

Development of a science cartoon-themed poster: Environmental sustainability

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ABSTRACT

In today's world, where sustainable development has gained global precedence, cultivating environmental awareness among younger generations has become a central objective of education. This study seeks to develop instructional posters enriched with science cartoons to enhance middle school students' understanding of environmental sustainability. A design and development research approach was adopted to create instructional materials that are both visually engaging and pedagogically sound. Posters were produced on core environmental issues, including renewable energy sources, global warming, pollution of air, water and soil, acid rain, deforestation, desertification and waste management, and each poster was complemented by scientifically accurate and thought provoking cartoons. Expert feedback was incorporated throughout the development process to strengthen the materials' educational value and visual appeal. The resulting posters are posited to be pedagogically effective tools that capture students' attention, concretize abstract environmental concepts and promote long term learning. Consequently, these visual materials are expected to serve as functional educational resources for instilling values such as environmental responsibility, sustainability consciousness and ecological awareness.

Keywords: sustainable environment, science cartoon, poster, middle school student

INTRODUCTION

In the contemporary era, sustainable development and the associated sustainable environmental education have gained unprecedented importance in response to global environmental crises and socio-economic inequalities. The concept of sustainability was first defined in the Brundtland Report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development [WCED], 1987). This approach emphasizes the necessity of balancing economic development with environmental protection. Sustainable environmental education not only imparts knowledge but also transforms individuals' values, attitudes, and behaviors, thereby contributing to the creation of a more just, peaceful, and livable world. As emphasized by UNESCO (2017), education for sustainable development entails a holistic and transformative learning approach aimed at empowering individuals to become agents of change equipped with the knowledge, skills, and values necessary to make effective decisions at local and global levels. Reflecting the understanding that human actions lie at the core of environmental issues, the United Nations declared 2005-2014 as the “decade of education for sustainable development” and emphasized the integration of sustainability principles into educational policies. One of the fundamental goals of education for sustainable development is to ensure that individuals assume long-term responsibilities for their societies and the planet, fostering attitudes and behaviors aimed at preventing environmental degradation. Thus, sustainable environmental education encourages individuals to think and act in ways that contribute to a safer and healthier world, thereby improving quality of life. Interdisciplinary education programs developed based on this approach play a critical role in achieving the United Nations' sustainable development goals (SDGs) outlined in the 2030 agenda (UNESCO, 2017).

The importance of education as a key instrument for realizing SDGs is frequently underscored in both international policy documents and academic literature (Boeve-de Pauw & Van Petegem, 2018; UNESCO, 2005). Within this context, environmental education is conceptualized not merely as cognitive knowledge transfer but as a multidimensional and value-oriented pedagogical process aimed at fostering a sense of responsibility toward nature, ethical values, and long-term behavioral change (Gough, 2024). Environmental education during childhood and adolescence is especially critical, playing a decisive role in shaping environmental attitudes and behaviors (Bağçeli-Kahraman & Poyraz-Rüstemoğlu, 2023). Individuals in these developmental

stages are at the most effective phase for developing environmental sensitivity and value-based awareness; thus, early exposure to sustainability principles increases the likelihood of making conscious, environmentally responsible decisions in the future (Tilbury, 1995).

Rising global environmental challenges necessitate that individuals adopt environmentally sensitive, conscious, and responsible behaviors. Consequently, the realization of SDGs depends not only on environmental policies but also on enhancing individuals' environmental awareness and responsibility levels (Erdoğan, 2009). Recent studies highlight the efficacy of visual and interactive instructional materials in achieving these objectives. Visual materials such as concept cartoons, science-themed posters, comics, and animated films attract students' attention, concretize abstract environmental concepts, and increase environmental awareness (Danıştay-Şanlıtürk & Zeybek, 2022; dela Cruz & Aril-de la Cruz, 2018; Topkaya & Doğan, 2020).

