

# Primary School Project Fostering Environmental Education through Art

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## Abstract

Promoting Education through the integration of Environmental Science and Art is a creative and innovative way to stimulate young people to learn Science and Art with pleasure. This study is based on the outcomes of an Educational Project implemented by Portuguese students from the D. Maria II School, V.N. Famalicão, Portugal. The project consisted in the implementation of several activities, exploring concepts related to 1) Science; 2) Art; and 3) Solidarity. The effectiveness of the project was assessed through student's engagement, quality of interactions and resulting products. According students' opinions, the experience of taking part in this project was exciting and help them to raise their understanding and interest about environmental issues. This study highlights the importance of taking advantage of art activities to teach and learn about environmental science.

**Keywords:** Innovation in education, STEAM education, interdisciplinary work, environmental education

## 1. Introduction

### 1.1 Introduce the Problem

Science education within schools is common and fundamental for intellectual growth; however, the association between environmental science and art is still unusual in Portuguese schools. Actually, some manuscript's report practices concerning interdisciplinary activity between the arts and sciences with interesting results. In this research paper, we intend to describe the results from an educational project where was adopted an interdisciplinary approach and using art activities to promote environmental literacy.

This work adopted art as a powerful channel for environmental awareness and this research describes how this approach induces student's awareness, knowledge, attitudes and skills related to environmental protection. This project is innovative since adopting an interdisciplinary approach that allowed the students' development of scientific, aesthetic and entrepreneurial mindset.

### 1.2 Explore Importance of the Problem

According to Ray (2012), environmental education presents a powerful contribution to public education regarding important environmental issues. Another author (Orr, 1992), claimed that environmental education would only be developed in children if it is integrated into a wider variety of subject areas such as art. Art education can and should be used to foster environmental literacy, and this form of literacy in children is considered by many educators essential to the continued existence of human life on this planet (Orr, 1992; Smith & Williams, 1999; Thomashow, 1995). Examples from other projects, like "Wetlands Environmental Art Project" (TransArtists, 2012), also demonstrated that this approach of environmental education through art is relevant, but also addresses attention to negative and positive environmental impacts, since revealed environmental issues related with food production and emphasizes organic aquaculture.

### 1.3 Describe Relevant Scholarship

Art is useful to communicate complex ideas in simple ways and also could influence values, beliefs and knowledge (Belfiore & Bennett, 2007). Is crucial that artists and scientists could find innovative ways to work

together and create new and relevant knowledge. Some scientists applied knowledge and methodologies from their own fields in order to gain new insights about how art is made and appreciated (Livingstone, 2002; Martindale, 2007). Robert Pepperell (2011), revealed the intersection between Art and Neuroscience. It is important to highlight that artists made certain discoveries relatively to human brains that are only now being discovered by scientists (Zeki, 1999). Related to environmental problems such as anthropogenic biodiversity crisis could also be treated through art, as addresses by several authors (e.g., A'Bear, Hayward, & Root-Bernstein, 2017; Ballengée, 2014; Curtis, 2017; Harrison & Harrison, 1993; Jacobson, Mcduff, & Monroe, 2007). McCullough and co-workers (McCullough, Martin, & Sajady, 2018), reported the implementation of "Green Walls in Schools" as a very advantageous strategy that combines art and science. From that project results it was demonstrated that Green walls are crucial to fostering critical thinking since they combined project-based learning strategies and environmental education (McCullough et al., 2018). The exhaustion of natural resources, and the increasing of waste production, has been linked to unsustainable human attitudes and behaviours (Oke, 2015; Stern, 2000). A work by Ray (2012), describe art projects with students using recycled and reused materials, which lead to a construction of a sculpture garden on the school. Furthermore, some artists explore their art relatively to the search of response to environmental problems (Muniz, 2010). This artist made art from trash collected at the world's largest trash dump outside of Rio de Janeiro. Art allows that the student practice, observe, value, analyses, synthesize and express their understanding and relationship with nature (Malosh, 2010).

