que reconozcan su potencial didáctico, así como la oportunidad de ofrecer una educación consciente y conectada con el medio natural y su biodiversidad.

Haber practicado la enseñanza y aprendizaje de las ciencias experimentales en RB (territorios protegidos y con características sociales y naturales destacables) puede haber sido una posible fuente de estímulo para que el alumnado cuestione sobre la naturaleza y sobre la relación que el ser humano tiene con ella.

Practicar salidas de campo con un acercamiento al aprendizaje ABJ en espacios naturales, puede ser una buena estrategia para generar implicación del alumnado por la educación científica.

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Nature Education for a Planetary Citizenship – the Erasmus+ 'ECoNNECT' Project: Training Nature Educators in Complex Systems Thinking

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Abstract

The "ECoNNECT" project (European Collaboration Network for Nature Education and Citizenship Training) brings together partners from 3 European countries, France, Belgium & Greece, aiming to help strengthening Nature Education through the creation of an innovative training course based on systems thinking as a way to grasp the complexity of environmental issues. Nature education forms an integral part of Environmental Education, however it emphasizes experiences 'along with' and 'within' the natural environment, while remaining an education for a planetary citizenship and for social justice.

Full Paper

The "ECoNNECT" project (European Collaboration Network for Nature Education and Citizenship Training) is supported by the EU Erasmus+ program for a period of three years, starting in September 2022. The project, which brings together partners from three European countries, France, Belgium and Greece, aims to help strengthening nature education and the professionalization of nature educators, through the creation of an innovative training course, adapted to the environmental, institutional and socio-economic context of partner countries.

Nature education forms an integral part of Environmental Education, however it emphasizes experiences 'along with' and 'within' the natural environment. As an educational process through a contact with nature (through observation, immersion...), it is based on first-hand experience, using multiple and complementary approaches (cognitive, sensory, emotional, etc.), which highlights the need for the respect of natural balances. The training we are developing aims to help stimulating, restoring and strengthening a deep, healthy and respectful link with nature, through the study of global issues and challenges (climate, biodiversity, etc.) and their impact in each territory, in the form of socially vivid questions.

We prioritize a 'complex systems' approach drawing on the French philosopher Edgard Morin's thinking as a source of inspiration (Morin, 2005). The environment is a complex and complicated reality. The complexity is due not only to the large number of elements involved in an environmental question (biophysical, social, economic, political, cultural, all together), but above all to the type and number of relationships and interactions between them. An environmental issue it to be considered as a system, which organically integrates all the factors involved and the interactions between them. Furthermore, environmental issues are situations that often raise social conflicts and inevitably lead us to address the values system of our society. Consequently, complex thinking appears to be the most fertile epistemological framework for organizing the foundations of the educational process and of human thought as a whole (Ragkou & Ziaka, 2019).

In his work "Terre-Patrie" (1993), Edgar Morin defines complex thinking in the following way: "a thinking which connects what is disjointed and compartmentalized, which respects the diverse while recognizing the one, which tries to discern the interdependencies; a radical thinking (which goes to the root of the problems); a multidimensional thinking; a systemic thought conceiving the relationships as it is developed in ecological sciences and Earth sciences; an ecologized thinking

(1) Polis – International Network for Environmental Education (Greece)

(2) Ecotopie (Belgium)

which, instead of isolating the object to be studied, considers it in and through its self-eco-organizing relationships with its environment; a cultural, social, economic, political, natural thinking; a thought which conceives the ecology of action and the dialectic of action and is capable of a strategy which makes it possible to modify or even cancel the action undertaken; a thinking that recognizes its incompleteness and negotiates with uncertainty, particularly in action, because action is only possible taking into account uncertainty.

One of the key elements of complex thinking is the systemic vision. Systemic theory is based on the key concept of a "system", that is to say "a set of elements organized in a dynamic interaction, in order to achieve a goal" (De Rosnay 1975). It was developed as a methodology for the study and analysis of complex situations, namely structures characterized by a large number of "component" elements which develop between them a variety of relationships and interactions. Although the systemic theory's first premises comes back to the beginnings of philosophical and scientific thought (Heraclitus: "one the whole..."), its theoretical foundations, as a methodology for the study and analysis of complex systems, finds its roots in the middle of the 20th century, in the theories of systems analysis (Wiener 1948, Shannon 1945, Von Bertalanffy 1968, Forrester 1968).

In Environmental Education, systemic thinking offers us the possibility to consider an environmental question by taking into account all the factors involved (ecological, economic, social) and the interactions between them. Systemic thinking then opens the way to a global reality and a planetary thinking.

What we are trying to propose within the framework of the ECoNNECT project is to 'translate' a complex thinking approach into a pedagogical methodology to be used in Nature Education. For instance, complex thinking touches several dimensions of our identity as educators and the purpose of our educational actions, including the question of uncertainty. Complex thinking suggests to accept uncertainty and doubt as part of us, part of the world, of science and knowledge. The more uncertainty grows - which is the case of many environmental issues, starting with climate change or the depletion of natural resources - the more accepting uncertainty in one's vision of the world can make sense and guarantee movement. The idea is that accepting doubt is not an alibi for inaction, but rather an engine of creativity in order to face and confront crises (Dufrasne, 2018).

We consider that a complex system thinking in Nature Education involves, among others: learning through a sensory and sensitive immersion; considering the emotions as an integral part of the learning process; integrating the ethical dimension withing the learning process (including the notions of solidarity, social justice, responsibility); establishing a democratic learning aiming to develop critical mind. The training course to be created through the ECoNNECT project consists of a common core and training 'chapters' (modules) comprising a choice of educational resources, adaptable to the training systems and the institutional and territorial context in which the training is going to take place.

The training course is being developed through a participatory approach, which actively involves the project's target group: nature educators (teachers, trainers, facilitators), professionals, or undergoing training (students in disciplines related to the environment and education). A preliminary inventory of existing educational resources was planned to be followed by two seminars bringing together nature education practitioners from the partner countries. The seminars create a space where the participants can share their own experience and the specific reality of their work which is very different from a country to another. This intercultural exchange provides a deeper, more complete and comprehensive view of what is Nature Education. It gives them the keys to re-think their work from a different perspective and help them bring more depth and complexity to it.

The first one-week seminar has been organized in France, in November 2023. The 30 participants, 10 educators from each one of the partner countries, under the coordination of the project's pedagogical team, worked on the definition of the project's training course, sharing experiences, tools and methods, choosing the best practices, exchanging on the training's scheduling. The participants have

been engaged to experiment in their country and evaluate selected parts of the training course that they have helped to develop. A second seminar is going to take place in November 2024 in Belgium, gathering the same participants. The seminar will allow the sharing of the results on the evaluation of educational resources, and will lead to the adaptation and refinement of the training course. The final product will be integrated into the project's portal and will be available for online free access by educators in Europe.

The participatory approach of 'co-construction' adopted during the seminars constitutes, in itself, a training process for the participants, as well as the exchange of the experiences is a form of a peer-to-peer education process, and therefore a contribution to the professionalization of the educators who will have participated. The project as a whole has already helped to establish a network of educators and trainers involved in nature education in the three project countries, a network that is gradually being expanding at a European level, thus contributing to the institutional recognition of Nature Education in Europe.

The complexity and extent of interdependences among human societies, facing questions such as the global issues of climate crisis and biodiversity loss, to regional war theaters, migrations, new forms of human exploitation, make us aware that we are all concerned and intrinsically dependent within a community of destiny. For us, partners in this project (1), Nature Education, just like Environmental Education as a whole, is a mission to teach autonomy and critical thinking, educate citizens to trust the value of citizen action, to encourage them to assume their responsibilities and engage in action at every level, from the local to the global. That is to become aware of our community of destiny and of the need for a planetary citizenship.

Notes:

1. The organizations participating in the 'ECoNNECT' project are the following:

Réseau français d'éducation à la nature et à l'environnement, le FRENE (formerly 'Nature and Education' network – Project Coordinator), France

Réseau Idée – Réseau Information et Diffusion en Education à l'Environnement, Belgium

'écotopie' Institut d'Eco-Pédagogie en Belgique, Belgium

Polis - International Network for Environmental Education, Greece

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Sensibilisation du public en plein air Concept de chemins pédagogiques spécifiques au site

Zair Latimad (1)

Résumé

La Fondation Mohammed VI pour la Protection de l'Environnement a mis en place le concept « chemin pédagogique », qui consiste à transformer un jardin en un espace de sensibilisation permettant aux visiteurs de se familiariser avec des comportements favorables à notre environnement. Il s'agit de l'implantation de modules interactifs, communiquant sur plusieurs thématiques environnementales, implémentés en un chemin adapté au jardin, et présentant un contenu scénographique interpellant. La Fondation a réalisé 7 chemins pédagogiques, en impliquant pour certains, les jeunes architectes via des concours d'idées pour faire émerger des solutions innovantes de sensibilisation à l'environnement.

Article Complet

De part sa mission de promouvoir la protection de l'environnement et l'amélioration du cadre de vie, la Fondation Mohammed VI pour la Protection de l'Environnement, présidée par Son Altesse Royale La Princesse Lalla Hasnaa, initie et met en œuvre un ensemble de programmes et projets pilotes avec la volonté de sensibiliser et faire prendre conscience aux citoyens des nouveaux enjeux, et de contribuer à la préservation d'un élément du patrimoine national ou d'un écosystème menacé.

Pour renforcer sa mission fondamentale d'éducation au développement durable, la Fondation Mohammed VI pour la protection de l'Environnement, anime ces parcs et jardins historiques de chemins pédagogiques et jardins éphémères et deviennent ainsi des lieux de sensibilisation et d'éducation des citoyens à la préservation de l'environnement.

Cette approche permet de réconcilier et repenser les rapports entre l'homme et son environnement, renforcer les apports et les connaissances en écologie et en durabilité, développer une prise de conscience quant à la fragilité de nos ressources et favoriser des comportements actifs et responsables, en vue de permettre un développement durable, humain et équilibré de notre terre.

Dans cette optique, la Fondation a conçu des chemins pédagogiques au sein de ses jardins hitoriques, offrant ainsi une expérience enrichissante et plaisante.

Le chemin pédagogique vise à renforcer la communication, l'information, et l'éducation, à travers la transformation d'un jardin ou d'un parc urbain, en un espace de sensibilisation permettant aux visiteurs, spécialement les jeunes, de se familiariser avec des comportements favorables à l'environnement et d'acquérir une meilleure compréhension et respect de la nature.

Il vise à susciter chez les promeneurs, la curiosité et l'envie de comprendre les enjeux de la protection de l'environnement. La démarche du consiste à l'implantation de plusieurs modules interactifs d'information et de sensibilisation, communiquant des connaissances sur des thématiques environnementales.

La Fondation a réalisé, à titre pilote, un chemin pédagogique au sein des jardins exotiques de Bouknadel en 2011. Compte tenu de l'impact qu'il a suscité auprès du grand public, ce concept a été reproduit au niveau de 7 parcs et jardins du Maroc.

Les thématiques explorées le long de chaque chemin pédagogique sont adaptées aux spécificités locales, et revêtent une importance capitale pour la sensibilisation environnementale : La biodiversité, la gestion des déchets, les énergies, l'eau, la préservation des forêts et des sols... Ces thèmes variés et bien d'autres offrent aux visiteurs une opportunité de découvrir ces jardins tout en enrichissant leurs connaissances sur les enjeux environnementaux actuels.

(1) Executive Manager GreenZa Education Factory, Fondation Mohammed VI pour la Protection de l'Environnement

Le réseau des chemins pédagogiques

- **Les jardins exotiques - Bouknadel**

Les jardins exotiques de Bouknadel abritent plus de 600 espèces végétales et plus de 80 espèces animales. Organisé autour de trois thèmes : Nature, Cultures et Didactique. En 2011, un parcours pédagogique a été installé pour sensibiliser le public aux questions environnementales et promouvoir une meilleure compréhension de l'écosystème local. Le parcours comporte cinq boucles thématiques composées chacune de plusieurs modules sur la biodiversité, les déchets et le recyclage, la protection des forêts et des sols (Figure 1), l'importance de l'eau et la chaine alimentaire aquatique (Figure 2), et le jardinage écologique offrant chacun une expérience éducative immersive et s'intégrant parfaitement avec l'environnement local. Ce chemin offre aux visiteurs une opportunité unique de plonger dans la richesse de la biodiversité présente dans les jardins exotiques, tout en leur prodiguant des connaissances sur les défis environnementaux.

Figure 1 : Module protection des forêts et des sols

Figure 2 : Module la chaine alimentaire aquatique

- **Parc de l'hermitage - Casablanca**

Le parc de l'Ermitage a été créé en 1920 par les architectes Jean-Claude Nicolas Forestier et Henri Prost. Il s'agissait initialement d'un jardin horticole irrigué par une source. La Fondation a procédé à une réhabilitation afin de préserver le patrimoine arboré exceptionnel du parc. La restauration a conservé les concepts d'origine, reliant le parc aux quartiers environnants. Des jardins pédagogiques dédiés à l'Afrique, à l'Amérique et à l'Australie ont été mis en place. Un chemin pédagogique a été lancé en 2011 également, proposant des modules pédagogiques comprenant : la pyramide alimentaire aquatique, l'importance de l'eau (en soulignant les menaces telles que la pollution et la surexploitation), des informations sur la végétation aquatique et le cycle naturel de l'eau.

Le module de la pyramide alimentaire offre une plongée dans le monde complexe du milieu aquatique qui permet de découvrir une multitude de végétaux et d'animaux parfaitement adaptés à la vie dans l'eau. Ce qui est particulièrement intéressant à observer, c'est le cycle de vie interconnecté qui se déroule sous l'eau. Ce module offre ainsi une occasion unique de comprendre la délicate équilibre qui régit la vie aquatique et de saisir l'importance cruciale de chaque élément dans cet écosystème dynamique.

Le module du puits (Figure 3) englobe trois thèmes: « L'eau, c'est la Vie ! Préservons notre eau!», et « Cycle naturel de l'eau ». Chacune de ces

thématiques est intégrée de manière interactive sur une bâche roulante montée au niveau du puits, permettant aux visiteurs de découvrir ces sujets de manière fluide et immersive. Il met en lumière un élément fondamental pour la survie de la vie sur terre : l'eau. Cette ressource n'est pas seulement vitale, mais elle est également indispensable à l'ensemble de nos activités économiques et sociales. Ce module souligne la menace que représente la rareté de l'eau pour des aspects aussi cruciaux que l'alimentation, la santé publique, l'industrie et l'agriculture.

Figure 3 : Module du puits

- **Palmeraie de Marrakech**

La Palmeraie de Marrakech, créée au XIIe siècle sous la dynastie des Almoravides, s'étend sur 13 000 hectares et est l'une des plus grandes palmeraies du monde. La palmeraie est dotée d'un système d'irrigation ancestral appelé «khettaras». En 2013, un chemin pédagogique a été mis en place, proposant des modules sur différents aspects de la palmeraie : Histoire et gestion de l'eau avec le système des khettaras, la végétation oasienne des palmeraies, les pratiques du compostage et l'écologie du palmier. Les modules installés sont remarquables et comprennent : Une présentation générale de la palmeraie, un module puits soulignant le rôle crucial de l'eau, un module interactif de gestion de l'eau : khettaras, une pyramide mettant en valeur les strates végétales au sein des palmeraies, un module compostage illustrant le processus de recyclage des déchets verts et un dernier module présentant l'écologie et l'importance du palmier dattier.

Le module initial se distingue par sa conception ingénieuse. Composé de deux panneaux en bois finement travaillés et façonnés pour évoquer la silhouette emblématique d'un palmier (Figure 4), il offre une présentation exhaustive de la palmeraie.

Figure 4: Module Palmier

Dans le module en forme de puits les visiteurs découvrent l'importance vitale de la nappe d'eau souterraine pour la survie de la palmeraie et de sa biodiversité. Sa face recto illustre le cycle de l'eau, tandis que la face verso se concentre sur l'infiltration et la formation des nappes souterraines.

Le module "Khettara" (Figure 5) met en lumière l'ingénieuse gestion traditionnelle de l'eau dans la palmeraie, mettant en avant des pratiques telles que les khettarras. Il expose sous forme de question

réponses l'histoire de cette méthode traditionnelle, ces différents types, son mode de fonctionnement au sein de la palmeraie.

Le module de la pyramide ici est une représentation riche et détaillée de la culture oasienne dans la palmeraie. Elle est dédiée à l'exploration des différents étages végétaux de la palmeraie.

Figure 5 : Module Khettara

Un autre module sur l'écologie du palmier est conçu sous la forme d'un palmier géant, avec un long panneau qui forme le tronc imposant de ce palmier et des tables circulaires, les visiteurs sont invités à remonter des racines de l'arbre jusqu'à sa couronne de feuilles. Ils découvrent ainsi le cycle de vie du palmier, ses conditions de survie, sa croissance, ainsi que son rôle crucial dans la lutte contre la désertification et la préservation des sols.

- **Jardin Hassan II à Dakhla**

Le chemin pédagogique de la baie d'Oued Eddahab à Dakhla a été créé entre 2016 et 2017 installé au jardin Hassan II situé dans une zone accessible et centrale de la ville, offrant ainsi un accès facile aux résidents et aux visiteurs. Il offre un parcours éducatif engageant avec des modules captivants sur des sujets environnementaux. Il est composé d'un panneau d'accueil recto-verso présente aux visiteurs la baie et les initiatives pédagogiques, d'un module sur la rareté et le caractère non renouvelable des ressources en eau souterraine dans la région, un autre module sur la gestion responsable des déchets grâce aux bacs de tri sélectif. Le module de plate-forme rotative donne un aperçu des diverses sources d'énergie. Module interactif de bacs à compost pour en savoir plus sur les pratiques de compostage. L'objectif général est de sensibiliser et d'éduquer les visiteurs aux défis environnementaux et à l'écosystème unique de la région.

Les trois bacs de tri sélectif présentent chacun une famille spécifique de déchets (plastique, métal et papier), expliquant les différentes façons de les valoriser et soulignant l'importance du tri sélectif. Chaque poubelle est accompagnée d'informations sur la durée de vie des déchets, offrant ainsi un aperçu éducatif sur la gestion responsable des déchets.