Cartoons create cognitive conflict by humorously and visually presenting alternative ways of thinking that challenge students' existing knowledge, thereby supporting conceptual change (Çakır & Aydoğdu, 2016; İnel & Balım, 2011; Keogh & Naylor, 1999; Kılınç, 2008). Numerous studies emphasize the importance of widespread cartoon usage in lessons to promote more permanent learning and recognize cartoons as valuable educational tools (Burhan, 2008; Chin & Teou, 2009; Çiçek, 2011; Özalp, 2006). Cartoons used in education have been found to increase student motivation, contribute significantly to academic success (Akengin & İbrahimoglu, 2010; Akman, 2023; Ayhan, 2017; Demirci, 2013; Kocakavak & Erökten, 2021; Numanoğlu, 2024; Yurttadur & Pehlivan, 2020), enhance critical thinking skills (Başarmak & Mahiroğlu, 2015; Evrekli & Balım, 2010), facilitate learning and information retention (İspir & Aydın, 2020; Kleeman, 2006; Rule & Auge, 2005; Rule et al., 2008), and make lessons enjoyable (Çelik & Gündoğdu, 2016; Çelikler et al., 2017; Hastürk & Ballıel-Ünal, 2021; Kılınç, 2008; Kleeman, 2006). The attention-capturing nature and cognitive development support provided by cartoons and comic-based materials, especially among younger age groups, demonstrate their effectiveness in environmental education. For example, Topkaya and Doğan (2020) found that environmental-themed comics significantly improved 7th grade students' environmental achievement and attitudes, while Şahin and Arslan (2022) reported positive impacts of the "water ambassadors" animated series on 5th grade students' environmental literacy components. Similarly, Marques et al. (2023) and von Reumont and Budke (2023) highlight how scientific comics structure complex environmental concepts at an appropriate student level, enhancing both conceptual learning and environmental sensitivity. Additionally, Hamadneh and Alqarni (2023) noted that environmental cartoons significantly raised awareness among individuals with special learning difficulties.

In conclusion, visual materials support learning objectives across cognitive and affective domains, particularly contributing to the development of environmental sensitivity, a sense of responsibility, and motivation, thereby enhancing the quality of environmental education. Instructional posters incorporating science cartoons, developed within this framework, are regarded as innovative materials serving the aims of environmental education. This study aims to develop such instructional posters to foster environmental sustainability awareness among middle school students and to evaluate the functionality of these materials within the context of environmental education. The posters' visually appealing and engaging content is designed to facilitate students' comprehension of environmental concepts and encourage the development of responsibility toward the environment.

METHODOLOGY

Preparation of Posters

In this study, the design-and-development research method, defined as the design, development, and evaluation of technological products for educational or non-educational purposes (Richey & Klein, 2007), is employed. The design-and-development research method is used to produce concrete and applicable solutions to everyday life problems with the goal of product development (Büyüköztürk et al., 2017; Şengel, 2013).

The research focuses on developing posters containing science cartoons to raise awareness among middle school students about sustainable environmental issues. While designing the posters, considerations such as suitability for middle school students' grade levels, their attention spans, and what they should take away from the posters were considered. Additionally, the designed posters were created as indoor posters. Indoor posters allow for longer examination periods and convey the intended message indirectly, encouraging students to think critically while maintaining an aesthetic integrity.

During the preparation phase of the posters, prominent sustainable environmental topics such as renewable energy sources (solar, wind, hydroelectric, geothermal, biomass, and wave energy), global warming, air, water, and soil pollution, acid rain, deforestation, desertification, and waste management were reviewed. The aspects of these topics suitable for cartoon illustrations were identified, and science cartoons were designed accordingly. Special attention was given to ensuring that the science cartoons included examples from daily life. The designed science cartoons were illustrated by a professional cartoonist, and the posters were finalized.

Posters Prepared With Science Cartoons

In the 1st and 2nd posters prepared; renewable energy sources such as solar, wind, hydroelectric, geothermal, biomass, and wave energy are highlighted, as they enable energy production in harmony with nature. The aim is for students to both recognize these energy types and comprehend their positive impacts on the environment.

