



Article

Nurturing Eco-Literate Minds: Unveiling the Pathways to Minimize Ecological Footprint in Early Childhood Education

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Abstract: This research explores the vital role of the ecological footprint as a pivotal indicator in ecological assessments and its significance in advancing environmental sustainability. Investigating the intricate dynamics of human activities, resource consumption, waste management, and ecological impact, this study underscores the need for a comprehensive understanding. Key aspects such as renewable energy, economic growth, biomass capacity, and trade policy within the expanding field of energy consumption are thoroughly examined, with data collected from 624 randomly selected pupils. The research methodology involved pre- and post-activity knowledge assessments. The research places a particular focus on the innovative examination of early childhood education as a potent tool for reducing the ecological footprint. Drawing on insights from prior research, the authors argue that instilling ecological awareness and sustainable practices at a young age can yield lasting benefits. This article highlights successful collaboration between higher education institutions and elementary schools, specifically through the “Green Ambassadors in the Community” course at the Holon Institute of Technology (HIT). This study not only emphasizes the crucial role of educational institutions in fostering sustainable practices but also advocates for the urgent integration of environmental education into early childhood curricula.

Keywords: environmental education; elementary school; renewable energy; ecological footprint



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1. Introduction

This research article aims to provide a comprehensive understanding of the intricate interplay between energy consumption and its environmental consequences, with a specific focus on the pivotal role of early childhood education in fostering competence for sustainable development. The growing importance of energy consumption in daily life, especially in the context of climate change and resource depletion, has led to increasing concerns. This study aims to move beyond a simple overview, exploring key areas such as the adoption of renewable energy sources, the intricate relationship between economic growth and energy consumption, biomass capacity, carbon sequestration, trade policies, and the significant influence of education on shaping the ecological footprint.

Numerous studies have highlighted the significance of environmental education in current discourse. A study conducted by the North American Association for Environmental Education demonstrated that students engaging in environmental education programs exhibited enhanced academic performance, reflected in higher test scores in science, reading, and math. Another study, featured in the *Journal of Environmental Education*, asserted that environmental education could induce favorable shifts in attitudes and behaviors toward the environment, fostering increased pro-environmental behaviors and decreasing environmental impact. Additionally, a report from the European Environment Agency underscored that environmental education plays a role in developing critical thinking

skills, creativity, and problem-solving abilities—essential attributes for addressing intricate environmental challenges. Furthermore, a study published in the *Journal of Environmental Psychology* indicated that environmental education correlates with heightened feelings of connection to nature, a factor linked to improved mental health and well-being. Collectively, these studies suggest that environmental education can yield diverse benefits, encompassing enhanced academic performance, positive changes in environmental attitudes and behaviors, and improved mental health and well-being (Hesselink and Kempen 2000; Kaltschmitt et al. 2007).

As societies grapple with the increasing challenges posed by energy consumption, the role of early childhood education in addressing these concerns becomes paramount. The article recognizes the need to explore this dynamic and emphasizes the expanding literature on the subject. It is imperative to consider the broader context of global challenges, such as climate change and resource depletion, to underscore the urgency of integrating sustainability into educational frameworks, especially during the formative years of a child's development.

A central theme in this exploration is the examination of renewable energy sources, with the authors shedding light on various facets of their environmental impact. Notably, the groundbreaking research of Jacobson and Delucchi takes center stage, emphasizing the potential of a global transition to 100% renewable energy sources to significantly curtail greenhouse gas emissions (Jacobson and Delucchi 2011). As the literature landscape is navigated, meticulous acknowledgment and engagement with controversial hypotheses, including the Environmental Kuznets Curve (EKC), are evident. The EKC posits a temporary increase in environmental degradation with economic growth followed by a subsequent decline (Jorgenson and Wilcoxon 1993; Flockerzi et al. 2018).

The review unfolds a multifaceted perspective on the contributions of renewable energy, extending beyond emissions reduction. The authors delve into reduced environmental impact, enhanced energy independence and security, technological advancements, local economic benefits, and the creation of green jobs. Simultaneously, the intricate relationship between economic growth and energy consumption is dissected, exploring the nuances of the EKC and the intriguing concept of “decoupling”, where economic growth occurs without a concomitant increase in energy consumption (Jacobson and Delucchi 2011; Canadell et al. 2007; Copeland and Taylor 2004).

Biomass capacity and carbon sequestration take center stage in mitigating the environmental consequences of energy consumption. Forests, identified as pivotal carbon sinks, are scrutinized for their role in sustainable forest management, afforestation, and reforestation initiatives. The authors, in their comprehensive approach, duly acknowledge the challenges and trade-offs associated with biomass utilization, including the intricate competition for land use and the potential pressures on ecosystems (Willits-Smith et al. 2020; Duarah et al. 2022).

Trade policies emerge as a focal point of discussion, illustrating their considerable influence on energy-intensive industries and the potential “pollution haven” effect. The authors advocate for regulatory harmonization, sustainability standards, and the implementation of carbon tariffs and border adjustment mechanisms to address environmental concerns while fostering economic growth. The transformative potential of environmental education in shaping energy consumption patterns is underscored, with specific emphasis on success stories like the “Green Ambassadors in the Community” course (Jacobson and Delucchi 2011; Jorgenson and Wilcoxon 1993; Flockerzi et al. 2018).

Drawing from research in countries like Kuwait and Portugal, which are characterized by distinct environmental challenges, the article provides in-depth case studies. In Kuwait, the unique challenges of a desert environment are addressed, emphasizing the potential of sustainability-focused education in mitigating issues related to land use, water resources, and food production. The research extends to Portugal, offering insights into a more sustainable future through an amalgamation of education and policy change, addressing

imbalances in food production, trade, and consumption (Shahid and Suleiman 2023; Miguel et al. 2023; Suleiman and Shahid 2024).

The authors explore the potential for transformation in environmental education, drawing insights from the noteworthy success story of the “Green Ambassadors in the Community” course (Friman et al. 2018, 2020, 2022). The methodology employed in these studies, each focusing on a distinct Israeli tribe, provides nuanced insights into the multifaceted elements shaping the ecological footprint through experiential learning and monitoring consequences.