Le module sur les différentes sources d'énergie (Figure 6) se présente sous forme d'un plateau rotatif. Il offre des informations détaillées sur diverses sources d'énergie, notamment la biomasse, l'énergie éolienne, les énergies fossiles, l'énergie hydraulique, l'énergie géothermique et l'énergie solaire. Grâce à son mouvement rotatif, il permet une exploration dynamique et engageante des diverses options énergétiques, offrant ainsi une expérience éducative innovante.

Figure 6: Module les sources d'énergie

Le module pyramide “Biodiversité” dans ce cas se concentre sur les espèces marines de la baie d’Oued Eddahab, offrant des informations détaillées sur chaque espèce, y compris sa famille, son nom spécifique et ses caractéristiques distinctives. De plus, il fournit des données sur l’état de conservation de chaque espèce.

Ces chemins, initialement conçus par des experts, ont ensuite évolués vers une réalisation par les étudiants en architecture via des concours d’idées, qui adaptent chaque itinéraire aux caractéristiques géographiques spécifiques des jardins. L'implication des étudiants dans la concrétisation de ces projets constitue un véritable motif de fierté pour la Fondation, qui fidèle à sa mission d’éducation au développement durable, Implique ces jeunes pour faire émerger des solutions innovantes de sensibilisation à l’environnement et au développement durable.

la Fondation réalise des projets et des initiatives d’éducation et de sensibilisation en collaboration et co-construction avec ses partenaires. C’est dans ce cadre que 4 concours d’idées ont été lancé auprès des étudiants des Écoles Nationales d’Architecture marocaines pour la conception de nouveaux chemins pédagogiques:

- En 2017 pour le parc Hassan II à El Jadida ;
- En 2020 pour le parc de l’Oliveraie de Ghabat Chabab de Marrakech ;
- En 2022 pour le jardin historique de Lahboul de Meknès ;
- En 2024 pour le jardin historique de Jenan Sbil de Fès ;

• Parc Hassan II - El Jadida

Le Parc Hassan II d’El Jadida est situé au cœur de la ville, offrant ainsi un espace de détente facilement accessible pour les habitants et les visiteurs. Avec une superficie généreuse, le parc s’étend sur plusieurs hectares, offrant ainsi une véritable oasis de verdure en milieu urbain. Ses vastes pelouses, ses allées ombragées et son lac pittoresque créent un cadre idyllique pour se promener, se détendre ou pratiquer des activités en plein air.

Le chemin pédagogique de ce parc se compose de 15 modules qui déclinent le thème de l’eau. Ils ont été conçus à l’issue d’un concours d’idées organisé auprès des étudiants de l’Ecole nationale d’Architecture de Rabat avant d’être réalisés, puis installés. Les étudiants ont donc imaginé pour le chemin des stations qui déclinent l’eau dans le corps humain, l’eau dans l’arbre, le robinet magique, la préservation de l'eau et son utilisation responsable, le cycle de l’eau, l’énergie des vagues, la faune aquatique, et les espèces de poissons disparues. Chaque station explique son thème sur l’eau dans une pédagogique ludique pour capter l’attention des enfants, leur transmettre des connaissances environnementales, les sensibiliser aux pratiques durables en matière d'eau et éveiller leurs consciences.

Le module dédié à la faune aquatique (Figure 7) vise à éduquer les écoliers à reconnaître les différentes espèces de poissons de la ville d’El Jadida. L’ensemble des espèces sont présentées avec des tiges verticales et accompagnées d’une plaque explicative fournissant des informations détaillées sur chacune d’entre elles.

Figure 7 : Module faune aquatique

Le module sur le cycle de l’eau présente une série de panneaux illustrant ses différentes phases. Un panneau dédié aux nuages offre une définition détaillée du phénomène de condensation, tandis que celui représentant une montagne enneigée

explique les précipitations. Le panneau illustrant une colline traite des processus d'infiltration et de ruissellement. Quant au panneau évoquant une forêt, il fournit des informations sur l'évapotranspiration. Enfin, le panneau représentant la mer aborde la question de l'évaporation. Chacun de ces panneaux contribue à une compréhension approfondie du cycle de l'eau.

- **Parc Ghabat Chabab - Marrakech**

Ghabat Chabab est un parc de 180 hectares à Marrakech, peuplé d'oliviers centenaires. Il offre un environnement verdoyant et serein au sein de la ville pour que les visiteurs puissent se connecter à la nature. Le chemin pédagogique de Ghabat Chabab a été conçu par des étudiants de l'Ecole Nationale d'Architecture de Rabat via un concours d'idées lancé par la Fondation en 2020.

Le concept paysager de Parc Ghabat Chabab comporte 6 haltes pédagogiques éducatives et ludiques dont 4 ont fait l'objet du concours d'idées, leurs modules concernent les thématiques suivantes:

- H1 : L 'Oliveraie de Ghabat Chabab ;
- H 2 : L'arbre en ville ;
- H 3 : La biodiversité de la région de Marrakech ;
- H 4 : L'adaptation des plantes en milieu sec ;
- H 5 : Le jardin des insectes et Pollinisation ;
- H 6 : Khettara.

La première halte est composée de 3 modules : le livre de l'olivier (Figure 8) qui offre des informations essentielles sur cet arbre emblématique, met en avant les effets positifs de l'olivier sur le climat, en tant que soutien précieux à la biodiversité, un allié dans l'amélioration des sols, et souligne son empreinte hydrique bénéfique. Le module moulin à huile d'olive (Figure 9), intégré harmonieusement dans le thème présente des informations sur l'huile d'olive et la riche palette aromatique résultant des savoir-faire traditionnels marocains. Le troisième module de cette halte "Branche de l'olivier" offre des informations détaillées sur les caractéristiques des feuilles, des fleurs et des racines de cet arbre.

Figure 8 : Module Livre d'olivier

Figure 9 : Module Moulin à huile

La halte 3 comprend 3 modules, l'un d'eux prend la forme symbolique d'un arbre, offrant des informations sur le rôle essentiel des arbres en milieu urbain en tant que carrefour de biodiversité, en tant qu'abri pour de nombreuses espèces, ainsi que leur capacité à stocker du CO2, contribuant

ainsi à atténuer l'impact du changement climatique. Il souligne aussi le rôle primordial des forêts en tant que puits de carbone.

La halte 4 est composé aussi de 3 modules éducatifs, tous sous forme de cactus, qui sont reconnues pour leur résistance aux températures élevées et aux conditions arides. Il présente les différents mécanismes employés par ces plantes pour prospérer dans des milieux secs et met en lumière leur extraordinaire capacité de s'adapter dans des conditions climatiques difficiles.

- **Parc Historique Lahboul**

Le Parc Historique Lahboul, fondé en 1906, dans lequel les habitants de Meknès retrouveront le plaisir de se promener et de se reposer, est un large espace de 5 hectares au cœur de la ville, ombragé par des arbres et des palmiers centenaires, avec de magnifiques terrasses créées sur les pentes de l'oued Boufekrane, qui lui donnent un air de parc suspendu.

En 2023, un chemin pédagogique a été installé au sein du parc dont le but de sensibiliser les communautés sur plusieurs enjeux environnementaux, et dont les concepts ont été dessinés par une trentaine d'étudiants architectes de l'école nationale d'architecture de Fès dans le cadre d'un concours d'idées lancé en 2022. Les modules de ce parcours visent à mettre en lumière l'histoire du Parc, l'importance de la biodiversité végétale, le rôle fondamental de la faune du sol dans les écosystèmes, la ressources en Eau, la préservation des écosystèmes naturels ainsi que la promotion d'écogestes.

Le module "Histoire des colonnes romaines" (Figure 10) l'histoire des colonnes de marbre posées dans ce parc historique qui provenait initialement du Palais Badiï de Marrakech et été réutilisées par le Sultan Moulay Ismail dans la construction de sa kasbah à Meknès. Elles ont été intégrées dans le projet du paysagiste Jean-Claude Nicolas Forestier. Leur présence ajoute une touche mythologique à l'aménagement du jardin.

Figure 10 : Module Histoire des colonnes romaines

Le module "Fontaine - Eau" met en lumière l'importance des fontaines traditionnelles dans le patrimoine culturel, social et architectural de la ville de Meknès. Ces fontaines symbolisent le partage de la ressource vitale qu'est l'eau. Autrefois présentes dans toute la ville, elles étaient essentielles pour l'approvisionnement en eau potable des habitants. Ce module souligne également l'importance des eaux souterraines, qui représentent une grande partie des réserves d'eau douce de la planète. Cependant, cette ressource est vulnérable à l'épuisement et à la pollution. D'ou l'importance de gérer cette ressource rare de manière durable.

Le module "Ombrière" offre un espace ombragé multifonctionnel tout en promouvant des ecogestes simples. Il encourage les visiteurs à

abandonner l'usage des sacs en plastique au profit de sacs réutilisables, et à s'engager dans la prévention des incendies de forêt en respectant les consignes de sécurité. Ces gestes simples, intégrées de manière intuitive dans l'espace, visent à sensibiliser et à adopter des comportements respectueux de l'environnement.

- **Jadin Jenan Sbil - Fès**

Toujours dans cette dynamique fait qui appel à la créativité des jeunes pour promouvoir la sensibilisation à l'environnement, un récent concours d'idées a été lancé en 2024 auprès des étudiants de l'école nationale d'architecture de Fès pour la conception d'un nouveau chemin pour le jardin Jenan Sbil à Fès suite aux expériences antérieures en termes d'évaluation du potentiel créatif des jeunes autour du développement durable.

Les concepts de ce chemin pédagogique abordent des sujets divers : la biodiversité, l'eau, et la culture de la ville de Fès.

La sensibilisation en plein air à travers des chemins pédagogiques interactifs et ludiques est une excellente approche pour encourager le grand public à respecter notre environnement, pour instiller une conscience environnementale durable et pour adopter des comportements écoresponsables.

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564 Building Community Partnerships for Ecorestoration Projects in Greater Mumbai through CSR

Dr. Vaylure Shubhalaxmi (1)

Abstract

As part of its corporate social responsibility efforts, DCB Bank spearheaded three distinct ecological restoration projects in 2021, focusing strongly on reforestation and ecological revitalisation. These initiatives were carried out in three degraded ecological settings: Taloja Hill forest in Kharghar, Navi Mumbai; Ambivli Biodiversity Park in Kalyan; and Sanjay Gandhi National Park in Mulund. The Taloja Hill forest restoration project involved afforestation efforts, including planting 8000 trees, shrubs, and herbs. Kalyan's Ambivli Biodiversity Park emphasised establishing a City Park, which was achieved by planting 10,000 saplings and creating six thematic gardens: Astral, Butterfly, Medicinal, Bat, and Bird Gardens. At Sanjay Gandhi National Park, the approach focused on assisted natural regeneration, addressing canopy gaps by reintroducing tree species and creating designated zones for pollinators and deer browsing. Educational assets such as nature trails, bilingual signs, exhibits, and field guides were developed to enhance visitor comprehension of local biodiversity. Over three years, in collaboration with the state forest department, Municipal Corporation, and DCB Bank, these projects managed 17 hectares of degraded habitats, planted 28,000 saplings, engaged over 6000 members of the local community, and developed various educational resources. Volunteer activities included land preparation, mulching, sapling planting, seed collection, and the creation of nature trails and educational materials. This engagement approach nurtured a sense of community ownership, facilitated site upkeep, and effectively solved incidents such as fires. The robust participation of enthusiastic volunteers fostered a symbolic relationship, elevating staffing demands, enriching expertise, and fostering a shared sense of accountability. Corporate volunteers, including those from DCB Bank, significantly contributed to the overall impact of the projects. This hands-on experience underscores the potency of involving local participants and collaborators in ecorestoration initiatives. This inclusive strategy alleviates organisational burdens, nurtures positive relationships, and garners support from funding agencies. Particularly during the pandemic, this approach proved invaluable in empowering technical organisations to disseminate expertise, refine strategies, and engage in cost-effective experimentation through collaborative community involvement.

1. Introduction

The ecological restoration of natural habitats in India has emerged as a pivotal endeavour in the broader global pursuit of environmental sustainability and biodiversity conservation. With its rich and diverse ecosystems, India exemplifies the complex interplay between ecological restoration and community engagement. Over the past few decades, there has been a profound shift in the approach to ecological restoration within the Indian subcontinent, emphasising the pivotal role of local communities in the planning, execution, and stewardship of restoration initiatives. This transformation symbolises a broader global recognition that conserving natural landscapes cannot be divorced from the empowerment and active participation of the communities within and around these ecosystems.

The involvement of local communities in ecorestoration projects in India represents a promising trajectory, echoing the principles of community-based natural resource management and sustainable development. The multifaceted relationship between these projects and local communities intertwines environmental, social, and economic dimensions, showcasing the intricate tapestry of ecological restoration as it unfolds in a diverse and culturally vibrant nation. This paper delves into the dynamic and evolving landscape of ecorestoration efforts across the three project sites

(1) iNaturewatch Foundation, Navi Mumbai, India

in Greater Mumbai (Taloja Hill Forest, Sanjay Gandhi National Park (SGNP), Mulund Range and Ambivli Biodiversity Park) managed by iNaturewatch Foundation, highlighting the motivations, challenges, and successes that emerge when local communities are not just stakeholders but active agents in the restoration of their ecological heritage.

Corporate Social Responsibility (CSR) has emerged as a powerful catalyst for ecorestoration efforts in India, where businesses increasingly recognise their role in environmental conservation. CSR funds have played a pivotal role in supporting projects to restore ecosystems, conserve biodiversity, and mitigate environmental degradation. These initiatives contribute to sustainable development and reflect a growing sense of environmental responsibility within the corporate sector (Hillestad & *et al.* 2010). The sites mentioned above are part of the CSR projects that DCB Bank Ltd supported. Each of these projects was of three-year duration, and each had a plantation as an integral part of the project activity. Drawing from a synthesis of existing knowledge and project insights, this paper navigates through the rich tapestry of ecorestoration initiatives in these three project sites, exploring the myriad ways local communities have become integral partners in safeguarding the nation's natural wealth.

2. Project Sites: The three project site details are given below:

2.1 Taloja Hill Watershed: Taloja Hill Watershed is a hill range adjoining the Taloja Lake and Owe Dam. It is a watershed zone as it separates the rainwaters flowing to different water bodies, including Taloja Lake, in the near vicinity. It is situated close to Sector 35-G in Kharghar, Navi Mumbai. The hill range, an urban oasis teeming with untamed wilderness, undergoes a dramatic transformation depending on the season. When the rains arrive, it bursts to life, vibrant and lush, but during the scorching summer months, it adopts a parched appearance, with only a few hardy plants clinging to its rugged slopes.

Unfortunately, this once-thriving ecosystem is on the verge of collapse due to a myriad of human-induced threats. Deforestation, rampant wildfires, uncontrolled cattle grazing, and erosion of the precious soil have all taken their toll, pushing the hill range to the brink of destruction.

Figure 1 Project site: Summer and Monsoon

Despite these challenges, the resilient local community has been working tirelessly to protect their beloved hills, utilizing whatever limited resources they have at their disposal. Recognizing the importance of their efforts, the iNaturewatch Foundation stepped in with a Corporate Social Responsibility (CSR) project in 2020 to bolster the community's conservation initiatives. Through this partnership, the foundation provided support and resources to enhance the community's ability to safeguard the fragile ecosystem of the hill range.

2.2 Ambivli Biodiversity Park: The Ambivli Biodiversity Park, nestled on a 40- acre parcel of land under the management of the Kalyan Dombivli Municipal Corporation (KDMC), stands as a testament to conservation efforts in the region. Initially, the park boasted 24,000 trees,

a commendable feat by the KDMC. However, recognizing the need to enhance biodiversity, iNaturewatch Foundation stepped in 2021 to complement their efforts by reforesting a deforested area spanning 5 hectares, incorporating vital components of biodiversity.

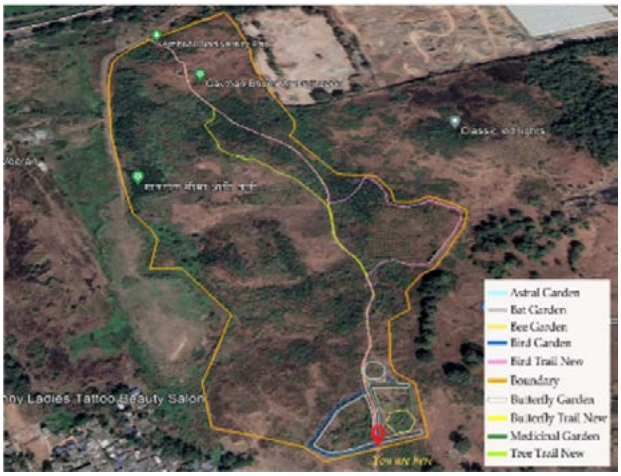

Figure 2 Map of Ambivli Biodiversity Park

The park faced numerous challenges stemming from its proximity to slum colonies, rampant tree cutting, illegal wildlife hunting, and forest fires instigated by vandals. These factors contributed to its degradation, threatening the fragile ecosystem it harbored. The project's primary objective is to develop the Ambivli site into a Biodiversity Park to foster environmental awareness and protection among the local community. Over the past five years, KDMC has undertaken tree plantation activities in the area, laying the foundation for the Biodiversity Park. However, to enhance biodiversity and promote ecological sustainability, the iNaturewatch Foundation has joined forces with KDMC and secured funds from DCB Bank to drive the project forward.

Over the course of just three years, the transformative project revitalized the park, breathing new life into its once-dwindling biodiversity. Through concerted efforts, iNaturewatch Foundation addressed the underlying issues, restoring balance to the ecosystem and mitigating further degradation. The culmination of these endeavors was marked by the park's inauguration on January 20, 2024, symbolizing a triumph of conservation and community collaboration.

2.3 SGNP, Mulund: Sanjay Gandhi National Park stands as Mumbai's precious sanctuary, encompassing 108 square kilometers across four municipalities within Greater Mumbai. Within its vast expanse, a specific area caught the attention of conservationists: a 5-hectare plot in the Mulund range, once lush with greenery, had succumbed to deforestation and degradation. This plot, though inaccessible to the public, held immense potential for ecorestoration efforts.

Figure 3 Map of Project site

The degradation of this area stemmed from various sources, including the encroachment of slum colonies near its boundaries, the dumping of waste, and even the inadvertent destruction caused by cricket games within the forest. Additionally, deliberate forest fires, often instigated by vandals, exacerbated the ecological decline.