The 1st poster aims to convey the importance of renewable energy sources in an entertaining and educational manner. At its center, a smiling sun symbolizes the possibility of energy production through eco-friendly and sustainable means. The five rays emanating from the sun emphasize various renewable energy sources. The Wind Turbine represents the critical role of wind energy in sustainability. The hydroelectric dam highlights the efficient use of waterpower for electricity generation. The solar panel and

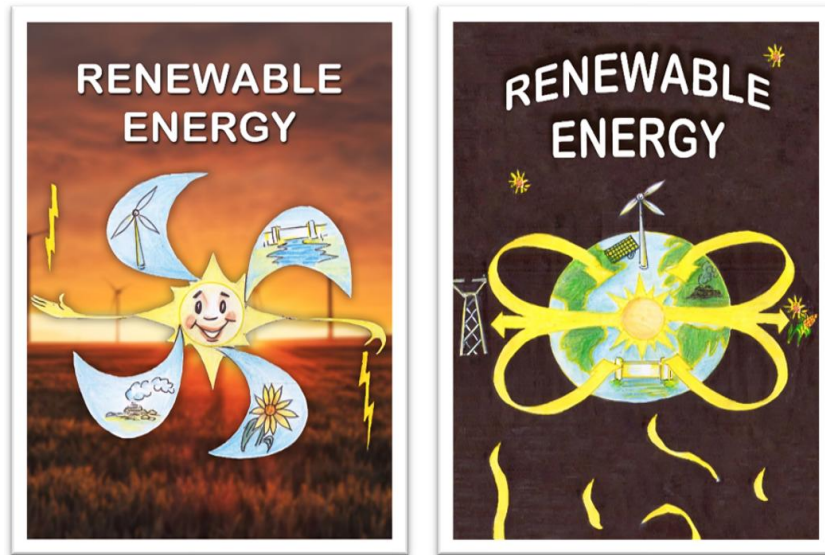


Figure 1. 1st and 2nd posters (Source: Authors' own elaboration)

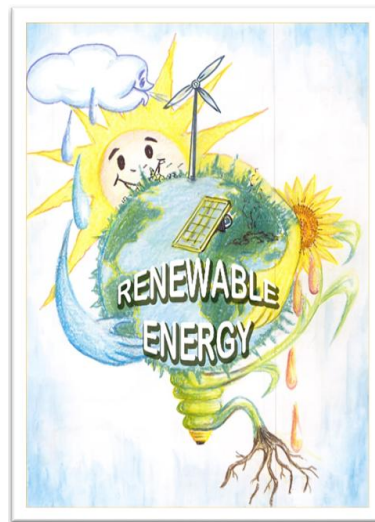


Figure 2. 3rd poster (Source: Authors' own elaboration)

sunflower symbolize solar energy and its harmony with nature. The cloud and rain illustrate the reusable water cycle and its relationship with energy production. The smiling sun at the center underscores solar energy as a clean and reliable energy source. In the background, wind turbines and a sunset depict how nature can coexist harmoniously with sustainable energy, while the phrase “renewable energy” at the top directly conveys the cartoon’s core message.

The 2nd poster emphasizes the importance and necessity of renewable energy sources. In contrast to the environmental harm caused by fossil fuels, it aims to raise awareness about the significance of utilizing renewable energy sources such as solar, wind, water, and biomass. Poster 1 and poster 2 are presented in **Figure 1**.

In the 3rd poster prepared, the importance of renewable energy sources in global electricity production is emphasized by symbolizing them with green leaves and trees, highlighting their eco-friendly and nature-conscious characteristics.

In the 3rd poster prepared; elements such as a smiling sun, wind turbine, solar panel, and sunflower symbolize the diversity of renewable energy sources and their harmony with nature. These elements emphasize the environmentally friendly and life-supporting nature of clean energy sources, while the earth design surrounded by roots at the bottom reinforces the idea that energy production should be deeply rooted in nature. Poster 3 is presented in **Figure 2**.

