Social Education Research
https://ojs.wiserpub.com/index.php/SER/

UNIVERSAL WISER PUBLISHER

Research Article

Can We Raise the Level of Environmental Awareness Through Art?

Rock Finale

Secondary School of Commerce and Visual Merchandising Ljubljana, Ljubljana, Slovenia
E-mail: rock.finale@gmail.com

Received: 25 July 2024; **Revised:** 9 January 2025; **Accepted:** 18 February 2025

Abstract: In this paper, we underscore the importance of integrating environmental education into the curriculum at all levels of education, especially at the primary level. Teachers are called to adopt innovative didactic approaches, such as Problem-Based Learning, Inquiry-Based Learning, Experiential Learning, and Gestalt pedagogy, to foster environmental consciousness in students. This study presents an experimental investigation conducted in two Slovenian primary schools, involving a sample of 154 fourth-grade students with an average age of 9 years. The research demonstrated that the innovative model of teaching environmental content through visual arts (ECTA) is a new approach that significantly enhanced students' environmental knowledge, awareness, attitudes, and behaviors toward the environment. The experimental group exhibited statistically marked improvements compared to the control group, with higher mean percentages in artworks and more positive ecological attitudes and behaviors. A key research finding was the statistically significant correlation between students' artworks and their environmental awareness, attitudes, and behaviors toward the environment in the experimental group. A strong, statistically significant correlation was found between artwork theme and environmental awareness in the experimental group ($r = 0.88$, $p < 0.001$). This correlation was not observed in the control group ($r = 0.077$, $p = 0.503$), underscoring the transformative potential of the ECTA approach. By encouraging the creative use of recycled materials and linking artistic expression to ecological topic, this approach provides a holistic learning experience that bridges theoretical knowledge with practical application. The broader adoption of interdisciplinary and innovative teaching models such as ECTA, is necessary to enhance environmental education. It is also important to emphasize the role of fine arts in cultivating ecological responsibility and creative engagement.

***Keywords*:** environmental awareness, fine arts, interdisciplinary integration, cross-curricular integration

1. Introduction

Scholars, teachers, and psychologists have identified significant limitations in the traditional *ex-cathedra* approach to teaching, particularly in its application to natural sciences. This method, characterized by authoritative, discipline-bound, and unidirectional instruction, often emphasizes the accumulation of factual knowledge without fostering interaction or critical engagement (Fiordelli et al., 2023; Taverna et al., 2023; Colucci-Gray et al., 2012; Pedretti, 2014). While effective for conveying structured information, this approach is insufficient for addressing interdisciplinary and complex issues such as environmental education, where shaping individual attitudes and fostering proactive behaviors are critical (Permanasari et al., 2021).

DOI: https://doi.org/10.37256/ser.6120255368

Comparative studies reveal that active learning strategies, such as Problem-Based Learning and Experiential Learning, significantly enhance student engagement, comprehension, and retention in environmental education compared to the *ex-cathedra* method (Negro et al., 2024; Finale, 2021; Diković & Gergorić, 2020; Schüßler et al., 2019). These approaches facilitate interdisciplinary integration, particularly between natural sciences and the arts, fostering a holistic understanding of environmental issues. Art education, when combined with natural sciences, offers a unique avenue for developing environmental consciousness, as artistic creation inherently engages with themes and materials derived from the natural environment (Summers, 2003; Hauser, 1961).

In Slovenia, connections between art and ecology are largely underrepresented in primary school curricula, with integration often limited to declarative mentions. Selan (2022) argues that "Art textbooks help teachers explain the content of art concepts in a way appropriate to children's level of artistic development". However, it was established that teachers prefer to conduct lessons their way, although collaborative teaching would give a better result. Art can be a bridge for collaboration between teachers of different subjects, especially in enhancing environmental awareness. Nonetheless, global research highlights the potential of ecological art, and artworks, addressing themes of environmental pollution or created using recycled materials as a transformative educational tool. This art form encourages students to engage with their environment critically and creatively, fostering ecological awareness and community involvement (Holmes, 2006; Song, 2009; Neperud, 1997; Gablik, 1991). Art significantly contributes to the development of a sustainable society by awakening consciousness through its capacity to express thoughts and emotions. This process enhances students' cognitive skills and fosters environmental empathy, cultivating a compassionate understanding of nature (Liao, 2024; Şeren & Gül, 2022; Dewey, 1938).

The symbiotic relationship between natural sciences and visual arts enriches students' understanding of sustainable development. Visual art, rooted in themes, colours, and mediums derived from nature, reflects humanity's connection to the environment while promoting creativity and ethical reflection (Kavčič, 2011; Summers, 2003). Integrating these fields in education nurtures critical thinking, values-driven decision-making, and a lifelong commitment to sustainable and resilient living. Art education, by motivating curiosity and exploration, enhances students' aesthetic and cognitive development and reinforces principles of ecological responsibility and sustainable living, as confirmed by research findings.