#### *1.4 State Hypotheses and Their Correspondence to Research Design*

It is crucial that artists and environmental scientist work together effectively to create new and relevant knowledge. Since this project intends to use the available knowledge of art and science, we claimed that through this approach we will: (a) Increase students' scientific curiosity and foster critical thinking and attitudes; (b) encourage creativity; (c) promote environmental awareness; (d) arise students' knowledge about art; (e) encourage entrepreneurial attitudes; (f) instigate collective action through involvement of the School Community.

The activities designed for this project include some experimental and field work combined with hand-on art. This activity will mobilize knowledge about autochthonous flora and Portuguese forest and increase students' knowledge about reusing and recycling materials in order to promote sustainability. The activities were designed to promote connection between environmental science and art. The assessment of the activities was performed in qualitative terms and was mainly focused on the processes, rather than products.

## **2. Method**

This is a school project and the specific research questions addressed were: to what extent: (a) are students familiar with the term autochthonous plants and can identify autochthonous plants from the Portuguese forest? (b) Are students conscious about the importance of reuse and recycling the materials in order to promote sustainability? (c) Are students motivated for art? (d) Are students sensitized to the importance of solidarity behaviours? (e) The project methodologies motivate students?

### *2.1 Participants*

The activities of this project were developed between December 2017 and September 2018. This project involved two schools, both belonging to School Cluster D. Maria II. V.N. Famalicão, Braga district. D. Maria II (n = 40) and Gavião School 1st Cycle, 4 year (n = 17). For this work we used a convenience sample. The participants D. Maria II aged between 12 and 16 years old and Gavião School 1st Cycle aged between 9 and 10 years old. This study was approved by the School Board of D. Maria II, V. N. Famalicão, after a hearing the Pedagogical Council because there is no ethics committee at the School. D. Maria II student's participation was voluntary, however the Gavião School 1st Cycle, 4-year students' participation was mandatory, since are integrated in the project "Science in School". Informed consent was obtained verbally from the students' guardians on behalf of the students enrolled. This consent was obtained during a regular meeting, in which the class director explained the aims of the project and requested authorization from the parents. Written informed consent was obtained from the students' guardians for the pictures shown in the manuscript. All the other data used in this study were anonymized. This is a collaborative project.

### *2.2 Activities Implemented*

Activity 0-Kick-Off: Creation of a Logo: The objective of this activity was to create a logo to make known this research. In this phase, we aimed at transmitting the importance of creating a brand as a strategy to promote/market a product or activity. We start this activity with a lecture about the story of logo creation. To

motivate the students, the speaker made a review of the logos success stories such as those related to the automotive industry. Subsequently, a pre-study was started in order to create the logo. Clues were provided to students to ensure that everyone participated. The pre-study consisted in the execution of a great mural under the role of scenery using oil pastel, with all the students' proposals. This mural was built by the 17 students of the Gavião School. Later, the best drawing was selected and became the project logo. Our aim is to show the importance of a product presentation to the consumer's in order to attract attention. In this stage through artistic production was possible to develop student's competencies and entrepreneurial thinking forms.

Activity 1 - Campaign to collect recyclable and organic materials: This phase was implemented throughout the project with the help of the students' guardians of the 17 students of the Gavião School. Plastic containers, tin cans, glass, stoppers, cork stoppers, cardboard fabrics, shells, conch, whelks, trunks and textile waste were collected. In this phase, besides the importance of the involvement of students and guardians, it was pointed out the importance of recycling materials and their reuse as a way to reduce environmental impacts created by the modern society due to the current consumption patterns.