In the 4th and 5th posters that were prepared, the symbols of renewable energy sources are carried by a zeppelin and a balloon, depicted in a caricatured style. These posters emphasize the significant role that renewable energy sources play in transitioning the world into a cleaner and more sustainable energy system.

The earth image at the center of the prepared 4th poster symbolizes our planet’s need for these types of energy. Renewable energy sources are integrated into this visual, each representing both technological innovations and harmony with nature. Solar energy, wind turbines, hydroelectric sources, and plant-based elements, which are part of nature, highlight the diversity of future energy systems and the necessity of being eco-friendly. The smiling sun and surrounding natural elements used in the overall

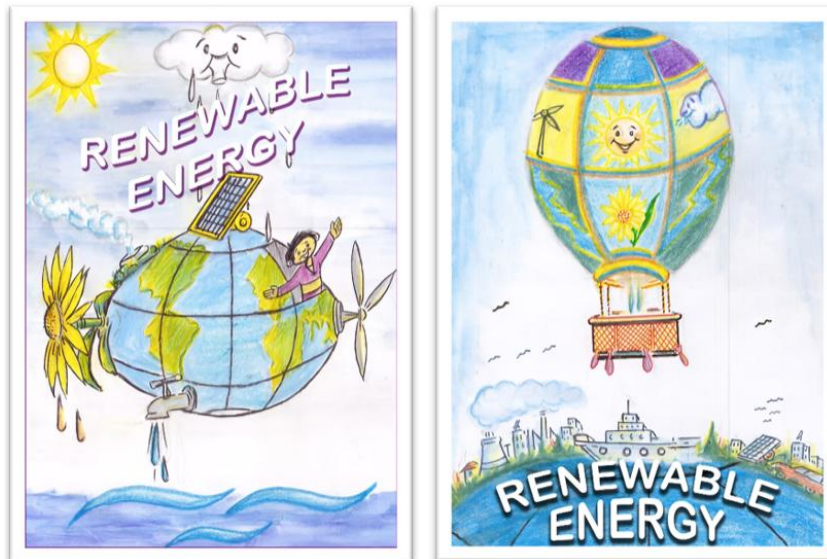


Figure 3. 4th and 5th posters (Source: Authors' own elaboration)

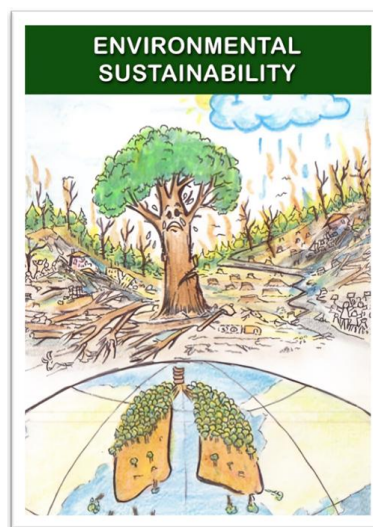


Figure 4. 6th poster (Source: Authors' own elaboration)

design convey a positive message, emphasizing that renewable energy is not only a necessity but also an opportunity for a hopeful future.

The prepared 5th poster is designed with a holistic approach to draw attention to the importance of renewable energy sources. Overall, it delivers an effective message combining the concepts of energy diversity and sustainability. The design emphasizes the energy potential offered by nature while also highlighting the need for technological innovations. The elements in the visual symbolize the harmony between nature and technology, as well as the necessity of reestablishing the balance between humans and the environment. Poster 4 and poster 5 are presented in **Figure 3**.

In the 6th poster prepared, the aim is for students to internalize and understand the consequences of deforestation by emphasizing that trees and forests are the lungs of the earth. In the 6th poster prepared; environmental sustainability and the impact of human activities on the planet are expressed in a striking manner. The tree with a sad expression at the center of the image serves as a warning against the destruction of nature. The depiction of the earth filled with forests resembling lungs is a powerful metaphor, emphasizing how vital forests are for the health of the planet. This design, which visually conveys the message “the earth cannot breathe without forests as its lungs,” aims to raise environmental awareness and increase understanding of sustainability. Overall, this poster not only draws attention to environmental destruction but also delivers a strong message about the critical importance of protecting forests. Poster 6 is presented in **Figure 4**.