2. The development of environmental awareness, knowledge, attitudes, behaviors towards the environment, and environmental sensitivity

Environmental education and the associated environmental awareness are linked to both, scientific content and visual arts (Akins & Akerson, 2002). Environmental awareness develops an understanding of the issues faced in the modern world, emphasizing the recognition and comprehension of environmental problems and the ability to formulate alternative solutions. When seeking solutions, it is essential to start from concrete life circumstances, as these encourage students to find their answers. Attitudes toward the environment influence the development of an individual's environmental ethics. In addressing environmental content, it is important to start from the child's experiences, values, and attitudes towards the environment, as environmental values and the value system are primarily dependent on early childhood experiences related to nature, family environmental values, role models, friends, teachers, and also education. Attitudes toward the environment can be defined as long-term positive or negative emotions towards a particular issue, object, or the environment as a whole. These attitudes are shaped by knowledge, values, and emotional involvement, leading to environmental awareness (Kollmuss & Agyeman, 2002).

The White Paper on Education in the Republic of Slovenia emphasizes the introduction of sustainable development insights and strategies, as well as various approaches that enable a sustainable and enduring relationship with natural resources (Krek & Metljak, 2011). A new draft proposal of the National Education Program for the period 2023-2033 has been published that also advocates for the introduction of new, cleaner, and more environmentally friendly technologies that contribute to reducing the threats to nature (ecosystems) and lead to the improvement of society and, consequently, nature.

Visual arts contribute to environmental awareness through their emotional component, which is evident in the treatment and transformation of attitudes toward environmental issues and behavior toward the environment (Orr, 1992).

The integration of environmental awareness with art education in primary schools is most commonly reflected in the use of recycled materials for artistic projects, which Frelih (2011) defined as artistic recycling. Through artistic recycling and engagement, students can contemplate social and, more profoundly, environmental issues that necessarily concern humanity as a whole (Graham, 2007). Environmental awareness pioneer Dewey (1938) argues that art as an activity can serve as a bridge between humans and nature.

Environmental awareness can be influenced primarily through experimental lessons in which students participate. When fostering environmental awareness, knowledge is essential, as well as outdoor education, watching scientific programs, and films (Yumusak et al., 2016; McGuire, 2015; Le et al., 2014; Hadzigeorgiou & Skoumios, 2013).

The relationship between behavior, attitude, knowledge, and environmental awareness is presented in the form of a funnel (Figure 1). The students typically acquire attitudes and behavior in their home environment, and knowledge while awareness subsequently gained through the educational process. Environmental awareness is influenced by the integration of formally and informally acquired knowledge with attitudes and behavior. The arrow in the diagram represents emotions connecting behavior, attitude, and knowledge with awareness. Only through emotional involvement can individuals become aware and sensitive to environmental issues.

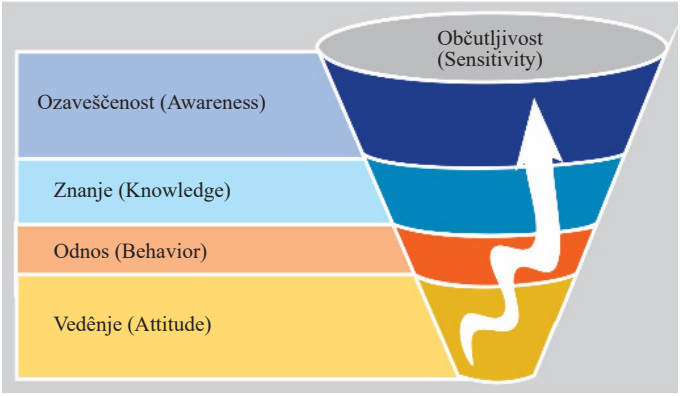

Figure 1. Awareness funnel; relationship between behavior, attitude, knowledge, and awareness
Source: Finale (2021)

3. Fine art and environmental awareness

Visual arts stem from a profound emotional connection to the environment, which is crucial for artistic creation. The emotional response of individuals to environmental influences (such as colours and their contrasts, lines, surfaces, and objects in nature/environment) is evident in their interpretation and recreation in space (theatrical scenography, architecture, and landscape architecture-gardens and parks).

Since ancient times, natural materials (broken branches, charcoal, sand, soil of various granulations, colours, and shades) have been essential for creation and painting, enabling humans to imagine space and the surrounding plants and animals everywhere. The "coexistence" of nature and humans has always led to the creation and depiction of the observed, making artistic creation an excellent basis for education as it synthesizes all acquired knowledge and skills. Regardless of the period in which a particular artwork was created, nature and the human environment have always been a source of inspiration. Nature and the artist's environment are the most commonly used motif of artists. Artists usually combine several techniques, such as painting, drawing, and collage, so individual works can be very relief-like (Brommer, 1994) and naturalistic.