To address these challenges, the Assisted Natural Regeneration (ANR) method emerged as a beacon of hope. This approach harnesses the power of nature's innate ability to heal itself, guiding and facilitating the natural processes of regeneration. Through ANR, the degraded land in the Mulund range was gently coaxed back to life, fostering the resurgence of native flora and fauna. DCB Bank

funds the project, and the area comes under the jurisdiction of the Forest Department. The Project duration was three years.

3. Project Methods and Results

3.1 Seasonal Biodiversity Surveys:

Every quarterly biodiversity survey was conducted to assess the increase in species of plants and animals. The surveys showed the following results:

- **Taloja Hill Watershed:** Periodic biodiversity assessment surveys showed an increase in species diversity from 76 to 423, demonstrating a 557% increase (see Fig. 4).
- **SGNP, Mulund:** Periodic biodiversity assessment surveys showed an increase in species diversity from 124 to 377, demonstrating a 304% increase (see Fig. 5).

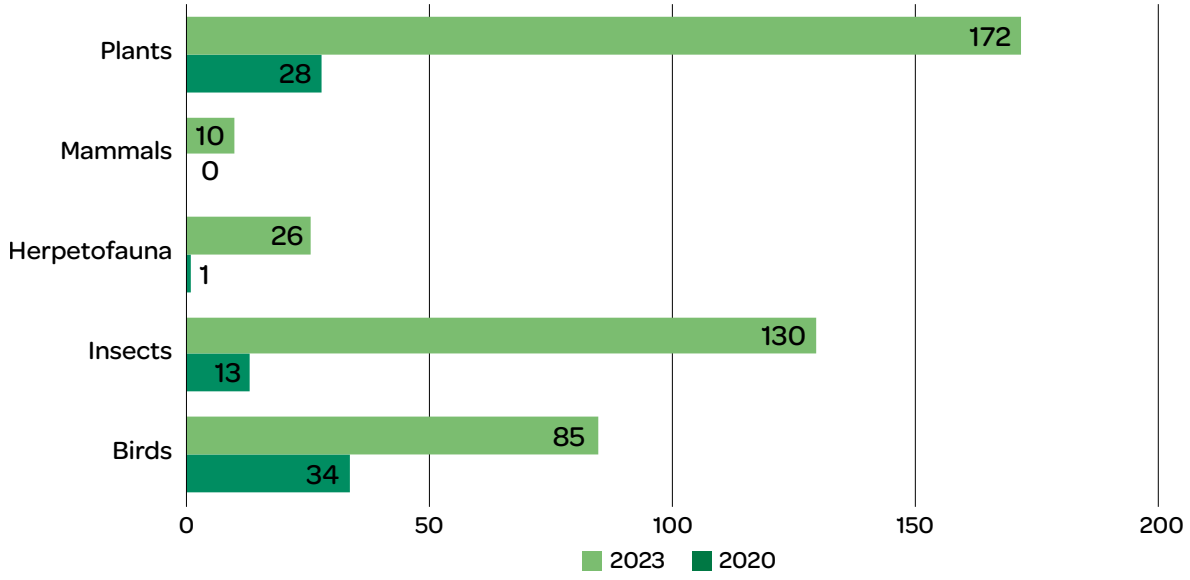

Figure 4: Species Diversity of Taloja Hill (2020-2023)

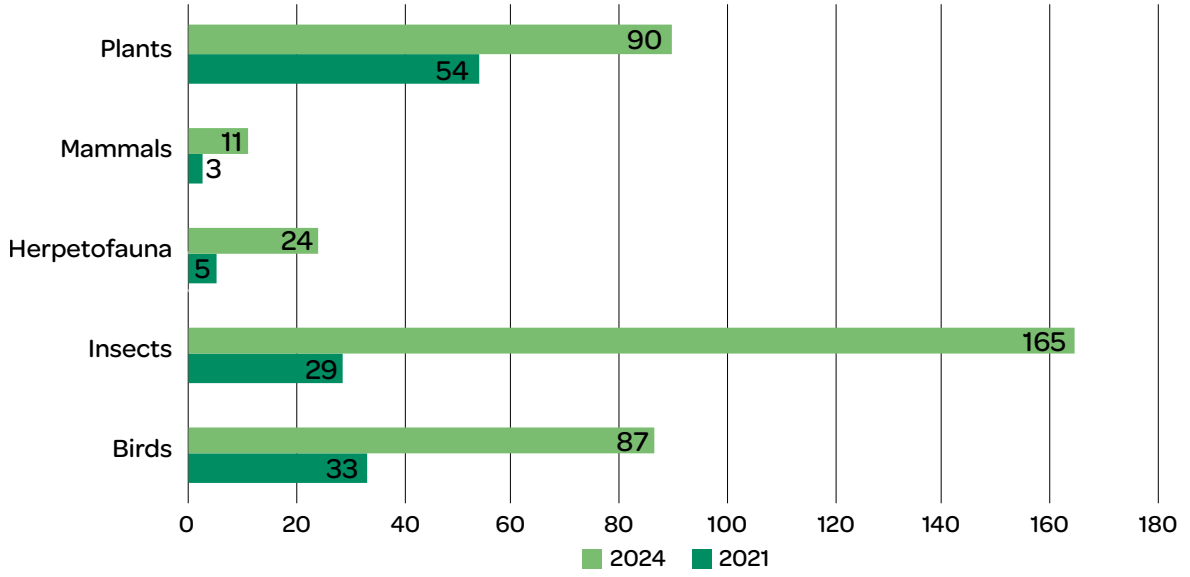

Figure 5: Species Diversity of SGNP (2021-2024)

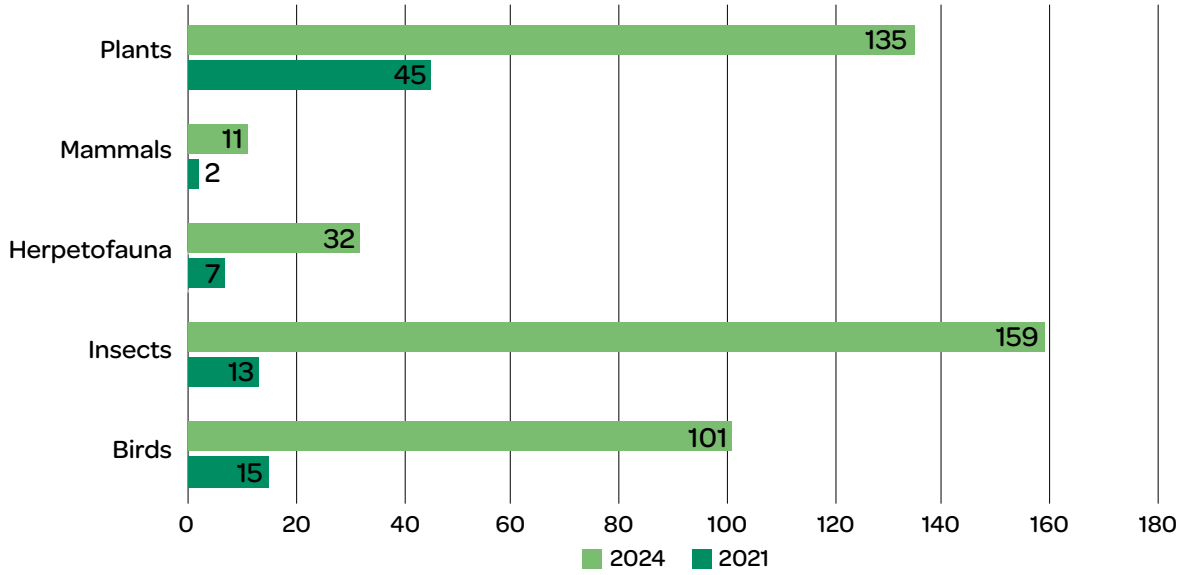

Figure 6: Species Diversity of Ambivli (2021-2024)

- **Ambivli Biodiversity Park:** Conducted biodiversity surveys and recorded 135 plants and 303 faunal species. There has been an increase in species diversity by 534% (see Fig. 6)

3.2 Plantation of Biodiversity Attracting Saplings:

Each site had the requirement for plantation for various purposes (see Table 1). The details are given below:

- **Taloja Hill Watershed:** A total of 7898 saplings were planted to curb soil erosion and plug canopy gaps. The target was to plant 5000 saplings, but 2898 additional plants were planted to compensate for the loss of plants due to rampant wildfires and cattle grazing. The survival rate was 36%.
- **SGNP, Mulund:** A total of 10876 saplings were planted to plug canopy gaps, create deer browse zones, and pollinate zones. The target was to plant 10,000 saplings, but 876 additional plants were planted to compensate for the loss of plants due to wildfires and vandalism. The survival percentage was 72%. Additionally, the Assisted Natural Regeneration Methods safeguarding wildlings were included. Four hundred ninety-three tree wildlings received protection and regular mulching to enhance their growth.

Figure 7 Taloja Hill Forest (Before: 2020, After 2023)

Figure 8 SGNP : Before 2021, After 2024

- **Ambivli Biodiversity Park:**

  A total of 11989 saplings were planted, which were meant to plug canopy gaps and create thematic gardens such as Astral, Medicinal, Bee, Bat, Bird, and Butterfly. The target was to plant 10,000 saplings, but in 1989, additional plants were planted to compensate for the loss of plants due to wildfires and vandalism. The survival percentage was 67%.

Table 1: Details of Plantation at Project Sites

Plants	Taloja	SGNP	Ambivli
Herbs	4512	3079	1566
Shrubs	1338	4612	7996
Trees	2048	3185	2427
Total	**7898**	**10876**	**11989**
Total survival	2873	6122	7823
Survival Percentage	**36%**	**72%.**	**67%**

Figure 9 Ambivli Biodiversity Park : Before 2021, After 2024

3.3 Habitat Maintenance Works:

All project sites require regular maintenance, such as controlling grass, creating firebreaks, removing invasive species, contour bunding, and creating forest nurseries. The site-specific works are mentioned below:

- **Taloja Hill Watershed:** This site faces challenges such as wildfires, which are rampant through the winter and summer months. This is primarily because of the grassland patches along the hill slopes. To deal with the problem, the grass needs to be cut, and fuel breaks along the pathway need to be created. The cut grass is handed over to local stable owners from neighbouring villages. Along with the grass, invasive species such as American Mint also cover the hill plateaus. These are removed regularly and their clumps are used as brushfrills along the streams. The soil erosion is rampant, and bundles are created along the slopes to address the same contour. The second challenge is uncontrolled cattle grazing, for which tree guards are installed along the plants and regularly repaired. The last challenge is vandalism, wherein miscreants from neighbouring areas destroy signboards, tree guards, and water tanks, and there is a constant cost to the project of repairing or replacing the same.
- **SGNP, Mulund:** This site faces challenges such as wildfires rampant throughout the summer months. This is primarily because of the grassland patches in the landscape. To deal with the problem, the grass needs to be cut, and fire lining is done along the plantation sites. The soil quality is poor, there is a constant requirement to mulch the land, and contour bunds are created to improve water retention. The last challenge is vandalism, wherein miscreants from neighbouring areas destroy signboards, tree guards, and water tanks, and there is a constant cost to the project of repairing or replacing the same.
- **Ambivli Biodiversity Park:** This site faces challenges such as wildfires rampant throughout the summer months. This is primarily because of the grassland patches in the landscape. The grass must be cut to deal with the problem, and fire lining is done along the plantation sites. The last challenge is vandalism, wherein miscreants from neighbouring areas destroy signboards, tree guards, and water tanks, and there is a constant cost to the project of repairing or replacing the same.

3.4 Development of Nature Trails, Trail Signages, Exhibits and Activity Stations for Visitor Engagement:

To engage communities, nature trail infrastructure was created at the project sites. The details are given below:

- **Taloja Hill Watershed:** Three 1-km-long nature trails were created, and the pathway was lined by empty coconut shells, as no curb stones were available at the site. A nature trail field guide was developed for the visitors.

Figure 10 Nature Trail at Taloja

- **SGNP, Mulund:** Three nature trails that were 1 km long were created, and stones demarcated the pathway. Sixty trail signs were developed on the park's biodiversity, and 12 nature exhibits were developed and installed strategically. In addition to this, three water holes were created for wildlife, and ten activity stations were created for visitor engagement. The activity stations included the following activities:

Table 10: List of Activity stations

Ambivli Bingos	SGNP Activity
1 Leaf Shape	Animal Scat Analysis
2 Leaf Type	Tree Height and Age Measurement
3 Leaf Arrangement	Study of Animal Tracks
4 Types of Fruits	Tree Carbon calculation
5 Types of Barks	Bug Hotel
6 Types of Reptiles	Topsoil analysis
7 Types of Insects	Identification of Bird Calls
8 Types of Flowers	Life Underground
9 Types of Birds	Study Biodiversity of a Plot
10 Types of Butterflies	Selfie with Tree

Figure 11 Nature Trail at SGNP

- **Ambivli Biodiversity Park:** Three one-kilometre-long nature trails were created, and stones demarcated the pathway. Sixty trail signs were developed on the park's biodiversity. Twelve nature exhibits were developed and installed at strategic locations. In addition, ten wildlife installations and ten activity stations were created for visitor engagement.

Figure 12 Trail Signs, Exhibits and Bingo Activity Sheet

3.5 Community Engagement Programmes:

Every project had a component of community engagement, and volunteering was the most common activity, followed by nature awareness programmes. The details are given below:

- **Taloja Hill Watershed:** Habitat restoration was the most common activity to which volunteers contributed. This project significantly benefitted community volunteers as they helped kickstart the project activities during the first two years of the pandemic. Throughout the project duration, 834 Corporate Employees and Community Volunteers were engaged and clocked 1668 hours. In addition to this, 13 nature awareness programs for 258 visitors were organised to promote the hill's biodiversity. The field guide brochure was given away as study materials. A wildfire management plan was developed and implemented, including fire awareness surveys through demonstrations, posters, and fire indicators. The project concluded by providing Naturalist training for 25 community volunteers. These trained volunteers helped conduct nature trails at the site beyond the project period.

Figure 13 Nature Trail at Taloja

- **SGNP, Mulund:** 834 corporate employees and community volunteers were engaged and clocked 1668 hours at this site. 13 nature awareness programs for 258 visitors were also organised here. Here, Ecolearn, a month-long Field Research Internship programme, was implemented for 20 undergraduates, where they were taught about ecorestoration methods.

Figure 14 Nature Trail at SGNP

- **Ambivli Biodiversity Park:** There were 927 corporate and community volunteering events, which clocked 1854 volunteering hours. We organised 23 nature awareness programmes, including 18 webinars, and engaged 603 participants. The project concluded with a month-long Naturalist Training Programme for 18 community volunteers.

Figure 15 Nature Trail at Ambivli

3.6 Understanding Community Volunteers:

For each project site, a whatsapp group was created where volunteers were enrolled, and volunteering events were posted. Altogether, 268 volunteers had volunteered as and when it was convenient for them (see Table 1).

Table 1

Name of Project Site	No. of Volunteers
1. Taloja Hill Watershed	152
2. SGNP, Mulund	75
3. Ambivli Biodiversity Park	41
Total	**268**

To understand our volunteers, we conducted an online survey (see Annexure 1), which 25 respondents undertook, and we got the following results:

- **Who are our volunteers?** Our study revealed that women were the predominant group among the 25 individuals surveyed, comprising 56% of the total sample. Additionally, the data showed that nearly 44% of the participants fell within the age range of 35 to 44 years, with 28% falling between 18 and 24 years old. Regarding occupation, a significant majority, constituting 69%, were employed professionals, while students comprised 17% of the respondents.
- **Best way to recruit volunteers:** The survey found that social media and word-of-mouth recommendations were the most successful recruitment methods.
- **What motivates volunteers?** Concerning their motivations, an overwhelming majority of 92% exhibited a solid commitment to environmental causes, indicating a deep passion for preserving the natural world. Moreover, 84% expressed a solid drive to positively impact, showcasing a desire to contribute constructively to environmental issues. Additionally, 60% of the respondents cited a strong interest in expanding their environmental knowledge as a key motivating factor.
- **How did volunteers benefit?** The vast majority of volunteers, comprising 96%, experienced an enhanced comprehension of local environmental concerns through their involvement. Additionally, 84% felt they contributed positively to enriching outdoor experiences and improving their community's environmental conditions. Moreover, 80% reported notable enhancements in their mental and emotional well-being as a direct consequence of their participation in environmental initiatives. Furthermore, 76% valued the opportunity to learn from peers who shared their environmental interests, and an equal percentage expressed a heightened appreciation for the natural world. 68% felt a strengthened sense of belonging within their community, while 56% embraced nature study as a newfound hobby.

Figure 16: Volunteers at SGNP

3.7 Discussion

- **Plantation:** According to Bremer & *et al.*(2010), there exists a clear relationship between plantation efforts and biodiversity. Their findings suggest that plantations are more beneficial for biodiversity conservation when they are established on degraded lands, rather than replacing natural ecosystems like forests, grasslands, and shrublands. Moreover, the study highlights that the use of indigenous tree species in these plantations tends to have a more positive impact on biodiversity compared to exotic species. All of our project sites have corroborated these findings by demonstrating an increase in biodiversity indices.
- **Stakeholder engagement:** As per UN Decade on Ecosystem Restoration 2021-2030 website (2024), stakeholder forums play a crucial role in the effectiveness of restoration initiatives. All of our project locations were pinpointed with the assistance of local communities either actively engaged at the site or demonstrating interest in its preservation. Additionally, government bodies like forest departments and municipal corporations were integral partners. It's evident that without this collaborative coalition, our projects would not have achieved success.
- **Educational Programmes:** Studies have shown that environmental education programs significantly enhance the appreciation of the natural world among local communities (Helen & Georgina, 2018). This was clearly demonstrated in our educational initiatives, where we emphasized the significance of local biodiversity. Our participants expressed genuine appreciation for our programs.
- **Volunteer Engagement:** Engaging in restoration activities could potentially lead to a general feeling of contentment among volunteers. In fact, overall satisfaction has been explored as a potential benefit of nature-related activities and experiences (Kaplan, 1973, 1993). Our own research also illustrated this phenomenon.

In summary, the project's alignment with the UN SDGs demonstrates its holistic approach to sustainable development, integrating social, economic, and environmental considerations to create positive and lasting impacts for both present and future generations.