In the prepared 7th poster, emphasis is placed on the harm caused to the world and living beings by soil pollution resulting from unplanned urbanization and waste from factories. The 7th poster prepared contains a striking metaphor focusing on environmental sustainability and the threats facing the planet. At the center of the visual, the earth is depicted with a cracked and dried surface, powerfully reflecting global environmental issues. Its barren and pale appearance symbolizes the disruption of nature's balance and the severe damage to ecosystems. Environmental threats such as fossil fuel use, industrial waste, and pollution are portrayed as the direct causes of this situation. Overall, this visual strikingly highlights the negative impacts of human

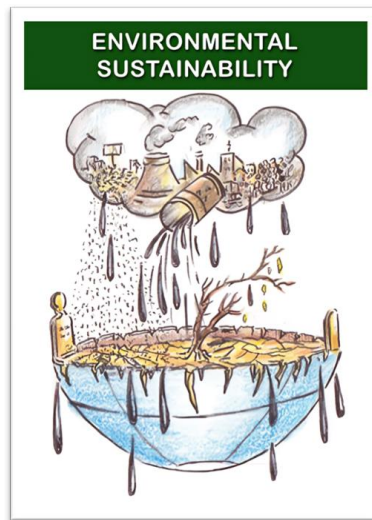


Figure 5. 7th poster (Source: Authors' own elaboration)

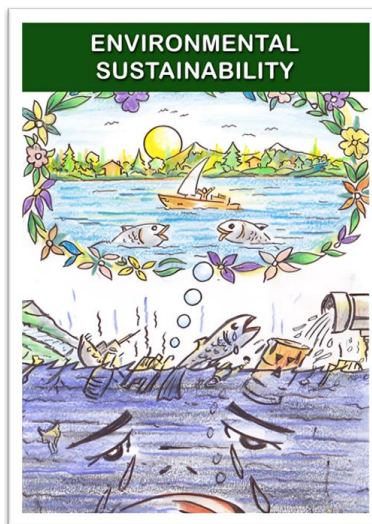


Figure 6. 8th poster (Source: Authors' own elaboration)

activity on the environment and the process of nature's depletion. The depiction of the earth in this manner strongly conveys a call to action for the protection of ecosystems and the promotion of sustainability. Poster 7 is presented in **Figure 5**.

In the 8th poster, which addresses the issue of water pollution, the emotional states of living beings are depicted through caricatures, comparing clean and polluted water sources. The poster emphasizes how water resources are contaminated by waste, causing harm to aquatic life.

Moreover, this visual conveys a powerful message about the importance of environmental sustainability by strikingly contrasting different states of nature. The composition juxtaposes a peaceful, harmonious natural environment with its degraded counterpart, creating profound meaning that encourages reflection on the necessity of environmental conservation. Poster 8 is presented in **Figure 6**.

Poster 9 clarifies the effects of air pollution on the environment using a visual narrative. It highlights the accumulation of gases emitted from households and factories in the atmosphere and the resulting harm to the planet. The visual particularly emphasizes the decline in breathable air quality, the increase in harmful atmospheric gases, and pollution factors threatening the environment. This serves as a powerful visual message, clearly conveying the multidimensional impacts of air pollution and its status as a global issue that requires urgent attention. Poster 9 is presented in **Figure 7**.

Poster 10 strongly emphasizes the numerous pollutants harming the environment and the devastating effects of waste on ecosystems. Gases emitted from households and factories stand out among air pollution components, while the uncontrolled accumulation of waste is visualized as another critical factor directly threatening the environment. Harmful gases accumulating in the atmosphere negatively impact habitats, whereas waste buildup pollutes both soil and water resources, endangering the sustainability of ecosystems.