In the 1990s, Finland established environmental education, where visual arts (education) play a crucial role. Visual arts education was taken as the basis of teaching, becoming a significant reason why students venture into nature and become more connected with it. Art enables individuals to perceive new information with their senses, making it easier to transform them into artistic works (Rauhala, 2003). Through artistic creation, individuals connect sensory, perceptual, emotional, cognitive, symbolic, and creative levels (Alerby, 2000), leading to reflections on life and the individual's

impact on the environment and nature. In the context of environmental awareness, art has the potential that conventional science education lacks, often based on a predetermined pattern of knowledge transmission (Song, 2012; Tereso, 2012; van Boeckel, 2009; Blandy et al., 1998).

Through artistic creation, individuals can perceive the environment on a different level, as art captures individuals unprepared and challenges them, with the ability to transport individuals into their world. Artistic creation is, therefore, an experiential learning process that is inherently open. Environmental awareness through artistic creation leads to a different and deeper understanding of human impact on the environment.

Visual arts should be the primary tool of education to elevate sensitivity towards the environment. The artist and the scientist deal with the same material: the world (e.g., sounds, colours) and life within it, but in a different way. The scientist collects material purposefully and systematically. They rely on notes, extracts, and tables. The artist's environment, however, encompasses everything they experience in their surroundings: nature, people, colours, and sounds they see and hear. The artist observes and studies the world differently from the scientist and inventor. Their observation is more subjective and blends with their emotions, beliefs, values, styles, and similar internal contents. They process and select observations in real time through their internal filters (Pečjak, 2006).

3.1 *Visualization in the natural sciences*

Visualization is one of the options for presenting information in a graphical form, which has gained prominence in recent decades. Its advantage lies in its universal clarity regardless of the language and phenomenon it represents. Visualization can also be defined as an essential element in acquiring knowledge, often being part of scientific fields such as architecture, geography, and natural sciences, among others. Visualization elements encompass various objects that help the student form appropriate visual representations of a specific natural phenomenon or concept. These objects can be different models, analogies, and metaphors, depicted in 2D or 3D static images in print or electronic media (Devetak, 2007). Visual elements are commonly used in various forms and media today, so it is necessary to prepare students for these artistic elements, which primarily serve explanatory and illustrative roles in learning materials. Students must understand the communicative power of visualizations and be able to read and interpret them.

We can also speak of visual literacy as part of scientific literacy, where students need to understand what visualization is, how it is created, and for what purposes and when it is used before it is employed in teaching. The basics of understanding visualization elements can be introduced to students in various school subjects (Alper et al., 2017).

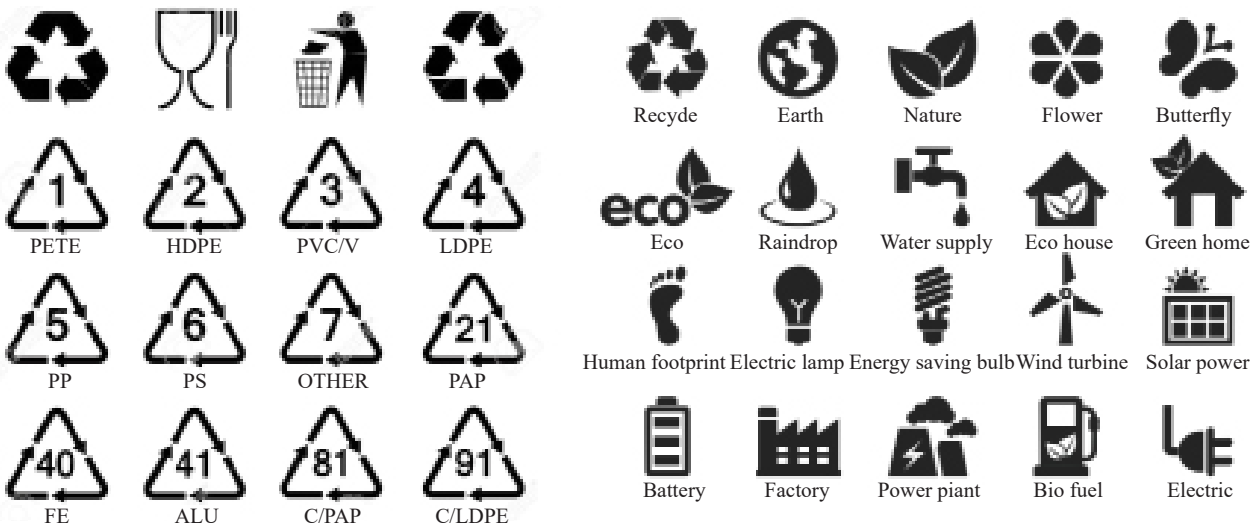

Figure 2. Example of pictograms as independent visual elements (visualizations)
Source: Freepik company (2024)

Visualizations facilitate understanding abstract concepts and enhance learning through comprehension and acquisition of various content. Moreover, visualizations are particularly suitable for students with learning difficulties because they need to have access to as many visual elements as possible, which provide additional support for different learning styles. Pictograms as standalone visual elements contain and convey simple information (Figure 2). The intersection of science and art leads to a point where both coexist. Science describes reality in a rational way, art with emotions, and both use common tools in the form of visualizations such as sketches, pictograms, and models to illustrate individual scientific phenomena and concepts.