Activity 2- Interactive lecture plus practical work- Listening to Science: The objective of this activity was to know autochthonous plants from Portuguese forests, measures for their conservation and protection. This phase was developed by an expert in this field, the Plant Biologist Sérgio Leite. He focused their lecture on Gerês Forest, the main protect area in Portugal. Gerês is the only National Park in Portugal (it is located in the Norte region, in the northwest of Portugal, specifically in the districts of Viana do Castelo, Braga and Vila Real). This area was created in 1971 due to its great national and international scientific value, and aims to protect the soil, water, flora, fauna, and landscape, while preserving the existent human and natural resources. Nowadays, in education and tourism are also feeling of this park. Sérgio Leite presented images of autochthonous species from Gerês such as: *Quercus robur*, *Quercus pyrenaica*, *Ruscus aculeatus*, *Acer pseudoplatanus*, *Prunus lusitanica ssp*, *Arbutus unedo*, *Ilex aquifolium*, *Iris boissieri*, *Hypericum androsaemum*, *Melittis melissophyllum*, *Vaccinium myrtillus*, *Salix repens*, *Betula pubescens*, *Spiraea hypericifolia ssp. abovata*, *Circaea lusitanica* and *Angelica laevis*. The researcher referred to the remarkable botanical diversity of forests, riparian vegetation and bushes of Gerês highlighting the presence of sparse and endemic species. This aspect is crucial since, in Portugal, the increase of exotic species is a threat to autochthonous plants and is a serious environmental problem. Exotic plants could develop new morphologies and reproductive behaviours to compete successfully in habitats. Additionally, they have the capability to spread over vast regions, even at considerable distances from the parent plants. Managing and monitoring this species is extremely difficult and expensive. Preventive solutions to control this situation are needed, in order to avoid their initial introduction.

The Plant Biologist was also concerned with the Portuguese forest since it is an essential ecosystem for soil protection; he focused the problem of the forest fires a national level given the vital functions of this ecosystem.

Later was developed a practical activity with the students. He distributed leaves of autochthonous species from Gerês for the student's decal, drawing attention to several details regarding leaves namely shape, trim and ribbing. To finish, students-built Leaf Fossils using moldable plaster paste.

Activity 3- Interactive lecture about fire prevention: This activity was developed by the Fire Commander of V.N. Famalicão Volunteer Firefighters. The Commander starts their presentation showing a video film about their Fire Department. In this video he exhibits all the firefighter's functions, namely: combat to fire and other natural disasters, wounded transport and ludic activities. After, he dedicated the lecture to forest fires stressing the main causes and care in their protection. Emphasis was placed on the role of native flora in fire prevention and sustainable environmental practices. Students were questioned about behavior's in order to avoid fires and warned of the danger of fires. To conclude, students were informed about the numbers, 112 and 117, in order to contact the firefighters.

Activity 4- Recycling workshop- Listening to Science: This activity was invigorated by Scientia Team from University of Minho, Braga, Portugal and start with an interactive lecture. The objective of this activity was to explore some contents such as: 3 R's policy and new R's (Refuse, Rethink and Respect). Several examples of the use of recyclable materials were presented. Furthermore, the Scientia Team addressed problems related to the use of fossil fuels and renewable energy. The water scarcity problem was emphasized being into consideration that such problem affects all the national territory. The severed water footprint was highlighted, being referred the necessary values for the production of food products. This constitutes a great surprise for the students, since being astronomical values. In the second part of this activity the composting phenomenon was explained with the help of devices built by students. They use plastic bottles in order to build a composting pile. Several materials were used such as sand, earth, ashes, chestnut leaves, potato, apple and banana peels. The device top was

covered by a permeable sock to promote oxygenation. The resultant product of this experiment was used as fertilizer for trees that the students planted in the activity 5.

Activity 5- Garden improvement: The objective of this activity was to plant autochthonous species from the Portuguese forest in the school garden with the aim of enhancing the respect, the protection and the conservation of our autochthonous forest. We selected some species such as: *Quercus robur*, *Quercus pyrenaica*, *Acer pseudoplatanus*, *Prunus lusitanica ssp* and *Arbutus unedo*. The soil was previously prepared and students with teacher guidance planted the species above referred. The soil was fertilized with the product resultant of the activity 4. Wooden plaques with vulgar and scientific name were placed next to each species planted. This activity was open to all the School Community.