The poster dramatizes the destruction caused by pollutants and waste in environmental balance, aiming to raise public awareness about this issue. The visual details concretely illustrate the dangers faced by the environment, strongly conveying the

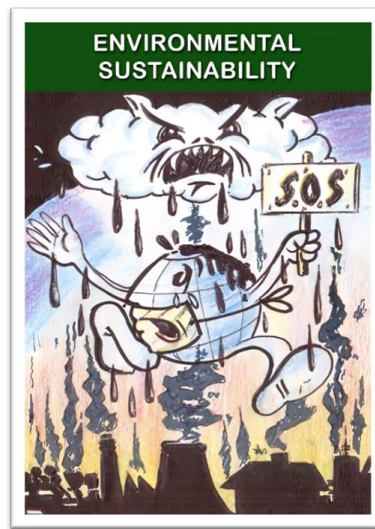


Figure 7. 9th poster (Source: Authors' own elaboration)



Figure 8. 10th poster (Source: Authors' own elaboration)

urgent need for action in these areas. This narrative serves as a call to action, encouraging individuals to adopt a more sensitive approach toward environmental problems. Poster 10 is presented in **Figure 8**.

Poster 11 carries a powerful message that vividly visualizes the impacts of environmental unsustainability on the planet. The illustration depicts environmentally harmful elements in a caricatured manner, with menacing clouds and spreading pollution portrayed as a looming threat to the earth. Specifically, it highlights how emissions from households and factories contribute to air pollution and direct environmental damage. Additionally, uncontrolled waste accumulation stands out as another factor negatively affecting soil and water quality. In this context, the poster exposes the multidimensional and interconnected effects of air and environmental pollution.

Furthermore, while emphasizing the multifaceted impacts of air pollution on the environment, the poster also makes an indirect reference to the formation of acid rain. Gases accumulating in the atmosphere due to air pollution descend to the ground with precipitation, adversely affecting soil and water resources. This process has devastating consequences for ecosystems, threatening vegetation, water sources, and overall environmental balance. By drawing attention to these cascading effects of air pollution, the poster aims to raise awareness about environmental protection and sustainability. Poster 11 is presented in **Figure 9**.

Poster 12 aims to raise general awareness about the impacts of environmental pollution on the world. The poster seeks to draw the attention of individuals and societies to fundamental environmental issues—such as air pollution, waste, and environmental degradation—by symbolizing them in a dramatic manner. Emissions from households and factories, along with uncontrolled waste accumulation, highlight the scale of environmental problems while powerfully conveying the potential devastation they may cause to ecosystems.

The poster reflects the adverse effects of human activities on nature and their cascading consequences using a visual language. Among the outcomes of environmental degradation are the weakening of ecosystems, depletion of natural resources, and air pollution. In the visual, the figure of the earth is depicted as if calling for help, evoking the need for individuals and



Figure 9. 11th poster (Source: Authors' own elaboration)

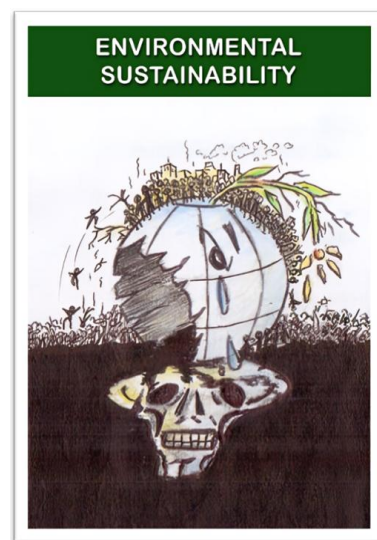


Figure 10. 12th poster (Source: Authors' own elaboration)

communities to take action to address environmental issues. Overall, the poster conveys a strong message about the necessity of environmental conservation and adopting a sustainable lifestyle. This message serves as an effective tool to encourage individuals to adopt more responsible attitudes and fulfill their environmental responsibilities. Poster 12 is provided in [Figure 10](#).