4. About the developed model of innovative teaching of environmental content with visual arts (ECTA)

The innovative ECTA approach is a combination of project-based learning with a problem-solving focus on environmental content, integrating research and a heuristic approach in fine arts. This method fosters holistic self-expression, encompassing personal ideas and emotions through drawing and designing. It promotes student independence under the teacher's guidance, enhancing comprehensive and active engagement with waste material issues and their reuse in art creation (Burton et al., 2000; Drake & Burns, 2004; Behren, 1998). This approach prioritizes the structured organization of the learning process, thereby facilitating the acquisition of durable knowledge applicable in everyday contexts (Krek & Metljak, 2011).

The ECTA teaching approach is characterized by: (1) creating a pleasant emotional and social climate through teacher involvement, fostering a creative atmosphere among students, and providing additional attention to students with special needs when necessary. (2) promoting holistic, independent research work by students and pair work based on the principles of Gestalt education and learning, wherein students identify types of waste materials, their properties, and potential reuse in creating artworks. Gestalt pedagogy is a trust-based approach that emphasizes students' innate ability to identify and meet their own learning needs. It blends art and science, fostering a learning environment where personal and professional growth are intertwined. By encouraging self-responsibility and mutual respect, teachers aim to create an engaging, shared experience that supports both foundational knowledge and practical skills. Students also learn the significance of pictograms on packaging (Göktuğ Kılıç & Parsıl, 2023; Woldt, 2009). (3) teachers monitor the creation of artwork. Students become familiar with the criteria for evaluating artworks and assess their work with the teacher.

The developed ECTA approach is divided into nine teaching units (Table 1) conducted in nine segments, each lasting from two to eight school hours. The first three teaching units (12 school hours) focused on understanding the impact of civilizational development on the environment, emphasizing the issue of municipal waste. The following six teaching units (28 school hours) integrated the discussed environmental content with fine arts.

The distribution of hours demonstrates a clear commitment to using art as a vehicle for environmental education and creative expression. While this allocation fosters deep engagement with both disciplines, teachers must remain attentive to maintaining balance. Ensuring that the artistic process is not subordinated to interdisciplinary objectives and keeping activities dynamic and engaging was crucial for maximizing the benefits of this time allocation.

To assess the implications of the allocated hours on teaching and learning art, we must consider both the benefits and potential limitations of the given time distribution (1) Art's Role in Interdisciplinary Learning is shown mostly as prominently integrated across multiple units (e.g., Units 2, 3, 4, 5, and 9), indicating its role as a medium for interdisciplinary learning. The six hours in Unit 2, focusing on waste and recycling, and the five hours in Unit 3, examining environmental themes in animated films, suggest that art is used to contextualize and reflect on environmental issues. (2) However, while these connections enrich students' understanding, the emphasis on other disciplines (e.g., natural sciences or geography) might overshadow deeper skill-building and conceptual understanding of art itself. (3) Hours Dedicated Solely to Artistic Creation are in a couple of units, such as Unit 6 ("Nature Can Draw" 3 hours) and Unit 8 ("Warm-Cold Contrast" 8 hours), and focus exclusively on artistic exploration. These units provide students with opportunities to develop their technical and creative abilities, as well as reflect on the emotional and expressive dimensions of art. (4) Eight hours for a single artistic task in Unit 8 demonstrates a deep commitment to fostering

technical precision and self-expression. This extended duration supports mastery but could risk disengagement if not scaffolded with varied activities or breaks.

Table 1. Nine teaching units of the ECTA teaching approach

Teaching unit	Content	Cross-curricular links	Number of lessons
1. Ecolution [The term "ecolution" was coined and used as the title of the first teaching unit]	Living, travelling, trade	Science and technology, Social studies	3
2. Waste and landfills	Generation, collection, and recycling of waste, landfills, recycling pictograms, waste decomposition in the sea	Science and technology, Visual arts	6
3. Environmental themes in animated films	Human impact on the environment, pollution, impact on animals, habitat destruction	Science and technology, Visual arts	5
4. Environmental art	Waste quantities, artwork made from waste	Science and technology, Visual arts, Mathematics	4
5. Film waste land	Exploring Brazil and the world's largest landfill, Trash art	Visual arts, Science and technology, Geography, English, Mathematics	4
6. Nature can draw	Drawing a tree in the wind, autumn forest colouring, spring blooming	Visual arts	3
7. Ljubljana marshes	Observing the marshlands, documenting illegal dumpsites	Science and technology	3
8. Art assignment	Warm-cool colour contrast	Visual arts	8
9. Home reading	Exploring literary works on environmental pollution themes	Slovene language, Visual arts, Science and technology	4
			Total: 40 hours

Source: Finale

Art often supports learning in other disciplines, such as environmental education (Unit 2), mathematics (Unit 4), and geography (Unit 5). While this integration promotes cross-disciplinary connections, it may diminish the focus on art as a distinct discipline. For example, Units 4 and 5, which allocate 4 hours each, combine art with mathematics and geography, potentially limiting time for creative experimentation or in-depth exploration of artistic methods. The total proportion of art is approximately 22-24 hours in the 40-hour program and involves direct or indirect engagement with art. This significant allocation underscores art's central role in the curriculum, providing students with an opportunity to develop creative thinking and visual expression. However, it also raises questions about whether this allocation sufficiently balances the time required for other essential skills, such as critical thinking, scientific analysis, or problem-solving in environmental contexts.