Acknowledgements

We are thankful to our funding agency DCB Bank Ltd. for funding our all three projects. A special thanks to our partners; Maharashtra State Forest Dept. and Kalyan Dombivli Municipal Corporation for providing us land and all support for making our projects successful. Our gratitude towards the community volunteers at all our project sites who helped us selflessly as and when we needed them.

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THE MEANS THEME 04

Promoting Collaboration and Learning Communities to Address Socio-environmental Challenges

Theme Background:

EE and ESD are not new to learning communities that serve as powerful platforms for fostering meaningful learning experiences, leading to both personal and societal change. The concept is rooted in the idea that people can learn more effectively when they collaborate, exchange ideas, and support one another in their learning journeys.

Several key elements underpin the creation and sustainability of such communities—recognizing the possibilities of formal and non-formal systems for outreach, a cause, interdependency and critical discourse. These elements enable educators and learners to engage in deep and meaningful learning experiences that can drive positive environmental and social transformations. With the advent of social media and virtual engagement platforms, which proved effective during the global COVID-19 pandemic, there is a growing interest in collaborations of various types.

This theme explores the roles of various collaborations and civil society organizations in strengthening EE and ESD

Theme Objectives:

The theme, "Promoting Collaboration and Learning Communities to Address Environmental Challenges," seeks to discuss strategies for sustaining and improving learning communities to serve EE and address environmental challenges effectively.

Theme Focus:

- Examples of effective collaborations between government agencies and local communities in addressing sustainability crises and driving positive change.
- Role of citizen science in the field of EE and ESD and its contributions to environmental monitoring, research, and public engagement.
- Good practices in the transfer of knowledge from EE and ESD initiatives to society, fostering informed decision-making and behaviour change.
- Collaborative initiatives for environmental education and sustainable development.
- Examples of citizen science projects in environmental monitoring and research.

Theme Outcomes:

Underlines the need for collaboration and learning communities that take various forms and exist within different contexts and which can contribute significantly to addressing local, regional, or global environmental and sustainability challenges.

Theme Conclusions:

The thematic track on "Promoting Collaboration and Learning Communities to Address Environmental Challenges" aligns with the overarching goal of WEEC 2024, which is to "Connect People, Create Tomorrow." It underscores the critical role of collaboration, education, and community engagement in addressing environmental and sustainability challenges.

Together, we can explore innovative approaches, share best practices, and build stronger partnerships to drive positive change and promote a sustainable and resilient future for all

THE MEANS THEME 04

Promoting Collaboration and Learning Communities to Address Socio-environmental Challenges

Proceedings

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621	Green Schoolyards as Learning Landscapes and Green Livingrooms of Neighbourhoods	Ian Mostert	Round table
648	Nature-Based Education Networks : Collaborative Transformation of the Territory in Colombia: A Comprehensive examination of the implementation of Nature-Based Education and Regenerative Leadership in Colombian Schools	Luis Alberto Camargo	Round table
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Desarrollo de una propuesta participativa para la restauración ecológica urbana de un espacio público en Costa Rica

Miriam Miranda Quirós [1], *Marcela Gutiérrez Miranda* [2]

Resumen

Este documento presenta el trabajo realizado por un equipo interdisciplinario en el Corredor Biológico Interurbano María Aguilar (en adelante CBIMA) en rehabilitación ecológica urbana con soluciones basadas en la naturaleza (SbN), entendidas como aquellas acciones y estrategias que están inspiradas o apoyadas en la naturaleza para la promoción y gestión adecuada de los ecosistemas y el abordaje de los retos de la ciudad a través de la generación de beneficios (ambientales, sociales, económicos), mismos, que ayudan a generar resiliencia para las personas, especialmente ante los impactos del cambio climático. Las SbN son intervenciones sistémicas, eficientes en el uso de recursos y adaptadas localmente (European Commission, 2020).

La intervención tiene como propósito mejorar las condiciones biológicas y restaurar los servicios ecosistémicos del territorio. Ello, como herramienta para incidir sobre el bienestar y la salud física y mental de los habitantes, Adicionalmente, motivar a otras ciudades a que inicien procesos similares.

La rehabilitación ecológica urbana es definida como un proceso que se lleva a cabo para mejorar los servicios ecosistémicos en estructura y composición de un ecosistema degradado a consecuencia de las actividades del ser humano (Gann y Aronson, 2013). De acuerdo con United Nations Environmental Program (en adelante UNEP), la rehabilitación ecológica es el proceso de detener y reversar la degradación que tiene como resultado, mejoras en los servicios de los ecosistemas y recuperación de la biodiversidad. Este proceso, abarca prácticas variadas y continúas, dependiendo de las condiciones locales y de las disposiciones e intereses de la sociedad que debe tener un rol activo en el proceso. El desarrollo de la propuesta requiere de sensibilización y educación ambiental a la comunidad con el fin de cambiar las conductas y hábitos actuales responsables del deterioro de los paisajes urbanos y rurales.

Las ciudades de Costa Rica presentan una serie de retos que demandan el trabajo conjunto entre los diferentes sectores y actores, para que, de manera articulada propongan y desarrollen ideas para una mayor sostenibilidad de las áreas urbanas y de esta forma incidir para mejorar el entorno para las personas. Este artículo presenta algunas reflexiones sobre la rehabilitación ecológica urbana a través de SbN en un espacio público rehabilitado "La Guápil" conocido por los habitantes como La Sabanita; ubicado en San Felipe del cantón de Alajuelita, en la provincia de San José.

La rehabilitación ecológica urbana en La Sabanita surge de una inquietud común de una gama diversa de actores que han estado trabajando juntos desde hace ya varios años en el CBIMA. Como resultado del trabajo conjunto y a las sinergias establecidas, se identificaron las necesidades de la comunidad y se llega al consenso de acercarse a la comunidad con una propuesta dirigida a rehabilitar un basurero a cielo abierto, transformándolo en un espacio con micro movilidad sostenible, inclusivo, verde, permeable, seguro para las mujeres, y resiliente ante los impactos del cambio climático. Paisaje urbano reestablecido para la gente y con los servicios ecosistémicos mejorados. (Miranda *et al.* 2023)

Antecedentes

Este articulo presenta una experiencia de restauración ecológica urbana desarrollada en La Guapil de Alajuelita espacio ubicado dentro del Corredor Biológico Interurbano Maria Aguilar

(1) Proyecto TEVU OET-PNUD

(2) Centro de Estudios Generales, Universidad Nacional de Costa Rica, Proyecto Interlace

ubicado en la Gran Área Metropolitana (GAM) de Costa Rica(Ver Figura 1). Alajuelita es uno de los cantones densamente poblados de la GAM. Según el censo 2022 tiene una población de 81012 personas y una densidad poblacional de 3773 Hab por km2. Lo anterior, impacta de manera profunda la integridad de los ecosistemas y los servicios que brindan, su interconexión, la biodiversidad, y en general impacta las condiciones de vida que tienen las personas del cantón (MINAE-GEF-PNUD 2019).

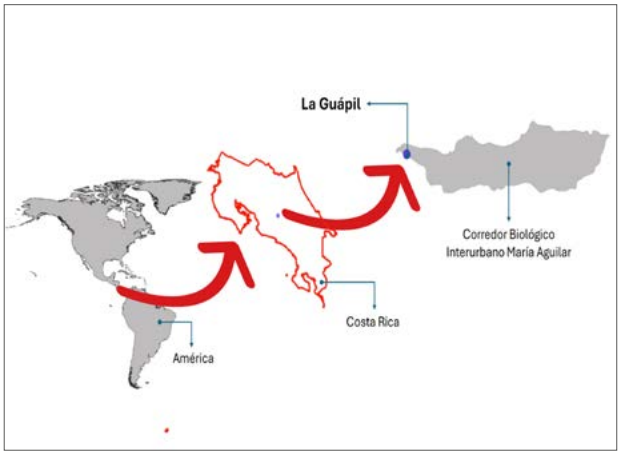


Figura 1 Ubicación de Alajuelita

La rehabilitación ecológica urbana de La Sabanita surge de una inquietud común y del trabajo colaborativo que desarrollan un grupo de actores donde destacan la Municipalidad de Alajuelita, Programa de Naciones Unidad para el Desarrollo (PNUD) con dos proyectos Paisajes Productivos(ejecutado en el periodo 2018-2022) y Transición hacia una economía verde urbana(2022-2027), la Asociación de desarrollo especifico de la Guápil, el proyecto Interlace (financiado con fondos Horizonte 2020 de la Unión Europea) ; con el apoyo de empresas privadas. A través de esfuerzos intersectoriales e interdisciplinarios La Sabanita pasó de ser un espacio contaminado con residuos sólido, con pocos árboles, sin sombra y cubierto por matorrales a un espacio verde inclusivo, seguro y accesible que contribuye con el bienestar de la comunidad.

Alajuelita es uno de los cantones más densamente poblados del CBIMA. Adicionalmente, este territorio tiene índices de desarrollo social condicionados por la pobreza, inseguridad ciudadana, escasa escolaridad y empleo informal, entre otros. La Sabanita, es un espacio verde que pertenece a la Municipalidad de Alajuelita , que colinda con la zona de protección del Rio Tiribí y abarca aproximadamente 2.6 hectáreas. Este terreno público se encontraba en 2020 en francas condiciones de deterioro y era utilizado desde hacía más de 30 años (Gómez M. comunicación personal, 15 de julio 2020)por vecinos y otras personas del cantón como espacio para la recreación, botadero de basura, parqueo y espacio para el consumo de sustancias no permitidas

La falta de un espacio verde en La Guapil enfrentaba a sus pobladores a vivir en condiciones marcadas por la pérdida de los servicios de los ecosistemas donde la contaminación, la inseguridad, el aislamiento social, el sedentarismo y la gestion inadecuada de residuos sólidos condicionaban la calidad de vida de las personas.

Métodos

La propuesta se desarrollo bajo una metodología de investigación acción participativa (IAP). La IAP se caracteriza por su enfoque colaborativo y su compromiso con la transformación social, lo que la convierte en una metodología idónea para abordar problemáticas complejas en contextos vulnerables.

La elección de la IAP responde a la necesidad de involucrar a la comunidad local en todas las etapas del proceso de restauración, desde la identificación de problemas y necesidades hasta la planificación, ejecución y evaluación de las intervenciones. Este enfoque participativo no solo promueve la apropiación y sostenibilidad de las iniciativas por parte de los habitantes, sino que también garantiza que las soluciones propuestas sean culturalmente pertinentes y socialmente aceptadas.

La metodología de IAP se estructura en ciclos iterativos de acción y reflexión, permitiendo ajustes continuos basados en la retroalimentación de los participantes y en los aprendizajes emergentes. En este estudio, se llevaron a cabo múltiples talleres comunitarios, entrevistas y grupos focales para recopilar información cualitativa y cuantitativa sobre las percepciones, expectativas y experiencias de los residentes con respecto al espacio verde a restaurar.

La colaboración entre las instituciones, proyectos, líderes comunitarios, organizaciones no gubernamentales y autoridades locales fue fundamental para crear un ambiente de confianza y corresponsabilidad. Se emplearon técnicas visuales y lúdicas, como mapas participativos y actividades de diseño colaborativo, para facilitar la expresión y el intercambio de ideas entre los participantes, asegurando una inclusión efectiva de voces diversas, incluyendo niños, , mujeres, jóvenes, adultos y adultos mayores.

Este enfoque metodológico permitió no solo la generación de una propuesta contextualizada y relevante, sino también la creación de un sentido de pertenencia y empoderamiento comunitario, esenciales para el éxito y la sostenibilidad del proyecto de restauración del espacio verde. La metodología utilizada es una herramienta que fomenta la justicia ambiental y la resiliencia urbana.

A partir del inicio de nuestro trabajo con esa comunidad se han visto avances producto de múltiples campañas de recolección de residuos, de mejoras en la gestión del espacio verde desde el gobierno local, campañas de siembra y reforestación, elaboración de senderos, colocación de mobiliario urbano, desarrollo de actividades para la apropiación del espacio público y el fomento de otros usos del espacio para actividades artísticas, culturales, deportivas y recreativas. Sin embargo, este terreno requiere todavía una considerable inversión para mejorar la infraestructura deportiva. Además, es imperativo solucionar un desfogue de aguas negras y grises que se vierten directamente, sin tratamiento alguno, al cauce del Río Tiribí.

La restauración ecológica de La Sabanita se realizó en etapas y sigue siendo a la fecha un proceso en construcción. Las etapas 1-4 incluyeron la recopilación de información biológica, topográfica, social, de los usos del espacio verde y de la visión a futuro del espacio desde la perspectiva de sus habitantes y del gobierno local. En la etapa 4 se construyó, validó e implementó la propuesta para la restauración del espacio (reforestación, plantación de jardines, sendero, mobiliario urbano). La etapa 5 incluyo la construcción de la Huerta comunitaria, el desarrollo de un Plan piloto para la gestión de residuos orgánicos y la construcción de un sistema de captación de agua de lluvia. A lo largo de todas las 5 etapas el involucramiento comunal, las actividades de educación ambiental y la La segunda etapa así como del gobierno local, se inició la cuarta etapa que fue la construcción de la propuesta para la restauración del espacio comprendió un diagnóstico ecológico incluye un diseño de sitio participativo que requirió múltiples sesiones de trabajo con vecinos, grupos organizados de la comunidad y todas las instituciones y proyectos involucrados.

El diseño participativo de espacios públicos es fundamental para garantizar que estos lugares satisfagan las necesidades y deseos de la comunidad que los utiliza.Algunos aspectos claves que se tomaron en cuenta en el proceso de diseño y ejecución de la propuesta fueron:

Inclusión de la comunidad: Invitar a diversos grupos de la comunidad a participar en el proceso de diseño desde el principio. Esto puede incluir residentes locales, grupos comunitarios, organizaciones sin fines de lucro, expertos en diseño urbano y funcionarios gubernamentales.

Escucha activa: Es crucial escuchar las ideas, preocupaciones y visiones de la comunidad. Realizar talleres, encuestas, entrevistas y reuniones abiertas para recopilar información y retroalimentación.

Análisis del contexto: Comprender el contexto social, cultural, económico y ambiental del área donde se ubicará el espacio público. Esto ayudará a garantizar que el diseño sea relevante y sensible a las necesidades locales.

Co-diseño: Facilitar sesiones de diseño colaborativo donde los miembros de la comunidad puedan contribuir activamente con ideas y soluciones. Esto puede implicar actividades de mapeo, prototipado rápido y visualización creativa.

Flexibilidad y adaptabilidad: Diseñar espacios que sean flexibles y adaptables a medida que cambian las necesidades y dinámicas de la comunidad a lo largo del tiempo. Esto puede incluir zonas multiusos, mobiliario móvil y áreas verdes modulares.

Accesibilidad universal: Garantizar que el espacio público sea accesible para todas las personas, independientemente de su edad, género,

capacidad física o condición socioeconómica. Esto implica considerar la accesibilidad en términos de diseño físico, visual y cognitivo.

Sostenibilidad ambiental: Integrar prácticas de diseño sostenible que minimicen el impacto ambiental y promuevan la resiliencia climática. Esto puede incluir la conservación de recursos naturales, la gestión de aguas pluviales, la plantación de árboles nativos y la incorporación de materiales ecoamigables.

Seguridad y confort: Diseñar espacios que se sientan seguros y acogedores para todos los usuarios. Esto implica considerar la iluminación adecuada, la visibilidad, la prevención del crimen, la vegetación abundante y áreas de descanso cómodas.

Educación y apropiación: Fomentar la educación y la apropiación del espacio público por parte de la comunidad. Esto puede incluir programas de participación cívica, eventos culturales, actividades recreativas y oportunidades para el voluntariado y el mantenimiento del espacio.

Evaluación continua: Realizar evaluaciones regulares del espacio público después de su implementación para medir su efectividad y recopilar comentarios adicionales de la comunidad. Esto permitirá realizar ajustes y mejoras según sea necesario.

Al integrar estos elementos clave en el proceso de diseño participativo, se creó un espacio público vibrante, inclusivo y sostenible , que enriquece la calidad de vida de la comunidad en general.

Discusión

La intervención en el Corredor Biológico Interurbano María Aguilar (CBIMA) a través de la rehabilitación ecológica urbana con soluciones basadas en la naturaleza (SBN) proporciona valiosas lecciones sobre gobernanza y servicios ecosistémicos en áreas urbanas. Este análisis aborda los impactos, desafíos y oportunidades emergentes desde la perspectiva de la gobernanza y la gestión de servicios ecosistémicos, resaltando las implicaciones para futuras iniciativas en contextos similares.

Gobernanza y Participación Comunitaria

La rehabilitación de La Sabanita es un ejemplo claro de cómo la gobernanza inclusiva y participativa puede transformar un espacio urbano degradado en un activo comunitario valioso. El proceso de involucrar a una diversidad de actores, incluyendo la Municipalidad de Alajuelita, el Programa de Naciones Unidas para el Desarrollo (PNUD), organizaciones comunitarias y el proyecto Interlace, muestra la efectividad de un enfoque de gobernanza colaborativa. La participación de la comunidad en todas las etapas del proyecto, desde el diagnóstico hasta la implementación, no solo asegura que las soluciones sean pertinentes y aceptadas socialmente, sino que también promueve un sentido de propiedad y corresponsabilidad entre los residentes.

Mejora de los Servicios Ecosistémicos

La rehabilitación ecológica urbana en La Sabanita ha logrado mejorar significativamente los servicios ecosistémicos en la zona. Las actividades de reforestación, la creación de jardines y la mejora de la infraestructura verde han restaurado la estructura y composición del ecosistema, proporcionando beneficios tangibles como la reducción de la contaminación, la mejora de la calidad del aire y la creación de hábitats para la biodiversidad. Estos cambios no solo benefician al medio ambiente, sino que también mejoran el bienestar físico y mental de los habitantes, demostrando cómo las intervenciones en servicios ecosistémicos pueden tener un impacto directo en la calidad de vida urbana.

Desafíos y Necesidades Futuras

A pesar de los avances logrados, persisten desafíos significativos que deben abordarse para asegurar la sostenibilidad a largo plazo del proyecto. La infraestructura deportiva aún requiere una considerable inversión para ser funcional y accesible. Además, es crucial solucionar el desfogue de aguas negras y grises en el Río Tiribí, un problema que amenaza con revertir los beneficios ecológicos obtenidos. Estos desafíos subrayan la

necesidad de una planificación y financiamiento continuo, así como la implementación de políticas de gestión de aguas y residuos más efectivas.