The objective of this study is to present a detailed analysis of the “Green Ambassadors in the Community” course as a pivotal case study, focusing on its effectiveness in fostering ecological awareness and sustainable practices among diverse tribes within Israeli society. This study aims to provide a comprehensive understanding of the background and context of each case, emphasizing the shared methodological approach employed across different societal contexts. Specifically, the authors delve into the methodology centered around experiential learning and monitoring consequences, highlighting its implementation in various schools representing different Israeli tribes. Through immersive activities such as eco-friendly projects and nature excursions, students actively engage in hands-on experiences to deepen their understanding of environmental issues. The systematic integration of monitoring consequences enables participants to witness the direct effects of their environmentally conscious behaviors, fostering a sense of responsibility and empowerment. By emphasizing the participatory nature of these interventions and the tangible outcomes observed through systematic monitoring, this study offers valuable insights into the transformative potential of the “Green Ambassadors in the Community” course in shaping energy consumption patterns and promoting sustainability within diverse communities.

The Global Imperative for Distributed and Renewable Energy

Comparative analyses conducted globally, particularly in Scandinavia and the United States, substantiate a recurring trend wherein exposure to environmental education not only enriches cognitive understanding but also instigates noteworthy behavioral shifts, fostering heightened environmental consciousness.

Within certain European nations, most notably Sweden, environmental education has been an integral component of the curriculum since 1969. This commitment is evident in the concerted effort to seamlessly integrate environmental education across diverse subjects ranging from science to home economics, commencing at the preschool level. This extensive integration reflects a sustained dedication to instilling environmental awareness in learners from their earliest educational experiences (Soren and Per 2010).

Similarly, Nordic countries such as Norway demonstrate a comparable commitment to early environmental education, where it is made compulsory in both nursery schools and schools. The overarching objective is to impart foundational knowledge of environmental sustainability during formative years, cultivating a lasting ethos of environmental protection and conservation. By making environmental education compulsory at an early age, these initiatives aim to instill a sense of responsibility and stewardship towards the natural world from the outset, laying the foundation for a lifelong commitment to environmental protection and conservation (Beery 2013; Kristin 2013).

The key challenges confronting environmental education and training in Europe include confusion, isolation, and bureaucratic barriers. The report notes limited attention to vocational training and a lack of exchange of experience and knowledge among practitioners. Furthermore, it emphasizes the necessity to integrate environmental education into all policy sectors and underscores the importance of providing appropriate teaching materials for both teachers and pupils (Hesselink and Kempen 2000).

In a separate instance within the literature, there is a case study focused on teacher perspectives regarding children’s awareness of zero-waste and recycling in preschool education. The authors of this paper employed a qualitative design and adopted a case-study approach to foster the professional development of preschool teachers. The objective

of Ayhan's research was to augment the awareness and comprehension of zero-waste and recycling initiatives among preschool teachers, thereby contributing to the advancement of sustainable practices within educational settings (Ayhan 2020).

Conversely, the United States and Canada, while witnessing a surge in environmental education programs, have yet to attain the widespread integration observed in some European counterparts. In the United States, these programs often serve as complementary elements to traditional classroom subjects rather than constituting the core curriculum of educational institutions. Nevertheless, concerted efforts are underway in the United States to bridge this gap. Various organizations and initiatives are diligently working to infuse environmental learning into schools and communities, addressing the pressing need for accessible environmental literacy resources. This includes the provision of easily downloadable classroom activities and professional development opportunities, signaling a growing commitment to advancing environmental education (Eagles and Demare 1999; Lester et al. 2006).

In light of the universally recognized importance of distributed energy systems and renewable energy, the research findings highlight a global consensus embedded in initiatives like the Paris Agreement and the United Nations Sustainable Development Goals. These overarching frameworks underscore the crucial role of education in addressing climate change challenges and promoting sustainable practices on a worldwide scale.

China's sustainability programs initiated the economic reforms and opened up in 1978. The paper notes that despite the launch of six programs, including the Three-North Shelterbelt Program and the National Key Construction Program for Soil and Water, these efforts fell short of fully mitigating the escalating environmental pressures stemming from rapid urbanization and industrialization. The analysis emphasizes the intricate challenges associated with balancing environmental sustainability goals against the imperatives of economic development and urban expansion. The authors propose that future initiatives would benefit from a nuanced understanding of these dynamics to formulate more effective and sustainable environmental policies (Sun et al. 2018).

The report identifies several areas where impacts can be extended, suggesting career opportunities in the field of renewable and sustainable energies. Examples include roles such as Renewable Energy Engineers, Sustainability Consultants, Energy Analysts, Environmental Policy Analysts, and Renewable Energy Project Managers. These professionals play pivotal roles in designing, implementing, and managing renewable energy systems, developing sustainable practices, assessing energy usage, formulating environmental policies, and overseeing renewable energy projects. The paper emphasizes the broad spectrum of career opportunities available in the renewable and sustainable energy sector, spanning engineering, policy development, consulting, and project management, among other domains (Hesselink and Kempen 2000).

2. Materials and Methods

The researchers undertook a comprehensive investigation centered on the environmental education initiative known as "Green Ambassadors in the Community", implemented by the Holon Institute of Technology (HIT). Their study aimed to provide a nuanced exploration of the course, delving into its theoretical underpinnings, practical components, and impact on both HIT students and elementary school pupils.

The methodology employed in this study comprised several key components:

Comprehensive Examination: The researchers conducted a detailed examination of the educational course, thoroughly scrutinizing its theoretical foundations and practical aspects. This approach allowed for a comprehensive understanding of the initiative and its broader implications.

Data Collection: Data collection involved gathering information on various aspects of the course, including its structure, implementation methods, and outcomes. Surveys, interviews, observations, and assessments were utilized to gather insights into the effectiveness of the environmental education initiative.