Art-based interdisciplinary learning can enhance engagement, particularly when tied to relatable environmental issues, as seen in Units 2, 3, and 4. These hands-on, creative tasks can foster curiosity and intrinsic motivation. However, the diversity of activities is crucial to prevent fatigue, especially in units with longer durations (e.g., Unit 8's 8-hour task). A variety of methods (e.g., collaborative work, and peer critiques) may help maintain student focus.

5. Research problem and objectives

The primary aim of the research was to evaluate the designed ECTA teaching approach in teaching environmental content through interdisciplinary integration, which employs active forms and methods of work. The ECTA approach specifically addresses the relationship and impact of humans on the environment, particularly concerning waste and waste as a material for artistic creation. The insights and results of the research can assist teachers in primary and secondary schools, who seek innovative teaching approaches but often lack the resources, knowledge, ideas, and confidence to implement this type of teaching. In addition, inclusion is welcomed and valued, so that all participating students can feel welcomed.

6. Method and sample

6.1 *Method*

The study employed quantitative research, utilizing a causal-experimental educational research method (Stuart & Rubin, 2008; Sagadin, 2003; 1993). In the causal-experimental method, participants are randomly assigned to either an experimental or a control group, reducing bias and allowing for more reliable conclusions about causality. This approach is commonly used in medical research, psychology, and pedagogy, as it helps to understand how specific interventions influence outcomes. A key advantage of this method is that it enhances the reliability of findings (Lin et al., 2021). The impact of the effectiveness of the developed ECTA approach on the understanding of environmental content, environmental awareness, and environmental knowledge of fourth-grade elementary school students was investigated. A quantitative method of scientific research (Mesec, 1998) was used with artworks on the environmental theme of Ljubljana Marsh Natural Park. Environmental content awareness was evaluated using criteria such as theme (alignment with the topic), composition (clarity, structure, horizontal, diagonal, vertical, or golden ratio), and creativity (originality in using basic shapes and lines, and innovative expression in using colours and/or prints like flowers). These criteria align with study objectives by demonstrating subject understanding, applying research methods effectively, and fostering critical, original thinking about environmental issues. For the artworks assessment, division into groups of art (below average, average, and above average), and mean calculations, we used Slovenian grades from 1 to 5, which coincide with the five-point Likert scale. For statistic analyses, we used The Pearson contingency coefficient (C_{corr}), correlation (r), percent (%), and mean (M) with degrees of freedom (df).

We also reviewed natural sciences, and fine arts curricula, seeking interdisciplinary connections between science, technique, and visual arts.

6.2 *Sample*

In the study a total of 154 fourth-grade elementary school students participated, representing 0.85% of the total population of fourth-grade students (SURS, 2024). Of the 154 participating students, there were 71 (46%) male and 82 (54%) female students. The average age of the students at the time of the study was nine years. All students were assigned codes used throughout the study, and only teachers who assigned students codes knew the link. Students were divided into experimental and control groups based on their performance on the environmental knowledge test, and afterward by their choice, so it was random. At a 5% risk level, it was found that there was no statistically significant difference in the success rates between the two groups (p = 0.167). The experimental group consisted of 37 (24.03%) male students and 39 (25.32%) female students, while the control group comprised 35 (22.73%) male students and 43 (27.92%) female students (Table 2). All students are from the Central Slovenian region, the suburbs of Slovenia's capital city Ljubljana.

Table 2. Number of students according to group (experimental, control) and school code

Group					
Control			Experimental		
Code of school	Students (N)	Students (%)	Code of school	Students (N)	Students (%)
PR	21	27	PR	28	37
ŠK	29	37	ŠK	29	38
ŠK	28	36	ŠK	19	25
Total	78	100	Total	76	100

Source: Finale

7. Measuring instrument

The environmental knowledge test was the first instrument used just for student division. The test was composed according to the science and technology curriculum, namely: separate waste collection and the importance of separation, waste can be used as raw materials (organic waste, paper, plastic, metals, packaging, etc.), people's attitude towards water, soil and air pollution, water consumption and human responsibility for sustainable development.