Implicaciones para Futuros Proyectos

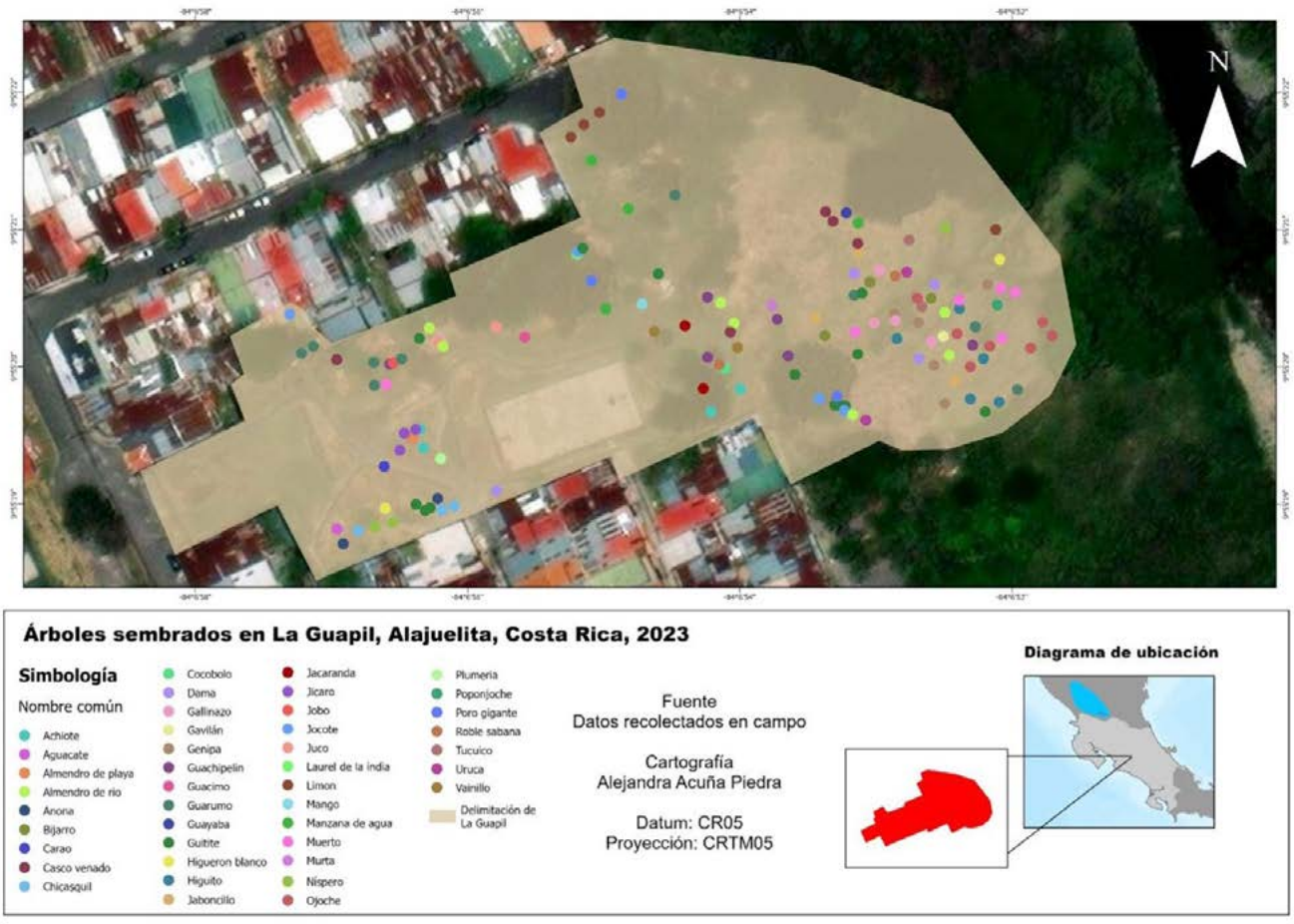
Los resultados de la intervención en La Sabanita proporcionan un modelo replicable para otras ciudades que enfrentan desafíos similares. Las futuras iniciativas deben considerar la importancia de una gobernanza inclusiva y la colaboración intersectorial, así como la necesidad de integrar mejoras en servicios ecosistémicos con infraestructuras básicas y programas de educación ambiental. Al adoptar un enfoque holístico y participativo, las ciudades pueden no solo restaurar ecosistemas degradados, sino también mejorar significativamente el bienestar de sus habitantes.

En conclusión, la experiencia en CBIMA resalta la importancia de la gobernanza colaborativa y la gestión efectiva de servicios ecosistémicos en la rehabilitación urbana. Estas intervenciones no solo benefician al medio ambiente, sino que también tienen un impacto positivo en la salud y el bienestar de las comunidades urbanas, proporcionando un camino hacia ciudades más sostenibles, resilientes e inclusivas.

Resultados

El trabajo conjunto en La Sabanita es un proceso no acabado que ha dado múltiples frutos donde destacan:

- La reforestación de 2.6 ha de terreno con más de 150 árboles de 42 especies Ver figura 2 Mapa de reforestación.
- El establecimiento de un huerto comunitario que produce hortalizas y otros cultivos locales para la alimentación de familias de la comunidad
- Un espacio verde en regeneración para el disfrute de la comunidad
- Acercamiento del Gobierno local con la comunidad
- Desarrollo de un programa de apropiación del espacio público para la comunidad de La Guapil



Conclusiones

Este artículo ha presentado una intervención interdisciplinaria en el Corredor Biológico Interurbano María Aguilar (CBIMA), enfocada en la rehabilitación ecológica urbana mediante soluciones basadas en la naturaleza (SBN).El trabajo realizado evidencia la importancia de una aproximación holística y participativa para la rehabilitación ecológica urbana, destacando el papel esencial de la colaboración y la educación ambiental para lograr un desarrollo urbano sostenible y resiliente. Desde la perspectiva de servicios ecosistémicos y la gobernanza participativa, se pueden extraer las siguientes conclusiones:

1. Impacto Positivo sobre los Servicios Ecosistémicos

La rehabilitación ecológica urbana en La Sabanita ha demostrado ser efectiva para mejorar los servicios ecosistémicos en un área urbana deteriorada. Las actividades de reforestación, la creación de jardines y la mejora de la infraestructura verde han contribuido a la restauración de la estructura y composición del ecosistema, proporcionando beneficios tangibles como la reducción de la contaminación y la mejora en la calidad del suelo, el confort térmico, biodiversidad entre otros elementos.. Estos cambios no solo favorecen al medio ambiente, sino que también mejoran el bienestar físico y mental de los habitantes, resaltando la interconexión entre la salud del ecosistema y la calidad de vida urbana.

2. Efectividad de la Gobernanza Participativa

La experiencia en el CBIMA subraya la importancia de una gobernanza inclusiva y participativa para el éxito de proyectos de rehabilitación urbana. La colaboración entre diversos actores, incluyendo autoridades locales, organizaciones comunitarias, proyectos internacionales y el sector privado, ha permitido una planificación y ejecución más integradas y efectivas. La participación de la comunidad desde el diagnóstico hasta la implementación ha garantizado que las soluciones sean culturalmente pertinentes y socialmente aceptadas, promoviendo un sentido de pertenencia y corresponsabilidad entre los residentes.

Modelo Replicable: El trabajo realizado en CBIMA sirve como un modelo que puede ser replicado en otras ciudades que buscan iniciar procesos similares. Las soluciones basadas en la naturaleza (SBN) implementadas aquí proporcionan un marco práctico y efectivo para la rehabilitación ecológica en entornos urbanos.

Importancia de la Participación Comunitaria: La intervención subraya la importancia de la participación activa de la comunidad en el proceso de rehabilitación ecológica. La educación ambiental y el involucramiento de los residentes son cruciales para asegurar la sostenibilidad y el éxito a largo plazo de estos proyectos.

Colaboración Interdisciplinaria: El éxito del proyecto en CBIMA se atribuye en gran medida a la colaboración interdisciplinaria entre biólogos, arquitectos, ingenieros, urbanistas, científicos sociales, autoridades municipales y la comunidad. Esta sinergia ha sido clave para identificar las necesidades locales y desarrollar soluciones adaptadas a las condiciones específicas del lugar.

Desafíos Persistentes y Necesidades Futuras

A pesar de los avances significativos, persisten desafíos críticos que requieren atención continua. La infraestructura deportiva de La Sabanita aún necesita inversiones considerables para ser funcional y accesible. Además, el desfogue de aguas negras y grises al Río Tiribí representa un problema serio que debe ser abordado para asegurar la sostenibilidad de los beneficios ecológicos obtenidos. Estos desafíos subrayan la necesidad de una planificación y financiamiento continuo, así como la implementación de políticas de gestión de aguas y residuos más efectivas.

Lecciones Aprendidas

Colaboración Intersectorial: La colaboración entre múltiples actores y sectores es esencial para el éxito de proyectos de rehabilitación urbana. Este enfoque permite aprovechar recursos y conocimientos diversos, facilitando soluciones integrales y sostenibles.

Importancia de la Participación Comunitaria: Involucrar a la comunidad desde el principio garantiza que las intervenciones sean pertinentes y socialmente aceptadas. La participación comunitaria también promueve la sostenibilidad a largo plazo al fomentar un sentido de pertenencia y responsabilidad.

Enfoque Adaptativo: La metodología de investigación acción participativa (IAP) permite ajustes continuos basados en la retroalimentación de los participantes. Este enfoque flexible es crucial para manejar las dinámicas cambiantes y los desafíos emergentes en el contexto urbano.

Educación Ambiental: La educación ambiental es fundamental para cambiar comportamientos y hábitos que contribuyen al deterioro del espacio. Programas educativos efectivos pueden empoderar a la comunidad para mantener y proteger los espacios rehabilitados.

Los resultados de la intervención en La Sabanita proporcionan un modelo replicable para otras ciudades que enfrentan desafíos similares. Las futuras iniciativas deben considerar la importancia de una gobernanza inclusiva y la colaboración intersectorial, así como la necesidad de integrar mejoras en servicios ecosistémicos con infraestructuras básicas y programas de educación ambiental. Al adoptar un enfoque holístico y participativo, las ciudades pueden no solo restaurar ecosistemas degradados, sino también mejorar significativamente el bienestar de sus habitantes.

La experiencia presentada resalta la importancia de la gobernanza colaborativa y la gestión efectiva de servicios ecosistémicos en la rehabilitación urbana. Estas intervenciones no solo benefician al medio ambiente, sino que también tienen un impacto positivo en la salud y el bienestar de las comunidades urbanas, proporcionando un camino hacia ciudades más sostenibles, resilientes e inclusivas.

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621 Green Schoolyards as Learning Landscapes and Green Livingrooms of Neighbourhoods

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Rotterdam Transforms Communities through Green-Blue Schoolyards

Many families live in neighbourhoods which offer few attractive opportunities for outdoor activities. Improving access to green spaces, such as parks, and blue spaces – lakes, canals or waterfronts – can boost children's physical and mental development while offering caregivers the opportunity to live a more active and healthy lifestyle, reducing stress and improving their mental health.

We face various challenges with regard to children's health. For example, the healthy development of children is under pressure, children have less knowledge about and connection with nature and the extreme weather conditions as a result of climate change and the loss of biodiversity can also negatively affect the health of children and adults in the future. These challenges require an appropriate solution. Greening schoolyards offers an ideal opportunity to tackle all these challenges together.

Children's Health is Under Pressure

The physical development of children is under pressure. Only 61% of 4 to 12 year olds meet the Dutch exercise guideline (NJI, 2021) and the motor development of children is deteriorating (De Vries, Hak, 2023). In addition, approximately 25% of 13-year-olds in the Netherlands are short-sighted (Tiderman *et al.*, 2016) and more than a third of children now wear glasses or lenses (Grandvison, 2021). This is partly because children play outside less and less. The number of children who play outside every day has plummeted to 14% in recent years (Jantje Beton, 2018) and 17% of children never play outside after school (Jantje Beton, 2023).

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Reduced Knowledge About and Connection with Nature

Increasing urbanization, the rise of sedentary activities such as watching television and playing computer games, and excessive planning of children's lives mean that children are increasingly less exposed to nature (Soga & Gaston, 2016). Due to the lack of experiences with nature in childhood, children increasingly develop a connection with nature (Soga & Gaston, 2016). For example, more than half of children in the upper grades of primary school do not feel connected to nature. This is problematic because if children still do not feel a connection with nature when they are adults, then restoring and managing nature becomes a huge challenge (Soga & Gaston, 2018). Furthermore, we see that having a connection with nature is associated with better health. For example, adults who have a stronger connection to nature are more likely to feel good and happy, have a purpose in life, and experience a sense of control over their environment (Capaldi *et al.*, 2014; Pritchard *et al.*, 2020; Harvey *et al.*, 2020; Chawla, 2020; Lumber *et al.*, 2017). In addition to well-being, a stronger connection to nature also promotes kind behavior (Collado & Corraliza, 2015).

Health Consequences of Climate Change and Biodiversity Loss

Climate change and biodiversity loss also have consequences for our health. For example, long periods of very high temperatures cause extreme heat in urbanised environments. This extreme heat can cause heat illnesses such as heat rash, heat cramps, heat stroke or heat exhaustion, and reduced cognitive and physical functioning (Daanen *et al.*, 2010). Among the elderly, it even leads to a huge increase in the number of people dying from heat. The loss of biodiversity is worrying because biodiversity plays a crucial role in our human health, food supply, medicine and protection against climate change (WUR, 2022).

Greening Schoolyards as a Solution

Greening schoolyards can make an important contribution to solving the health challenges surrounding children and adults. Firstly, because various studies show that people who live in a greener living environment are healthier in general (Maas & Postma, 2022). More specifically for children, we see that children who are exposed to more greenery have better mental well-being, less stress, a more positive mood, more resilience and a better quality of life (Van den Bogerd *et al.*, 2023). After exposure to nature, children experience less hyperactivity and inattention problems and more self-control. Research also shows what a lack of nature can mean. Children who grow up with little greenery in their environment have a 55% higher risk of developing a psychiatric disorder during adolescence, compared to children who grow up with a lot of greenery in their environment (Engemann *et al.* 2019). Secondly, we see that children in schools with a green schoolyard move and play more versatilely (Van Dijk-Wesselius *et al.* 2022), that there is less bullying and that children can concentrate better after the break (Van Dijk-Wesselius *et al.* 2018).

Thirdly, a green schoolyard offers an attractive, accessible outdoor space in neighbourhoods where this space is not or hardly available. Quality and space are added here. Fourthly, by greening schoolyards, we can ensure that all children and their parents/guardians come into regular contact with greenery as a matter of course, and therefore also benefit from the advantages of greenery.

To support schools in creating optimal green schoolyards, we have developed an approach. The approach integrates 10 years of knowledge and experience around the implementation of green schoolyards. The approach focuses on neighbourhoods where many children live, there is little outdoor (play) space, there is relatively much poverty and where relatively many people live with a lower level of education and poorer health. In recent years, the approach has also focused more on tackling climate challenges such as less heat and more water storage, and work is being done on biodiversity and outdoor education. The approach requires that the neighbourhood can use the schoolyard outside school hours. In this way, green, safe oases are created in every neighbourhood close to children and families, where children and families are welcome and can grow up and develop healthily, while parents can relax and meet.

Rotterdam Approach

Green-Blue Schoolyards are an increasingly popular in the city of Rotterdam. The programme supports schools to turn their outdoor spaces into natural play areas that are also open to the local community outside of school hours. You can experience the adventure and impact of a Green and Blue Schoolyard yourself in this virtual tour.

Green and blue spaces offer other benefits to neighbourhoods: they improve stormwater management, reduce the urban heat island effect, support biodiversity, and typically also increase real estate values. Because they combine multiple agendas – from early childhood development to climate change adaptation – Green-Blue Schoolyards can potentially tap into diverse sources of funding.

In Rotterdam the municipality funds the Green-Blue Schoolyards programme, investing up to EUR 80,000 per school. The programme is managed by a team including staff from municipal agencies such as education, health and spatial planning. Technical support is offered by IVN Nature education, a large national expertise organisation which runs educational programming on nature.

Schools themselves are expected to lead the implementation process – gathering input from children, parents and neighbours – and oversee maintenance of the space and programming of activities. The application process for funding involves assessing a school's motivation, as well as looking at the neighbourhood's socioeconomic indicators, existing play spaces, and vulnerability to floods or urban heat.

By asking schools to present a comprehensive plan when they apply for Green-Blue Schoolyard funding – rather than simply dividing funding equally among all schools – and supporting them to take the lead, the programme aims to maximise the potential positive impact on the local community and the city as a whole.

It also distinguishes the Green-Blue Schoolyards programme from similar initiatives in other cities that instead take a centralised, top-down approach to expanding natural play areas. Rotterdam's approach does, however, create the challenge

of establishing a clear shared vision among the school, parents and neighbourhood groups. Often risk-averse attitudes need to be overcome.

Although research increasingly shows that natural play areas can be safer than playgrounds with standardised play equipment, for example, people often worry about the potential for injuries, or liability for accidents. Sometimes outdated national-level regulations on play areas also pose a stumbling block. Other commonly expressed concerns include future maintenance and the potential for vandalism.

Changing mindsets about the importance of nature to children's well-being and development is key to overcoming these concerns. Many urban populations have become increasingly biophobic and need to be convinced that the benefits for children of spending time in nature outweigh any risks from insects, dirt or harmful plants.

However, the upfront time and effort put into building a shared vision pays off in the longer term by increasing the community's ownership of the space.

At the time of writing, almost 50 schools in Rotterdam have participated in the programme.