Setting and Participants: This study focused on the Green Ambassadors course, a flagship initiative introduced by HIT, which has significantly influenced the environmental consciousness of students over the past seven years. This course aligned with the broader framework of the “Israeli Hope” program, reflecting the institute’s commitment to fostering positive change within diverse communities.

Experiential Learning and Monitoring Consequences: The methodology emphasized a combination of experiential learning and monitoring consequences. Participants engaged in activities designed to deepen their connection with environmental issues, while systematic monitoring of consequences allowed them to observe the real-world impact of their actions on energy consumption patterns.

Through these methodological approaches, the researchers aimed to provide a comprehensive understanding of the interplay between energy consumption and its environmental consequences, particularly focusing on the pivotal role of early childhood education in fostering competence for sustainable development. This study moved beyond a simple overview to explore key areas such as the adoption of renewable energy sources, the relationship between economic growth and energy consumption, biomass capacity, carbon sequestration, trade policies, and the significant influence of education on shaping ecological footprints.

This article also highlighted successful collaboration between higher education institutions and elementary schools, specifically through the “Green Ambassadors in the Community” course at HIT. It emphasized the crucial role of educational institutions in fostering sustainable practices and advocated for the urgent integration of environmental education into early childhood curricula.

2.1. *Setting and Participants*

The Green Ambassadors course, a flagship initiative introduced by the Holon Institute of Technology (HIT), has played a pivotal role in shaping the environmental consciousness of students over the past seven years, starting in the 2017 school year. The course, deeply rooted in the principles of multiculturalism and cultural competence, aligns with the broader framework of the “Israeli Hope” program, reflecting the institute’s commitment to fostering positive change within diverse communities.

Commencing its journey at the “Ravivim” school in Holon in 2017, the course marked a significant step in promoting multicultural education. The subsequent expansion of the “Al Omari” school in Ramla, representing Arab society, underscored the program’s commitment to inclusivity. Over the years, the course continued its expansion, reaching the state religious school “Yeshuron” in Holon in 2019 and making a meaningful impact at the school of Arab society, “Neva Shalom”, in Lod in 2020. The year 2021 witnessed a groundbreaking moment as the course extended its reach into the ultra-Orthodox society, encompassing two schools, “Ben Menachem” for girls and “Bnei Menachem” for boys, both located in Holon.

However, the challenges posed by the COVID-19 pandemic in 2022 prompted a reconsideration of the course’s operational model. Faced with the impossibility of physical gatherings, the course adapted by venturing into the geographical periphery of the State of Israel, reaching schools such as “Ben Atar” and “Yitzhak Sade” in Dimona. In the 2023 academic year, the course expanded its footprint further to include the “Shalhavot” Chabad school in Gedera, adding diversity to its portfolio of participating schools.

This study offers a broad perspective on the potential transformative influence of the program within diverse educational and cultural contexts, emphasizing its adaptability and resilience in response to evolving challenges. This study encompassed two primary participant groups: students from the Holon Institute of Technology (HIT) and elementary school pupils actively engaged in the “Green Ambassadors in the Community” course (Friman et al. 2018, 2020, 2022). Since the inception of the course in 2016, a total of 181 HIT students have participated, representing diverse segments of Israeli society, including secular, religious, Haredi, and Arab backgrounds with varying socio-economic profiles. Participants

were drawn from all of HIT's faculties, ensuring a well-rounded representation across disciplines. HIT students were chosen based on their expressed interest in environmental studies and their willingness to actively participate in the "Green Ambassadors" course. This criterion ensured a cohort of students genuinely interested in environmental topics, enhancing the overall effectiveness of the course.

In the program, 624 pupils between the ages of 6 and 13 are actively engaged in sustainability education. These young learners, drawn from elementary schools across Israel, offer a diverse representation of backgrounds, reflecting secular, religious, Haredi, and Arab communities. The participating schools hail from various towns and cities, including Holon, Lod, Ramla, Sderot, and Dimona, located in both the central and southern regions of Israel. The socio-economic landscape of these cities is characterized by significant diversity. While Holon enjoys a relatively high socio-economic status, Lod, Ramla, Sderot, and Dimona are positioned within lower socio-economic strata. This variation underscores the multifaceted nature of the participants' familial backgrounds, which span across a spectrum of socio-economic conditions. Families within the cohort exhibit diverse structures and educational orientations, ranging from small and highly educated family units to larger and less educated ones. Moreover, the educational frameworks from which the participants originate vary significantly, encompassing state schools, religious institutions, and Orthodox and Arab educational settings. These differences in educational ethos and family backgrounds contribute to the richness and complexity of the program's participant demographics, enhancing the holistic learning experience and fostering a comprehensive understanding of sustainability across diverse societal contexts (German et al. 2022).

2.2. Course Structure and Theoretical Component

This study delved into the "Green Ambassadors in the Community" program's course structure and theoretical components, analyzing curriculum materials covering ecology, energy generation, efficiency, renewable energy, waste management, and recycling. Pedagogical strategies emphasizing interactive teaching methods were examined alongside resource utilization, including textbooks, multimedia presentations, and guest lectures. The practical component scrutinized collaboration between HIT students and elementary pupils, assessing lesson plans, experiential learning integration, and learning outcomes. Logistical considerations for program expansion, response to the COVID-19 pandemic, and inclusivity measures, such as school selection criteria and inclusivity measures, were also evaluated, highlighting the program's adaptability and effectiveness in engaging diverse populations.

2.3. Evaluation of the Impact

Evaluation of the impact of collaborative initiatives between higher education institutions and elementary schools on ecological awareness in young children is conducted through various methods. Surveys and questionnaires administered to HIT students, pupils, teachers, and parents offer valuable feedback on the effectiveness of collaborative programs in enhancing ecological awareness. Pre- and post-"Kahoot!" trivia games measure pupils' knowledge and understanding of ecological concepts before and after participating in the course, providing insights into learning outcomes. Observations of pupils' engagement in environmental activities, projects, and discussions yield qualitative insights into their involvement and interest in ecological awareness. Assessing participation and behavior during collaborative projects, as well as performance in tasks related to environmental conservation, serves as a measure of the practical application of ecological knowledge acquired through programs like "Green Ambassadors in the Community." Each course is a semester-long course that spans approximately four months, comprising 12 sessions totaling 48 h of study, facilitating a thorough assessment of the program's impact on ecological sustainability awareness and understanding. Notably, the "Green Ambassadors" course emerges as a tangible embodiment of these global commitments, seamlessly aligning with the objectives set forth in both the Paris Agreement and the Sustainable Development

Goals. The course plays a pivotal role in fostering awareness and inspiring action within the domain of distributed energy systems and renewable energy.