Poster 13 carries a powerful message emphasizing the adverse effects of global warming and climate change. The visual dramatically depicts the impacts of rising temperatures and climate change on nature, evoking global threats such as melting glaciers, rising sea levels, and ecosystem degradation. Additionally, it reflects the temperature increase caused by rising greenhouse gas concentrations in the atmosphere, contributing to the progressive warming of the earth's surface. The figure of the earth serves as a metaphor, directly affected by this warming and calling for help, urging individuals to act against this issue.

The poster also emphasizes the importance of adopting environmentally conscious behaviors at both individual and societal levels, while issuing a call to action to combat global climate change and drought, one of its direct consequences. In particular, drought—with its outcomes such as the depletion of water resources and the drying up of habitats—constitutes a key part of the poster's environmental message, highlighting the need to adopt more sustainable lifestyles to prevent such crises in the future. Poster 13 is provided in [Figure 11](#).

Poster 14 presents a positive narrative emphasizing the invaluable importance of conserving water resources. The cheerful globe figure at the center of the visual represents how access to clean and abundant water resources is vital for a sustainable ecosystem. The raindrops symbolize the continuous renewal of the water cycle and the healthy functioning of natural systems, while the flowers serve as a symbol of biodiversity and the richness of ecosystems. The poster visually conveys the role of water in the natural life cycle and its critical importance for the survival of all living beings. The vibrancy of the colors and the dynamic composition aim to draw attention to the life-sustaining properties of water, delivering a message of positivity to the audience.

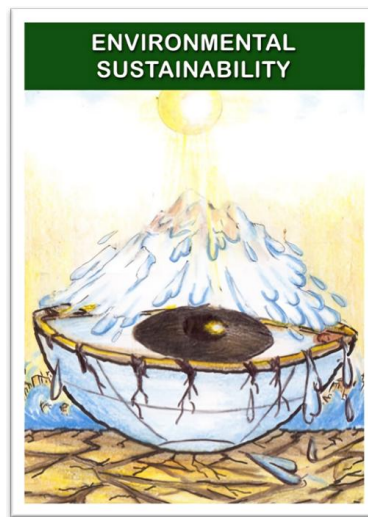


Figure 11. 13th poster (Source: Authors' own elaboration)



Figure 12. 14th poster (Source: Authors' own elaboration)

The poster strongly emphasizes that protecting clean water resources is not only essential for today but also a necessity for creating a habitable world for future generations. Its positive and motivational visual design stands out as an awareness-raising tool that encourages individuals to adopt more environmentally friendly attitudes. Poster 14 is provided in **Figure 12**.

Poster 15 addresses the theme of environmental sustainability in an exceptionally positive manner. The poster features various symbols representing nature and environmental elements, such as the sun, trees, birds, fish, water resources, and a house. Through these elements, the poster visually emphasizes the value of a healthy and balanced ecosystem. The cheerful and friendly demeanor of the character conveys the message of environmental sustainability in an optimistic way, demonstrating that this issue is an achievable goal for everyone. The elements in the poster illustrate the interconnected structure of the ecosystem and highlight the crucial role each component plays in environmental conservation. For instance, the water resources and fish signify the importance of healthy aquatic ecosystems, while the trees and birds symbolize the necessity of protecting terrestrial ecosystems. Overall, this poster communicates the importance of environmental preservation through a simple yet powerful narrative that is accessible to all. Aiming to raise societal awareness for a sustainable future, this visual carries a strong message with a positive approach. Poster 15 is presented in **Figure 13**.