Challenges

1. *Complex systems are hard to change* (Go, E. and Vincelot J., 2021). Green-Blue Schoolyards programme requires the cooperation of many stakeholders from city agencies to schools, parents, children, and neighbourhood organisations, each with their vision and objectives for the project. It is sometimes challenging to keep everyone aligned around the wellbeing and development of children. Each schoolyard renovation project needs to deal with various levels of riskaversion and other constraints such as budget limits or construction protocols. It also faces different opinions within the community related to outdoor education, neighbourhood activities, maintenance standards, and tolerance of noise generated by children. To mitigate these difficulties in implementation, the programme manager tries to devote a significant amount of time to vision building, strengthening and alignment among stakeholders before diving into implementation. This is important as the programme is looking to change not only the environments but also the minds of the stakeholders who will manage these playgrounds.
2. *Fragmented implementation requires more coordinatio*n (Go, E. and Vincelot J., 2021). Having schools take the lead in implementing the programme helps tailor projects to specific neighbourhoods but means that overall coordination is more fragmented. This can prove challenging for assuring quality and ensuring that projects are following implementation protocols and conditions. Other cities such as Amsterdam or Paris have similar programmes for greening schoolyards but manage them centrally from within the city government to avoid this issue. In Rotterdam, the challenge is addressed by having an external expert, Ian Mostert, who used the Speeldernis as a good example, the expert nature playground organisation, act as technical support and reviewer, as a hub for schools to meet and learn from each other, and get the training they need to carry out quality implementation.
3. *Managing inconsistencies from city- to national-level policies* (Go, E. and Vincelot J., 2021). When implementing Green-Blue Schoolyards projects, schools are confronted by a series of protocols, regulations, and entrenched practices related to risk, liability, construction guidelines, sanitation, and education that sometimes come into conflict with the objectives of the project. This stems from national-level regulations and laws that have not yet evolved to reflect the new mindset on play and risk that Rotterdam is adopting with this programme. For example, the national policy for schoolyards does not grant much financial freedom for schools to take the lead in organising their own education programming and environments for children, a situation that makes it difficult for schools in Rotterdam to adapt their budget to their child-centred vision.

Solutions

A national fund. In the Netherlands, years of experience have been gained with the development of nature-based schoolyards. Lessons learned are that schools often lack time, money and also knowledge and skills. Schools and governments ask for support and guidance in the development of these schoolyards but also the cultural change within a school. That is why a national fund is currently being developed that helps schools and governments with process guidance, the quality standard and financing to achieve successful transformations.

European Collaboration

We also see many similar developments internationally. Every success is based on a vision. This vision focuses on the healthy development of children, on outdoor education, the well-being in a neighbourhood, on climate and on biodiversity. More and more exchange is taking place in Europe. For example, within the research programme Coolschools. See this link: https://coolschools.eu/

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Nature-Based Education Networks: Collaborative Transformation of the Territory in Colombia: A Comprehensive Examination of the Implementation of Nature-Based Education and Regenerative Leadership in Colombian Schools

Luis Camargo(1)

Abstract

The study explores the transformative impact of Nature-Based Education (NbE) within the Nature Education Networks in Colombia, training over 1,540 teachers and 46,200 students across 250 schools. The study shows how NbE fosters socio-environmental change, biodiversity conservation, and poverty reduction by integrating regenerative leadership and systems thinking. Utilizing tools like living maps, adaptive learning environments, and leadership training, NbE activates community empowerment and enhanced collaboration, leading to sustainable, regenerative communities.

Introduction

The Organization for Environmental Education and Protection, OpEPA, has led pioneering outdoor and nature education work for over 25 years in Latin America. From this work, a relational approach to Nature-Based Education (NbE) has emerged as a powerful approach to education, placing nature at the heart of learning and leveraging natural environments as both a teacher and a classroom[1]. Nature-based Education is an ecosystem of blended educational strategies acting as an enabler that transforms educational practices; it is a holistic approach that integrates the living systems framework into all forms of education to inspire and re-establish a deep connection between humans and the rest of nature[2].

This approach fosters a deep connection between students and the environment, nurturing a sense of responsibility and stewardship towards the Earth[3]. In Colombia, the Organization for Environmental Education and Protection (OpEPA) has pioneered the implementation of NbE through the Nature-Based Education Networks initiative. This program has been recognized for its innovative approach to education, earning the 2023 WISE Award for Innovation in Education.

This study examines the Nature Education Networks initiative, focusing on how Nature-Based Education (NbE), combined with regenerative leadership and systems thinking, can drive transformative change within communities. The study area includes 14 cities in Colombia (Figure 1): Bogotá, Barranquilla, Armenia, Barrancabermeja, Bucaramanga, Leticia, Manizales, Medellín, Montería, Pasto, Quibdó, Villavicencio, Yopal, and San Andrés.

Nature-Based Education and Regenerative Leadership NbE extends beyond traditional environmental education by incorporating

Keywords: Nature-Based Education, Regenerative Leadership, Collaborative Network, Territorial Appropriation

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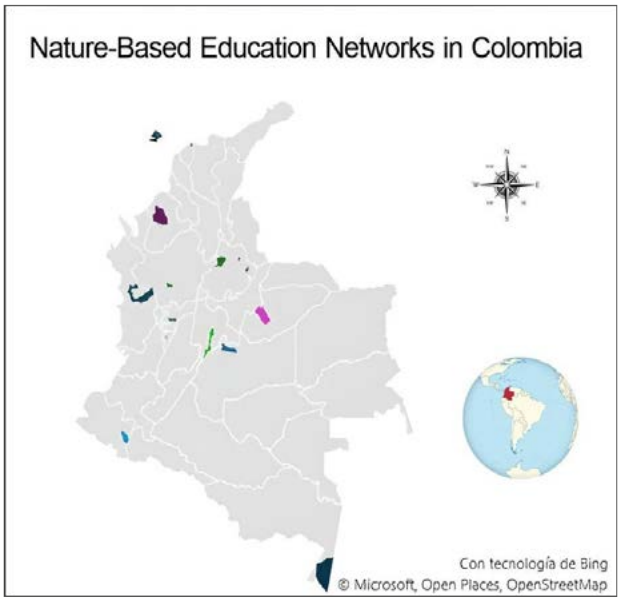

Figure 1: Nature-Based Education Networks in Colombia. Created by Laura Sandoval, Project Leader NBE Networks, 2024

experiential learning and outdoor education methodologies. It emphasizes the inter-connectedness between self, community, and nature, fostering capacities such as knowing how to be, do, learn, and coexist[4] (Figure 2). These capacities culminate in activating individual and collective "regenerativeness" and enable a holistic regenerative approach, essential for addressing the complex socio-environmental challenges of our time[5]. Since 2016, the initiative has trained 1,540 teachers and 46,200 students across more than 250 schools, demonstrating its extensive reach and impact.

This relational approach to NbE helps bridge different areas of experience and knowledge into an integral living system-centered approach to learning that acknowledges the importance of inter-relations and inter-connections, exchanges, and entanglements. Fast-changing complex

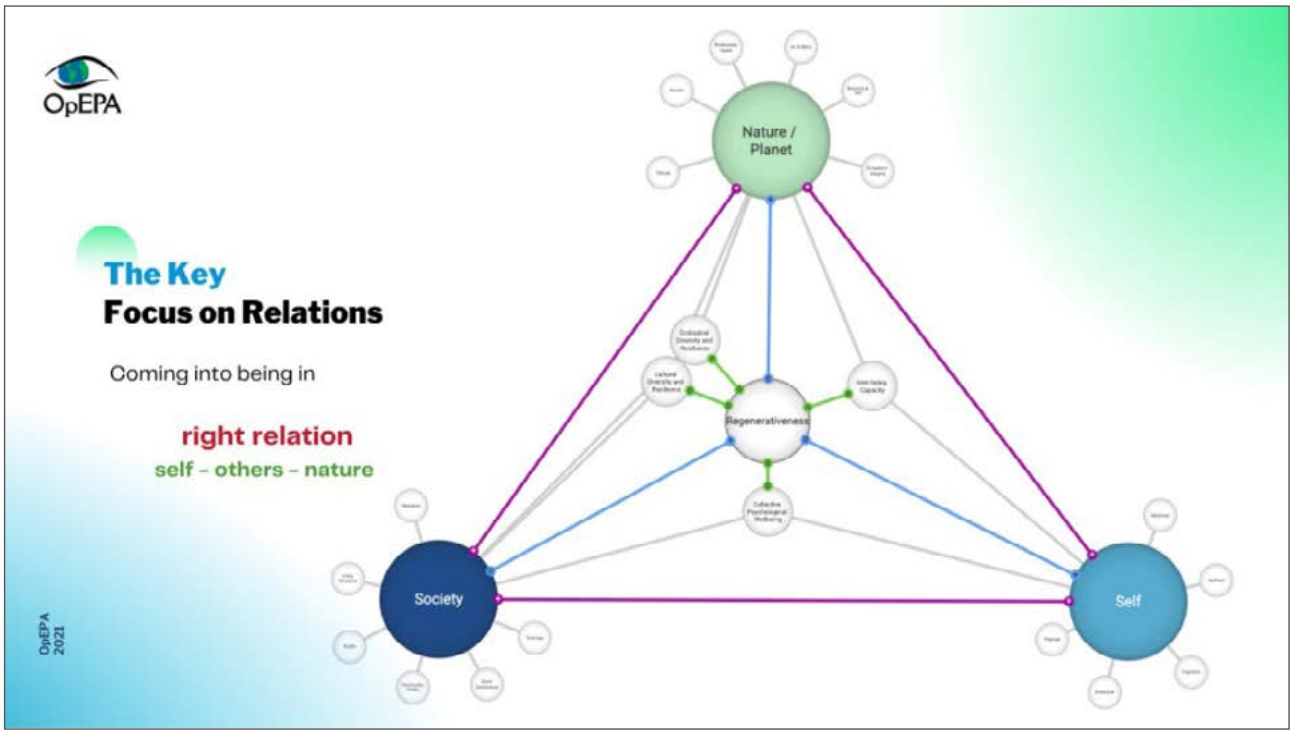

Figure 2

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Figure 3: Community leaders in action: Women explore the connection between their personal purpose and regenerative educational projects. Environmental Classroom, Ciénaga de Mallorquín-Colombia. Photograph by Sergio Borrero, 2024.

systems and conditions such as the ones we are currently facing at local and planetary scales require education to embrace living system dynamics, emergence, and radical creativity that can see overarching patterns and create solutions that bring vitality back to our planet. OpEPA's approach to NbE incorporates four key components: connecting deeply, awakening the naturalist spirit (learning to sense the visible and invisible), acting for regeneration, and nourishing all our relations[6].

Regenerative and nature-based leadership[7] are critical components of NbE, promoting a holistic and systemic view of the world and activating agency. This leadership model encourages individuals to see themselves as part of a more extensive system where their actions directly impact the environment and community[8]. By embracing regenerative leadership, educators and students alike are empowered to take collective action toward creating a sustainable future.

Through regenerative leadership, teachers and students have been empowered by the principles of life applied to social systems. Katherine Parrado from IED San Vicente de Paul reflects: "The network has helped me to have more confidence in myself and as a teacher. It has opened up a space for me to realize that I am indeed a leader. I am a leader among my students and among my fellow teachers. I have learned to have a bit more confidence in my voice" (April 28, 2024).

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Figure 4: Finding Identity: Students from different institutions meet to find identity and collective work, relating different symbols of nature. El Tambo - Colombia.
Photograph by Sergio Borrero, 2024.

Collaborative Networks and Territorial Appropriation

Collaborative networks are vital for the successful implementation of NbE. These networks bring together educators, students, and community members to share knowledge, resources, and experiences[9]. Through collaboration, participants can develop a deeper understanding of their local environment and work together to protect and conserve it[10].

Territorial appropriation refers to the process of recognizing and embracing one's connection to a specific place. In the context of NbE, territorial appropriation involves understanding a territory's ecological, cultural, and historical significance and taking responsibility for its preservation. This concept is central to the Nature-Based Education Networks initiative, as it encourages students and educators to develop a strong sense of place and work towards the regeneration of their local environments[11].

Methodology

This study employed a qualitative research approach, drawing on data collected through interviews, observations, and workshops. The research focused on the Nature Education Networks initiative in Colombia, specifically examining the experiences and perspectives of educators, students, and community members involved in the program findings.

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Collaborative Networks and Territorial Appropriation

The Nature Education Networks initiative has successfully fostered collaborative networks by bringing together educators, students, and community members to work on environmental conservation and sustainable development projects. These networks have facilitated knowledge sharing, resource mobilization, and the development of shared goals and strategies.

The strategic plans of the networks are evidence of this collective construction. For example, the Strategic Plan of the Cerros de Bogotá Network, developed by teachers and allies in a participatory manner, projects the consolidation of a school community with citizenship competencies that promote the harmonization of relations between the population and its environment. This plan reflects a shared environmental awareness that supports biodiversity conservation and well-being, demonstrating a commitment to transforming the ecological perception of the community.

The territorial appropriation is promoted by encouraging participants to develop a deep understanding of their local environment, including its ecological, cultural, and historical significance. This increased sense of place and belonging has been achieved through various activities, such as:

Living Maps: The emotional maps produced in the Living Maps workshop reveal the importance of the physical environment and its impact on participants' emotional experiences. Spaces like streets, parks, and homes are perceived ambivalently, generating positive and negative emotions. This underlines the need for learning environments to adapt and integrate nature in ways that promote positive emotions and experiences.

Adapting Learning Environments: In a complementary way, the results on adapting learning environments emphasize the importance of the 'naturalization' of school spaces, with the incorporation of natural elements such as trees, green areas, and spaces for interaction with the environment. This holistic and multidimensional vision seeks to go beyond mere 'decoration' to achieve a deep integration of nature into learning experiences.

Figure 5: Reconnect - Recognize: Promoting the articulation of educational proposals and encouraging collaborative work, strengthening environmental governance. Bogotá -Colombia. Photograph by Leonardo Centeno, 2023.

Regenerative Leadership Training: In the training, participants recognized the importance of regenerative leadership and the role of educators in finding community solutions and working towards network objectives. They understood that with emergent leadership, conditions can be created for life to thrive. They valued the diversity of leadership styles beyond single approaches. They looked at emergent leadership from a systemic and collaborative perspective based on self-organization and role fulfillment for collective purposes.

Outcomes and Impact

The implementation of NbE through the Nature Education Networks initiative has led to significant outcomes in terms of both educational and environmental impact. Teachers have reported an increased understanding of regenerative leadership and its application to territorial appropriation. Six months after the training, 79% of participants reported that they had strengthened their competencies in regenerative leadership, as evidenced by pre- and post-training evaluations.

Students have developed a stronger connection to their local environment, which has led to greater involvement in conservation efforts. 80% of the students demonstrated improved skills to apply the principles of living in nature in biodiversity conservation actions, including participating in collaborative school projects and discussions focused on biodiversity conservation.

The initiative has also contributed to poverty reduction by empowering communities to take ownership of their local resources and work towards sustainable development[12]. By fostering a sense of responsibility and stewardship, NbE has the potential to drive long-term socio-environmental change[13]. The poverty reduction component has worked by involving diverse stakeholders, including women and youth, in decision-making processes related to biodiversity conservation and sustainable development, addressing social inequalities, and empowering communities. In addition, in the case of Barranquilla, green business ideas such as ecotourism, waste management, and green schools have been promoted to improve the quality of communities.

Discussion

This study's findings highlight NbE's transformative potential in fostering collaborative networks and territorial appropriation. The Nature-Based Education Networks initiative in Colombia demonstrates how NbE, when combined with regenerative leadership and systems thinking, can drive positive change within communities.

The initiative's success can be attributed to its focus on empowering communities, promoting collaboration, and integrating local knowledge and perspectives. By providing educators with the skills and knowledge needed to lead others in creating sustainable and regenerative communities, the initiative has fostered a sense of shared responsibility and ownership among participants.

Conclusion

The Nature Education Networks initiative in Colombia provides a compelling example of how NbE can be used to foster collaborative networks, promote territorial appropriation, and drive transformative change within communities. Bringing nature to the center of learning experiences and allowing nature to become a teacher and source of inspiration, the initiative has enabled whole-person development among teachers, students, and the broader community. Integrating NbE with regenerative leadership and systems thinking has empowered communities to take ownership of their local environment, work towards sustainable development, and contribute to the creation of a more just and equitable future.

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Urban Cohousing in Search of (Socio-Eco)-Sustainability: Italian Cases

Fabio Corbisiero[(1)], *Carmine Urciuoli*[(2)]

Abstract

This paper explores cohousing as a sustainable urban housing solution, examining projects in Italy and Germany. Cohousing promotes social interaction, community cohesion, and sustainable living, offering a significant alternative to traditional housing models. By incorporating shared spaces and collective management, cohousing addresses the needs of vulnerable groups such as the elderly, migrants and LGBTQIA+ individuals. Through a comparative analysis of projects in Naples, Rome, and Berlin, the study showcases best practices and challenges, providing policy recommendations for integrating environmental, economic, and social sustainability into cohousing to enhance urban resilience and inclusivity.

Introduction

The pursuit of sustainable urban development has increasingly turned towards innovative housing solutions tailored for vulnerable communities, including the elderly, migrants, disabled individuals, and sexual minorities. Cohousing emerges as a significant response, fostering social interaction, community cohesion, and sustainable lifestyles, which are often overlooked by traditional housing models. This approach not only provides shelter but also promotes inclusivity and resilience within urban settings (Boniatti & Bramerini, 2014).

Cohousing appeals to environmentally and socially conscious citizens seeking alternative, low-impact housing options. This model is examined within the "ecological modernization" framework, which integrates scientific and technological advancements to address sustainability challenges, promoting concepts like "green growth". By facilitating shared spaces and collective management, cohousing reduces social isolation and increases resource efficiency, crucial for building sustainable communities.

This paper explores cohousing as a sustainable urban housing solution, with a focus on models in Italy and Germany. It assesses cohousing projects in Naples and Rome, highlighting their design, community dynamics, and efforts to meet the needs of vulnerable groups, alongside a comparative analysis of a longstanding project in Berlin. This study not only showcases best practices but also identifies challenges and provides policy recommendations to enhance the viability of cohousing for sustainable urban living. The analysis demonstrates how integrating environmental, economic, and social sustainability in cohousing can significantly enrich urban communities, making them more vibrant, resilient, and inclusive.

This document begins by detailing the origins and evolution of cohousing to its adaptation in contemporary urban settings, then discusses the methodologies employed in studying cohousing communities. A combination of qualitative methods such as participant observation, semi-structured interviews, and visual data analysis are used to provide a deep understanding of the internal dynamics within these communities. The core of our reflections presents a comparative analysis of cohousing models from Berlin, Rome, and Naples, examining how each addresses the needs of its residents while contributing to sustainability and social cohesion. This analysis highlights differences in design principles, community dynamics, and sustainability practices. Conclusions reflect on the potential for cohousing to become a normalized component of urban planning, emphasizing the need for such models to expand beyond niche implementations. It suggests strategies for promoting and integrating cohousing into mainstream housing policies and urban development plans.