The “Green Ambassadors” course, thoughtfully crafted to resonate with international sustainability initiatives, stands as a valuable resource for middle and high school educators. Its modular curriculum delves into pertinent sustainable issues and offers practical solutions. The primary aim is to empower educators, enabling them to guide students in collaborative efforts geared toward educating their communities on these critical matters. Through this approach, the course contributes to the broader mission of advancing global sustainability goals by instilling a sense of environmental responsibility and promoting collective action.

2.4. Learning through Experience

Learning through experience emerges as a cornerstone in deepening elementary school pupils’ grasp of environmental concepts and fostering environmental awareness. This pedagogical approach, incorporating hands-on activities such as experiments, demonstrations, and interactive sessions, offers an immersive learning environment. Through empirical exploration, students not only enhance their comprehension and retention of environmental principles but also develop a profound connection with the subject matter. Survey findings revealed that topics involving practical engagement were absorbed more effectively compared to conventional face-to-face learning methods. Moreover, pupils reported the enduring impact of these experiential activities, extending beyond the classroom as they shared their experiments with their families. This highlights the potential for long-term learning outcomes, suggesting that experiential learning fosters a deeper understanding and appreciation of environmental stewardship among young learners. Furthermore, collaboration between higher education institutions and elementary schools emerges as a catalyst for nurturing ecological awareness. By leveraging the expertise of HIT students passionate about environmental issues, young pupils gain access to role models and mentors who inspire them to care for the environment. This exposure ignites curiosity and motivation, fostering a lifelong commitment to ecological awareness and sustainability.

2.5. Ethical Considerations

In alignment with the ethical considerations of the Holon Institute of Technology (HIT), this study upholds rigorous standards to ensure the rights and well-being of participants. Specifically, parental consent was obtained in accordance with domestic laws, emphasizing transparency and respect for participants’ autonomy. Parents were provided with detailed information about the research objectives and procedures, and consent forms were obtained prior to participation. Participants, including pupils and students, were informed about the research’s purpose, confidentiality, and voluntary nature. No incentives were provided to participants, maintaining the integrity of the research process. Importantly, this study did not require ethics committee approval, as it adhered to Ministry guidelines regarding parental consent for data collection. Detailed instructions (in Hebrew) on the Ministry of Education’s website further elucidate the protocols followed during the research ([Ministry of Education n.d.](#)).

3. Results

The Green Ambassadors course, established as a flagship initiative by the Holon Institute of Technology (HIT), has played a pivotal role in molding the environmental awareness of students since its commencement seven years ago in the 2016 school year. This chapter stands as a culmination, presenting a detailed exploration of the experiences and responses of 624 pupils and 181 HIT students who actively participated in the Green Ambassadors course. As an instrumental aspect of the academic landscape, the Green Ambassadors course has left an indelible mark on the educational journey of participants. The diverse group, consisting of 624 pupils and 181 HIT students, offers a diverse array of perspectives and insights, providing a nuanced portrayal of the potential transformative

impact of the course. The experiences shared by these participants shed light on the course's notable impact across various educational and cultural settings. The chapter delves into the nuances of the Green Ambassadors course, offering a comprehensive examination of its outcomes and implications. By detailing the responses of both pupils and educators, the narrative captures the multifaceted nature of the course's impact, emphasizing its resilience and adaptability in navigating the challenges posed by the evolving educational landscape. By delving deeply into the gathered data, this chapter seeks to offer readers a nuanced insight into how the Green Ambassadors course may have played a role in influencing the environmental awareness of its participants. By unraveling the complexities and intricacies of the experiences shared by pupils and educators, the chapter seeks to underscore the significance and enduring relevance of this transformative initiative in the face of evolving challenges.

3.1. Knowledge Enhancement through the Course

In order to enhance awareness and understanding, this outcome was measured through a comparative analysis of respondents' perceptions before and after participation in the "Green Ambassadors" course. A pre- and post-"Kahoot!" trivia game design was employed, wherein participants completed questionnaires assessing their initial levels of awareness and understanding of environmental concepts at the outset of the course (pre-"Kahoot!" trivia game). After completing the course, the same assessments were administered again (post-"Kahoot!" trivia game) to measure any changes or improvements in participants' perceptions and knowledge (see Figure 1 below). This approach allowed for quantifying the measured change in perception by comparing responses at two distinct time points, thereby providing a clear picture of the course's impact on participants' awareness and understanding of environmental sustainability.

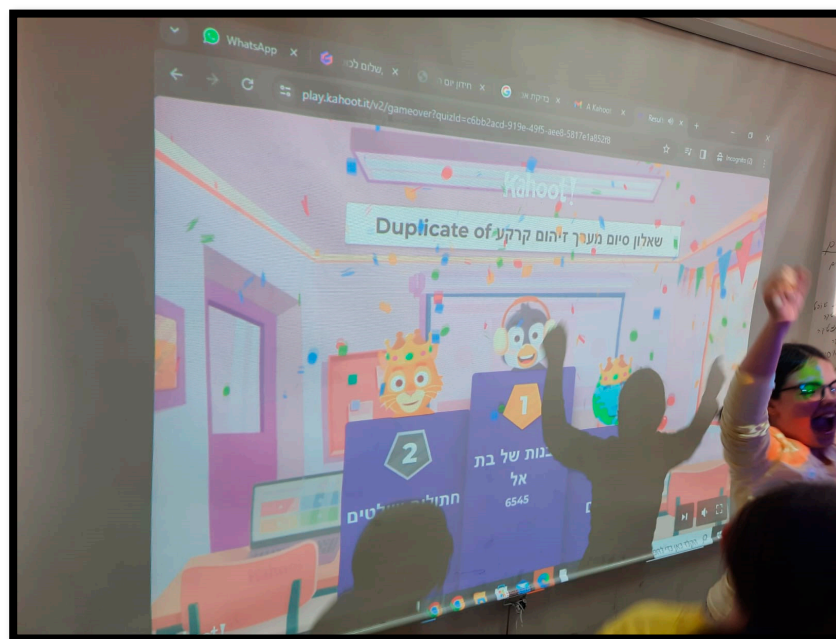


Figure 1. Pupil, at the post-"Kahoot!" trivia game questionnaire with a triumphant expression on her face.