The art task was the second, and for this paper, the most important instrument. It was essential for linking visual art and science. It was based on the environmental theme of the Ljubljana Marsh Natural Park. This location was chosen as students of both schools live close to it, and it is a historically and even more environmentally important place in the geographical area. For the task, students created a poster using warm/cool colour contrasts in the collage technique. They collected waste paper, magazines, newspapers, and promotional leaflets, then identified warm and cool colours and used cut-outs.

In this task, students identified warm and cool colours in nature, developed skills in colour relationships, contrast, and shape arrangement, and enhanced their manual and artistic expression skills.

The students' artworks were evaluated by three independent assessors from the field of visual arts. When assessing a student's artwork for its environmental attitude, it is essential to incorporate assessment criteria for the ethical implications of the artwork, its ability to engage viewers emotionally and cognitively, and the contextual factors that enhance its impact. Similar was highlighted by Ahmed and Aly (2023) and Keller et al. (2020), who stated that evaluators should consider how well the artwork communicates its environmental message and engages the audience in reflection on ecological issues. Furthermore, Klöckner and Sommer (2021) emphasize that visual art inspired by environmental issues can evoke strong audience reactions and facilitate a deeper understanding of environmental challenges. The aim of the art task, among others, was to awaken strong feelings in students. Those emotions would provide higher environmental awareness or even environmental sensitivity.

Two criteria were developed for evaluating the artworks. (1) The original artwork reflects the student's sensitivity to environmental issues demonstrates imaginative artistic expression. (2) The student has successfully aligned the theme with environmental issues, artistic concepts, and the use of materials. Both criteria in the students' art task were assessed with grades from 1 [Slovenian grades translated to USA grades: excellent (5 = A), very good (4 = B), satisfactory (3 = C), sufficient (2 = D), insufficient (1 = F)] to 5. Grades were based on Slovenia's primary school grading scale, and also correspond to the five-point Likert scale used for statistical analysis.

8. Research results: differences between experimental and control group students in the art task

The same art task was conducted before and after teaching with the ECTA approach. Both groups (control and experimental) had the same preparation, theme, and art technique. Before the introduction of the ECTA approach, there were no significant differences in the evaluations of the individual criteria for the artworks between the two groups.

However, after the approach was implemented, noticeable differences emerged in the artwork assessment.

A key difference after teaching is that students in the control group began creating assemblages, and their artworks predominantly featured cool tones (Figure 3). Very few students in the control group adhered to the main instruction of warm-cool contrast.

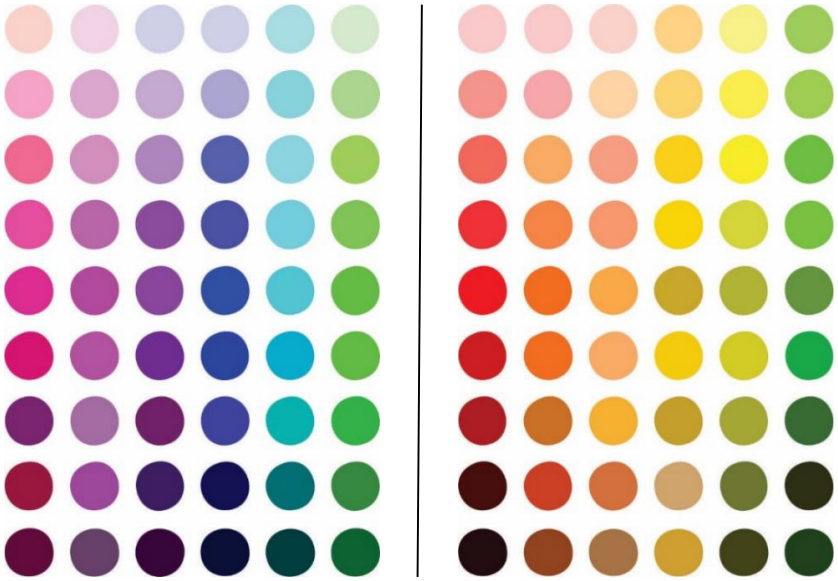

Figure 3. A cool colour palette that also contains warm colours (left), and a warm colour palette that also contains cool colours (right)
Source: Finale (2021)

The artworks of students in the experimental group, after being taught using the ECTA approach, are more vibrant in terms of colour as they adhered to the main instruction regarding the warm-cool contrast. This is particularly noticeable when comparing the artworks between the two groups. The art tasks completed after teaching with the ECTA approach are technically better executed, with clearer ideas and greater environmental sensitivity demonstrated compared to their peers in the control group. The artworks of students in the experimental group generally achieve higher grades-good, very good, and even excellent-as they successfully align the theme with environmental issues, art concepts, and appropriate use of materials. They also show greater environmental sensitivity and sreative expression than those of the control group.