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1. Integrating Sustainability in Urban Cohousing

Sustainable development, a crucial paradigm for modern society, tackles the challenges of urbanization, environmental degradation, and social inequality through three interdependent pillars: environmental, economic, and socio-cultural sustainability. The concept of sustainability is understood to be a key determinant of citizenship rights, included health and well-being, and is strongly influenced by the degree to which individuals and groups can equitably access resources and public services such as healthcare, education and criminal justice systems (United Nations. 2016). Social exclusion involves processes driven by unequal power relationships that result in a lack or denial of resources and rights and the inability of some social groups to participate on equal terms in economic, social, cultural or political arenas

This paradigm supports the creation of resilient and inclusive urban environments, crucial for cohousing initiatives aimed at vulnerable groups such as the elderly, LGBTQIA+ individuals, and migrants.

Environmental Sustainability focuses on the responsible use and conservation of natural resources to ensure their availability for future generations. It includes practices like green building, energy efficiency, and sustainable waste management. Initiatives such as integrating renewable energy sources, employing rainwater harvesting, and promoting urban agriculture are vital

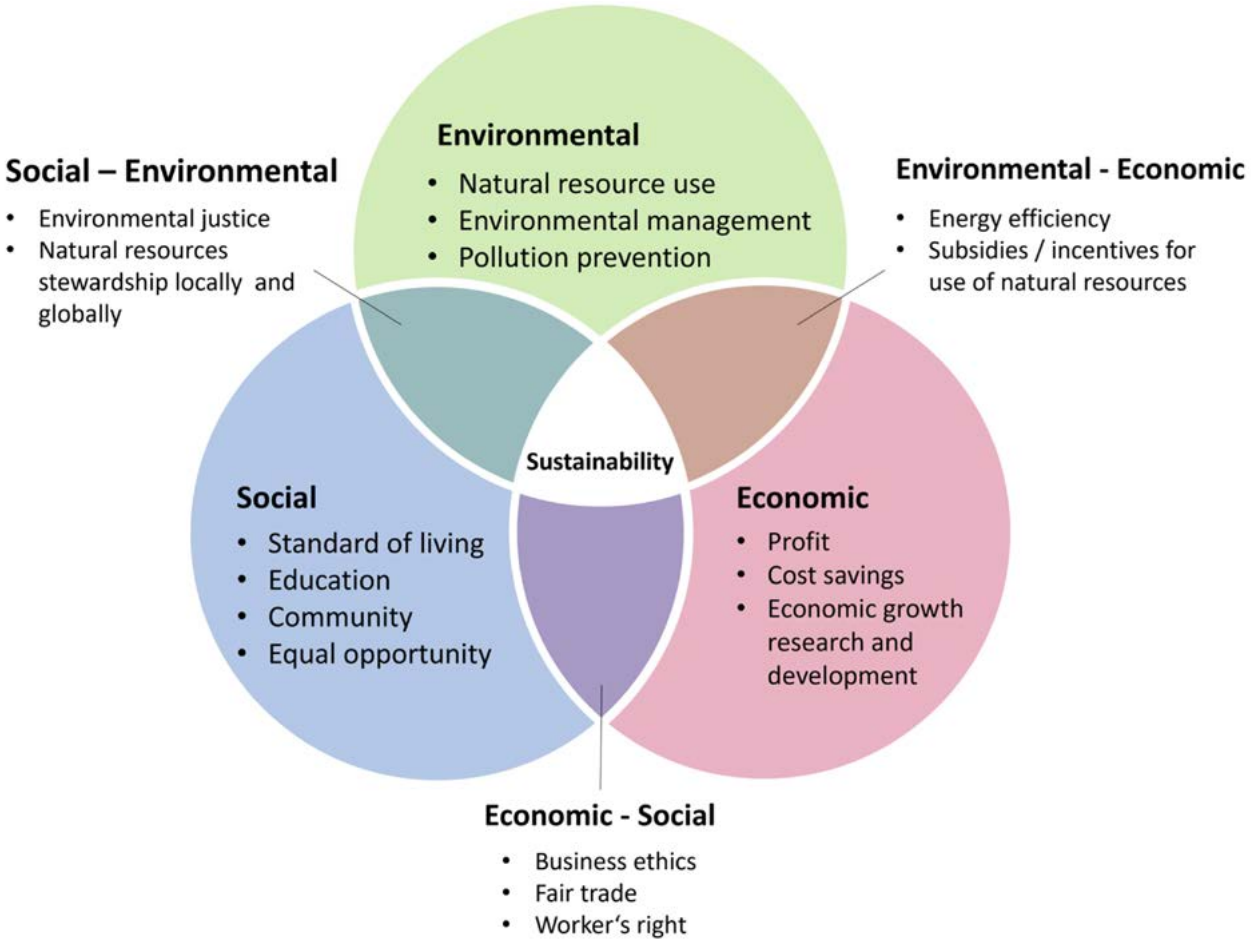

Figure 1: The diagram represents the interconnected pillars of sustainability: social, environmental, and economic. Each section highlights focuses such as living standards, resource management, and profitability, respectively. The overlaps show critical intersections like global stewardship, energy efficiency, and ethical business practices, illustrating a comprehensive framework for sustainable development. Source: siq.si.

in reducing environmental impacts and enhancing residents' quality of life. Economic Sustainability aims to build robust and inclusive economic systems that ensure long-term prosperity without resource depletion. In cohousing, this is achieved through affordable housing, shared resources, and community-based economic activities. Sharing economies within cohousing reduce individual financial burdens and foster community and mutual support, contributing to local economies and enhancing economic resilience. Socio-Cultural Sustainability underscores the importance of social equity, cultural diversity, and community cohesion. It advocates for the inclusion of marginalized groups and the creation of supportive environments that promote diverse cultural expressions and social interactions. Cohousing addresses the specific needs of vulnerable populations by designing communal spaces that encourage interaction and participation, fostering a sense of belonging and community resilience. The integration of the sustainability pillars is fundamental to developing adaptive and resilient urban cohousing communities. These principles align with the UN's 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs), particularly Goal 11, which emphasizes sustainable cities and communities (UN, 2015). By applying these sustainability principles, cohousing initiatives not only support vulnerable populations but also contribute to the broader objectives of sustainable urban development. The forthcoming analysis will explore how these principles are implemented in Italian cohousing projects, enhancing local policies and promoting eco-sustainability.

Italian cities have been proactive in integrating sustainability recommendations from various institutions, reflecting a strong commitment to the principles of the UN's 2030 Agenda. Cities such as Milan, Bologna, and Turin have launched innovative urban development projects that emphasize sustainable living, social inclusion, and economic resilience.

Milan, for instance, has implemented the "Sharing Cities" project, which focuses on reducing carbon emissions through smart technologies, enhancing energy efficiency in buildings, and promoting shared mobility solutions (European Commission, 2020). Bologna has established a network of urban gardens that not only improve green spaces but also foster community engagement and social cohesion (Urban Europe, 2019). Turin, on the other hand, has been a pioneer in integrating circular economy principles into its urban planning, promoting the reuse and recycling of materials to minimize waste and reduce environmental impact (EEA, 2019). These initiatives demonstrate how Italian cities are embracing sustainability, leveraging local strengths, and fostering innovative solutions to create more resilient and inclusive urban environments.

Sustainability extends beyond environmental, economic, and sociocultural domains, encompassing principles of diversity and inclusion, which are fundamental for harmonious and enduring development. Diversity can be defined as the range of variations found within a given characteristic or set of characteristics among individuals in a population. This concept encompasses differences in race, ethnicity, gender, age, physical abilities, sexual orientation, educational background, socioeconomic status, and more. Philosophically, diversity is often linked to notions of pluralism and multiculturalism, emphasizing the value of different perspectives and experiences in enriching collective understanding and fostering social cohesion. Scientifically, diversity is seen as crucial for the resilience and adaptability of systems, whether they are biological ecosystems or social organizations.

1.1 Urban Cohousing: A Sustainable Housing Model

Urban cohousing represents a paradigm shift in contemporary housing strategies. Originating in Denmark in the late 20th century, cohousing involves collaborative living arrangements where private dwellings are supplemented by extensive shared spaces. These communities are designed to promote social interaction, mutual support, and collective management of resources, thus creating a resilient social fabric capable of addressing the unique needs of vulnerable groups (McCamant & Durrett, 2011). Cohousing models offer an effective solution to the increasing urban challenges associated with housing shortages, social fragmentation, and

environmental degradation. The collaborative nature of cohousing enhances social cohesion by fostering strong interpersonal relationships among residents. This social connectivity is particularly beneficial for vulnerable groups such as the elderly, LGBTQIA+ individuals, and migrants, who may otherwise experience isolation and marginalization (Droste, 2015). The environmental sustainability of cohousing communities is achieved through shared resources and facilities, which reduce individual consumption and promote efficient use of space and materials. Cohousing developments typically incorporate eco-friendly building practices, such as energy-efficient designs, renewable energy systems, and sustainable waste management. For instance, the cohousing project in Naples integrates green building technologies and renewable energy sources to minimize its carbon footprint and promote environmental stewardship. Moreover, economic sustainability is a core component of cohousing, as shared amenities and collective purchasing power can lower living costs for residents. This model not only makes housing more affordable but also encourages economic resilience by fostering a culture of sharing and cooperation.

Table 1 - The most common forms of cohabitation and solidarity housing

N	Category	Description
1	Intentional Cohousing	A community created with deliberate effort, with residents actively involved in planning and decision-making processes, strengthening community identity and cooperation.
2	Urban vs. Extraurban Cohousing	Urban: Integrated into city fabric, an alternative to conventional housing in dense areas. Extraurban: Located in suburban or rural settings, emphasizing sustainability and connection with nature.
3	Intergenerational Cohabitation	Young individuals and older adults live together, facilitating mutual support and intergenerational solidarity, reducing social isolation.
4	Spontaneous Cohabitation	Arises organically due to immediate needs or circumstances, lacking the structured planning of intentional cohousing but still capable of fostering strong community bonds.
5	Temporary Cohousing	A short-term housing solution for emergencies or transitional periods, offering a flexible and supportive environment.
6	From Social Housing to Cohousing	Transforming traditional social housing into cohousing spaces to enhance community interaction and shared living, boosting social cohesion and collective resilience.
7	Supportive Cohabitation	Provides mutual support, catering to vulnerable populations such as the elderly, LGBTQIA+ individuals, or migrants, emphasizing a safe and inclusive environment that meets specific support needs.
8	Solidarity Condominiums	Designed to promote solidarity and mutual aid among residents, with management focused on strengthening community ties and collective support.
9	Refugees and Shelter Cohousing	Addresses the immediate housing needs of refugees and displaced individuals, integrating them into cohousing arrangements to provide stability, community support, and a pathway to social integration.

The Berlin cohousing community, for example, has demonstrated how collective management and resource pooling can lead to significant cost savings and enhanced economic stability for its residents (Nandy, 2023). As we argued, cohousing also plays a critical role in promoting citizenships rights as health, well-being and quality of life.

In addition to these benefits, there are established models of cohousing based on housing typologies commonly adopted in countries where this practice has been prevalent for a considerable time. Specifically, the Danish and Swedish models provide distinct approaches to cohousing design and community layout. The Danish model typically features an extensive plot of land with 12-36 housing units that are one or semi-detached dwellings of 2-3 floors, including a separate Common House. These communities are generally located in urban peripheries and rural areas (see Fig. 1). In contrast, the Swedish model usually consists of a single building of varying size, sometimes divided into several units across multiple floors. This model offers less spacious accommodation than the Danish counterpart and integrates collective functions on the ground and first floors, including a courtyard-garden or roof-terrace, predominantly situated in urban locations (see Fig. 2).

Urban cohousing is a sustainable housing model that addresses the multifaceted challenges of contemporary urban living. By fostering social interaction, promoting environmental sustainability, and enhancing economic resilience, cohousing communities offer a holistic approach to creating inclusive and sustainable urban environments.

As cities continue to evolve, the principles and practices of cohousing provide valuable insights for developing housing solutions that are not only sustainable but also equitable and resilient.

The study of cohousing, particularly in the context of urban sustainability and vulnerable populations, reveals its potential as a flexible and adaptive housing solution. Each form of cohousing offers unique benefits and challenges, reflecting the

Fig. 2 - Danish Model - (ph. Of the Jystrup Savværk co-housing community, from jystrupsavvaerk.dk)

- Extensive plot of land
- 12-36 accommodation units
- One/semi-detached dwellings of 2-3 floors
- Common House autonomous
- Location in urban peripheries and rural areas

Fig. 2 - Danish Model - (ph. Of the Jystrup Savværk co-housing community, from jystrupsavvaerk.dk)

- A single building of varying size, sometimes divided into several buildings, developed on several floors
- Less spacious accommodation than the Danish model
- Collective functions on the ground and first floors
- Courtyard-garden or roof-terrace
- Urban location

diverse needs and aspirations of its residents. As urban policies increasingly focus on sustainability and social inclusion, understanding these varied models becomes crucial for effective implementation.

2. Research Design and Data Collection Techniques

The study of cohousing communities adopted a qualitative research methodology augmented by innovative, non-standard methods to explore the social structures within these environments. This multifaceted approach included participant observation, semi-structured interviews, and photography, supported by a brief questionnaire that captured the socio-economic and cultural characteristics of residents. This methodological blend yielded a detailed framework that facilitated a deep understanding of the internal dynamics of cohousing settings. Our findings can be understood in relation to theories of social exclusion and sustainability, involving processes that generate and maintain social hierarchies in the urban context.

Participant observation proved critical for assessing daily interactions and behavioural patterns within cohousing communities, especially during the pandemic when restrictions limited direct contact, necessitating the reliance on visual data such as photographs and videos. Semi-structured interviews, involving twelve participants including coordinators and designated community spokespeople, enriched the narrative by providing insights into the daily operations, interpersonal relationships, and prevalent challenges within these settings.

Visual documentation was essential for illustrating both the physical layout and the symbolic dimensions of the living spaces. Geographic mapping further aided in situating cohousing structures within their broader urban landscapes, evaluating elements like their central or peripheral locations. Complementary to this, official statistical data provided a quantitative dimension that underpinned the qualitative findings, offering a comprehensive view of the operational contexts.

The analysis extended across various units, including individual residents, the collective group, and the wider community context, focusing on the residents' roles, interactions, and the communal ethos within the cohousing framework. This included an examination of shared resources and communal objectives, which underscored the community's cohesion and identity development. The approach not only illuminated the everyday lives of residents, particularly those from the LGBTQIA+ community but also the structural and communal mechanisms that foster a sense of belonging and identity within urban cohousing environments.

The research considered multiple units of analysis including the individual, the group, the community, the structure, and the broader context in which these communities are situated. Focus areas included the internal composition of the community, the role of the individual within the cohousing setting, and their personal experiences as part of the LGBTQIA+ community. The research also explored what binds the group together, their shared resources (both material and immaterial), and their collective goals, as well as the history of the community, their sense of belonging, and the development of a common identity.

The intermittent and fragmented nature of the fieldwork, necessitated by privacy concerns and the periodic lockdowns during the COVID-19 pandemic, posed significant challenges. These interruptions significantly altered the daily routines of the subjects, particularly the elderly and other vulnerable groups, impacting the dynamics observed. Nonetheless, these circumstances also provided opportunities to establish a deeper personal interaction with community members, enhancing the understanding of their actions and motivations through an empathetic engagement process.

This methodological approach, by combining direct observation and personal interaction with residents, aims to achieve a comprehensive and accurate representation of the social and behavioral dynamics characterizing life in cohousing environments.

3. The Cases

Here is the information on the cohousing case studies laid out in a tabular format with analytical dimensions to facilitate comparison: 1. Location and project name; 2. Cohousing model (temporary/permanent); 3. Managing bodies and partners; 4. Year of foundation and project status; 5. Social focus (LGBTQIA+, seniors, etc.); 6. Capacity and expansion; 7. Initiatives and activities; 8. Environmental and civil sustainability; 9. Social and cultural impact; 10. Key differences with other models.

Table 2 - Comparative table of the case studies composed with analytical dimensions

Category	The Case Studies		
Location and project name	Lebensort Vielfalt am Südkreuz (Berlin, Germany)	Rainbow Center Naples (Italy)	Agapanto, Rome (Italy)
Cohousing model	Permanent	Temporary	Permanent
Managing organization and partners	Schwulenberatung Berlin	i Ken APS Onlus, C.O.R.A. ONLUS	Agapanto Association
Year of establishment and current status	Established over a decade ago, operational	Founded five years ago, expanding	Founded in 2017, project imminent
Target social group	Elderly LGBTQIA+ individuals	Young homosexual and transgender victims of violence	Elderly LGBTQ+ individuals
Capacity and facilities	40 housing units, communal spaces like a library and terraces, restaurant	Expanded capacity, emergency shelter facilities	Not specified, but aimed at stable and permanent residency
Key initiatives and activities	Long-term residential model with variable fee structure	Temporary shelter, cultural meetings, events	Active community, advocacy, education
Focus on environmental and social sustainability	Eco-sustainability projects, social integration	Reuse of assets confiscated from organized crime, eco-friendly practices	Commitment to environmental sustainability and civil rights
Impact on social and cultural integration	Stable environment for inhabitants, community integration	Social and cultural inclusion, urban integration	Visible and supportive community, policy influence
Key differences with other models	Long-term residency model	Temporary model focused on rapid integration	Permanent model focused on long-term stability

Lebensort Vielfalt am Südkreuz, Berlin - Lebensort Vielfalt am Südkreuz in Berlin exemplifies a model of urban cohousing that addresses the specific needs of elderly LGBTQIA+ individuals. Managed by Schwulenberatung Berlin, a key player in the support framework for LGBTQIA+ rights in Germany, this project underscores the importance of long-term stability for its residents. Established over a decade ago, it has consistently expanded its reach and depth of services. The cohousing model at Lebensort Vielfalt am Südkreuz is notable for its eco-sustainability focus, which integrates green technologies and sustainable practices to minimize environmental impact while enhancing the quality of life for its residents. The facility includes 40 individual housing units, extensive communal spaces such as a library, terraces, and a restaurant, which facilitate not only personal independence but also a thriving community life. This approach sets a high standard for other projects globally, showcasing how integrated, sustainable living arrangements can provide significant social benefits while also promoting environmental responsibility.