Before the implementation of the "Green Ambassadors" course, pupils exhibited gaps in their comprehension of renewable energy and distributed systems. The baseline assessment revealed a deficiency in their understanding, particularly evident in responses to a pre-course question prompting students to define renewable energy sources. Responses at this stage indicated a limited grasp of the concept, with pupils struggling to articulate a comprehensive understanding.

Upon completing the “Green Ambassadors” course, an influence on pupils’ perceptions of energy sources emerged. The post-course assessments demonstrated a marked improvement in students’ knowledge and a notable shift in their responses. Figure 1 illustrates the results for the question, “Which of the following can be used as a source of energy?” The visual representation of the data underscores the substantial positive changes observed after the course intervention (see Figure 2 below).

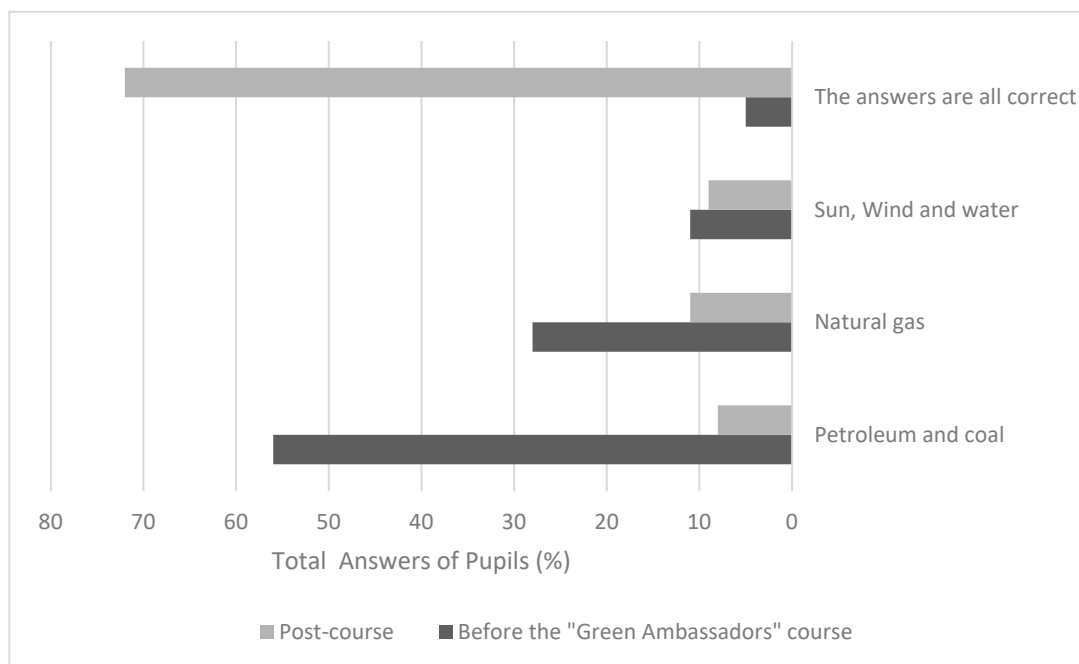


Figure 2. Results for the question “Which of the following can be used as a source of energy?”.

Specifically, the pre-course survey exposed prevailing misconceptions among pupils, with a significant percentage (56%) perceiving oil and coal as the exclusive sources of energy. Another 28% identified natural gas as the sole contributor to energy generation. Additionally, a minority of pupils (11%) recognized a broader spectrum of energy sources, encompassing the sun, wind, and water, while merely 5% demonstrated an understanding of the comprehensive nature of all the energy options presented.

The “Green Ambassadors” course played a pivotal role in reshaping these initial perceptions. Some pupils believe that energy solely originates from mineral sources like coal or natural gas, unaware of the various renewable and non-renewable resources utilized in energy production. Pupils did not understand the environmental effects of energy production. Through exposure to diverse content on energy generation from renewable sources, students underwent a remarkable transformation. The post-course assessments revealed a substantial increase in awareness, with approximately 72% of pupils accurately identifying that energy can be derived from both fossil sources (such as oil, coal, and gas) and renewable sources (including the sun, wind, and water). This noteworthy shift indicates a comprehensive understanding achieved through the course, emphasizing its efficacy in not only broadening students’ knowledge but also fostering a nuanced comprehension of energy generation possibilities.

The authors aimed to address misconceptions about energy use through the Green Ambassadors course and assess the impact of exposure on pupils’ understanding and behavior. Misconceptions addressed included a lack of awareness regarding polluting energy sources and an inattention to energy-saving practices in daily routines. After exposure to the course, pupils demonstrated a changed understanding of polluting energy sources, effectively explaining concepts to peers and family members. Pupils applied knowledge by adopting energy-saving behaviors in daily life, such as writing on both sides

of the page and turning off lights when leaving rooms. This study confirmed the course's efficacy in improving environmentally conscious behaviors among pupils by evaluating pre-course and post-course responses and conducting interviews.