Activity 6- Interactive lecture about the importance of native forest and solidarity with the victims of fires: The objectives of this interactive lecture were: a) to sensitize students to the products and services provided by the forest and b) to appeal for solidarity with fire victims. The last objective is very timely given that Portugal in the last years was flogged by fires which resulted in numerous human and material damages.

In the first part of this activity, the teachers involved promoted an interactive lecture based on the Shel Silverstein Book entitled "The Generous Tree" using a PowerPoint presentation. This book pointed out the importance of the forest and the biodiversity associated. This book also draws attention to the forest product's richness and its environmental and recreational role. Subsequently, the focus was on cleaning the forest as a fire prevention measure. In the second phase of this activity, aspects related to human solidarity and sharing were addressed through the "Lizard History". Several examples of Human Solidarity have been mentioned, with particular emphasis on the fire victims.

Activity 7- Construction of three-dimensional artistic objects allusive to Portugal: This phase involved students and teachers of several cycles of learning. The three-dimensional artistic objects were built using recyclable and/or organic materials. In this stage our intent to combine Science and Art. The materials used were: waste from the textile industry, plastic, empty cans, used tissues, remains of wood, shells, sand, whelks, used paper, cork stoppers, plastic bottle caps. We build five artistic objects such as: Portuguese sardine (figure 6), Barcelos cock (Figure 7), Installation called "On the Memory Rails" inspired on Bordalo Pinheiro Sardine and Portuguese Sidewalk, made by traditional cheetahs (Figure 8), Folding Screen related with Fado (traditional Portuguese music), Panel inspired in the Portuguese Mosaics. Since the School D. Maria II is geographically located in a traditional textile area, we used mainly remains of textile fabrics.

Activity 8- Exhibition of artistic work: In this activity, students with the help of the teachers set up an exhibition with the three-dimensional artistic objects building in activity 7, in the Arts House of V.N. Famalicão. This exhibition in open to the general public and was noticed in the Portuguese National TV (RTP1).

Activity 9- Solidarity auction/Public sale: The last activity of this project was realized on September 27, 2018 in the Arts House of V.N. Famalicão and was a solidarity auction. The three-dimensional artistic objects were auctioned. The money obtained in this auction will revert to the victims of the fires that devastated Portugal in the summer of 2017.

During the activities 1, 2, 4, 5 and 7 workshops, hands-on field and experimental work promoted practical knowledge useful for day-to-day and simultaneously raising the standards of scientific knowledge.

### 3. Results

The results obtained in this study were only qualitative (Fig 1), and we believe that the repercussions will be visible in the following years in terms of student's behaviour change.

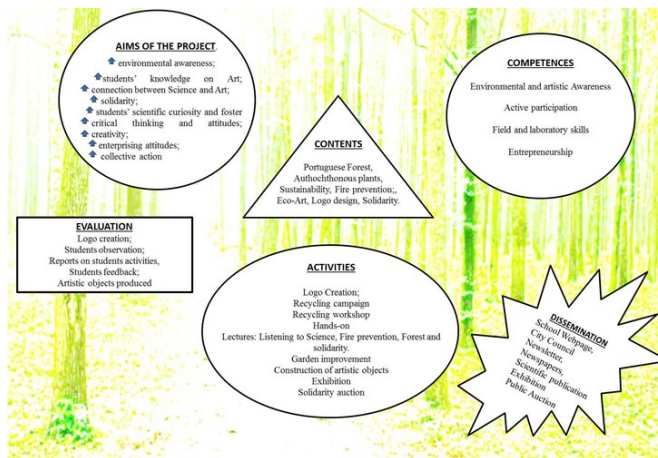


Figure 1. Project Diagram

This project comprises a variety of important practical activities (Fig 2, 3, 4) where students have worked with autonomy. Teachers have an important meditative role in order to scaffold the students' work. The context in which the project was developed, allowed a very active involvement of students, namely: a) logo development, where the students worked the scientific illustration and the construction of the mural based on the pre-study. In this activity, students were very enthusiastic.