Table 3. Mean values of the evaluation of works of art by three evaluators before and after teaching according to the group

Criteria	Evaluator	Before teaching				After teaching			
		Experimental		Control		Experimental		Control	
		M	df	M	df	M	df	M	df
5	JS	3	0.9	2.8	0.8	3.4	0.85	3.3	0.84
	SM	2.8	1.12	3	1.41	3	1.22	2.7	1.33
	RF	3	0.78	2.9	0.7	3.4	0.85	3.3	0.8
6	JS	2.9	0.95	2.8	0.8	3.4	0.85	3.4	0.81
	SM	2.8	1.07	3.1	1.21	3.1	1.19	2.6	1.24
	RF	2.9	0.81	2.8	0.71	3.4	0.85	3.3	0.78

Source: Finale

The results indicate an understanding and adherence to the instructions. The artworks of the experimental group students reflect a higher level of environmental awareness after the teaching. From the average ratings of the evaluators, it is evident that the artworks of the experimental group students are more original after teaching, compared to those of the control group, with the former also being more environmentally sensitive and having a richer artistic expression.

The students in the experimental group managed to align the theme with environmental issues, art concepts, and the use of materials in their artworks (Table 3).

The average grade of the artistic works of the students of the experimental group in the measurement after teaching with the ECTA approach increased by 0.5 points, while it remained unchanged for the students of the control group (Table 4).

Table 4. Mean values of the evaluation of works of art by three evaluators before and after teaching according to the group

Group	Before teaching	After teaching	N
Experimental	2.8	3.3	75
Control	2.9	2.9	78

Source: Finale (2021)

In addition to the change in the assessment of artworks before and after teaching with the ECTA approach, the Corrected Pearson contingency coefficient (C_{corr}) was applied to indicate the measure of the correlation between the artworks and their evaluations before and after the teaching. The strength of this correlation varies depending on the similarity of the artwork's execution or the similarity of the evaluation criteria grades before and after the teaching.

First criterion: The original artwork shows the student's sensitivity to environmental issues and rich imagination. After the teaching, there is a statistically significant improvement in the originality of the experimental group's students' artworks. The artworks also demonstrate greater sensitivity to environmental issues and are richer in imagination than pre-teaching assessments (p = 0,001). The Pearson contingency coefficient (C_{corr} = 0.302) indicates a weak correlation between the artworks before and after the teaching.

Second criterion: The student successfully integrated the theme with environmental issues, artistic concepts, and the use of materials in their artwork. The students in the experimental group showed a statistically significant improvement in integrating the theme with environmental issues, artistic concepts, and the use of materials (p = 0,001). The Pearson contingency coefficient (C_{corr} = 0.187) indicates a weak correlation between the artworks before and after the teaching.

The students in the control group did not show statistically significant improvement in their artworks for any of the criteria after the teaching. Furthermore, the Pearson contingency coefficient (C_{corr} 0.621 < C_{corr} < 0.836) indicates a strong correlation between the artworks before and after the learning. This strong correlation suggests minimal changes in the artworks (use of materials, composition, colours, and especially sensitivity to environmental issues and alignment of the theme with the given topic) after implementing the ECTA approach compared to the artworks before the ECTA approach.

Table 5. Division of works of art according to evaluation

Below average artworks		Average artworks		Above average artworks	
Group		Group		Group	
Experimental	Control	Experimental	Control	Experimental	Control
6 (8%)	17 (21%)	31 (41%)	34 (44%)	38 (51%)	27 (35%)

Source: Finale (2021)

The artworks of the students, based on their group, were divided into three categories after the implementation of the ECTA approach, according to the average grade of the first, fifth, and sixth criteria (Table 5). The artwork was classified according to given grades, with grades 1 and 2 combined as below average, 3 as average, and 4 and 5 combined as above average.

Examples of students' artwork:

A. Below-average artworks according to criteria related to environmental awareness

The artwork of the students in the control group appears very random. There are no clippings from magazines and advertisements. Bottle caps are superficially pasted, unevenly or rather accidentally, without spatial and artistic order. The spatial landscape pattern is not visible, and the student also does not show environmental sensitivity in the artwork. The average grade of the artwork is insufficient (1/F). (See Figure 4)

Figure 4. Artwork A
Source: Finale

The artwork of the student in the experimental group does not show environmental sensitivity and is very random with too many white surfaces that do not exist in nature. The student used artificial leather as material, not even following the instructions on color contrast. The landscape pattern of the Marshes is not visible, and no environmental sensitivity is observed in the artwork. The average grade of the artwork is insufficient (1/F). (See Figure 5)

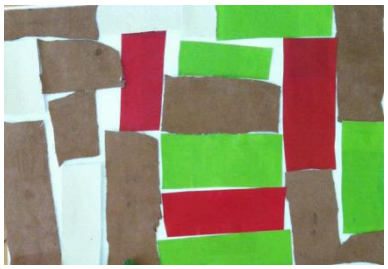

Figure 5. Artwork A
Source: Finale

B. Examples of average artworks according to criteria related to environmental awareness

The average artwork of the student in the experimental group indicates very good environmental awareness. The art motif is only well coordinated with the environmental theme of the art assignment, the student used manley warm shades of cuttings. The artwork is rated satisfactory (3/B), and the average artwork grade is 3.3. (See Figure 6)