3.2. Comprehension of Renewable Sources and Distributed Systems

In addition to acquiring new information, pupils participating in the “Green Ambassadors” course exhibited a nuanced understanding of renewable energy concepts. A pre-course question designed to assess their comprehension of distributed systems elicited responses indicating a level of confusion. However, the post-course assessments revealed a notable transformation, as students demonstrated a clear grasp of the subject matter. Figure 2 visually represents the results for the question “Where is electricity produced in Israel?” illustrating the positive changes in students’ understanding (see Figure 3 below).

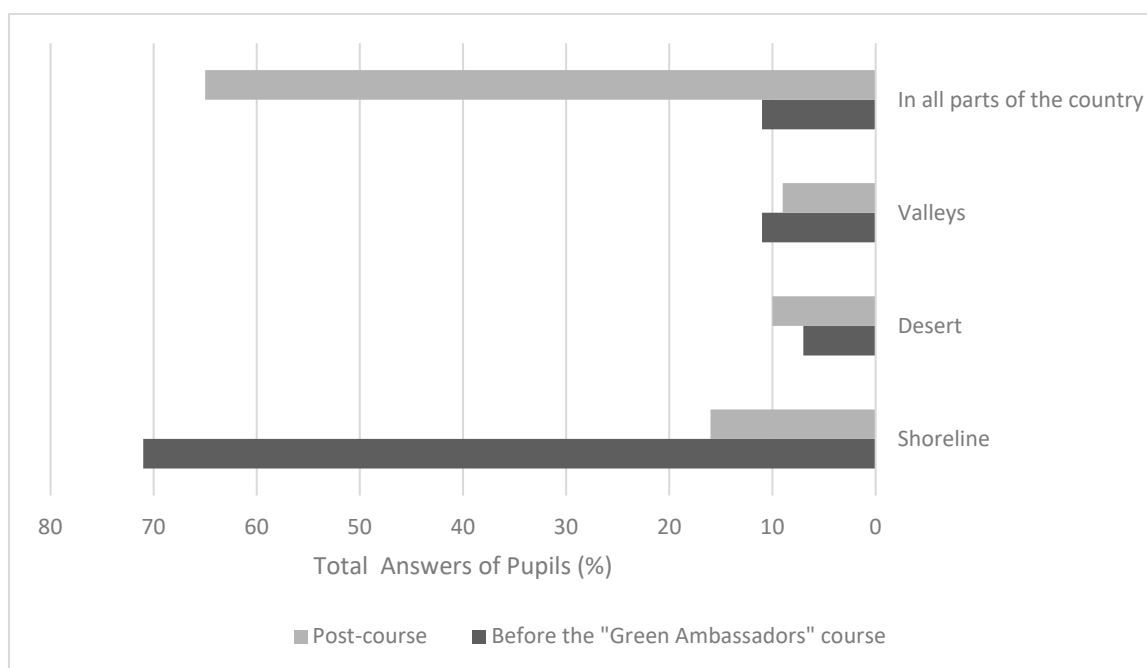


Figure 3. Results for the question “Where is electricity produced in Israel?”.

The exploration of students’ perceptions concerning the production of electricity in Israel provided intriguing insights. Before the intervention of the Green Ambassadors course, responses to the question highlighted a significant disparity in understanding among participants. A substantial majority, comprising 71 percent of pupils, held the belief that electricity production was confined solely to coastal areas, potentially influenced by the transportation of coal via ships and the presence of desalination plants in these regions. In contrast, 7 percent of pupils believed electricity was exclusively generated in the Negev, while 11 percent associated electricity production with the valleys. Only a similar fraction, 11 percent, correctly acknowledged that electricity production was distributed across various locations within the country.

The Green Ambassadors course significantly contributed to dispelling these misconceptions. By exposing pupils to a variety of power plants and energy production methods, they underwent a valuable learning experience. The post-course assessments demonstrated a significant shift in perspectives, with 65 percent of pupils accurately recognizing that energy production occurs in multiple locations across Israel. This outcome underscores the efficacy of the Green Ambassadors course in broadening pupils’ awareness of the geographical diversity of energy production sites within the country.

The detailed analysis of pre-course and post-course responses emphasizes the course’s effectiveness in not only imparting knowledge but also fostering a more accurate and

nuanced understanding of the complexities associated with renewable energy concepts and the geographical distribution of electricity production in Israel. The results affirm the positive impact of the Green Ambassadors course in enhancing pupils' comprehension of these intricate topics, aligning with the overarching goals of environmental education and sustainable awareness.

3.3. Assessing the Impact on Student Engagement

The "Green Ambassadors" course was designed to foster environmental awareness and sustainable practices among students, empowering them to advocate for sustainable energy solutions within their communities. Post-course surveys were conducted to evaluate the course's impact. Participants were asked about their engagement in discussions regarding renewable energy with family and friends, as well as their influence on peers who did not take the course. A significant percentage of "Green Ambassadors" actively discussed renewable energy benefits with their social circles. These students, often termed "knowledge centers", played a crucial role in promoting sustainability and renewable energy to peers outside the course. Notable instances included convincing family members to adopt solar panels, attributed to the students' deeper understanding of economic and environmental advantages. While this study primarily focused on individual knowledge enhancement and behavior change within communities, it inadvertently indirectly highlighted the course's ripple effect on shaping public opinion. The documented cases underscore the potential of educational initiatives like the "Green Ambassadors" course to catalyze broader societal shifts towards sustainability.

The "Green Ambassadors" course effectively empowered students to become advocates for sustainable energy, with documented instances of influence extending beyond course participants. While this study did not explicitly measure its impact on shaping public opinion, it hints at the course's broader societal implications and potential for fostering widespread environmental advocacy.

3.4. Expanding the Reach of Environmental Education

The success of the "Green Ambassadors" course suggests a promising potential for broader implementation and proposes a scalable model that could exponentially impact society. The course's effectiveness in inspiring positive environmental actions and behavioral changes among students led to the consideration of extending similar programs to different age groups, including adults. The hypothesis was that by targeting diverse demographics, the impact on environmental awareness and sustainable practices could be amplified.

To explore this possibility, a pilot initiative was launched, extending the "Green Ambassadors" course to adult community leaders. The rationale behind this initiative was to assess the transferability of the course's impact beyond the student demographic and into adult populations. The results of this extension revealed encouraging outcomes, particularly in the form of increased community-wide sustainability projects.