Figure 2. Practical activity- leaves decal



Figure 3. Students building a composting pile



Figure 4. Autochthonous species plantation

We observed students' entrepreneurial competences in terms of design and creativity; b) collection and sorting of recyclable materials with the parent's involvement.

This activity promoted sustainable development and interaction between students/parents, the involvement of both was fantastic; c) Interactive lecture plus practical work (activity 2), the students were very interventionist, made numerous questions and did practical activities with concernment and great enthusiasm; d) Recycling workshop (activity 4), students with the collaboration of the Scientia Team developed several competences related to science, such as discussion, problem solved, experimental work, inquiry, accuracy and precision. They learned about the composting process, and with plastic bottles have built devices for mounting a compost pile. They used several materials such as: sand, earth, ashes, chestnut leaves, potato, apple and banana peels.

The resulting product was used as fertilizer in the trees that the students planted in the activity 5. This activity that involves hands-on was very appreciated by the students; they participated with great enthusiasm, making a lot of questions. In the activity 5, students of several years of learning developed fieldwork with the help of the teachers. They had contact with nature and learned about autochthonous species from the Portuguese forest.

The activity 7 was the heart of the project, students of different levels developed fine motor, creativity, imagination and problem-solving skills. They were involved in the construction of artistic objects with soul and heart (Fig 5, 6, 7). In addition to the time that the teachers reserved for this activity, students during the breaks worked in the artistic works and always have been very committed and enthusiastic.



Figure 5. Three-dimensional artistic objects allusive to Portugality - Portuguese Sardine



Figure 6. Three-dimensional artistic objects allusive to Portugality - Barcelos Cock





Figure 7. “On the Memory Rails” inspired on Bordalo Pinheiro Sardine and Portuguese Sidewalk

In this stage Science and Art were discussed and articulated. There was a concern to use only organic or recyclable materials to build the artistic objects. According to the master Nadir Afonso, a well knowing Portuguese painter “The work of art is governed by laws which are only apprehended by sensible intuition, only people who work forms, those who develop their perceptual intuition understand the mechanism of creation. Intuition develops through work”.

In the exhibition installation, activity 8, student’s involvement was remarkable; they developed skills related to communication, aesthetics and spatial distribution of objects. This activity was noticed in the Portuguese National TV. In the activity 9, auction, it is noticed the call for values related to human solidarity. This activity was disseminated in the local radio (Radio Cidade Hoje).

#### 4. Discussion

In 2015, the United Nations Organization (UN) defined the “17 Sustainable Development Goals”, the new agenda until 2030. This agenda is the result of the joint efforts between governments and citizens around the world. It aims to create a new global model to eradicate poverty, promote prosperity and well-being, protect the environment and combat climate change. The present work exploits the proposed objectives such as number 4 and number 12, namely: Quality in Education and Sustainable Production and Consumption (Rieckmann, Mindt, & Gardiner, 2017). It was assumed that human activities intensely change the world, leading to biodiversity loss, without key changes in policy and human behaviour (Newbold et al., 2015). In this study, we design a holistic approach between Environmental Science and Art.

In the first part, we focused on environmental education which is crucial since enhances awareness of environmental problems, promoting students’ behaviour change (Steg & Vlek, 2009). In this perspective, the activity 2, about autochthonous species from Gerês Forest constituted a key moment. Workshops improve integrated learning, resulting in learning achievements that students recognize and appreciate (Durrant & Hartman, 2015; Schreck Reis, Marchante, Freitas, & Marchante, 2013). The activity 5, “Garden improvement”, also promotes environmental education and awareness. This activity involved hands-on activities, which were very appreciated by students at this age. Research has shown that environmental gardens enhance student learning by incorporating a hands-on approach to experiential learning, impacting on both the personal and educational levels (Skelly & Bradley, 2000). The activity 3, developed by the Fire Commander is associated with the activity 2, promote knowledge for: a) forest protection/conservation, b) sustainable environmental practices and c) explore the role of firemen’s in fire prevention and fight. This activity motivated very much the students, since they see firemen’s as heroes. The link between natural disasters, such as fire and the emergency of solitary behaviours was treated in the activity 6 through a children’s story.