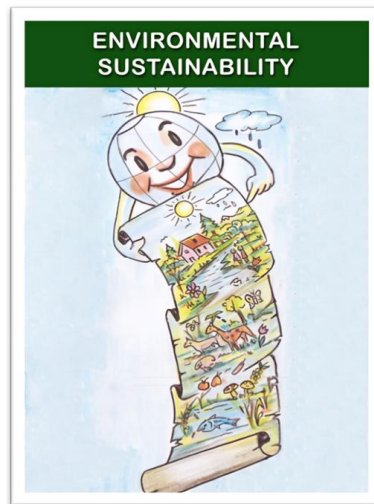


Figure 13. 15th poster (Source: Authors' own elaboration)

CONCLUSIONS

In the research, posters featuring scientific cartoons were developed, covering sustainable environmental topics, including renewable energy sources such as solar, wind, hydroelectric (hydraulic), geothermal, biomass, and wave energy, as well as global warming, air, water, and soil pollution, acid rain, desertification, and waste management.

In poster design, ensuring a balanced harmony between content and visual elements supports the clear communication of the message.

In this context;

- Using catchy and concise titles in posters helps the audience focus on the topic more quickly.
- The inclusion of illustrations, particularly symbolic renewable energy elements such as the sun, wind turbines, and waves, along with other environmental motifs, enhances the effectiveness of the poster's message.
- Vibrant colors and contrasting details create an engaging visual presentation, while ensuring that the tones align with the environmental theme is another crucial factor to consider. Indeed, the design of the posters has been developed in accordance with the specified criteria in terms of content and visual harmony.

The prepared posters have the potential to make sustainability issues more tangible and comprehensible for students. Students can more easily interpret the scientific concepts in the visuals and recognize the importance of environmental issues. For example, the images on the posters can spark curiosity and encourage students to conduct further research. Science cartoons enhance young individuals' environmental awareness in an engaging way by presenting complex environmental problems through humor or striking language. Additionally, visually explaining topics such as renewable energy and environmental pollution contributes to the development of a sense of individual and societal responsibility among students. Raising awareness of such critical issues can yield positive outcomes for a sustainable world.

The widespread dissemination of posters promotes environmental consciousness across society. Introducing renewable energy sources and environmental protection strategies can foster behavioral changes, encouraging individuals to adopt a more eco-sensitive approach. The themes in the posters create strong motivation for conserving natural resources and modifying environmentally harmful habits. In conclusion, such posters not only combine scientific accuracy with art to convey knowledge but also enhance environmental awareness among individuals, thereby contributing to a sustainable future.

Indeed, posters displayed on school walls are among the materials that influence students through their ability to deliver messages effectively and quickly, as well as through their color and design features. The posters developed as a result of this research include striking, surprising, and memorable science cartoons, which are expected to play a significant role in embedding messages related to sustainable environmental issues into students' memory. Posters enriched with science cartoons that present the identified themes in an impactful and memorable manner are considered important educational tools, as they facilitate easier reception and retention of sustainability messages, enhance students' interest and motivation to learn, and support the integration of sustainability into their life philosophies. Moreover, adapting these materials to digital platforms and making them interactive can further enhance the learning process by promoting active participation and engagement. Through applications tailored to different age groups, individuals with special needs, or specific cultural contexts, the potential educational impact of such visual materials on environmental education can be explored more deeply.

This study offers an original contribution to the field of visual material design aimed at fostering environmental education and sustainability awareness. In particular, the use of educational posters supported by science cartoons represents a relatively underexplored approach in the literature for concretizing environmental concepts and enhancing students' environmental awareness. By integrating components of both visual and environmental literacy, the study has developed an interdisciplinary instructional material, thereby demonstrating that environmental issues can be more effectively communicated within a

pedagogical framework. Conducted through a design- and development-based methodology, this research also contributes to the literature on educational technologies and instructional material development. Furthermore, by emphasizing the impact of humorous and thought-provoking content on students' learning motivation, it presents an original model for how visual narratives can be functionalized in the context of environmental education. In this regard, the study proposes both a theoretical and practical framework for enriching environment-themed instructional materials at both the visual and conceptual levels.

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Ethical statement: The authors stated that the study focuses on creative design processes that do not involve physical intervention on humans or animals, and therefore, ethical approval was not required. The posters have been used for the first time in this study, and the copyright of the posters belongs to the authors.

AI statement: The authors stated that no AI technologies were used in any part of this study.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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