Rainbow Center Naples - The Rainbow Center Naples is situated in a building in Naples that was confiscated from organized crime, transforming a symbol of illegality into a beacon of hope and safety. This center operates under the management of local NGOs, i Ken APS Onlus and C.O.R.A. ONLUS, and serves as a temporary shelter for young homosexual and transgender individuals who have experienced violence. The project is part of a broader initiative supported by the Presidency of the Council of Ministers—UNAR Office, which aims to provide emergency responses and facilitate rapid integration into the community for those at risk. By hosting cultural events, meetings, and social gatherings, the Rainbow Center not only provides immediate safety but also promotes social inclusion and cultural integration. The project's innovative use of a confiscated space not only challenges the legacies of its past but also serves as a powerful example of community resistance and transformation. Five years into its operation, the center has plans to double its accommodation capacity, highlighting its growing role in the Southern Italy region as a crucial support structure for the LGBTQ+ community.

Agapanto Rome - In Rome, the Agapanto project is paving the way for a new kind of cohousing tailored specifically for elderly LGBTQ+ individuals. Inspired by successful models in Berlin and beyond, Agapanto was founded in 2017 by a group of activists from the 1970s civil and environmental rights movements. This background infuses the project with a deep commitment to social and environmental principles. The cohousing initiative is designed to be more than just a living space; it aims to be a vibrant community that sustains its members socially, culturally, and environmentally. Agapanto places a strong emphasis on creating a supportive environment where residents can share their experiences and continue their activism within a collective setting. The project's focus on stability and permanence seeks to provide a dignified, secure home for its members, contrasting sharply with temporary models and highlighting the unique needs of its demographic. By fostering a cohesive community that actively engages with broader societal and environmental issues, Agapanto exemplifies how specialized cohousing can enhance the lives of its residents and impact the surrounding urban landscape positively.

Each of these case studies reflects a thoughtful integration of social support systems, environmental sustainability, and community engagement, tailored to the unique needs of their respective populations. These projects not only provide critical housing solutions but also enrich the social fabric of their cities, demonstrating the profound impact of cohousing on community development and individual well-being.

4. Discussion

The socio-environmental impact of cohousing, as evidenced through three distinct case studies, underscores the substantial potential of cohousing to seed broader urban sustainability and neighbourhood cohesion. This housing model can indeed serve as a source of innovative and sometimes experimental practices that positively influence the entire cityscape by introducing new modes of interaction with the environment and facilitating the implementation of urban-level policies. Beginning with the Berlin case study,

Lebensort Vielfalt am Südkreuz, it becomes evident how the design of cohousing inherently integrates sustainability dimensions into both the architectural and community practices. Managed by Schwulenberatung Berlin, this project serves elderly LGBTQIA+ individuals with a focus on long-term stability and eco-sustainability. The integration of green technologies and sustainable practices at Lebensort Vielfalt significantly minimizes environmental impacts and enhances the residents' quality of life, thus setting a high benchmark for cohousing globally.

In Italy, the Agapanto Rome project illustrates how cohousing can act as a catalyst for positive environmental influence within its locality. Founded on the ideals of 1970s civil and environmental activism, Agapanto is not merely a residence but a dynamic community that supports its elderly LGBTQ+ residents in a permanent, secure environment. This project leverages its foundational principles to extend its socio-environmental impact beyond its immediate boundaries, envisaging the structure itself as a future source of positive contagion to the surrounding areas.

Meanwhile, the Rainbow Center in Naples offers an example of how cohousing can amplify urban ethical practices, particularly in peripheral urban areas where such practices might otherwise dissipate. Located in a building reclaimed from organized crime, the center has become a hub for cultural and social integration for young LGBTQ+ individuals at risk. This innovative use of space not only challenges its past associations but also fosters community resilience and environmental awareness through its ongoing activities and planned expansion. Together, these cases from Berlin, Rome, and Naples demonstrate how cohousing can significantly contribute to the sustainable development of urban areas. Cohousing communities not only facilitate the reduction of environmental footprints through shared resources and collective living arrangements but also foster a strong sense of community and social support. This model of housing, therefore, provides a robust framework for addressing contemporary urban challenges by enhancing social cohesion, promoting environmental sustainability, and embedding economic resilience within the fabric of urban life. As cities continue to grow and evolve, the principles and practices exemplified by these cohousing projects offer valuable insights into creating more sustainable, inclusive, and resilient urban environments. The case studies highlight the importance of integrating community needs with environmental stewardship to foster urban developments that are not only viable in the present but sustainable for future generations.

5. Conclusions

The findings of this scholarly examination on cohousing as a mechanism for environmental sustainability prompt a crucial reflection on the future of urban development. The evidence from the Italian cases clearly illustrates that cohousing is not merely an alternative living arrangement but a profound strategy towards achieving sustainable urban environments. To mitigate the challenges posed by conventional housing models, which often prioritize private ownership and isolated living spaces, there is a pressing need to incorporate cohousing more deeply and broadly into urban planning.

Our evidence shows cohousing provides a range of urban challenges, including social isolation, inefficient use of resources, and significant environmental degradation. In contrast, cohousing offers a paradigm shift, fostering communities that are both socially inclusive and environmentally responsible.

The case studies presented argue convincingly for the integration of cohousing into mainstream urban planning. For instance, Lebensort Vielfalt am Südkreuz in Berlin demonstrates how cohousing can cater to the specific needs of vulnerable populations while adhering to principles of environmental sustainability, such as energy efficiency and reduced resource consumption. Similarly, the Agapanto project in Rome showcases how such initiatives can not only provide stable and supportive living conditions for elderly LGBTQ+ individuals but also actively contribute to the social and environmental vitality of their neighbourhoods.

Furthermore, Rainbow Center case highlights the potential for cohousing to regenerate and revitalize urban areas that are often overlooked or underserved. This initiative underscores the role of cohousing in challenging outdated urban practices tied to private ownership and segregation, promoting instead a model that is inclusive and integrative.

Given these benefits, it is imperative that cohousing be normalized and extended within urban design, especially in contexts where outdated housing practices prevail. This requires a concerted effort from urban planners, policymakers, and socialization agencies to advocate for and implement cohousing models. Promoting these sustainable living arrangements should be prioritized not only as isolated experiments but as fundamental components of urban development strategies.

To effectively mainstream cohousing, it is crucial that educational and policy-making frameworks incorporate and promote these models. Socialization agencies, educational institutions, and media must play a pivotal role in disseminating the values and benefits of cohousing, integrating it with urban sustainability practices that are becoming increasingly essential in the face of global environmental challenges.

In conclusion, as urban populations continue to grow, and as the pressures on environmental and social infrastructures mount, the implementation of cohousing should be seen not as a novelty but as a necessity.

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Innovation Communities: A Tool for Innovation and Sustainable Development in the New Post-Columbian Normality

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Abstract

Finding new ways to generate impact in companies and promote innovation is increasingly important. In Bogotá, Colombia, a work process is being carried out in which innovation communities of students, companies, and teachers are formed. These communities have implemented incremental innovations that have provided solutions to the needs of organizations, thus contributing to the fulfillment of SDGs 8, 9, and 11.

Introduction

The productive sector requires more excellent added value, while the educational sector needs to generate new knowledge that can be applied (Nam *et al.*, 2019). Enhancing added value or advancing the sophistication of the productive sector demands applying specialized, relevant knowledge, which necessitates a new perspective on educational processes driven by what is now known as the knowledge society.

In this context, the topic of university-industry cooperation is widely explored in the literature (Cai & Etzkowitz, 2020; Sjöö & Hellström, 2019; Fischer *et al.*, 2019; de Wit-de Vries *et al.*, 2019; Rybnicek & Königsgruber, 2019; Ankrah & AL-Tabbaa, 2015). However, the literature reveals gaps in understanding, particularly concerning the importance of deepening our comprehension of the relational processes involved in the production and transformation of knowledge into innovation as a result of the articulation of various actors (Ranga & Etzkowitz, 2013; Etzkowitz & Leydesdorff, 1995; Chesbrough, 2003; Lave & Wenger, 1991; Wenger *et al.*, 2002).

Consequently, understanding knowledge flows, mechanisms, and strategies in the collaborative work between universities and industry through the creation of knowledge networks has become increasingly relevant. Among the many formal and informal mechanisms of university-industry relationships, this study focuses on analyzing the factors that condition academia-industry collaboration through a specific relational mechanism: university-industry innovation communities (OICs).

Thus, OICs should be understood as spaces that facilitate the exchange and capitalization of tacit and explicit knowledge, promote collective learning, enable problem-solving, and create valuable opportunities for innovation. This study presents an empirical case of the development of university-industry innovation communities that contribute to achieving the SDGs by generating innovative solutions that positively impact the productive sector. The experience has been on going in Bogotá, Colombia, since 2020.

Literature Review

1.1. University-Industry Collaboration

The relationship between academia and industry has evolved in response to changes in production systems, where knowledge has become a fundamental pillar for productivity. In this context, companies have had to reorient their focus toward creating alliances with the academic sector (Sam & van der Sijde, 2014). According to Fe (2009), the interest in the relationship between universities and industry has shifted from focusing on R&D in the post-war decades to a contemporary emphasis on innovation as a driver of wealth generation in the 21st century. This surge in innovation has opened new opportunities for higher education institutions to establish networks of cooperation with the private sector, which seeks research for product development and training a more skilled workforce.

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Various theoretical approaches have attempted to explain these interactions, highlighting the triple helix model (Etzkowitz & Leydesdorff, 1995), the mode 2 knowledge production (Gibbons, 1994), and open innovation (Chesbrough, 2003). All these approaches agree on the importance of collaboration among different actors to foster innovation, emphasizing boundary expansion, interactive learning, and the evolutionary nature of innovation (Cai & Etzkowitz, 2020). Chesbrough (2003) introduces the concept of open innovation, a mechanism that enables intensive collaboration using internal and external knowledge to develop R&D strategies.

Innovation Communities

A particular focus in the university-industry relationship is the Innovation Communities (IOC). These communities are defined as spaces where the exchange and capitalization of tacit and explicit knowledge are facilitated, promoting collective learning, problem-solving, and the generation of valuable opportunities for innovation (Wenger & Wenger-Trayner, 2015).

Innovation communities are grounded in the social learning theory proposed by Wenger (2001), where learning is understood as a social participation process that contributes to the construction of identities through shared practice. The critical components of this theory include community (learning through affiliation), practice (learning through action), identity (learning as becoming), and meaning (learning as experience).

Innovation, learning, and the creation and application of scientific and technological knowledge in the productive sector are fundamental to the economic performance of companies and countries (Science, Technology, and Innovation Policy 2015–2025).

Gibbons (1994) emphasizes applying knowledge in practical contexts, a key characteristic of mode 2 research. Implementing knowledge management strategies through communities of practice in the university-industry relationship can lead to innovations that add value to companies and universities.

Proposed Conceptual Model for Communities

Thus, the constructed model meets the following conditions (Vélez, 2019):

- Research CoPs formed as communities of practice.
- Capitalizing on the classroom-industry relationship.
- Promoting industrial improvements in defined areas.
- Following the logic of action research cycles (IAP).
- Using ICT as a mediator.

The model emerges from analyzing various knowledge management models (Anderson, 1983, 1989, 1992; Nonaka & Takeuchi, 1995, 1999; Gairín & Rodríguez Gómez, 2012; Firestone & McElroy, 2003; Petrides & Nodine, 2003; and Senge's model) and from analyzing different models of communities of practice, particularly those proposed by Wenger (1991), which understand communities as spaces where dialogue mediates learning. Additionally, the propositions by Senge & Kim (2013) emphasize the integration of theoretical knowledge with practical knowledge, Brown & Duguid (1991) explore the communities of practice and innovation processes, and Gairín (2015) addresses organizational change.

Results

University-Industry Innovation Communities: A Collaboration Model for Innovation

The primary objective of university-industry innovation communities is to develop innovation projects that generate value for organizations by conducting in-depth research on their organizational needs. These communities facilitate collaboration among students, companies, and researchers, making scientific research a fundamental pillar for finding novel and practical solutions that address the challenges faced by the business sector.

This initiative significantly contributes to the achievement of several Sustainable Development Goals (SDGs), with a particular emphasis on SDGs 8

(Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), and 12 (Responsible Consumption and Production). Specifically, targets 9.5 and 9. A of SDG 9 is addressed as follows:

1. **Promotion of Innovation:** Innovation communities create an environment that actively encourages company participation, bridging gaps with academia. Students engage in research and development activities, generating new ideas through an in-depth analysis of organizational needs. The solutions are validated and prototyped, effectively addressing these challenges.
2. **Increase in the Number of People in R&D:** Student participation in innovation projects, alongside researchers and companies, fosters the development of strategic skills and competencies. This process contributes to an increase in the number of people interested and active in research and development, which is essential for the transformation of organizations.
3. **Boosting R&D Expenditure:** Collaboration between academia and industry to develop and implement innovative prototypes promotes investment in R&D. Companies view these communities as a solution to their strategic challenges, reducing costs, risks, and uncertainties. By leveraging academic research, organizations enhance their technological capabilities and maintain their competitiveness in the market.

The university-industry innovation communities model, implemented through the Business Research and Innovation Laboratory at CESA, aims to foster the development of innovative projects in collaboration between students, researchers, and companies. This approach allows students to apply the knowledge acquired during their studies while providing validated solutions at the business level.

The process within these communities lasts between 8 months and a year and a half, depending on the academic level of the participating students, and is structured into three fundamental stages:

1. **Research:** The company's needs, challenges, and relevant indicators are identified through academic and contextual research utilizing primary and secondary sources. This in-depth analysis allows for developing innovation opportunities aligned with the organization's needs.
2. **Solution Development:** In this stage, innovative prototypes are developed and tested to address the identified challenges. Based on the results obtained, the solutions are continuously improved to ensure they are effective and viable.
3. **Implementation & Indicator Mobilization:** Once validated, the participating companies implement the solutions. This allows for the adoption of innovative tools and the evaluation of their impact through monitoring key indicators, ensuring the effectiveness and sustainability of the introduced innovations.

This initiative contributes to SDG 4 (Quality Education) by providing students with practical experience in the business field and promoting the application of acquired knowledge. Additionally, it positively impacts the management and quality of participating companies, ensuring that the developed solutions are of high quality and meet the business sector's expectations.

Several vital aspects support the effectiveness of these communities:

- **Clear Objectives:** Well-defined goals ensure that projects focus on solving relevant problems and contribute to achieving the SDGs.
- **Strong Leadership:** The support of a research group, effective coordination, and an innovation manager are crucial for process traceability, ensuring clear direction, and promoting the active participation of all involved actors.
- **Quality Orientation:** Each process within the communities is constantly validated to ensure proper development and the quality of results.

- **Effective Communication:** Open dialogue and efficient digital channels facilitate interaction among students, researchers, and companies, strengthening collaboration and the implementation of innovative solutions.

Innovation communities are presented as an effective collaboration model between academia and industry and an educational innovation. This model fosters critical thinking, systemic approaches, change management, technological adoption, and creativity, providing an experimental field that deeply addresses organizational needs and generates disruptive solutions.

The replicability of this best practice lies in its structured and adaptable approach. The management model of innovation communities can be adapted and applied in other educational or business institutions that promote innovation and collaboration among different actors, thus ensuring sustainability and expansion.

Translation and Adaptation: Implementation of Innovation Communities (ICs)

The implementation of Innovation Communities (OICs) generated several lessons learned, which should be considered in future ICs. These will be analyzed based on the success factors described by Barrera-Corominas *et al.* (2015) and the quantitative results obtained

Organizational Context:

- **Adequate Physical Spaces:** It is necessary to have appropriate physical spaces for in-person meetings. While industries often prefer to hold these meetings on their premises, the presence of industry professionals can sometimes inhibit participation.
- **Technological Tools:** Although the use of technological tools facilitates communication, it is important to train participants in innovative tools that can enhance knowledge management without becoming the central focus of the process.
- **Application and Systematization of Knowledge:** The knowledge provided in meetings or in the classroom should be directly applied in the industry and systematically documented to ensure it returns to the classroom. This helps maintain high levels of motivation.
- **Influence of Organizational Culture:** The organizational culture of industries had a significant impact on participants, as their ideas could influence those of other participants.
- **Leadership in Higher Education Institutions (HEIs):** Regarding the organizational culture of HEIs, it is important to focus on the leadership model necessary for the development of ICs.
- **Involvement of Superiors:** Superiors in HEIs should be involved as members of the team to overcome the inherent obstacles of OICs.
- **Direct and Fluid Communication:** A direct and fluid communication channel between industries and IC tutors is essential to build trust in the work being developed, ensuring that industry professionals recognize the benefits of these OICs.
- **Incentives for Innovation:** It is important to have incentives within industries for the development of ideas that improve organizational aspects. These incentives should also be reflected in the classroom.
- **Understanding Organizational Culture for Innovation:** Innovation should be aware of the organization's cultural system from the beginning, identifying specific information, tools, behaviors, and processes. This is crucial, as the innovation process often conflicts with the existing system (Vélez & Ríos, 2018, p. 128).
- **Support from Industry:** Support from the industry in obtaining information and knowledge of processes is critical.

Development Factors Specific to OICs:

- **Alignment of Program Content:** Program content should be aligned with an innovation proposal previously established between the HEI and the industry, based on a recognized need.
- **Effective and Practical Training:** Training developed with industry professionals should be effective and not overly theoretical, given the limited time available to them.
- **Role of the IC Moderator:** The OIC moderator should develop strategies to encourage dialogue and avoid demotivating participants.
- **Key Contact with Industry Professionals:** Contact with industry professionals is crucial for the OIC success, as their contributions significantly enhance any proposals made.
- **Importance of In-Person Meetings:** In-person meetings are indispensable, as they allow for broader debate, complementing virtual sessions.
- **Clear Objectives and Tangible Outcomes:** The objectives of OICs must be clear, with a tangible product to be achieved.
- **Innovation as a Mediator:** It is important that the OIC is mediated by an innovation process.

Factors Related to IC Participants:

- **Motivators for Participants:** Participants should have motivators that help the IC achieve its stated objectives.
- **Collaborative Work and Continuous Monitoring:** Collaborative work requires continuous monitoring and moderation by an expert or tutor, who should also assign responsibilities that capitalize on members' skills and competencies.
- **Involvement of Senior Management:** Senior management in the industry should play an important role in ensuring that the goals set in the OIC are met.
- **Role of the Moderator in Innovation:** The moderator's role is crucial at each step of the innovation process, ensuring the validation of each stage.

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