In this project the reuse of materials and the reduction of waste played a major role and translated into meaningful learning on how to reduce the environmental impact of some products by giving them a new life through the creation of three-dimensional artistic works. The activity 1, recyclable campaign, and the sensitization of the Scientia Team from UM, activity 4, were critical at this stage and constitutes a bridge for the activity 7. Results from the literature revealed that taking part in recycling activities could developed environmental behaviors with wide participation levels among populations (WRAP, 2008). Chase and collaborators published results concerning a recyclable campaign showing that the majority of the participants “agreed” or “strongly agreed” that campaign messages increase awareness about recycling (Chase, Dominick, Trepal, Bailey, & Friedman, 2009). The researchers from the team “Scientia, UM”, during the activity number 4 engaged students in tasks about these issues, using several strategies such as active discussion, collaborative work and practical work. The use of several materials was reported in order to build new products. Contents related to the 3Rs policy were revisited and new R’s presented such as Refuse, Rethink and Respect. This

approach is crucial since there is still a lack of knowledge about what can be recycled. A survey conducted in 2000 households in England shows that a considerable number, about 30%, are still confused about what and where to recycle (Moore, 2015). However, according to Hopewell and co-workers there is an increasing public awareness about the need to find new sustainable patterns of production and consumption (Hopewell, Dvorak, & Kosior, 2009). This fact must encourage: a) local authorities organize a gathering of recyclable and reusable materials, b) manufacturers to develop products with recycled waste, and c) other businesses to supply this public demand (Hopewell et al., 2009). With the activity 7, Art and Environmental Science were connected. Data from the literature reveal studies showing the positive link between Art and Science (MacRitchie, 2015).

Building science-inspired art can increase students understanding about, for example, the biodiversity crisis. Art education should be used to raise environmental literacy and is considered to be critical for the sustainability of human life on this planet (Smith & Williams, 1999; Thomashow, 1995). Several researchers demonstrated the need for added arts-based, effective approaches to environmental education. It was believed by several authors (e.g., Gradle, 2007; Graham, 2007; McKibben, 2005) that art education offers the possibility of altering behaviour toward the environment. A study developed by Inwood also showed an important contribution of eco-art education (Inwood, 2013). Recently, Harrower and his co-workers revealed the great potential of combining art and science to influence public understanding and concern relative to species loss (Harrower et al., 2018). In Harrower's related case, was found that art has the potential to evoke a strong emotional response that could inspire new behaviours (Harrower et al., 2018). Art has the possibly to influence values, belief, knowledge and the development of societies (Belfiore & Bennett, 2007).

A great deal of creativity is required to make scientific breakthroughs, and art is just as often an expression of or a product of scientific knowledge. Some of the most famous examples of the interconnection between art and science are the work of Leonardo Da Vinci, the paintings of Marianne North's, with tropical plants with both historical and scientific records. Also, Charles Darwin considered North's paintings, excellent examples of natural selection. Together, art and science help us to interpret studies and explore the world (Richter & Wallis, 2017).

## 5. Conclusion

In this work we developed awareness, knowledge, attitudes and skills related to environmental protection. Furthermore, we promoted the interconnection between Art and Environmental Science. This project also allowed students' acquisition of a new model of scientific, innovative and entrepreneurial culture.

Thought the engagement of students in this project they have developed cognitive, affective and fine motor skills. Additionally, students become more aware about the importance of sharing and became more solitary, since they achieve the strengthens about their collective actions.

The limitations of this study are connected with the fact that this intervention was carried out with a small group of students, in particular context. In order to transfer these results to other contexts, teachers and researchers must take that into account. The sustainability of this project through the time must be ensured. In order to accomplish that we need to replicate this approach with a larger number of students. It is also important to include more hands-on activities in the student's curriculum and engage a larger number of teachers for different subjects, artists, scientists and scholar community. Students need to have more opportunities like this so it is important to reinforce this kind of interventions in schools.

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