The pilot initiative demonstrated that the core principles and methodologies of the "Green Ambassadors" course could be adapted successfully for adult learners and community leaders. The positive response and the subsequent implementation of sustainability projects at the community level underscored the course's potential to influence a broader audience beyond the traditional educational setting. This result suggests that the model established by the "Green Ambassadors" course is not confined to a specific age group or educational context but has adaptability and the potential for scalability to different demographics.

The findings imply that similar programs targeting various age groups, including adults, could play a pivotal role in promoting environmental education and fostering sustainable practices at a broader societal level. This extension aligns with the course's overarching goal of creating a more environmentally aware and proactive society, emphasizing the transferability of its success to diverse communities and age cohorts.

An illustration of the implementation and expansion of environmental education activities is evident in Japan. The paper discusses the incorporation of Education for Sustainable Development (ESD) viewpoints into the National Curriculum Standards in Japan, scheduled for enactment in 2020. This incorporation implies an anticipated broadening of the scope and content of environmental education. Since the 2000s, Japanese schools have adopted diverse approaches to environmental education, aligning with the unique characteristics of each region. Generally, environmental education has adhered to the guiding principles outlined in the Teacher's Guide for Environmental Education, primarily implemented in classes such as Life-Environmental Studies and during the Period for Integrated Studies.

Moving into the 2010s, there has been a notable shift towards “environmental education incorporating the viewpoints of ESD”, emphasizing a comprehensive approach that addresses various issues (environment, industry, culture, history, welfare, etc.) and establishes connections with diverse sectors (government, non-profit organizations, companies, research institutions, etc.) to contemplate the sustainability of different regions. The impending implementation of the National Curriculum Standards in 2020, with its integration of ESD viewpoints, is expected to further expand the scope and contents of conventional environmental education (Toshiya 2017).

3.5. Overall Impact of the “Green Ambassadors” Course

Aggregated data showcase the overall positive impact of the course on knowledge enhancement, behavior change, and community engagement. Interviews with participants reveal personal transformations, such as increased environmental activism and career aspirations in sustainable fields. The investigation into fostering cooperation and cultural understanding in environmental education has unearthed compelling narratives from participants within Jewish and Arab communities. Interviews conducted with those engaged in local environmental projects have revealed instances of collaborative efforts, showcasing a shared sense of responsibility toward addressing environmental issues. A noteworthy outcome of this collaboration is the heightened awareness and increased engagement resulting from shared environmental initiatives (see Figure 4 below). Anecdotal evidence illustrates joint projects focused on pollution reduction and water conservation. Moreover, both communities actively participated in awareness campaigns, challenging stereotypes, and nurturing positive relationships through collective environmental efforts. The “Green Ambassadors” course emerged as a tangible manifestation of environmental education's role in bridging cultural divides. Testimonials from students underscore the program's success in overcoming language and cultural barriers. Creative teaching methods, such as visual aids, interactive games, and collaborative projects, facilitated effective communication, fostering an inclusive learning environment (see Figure 5 below). Acknowledging the challenges posed by language and cultural disparities, this study delves into participant experiences. For instance, discomfort with communicating in Hebrew was identified among participants. The program responded proactively, incorporating bilingual elements to ensure a comfortable space for expression and learning. In overcoming these challenges, this study reveals a spectrum of strategies employed in bilingual learning.

In a study conducted in Colombia that examined the subject, these results emerged. This paper empirically investigates the extent to which environmental education at school can explain the variation in environmental literacy among 15-year-olds in Colombia while considering various student- and school-level confounding factors. Utilizing a two-level nested model, where individual observations are nested within schools, the researchers employ the maximum likelihood estimation method to estimate a linear mixed model incorporating both fixed and random effects. The empirical results only yield weak evidence supporting the notion that environmental education can contribute to a higher level of environmental awareness. Notably, the relationship between environmental education and awareness of renewable energy technologies (RETs) is found to be even weaker. Consequently, the findings suggest that environmental education should not be perceived as

a panacea for promoting environmental literacy among students. Moreover, this study identifies more reliable predictors for environmental awareness than for awareness of RETs. Overall, socio-economic status, stronger student science abilities, parent characteristics, and certain school-level factors such as the quality of education resources and school ownership (public versus private) emerge as decisive factors influencing varying levels of environmental literacy among students in Colombia (Hans-Erik and Tobias 2020).



Figure 4. The Green Ambassadors course at “Al Omariya” school in Ramla represents Arab society.



Figure 5. Teaching without words through play and experience at “Al Omariya” school.

4. Discussion

The findings uncovered in this study offer insights into the potential influence of environmental education, particularly with a focus on the “Green Ambassadors” course. The subsequent discussion explores the implications of the results, emphasizing promising avenues and practical solutions that environmental education may provide.

One notable aspect emphasized is the potential of environmental education, as illustrated by the success of the “Green Ambassadors” course. The program serves as a beacon,

showcasing its potential to foster cooperation and understanding among participants from diverse cultural backgrounds. By providing a shared space for dialogue, the course acts as a catalyst for building bridges and fostering collaboration, offering a blueprint for leveraging education to bridge cultural gaps and promote unity in addressing shared environmental concerns.

The discussion also delves into the instrumental role of environmental education, particularly through initiatives like the “Green Ambassadors” course, in addressing shared environmental challenges. The success of the program is portrayed as more than an isolated achievement; it stands as a testament to the practical solutions that inclusive education can provide. Participants actively contribute to overcoming challenges affecting both Jewish and Arab communities, emphasizing the importance of inclusive educational programs in building collective awareness and fostering collaboration to find sustainable solutions.

Other research found the importance of concurrently educating the community to foster widespread understanding and compliance with the new policies. It posits that an informed and engaged community is instrumental in realizing the envisioned shifts in agricultural practices and consumption patterns. Countries like Kuwait, characterized by a desert environment with low rainfall, high temperatures, and limited arable land and water resources, face unique challenges in food production and sustainability. The article posits that implementing education focused on sustainability and environmental awareness can play a pivotal role in mitigating issues related to grazing areas, fishing grounds, built-up land, forest areas, and carbon demand on land in such hyper-arid regions ([Shahid and Suleiman 2023](#)).

The research extends its purview to Portugal, where the environmental situation presents a distinct set of challenges. Through an amalgamation of education and policy change, the research envisions a more sustainable future for the country. The research posits that a concerted effort in this direction can ameliorate three critical imbalances simultaneously: reducing the food footprint, improving the trade balance, and enhancing human consumption of vegetables, thereby contributing to a healthier diet. A comprehensive evaluation is presented in the research paper, proposing a single equation to address these imbalances. The equation hinges on the synergy between reducing the ecological impact of food production, boosting vegetable consumption, and optimizing trade dynamics. The study suggests that achieving these objectives requires a paradigm shift in the application of the common agricultural policy in Portugal. Central to the proposed strategy is the need for the establishment of new rules governing the implementation of the common agricultural policy in Portugal. These rules, as outlined in the research, are pivotal in reshaping agricultural practices to align with sustainability goals ([Miguel et al. 2023](#)).

The potential of education and policy change in transforming both arid and temperate environmental landscapes. The proposed strategies for Kuwait and Portugal underscore the multifaceted benefits of integrating sustainability and environmental awareness into educational frameworks, coupled with targeted policy adjustments, to pave the way for a more balanced and resilient future.

The “Green Ambassadors” course is portrayed as a microcosm, demonstrating that environmental education transcends theoretical knowledge, becoming a vehicle for societal transformation. Actively involving participants in addressing environmental challenges, the course goes beyond traditional educational boundaries, serving as a catalyst for positive change, influencing attitudes, fostering collaboration, and contributing to broader societal transformation.

The comprehensive exploration of various works in the field underscores a consistent argument for the impactful role of environmental education. In the face of increasing challenges related to environmental and mental well-being, initiatives like the “Green Ambassadors” course serve as illuminating examples, providing valuable insights into the potential impact of education on fostering a sustainable and collaborative future. The nuanced discussions within this discourse on environmental education contribute

to a deeper understanding of the diverse dimensions and wide-ranging implications of educational initiatives centered on ecological awareness.

The “Green Ambassadors” course, as a case in point, has demonstrated a compelling capacity to transcend conventional educational paradigms. By actively engaging participants from diverse cultural backgrounds, the program serves as a dynamic platform for fostering cooperation and understanding. This cooperative ethos is particularly significant in the context of environmental challenges that have no cultural or geographical boundaries. The course’s success in creating a shared space for dialogue not only underscores its practical efficacy but also contributes depth to the broader discourse on environmental education.

One noteworthy aspect highlighted in the ongoing discussion is the potential of such initiatives to act as catalysts for societal transformation. The findings of this study, as discussed in the previous chapters, reveal not only an enhancement of knowledge among participants but also substantial behavioral changes that extend beyond the individual level. This influential capacity resonates with broader discussions on the role of education in potentially instigating positive societal changes.

The “Green Ambassadors” course, in this context, emerges as a microcosm illustrating the potential of environmental education to influence attitudes, foster collaboration, and contribute to a more sustainable and interconnected society.

Numerous studies have highlighted the positive impacts of environmental education, and the current findings contribute to this collective body of knowledge. The discussion, therefore, places the results within the context of existing research, emphasizing the consistent patterns of positive change observed in participants engaged in environmental education initiatives (Caine and Caine 1997; Itin 1999; Lewis and Williams 1994). The “Green Ambassadors” course serves as a beacon within the ongoing discourse on environmental education. By providing valuable insights into the potential of education to build a sustainable and collaborative future, the program not only adds depth to the current discussion but also reinforces the broader argument for the impactful role of environmental education in addressing contemporary environmental challenges. The nuanced perspectives gained from initiatives like the “Green Ambassadors” course contribute substantively to shaping the future trajectory of environmental education, providing a blueprint for cultivating informed, environmentally conscious, and collaborative societies.

5. Conclusions

The thorough evaluation of the “Green Ambassadors” course has suggested its notable impact, reaching beyond individual participants to potentially influence entire communities positively. The study’s nuanced results and illustrative examples highlight the transformative potential of environmental education, addressing specific issues and broader societal challenges, particularly cultural divides. The initiative emerges as a beacon of hope and a model for global endeavors, underscoring its relevance in shaping attitudes, behaviors, and societal structures toward a more sustainable and interconnected world.

The study’s conclusions are anchored in data, indicating the potential for positive changes inherent in the core of the “Green Ambassadors” course. Participants not only demonstrated improved knowledge but underwent substantial behavioral changes, radiating into their communities. Specific impacts, notably the heightened awareness of renewable energy sources, underscore the course’s efficacy in addressing targeted issues. The focused curriculum and hands-on activities emerged as effective tools for enhancing knowledge and understanding within the realm of renewable energy.

In addition to its demonstrated capacity to tackle broader societal challenges, such as overcoming cultural divides, the course showcases its unifying power in fostering collaboration among participants from diverse backgrounds. In the global context, initiatives like “Green Ambassadors” gain heightened relevance as beacons of hope, illustrating the potential for environmental education to play a crucial role in building a more informed, environmentally conscious, and harmonious future.

While highlighting the positive outcomes, it is crucial to acknowledge the study's limitations. The research primarily focused on short-term impacts, and a longitudinal study could provide insights into the long-term sustainability of the observed changes. Moreover, the study's scope primarily covered a specific demographic, and future research should explore the applicability of the "Green Ambassadors" model to different age groups and cultural contexts.

In conclusion, the "Green Ambassadors" course, extending beyond knowledge impartation, initiates a ripple effect, fostering a collective commitment to a more environmentally aware and harmonious future. The revised conclusions offer a concise overview, emphasizing the main take-home messages supported by robust data, and provide a transparent acknowledgment of the study's limitations, paving the way for future research endeavors.

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