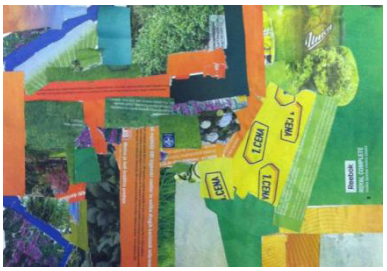

Figure 6. Artwork B
Source: Finale

The student in the experimental group used color contrast moderately successfully, as well as average environmental sensitivity, reflected in the unrealistic landscape pattern with mostly flooded fields of cultivated areas. The average grade of the artwork is satisfactory (3.2/B). The grades of the individual criteria are also 3, which is higher only for a well-executed glueing technique. (See Figure 7)

Figure 7. Artwork B
Source: Finale

C. Examples of above-average artworks according to criteria related to environmental awareness

The student in the control group used color contrasts very successfully and showed environmental sensitivity by depicting the marshes from a bird's eye view. The landscape pattern of the Ljubljana Marsh is exceptional, almost photographically accurate. The average grade of the artwork is 5/A, and the grades according to individual criteria are also excellent (5/A). (See Figure 8)

Figure 8. Artwork C
Source: Finale

The student in the experimental group consistently followed the criteria for color contrast, as the opposite colors blue, yellow, green, and orange were used. Unlike the previous students, they decided to depict the Marsh from a point of view of a person standing in the March. Environmental sensitivity is evident in the landscape pattern and the use of clippings with plants that are an essential part of the Marsh, and in the slogan "Living Marsh" (si. Živo Barje). The average score for all three criteria is excellent (4.5/A). (See Figure 9)

Figure 9. Artwork C
Source: Finale

Originality of Artwork about the Student's Level of Environmental Awareness.

The Pearson correlation coefficient in the experimental group, which assesses the originality of the artwork about the student's sensitivity to environmental issues, strongly correlates with environmental awareness and is also statistically significant ($r = 0.98$; $p = 0.003$).

In the control group, the correlation between the first criterion and environmental awareness is negligible ($r = 0.117$; $p = 0.307$) and is statistically insignificant.

Alignment of Artwork Theme with Student's Environmental Awareness.

The correlation between the second criterion, which assesses how well the student has aligned the theme with environmental issues, art concepts, and use of materials, and environmental awareness is strong and statistically significant ($r = 0.88$; $p = 0.001$).

In the control group, the correlation between the second criterion and environmental awareness is negligible ($r = 0.077$; $p = 0.503$) and is statistically insignificant.

Originality of Artwork about Student's Environmental Behaviour.

The correlation between the first criterion, which evaluates the originality of the artwork based on the student's sensitivity to environmental issues and environmental behavior, is weak among students in the experimental group ($r = 0.325$; $p = 0.426$) and not statistically significant.

In the control group, the correlation between the first criterion and environmental behavior is negligible ($r = 0.038$; $p = 0.741$) and not statistically significant.

Alignment of Artwork Theme with Student's Environmental Behaviour.

The correlation between the second criterion, which evaluates how well the student has aligned the theme with environmental issues, artistic concepts, material use, and environmental behavior is also weak and not statistically significant ($r = 0.309$; $p = 0.474$).

In the control group, the correlation between the second criterion and environmental behavior is negligible ($r = 0.144$; $p = 0.21$) and is not statistically significant.

9. Discussion and conclusion

9.1 *Discussion*

Children's artwork is a significant medium for evaluating their environmental awareness and attitudes, but it is necessary to consider their general and artistic developmental levels. Research indicates that integrating art into

environmental education can effectively enhance children‘s understanding of ecological issues. For instance, Zhongbin (2024) highlights the use of art as a tool for assessing children‘s environmental attitudes, demonstrating that modified drawing prompts can yield insights comparable to traditional survey methods. Approaches using art engage children creatively, and emotionally, and allow teachers to assess their environmental consciousness through visual expression. Moreover, Flowers et al. (2015) further support this notion by illustrating how children‘s drawings can serve as a practical tool for measuring environmental attitudes and awareness. Their study, which involved a comparison of children‘s drawings with a conventional survey instrument, revealed that art-based evaluations can uniquely capture distinct components of environmental perception. This aligns with the findings of Papavasileiou et al. (2020), who emphasize the role of wall painting activities in schools as a means to enhance children’s awareness of environmental issues. Eco-art projects encourage students to develop a deeper connection with their surroundings, fostering long-term changes in environmental behavior.

By utilizing art as a medium for expression and assessment, teachers can foster a deeper understanding of ecological issues among children.

The ECTA teaching approach not only enhances creativity but also cultivates a sense of responsibility towards the environment, ultimately contributing to a more sustainable future.

The comparison of the data collected with the artwork assessments served as the basis for determining the impact of the ECTA teaching approach on knowledge, attitudes, behavior toward the environment, and environmental awareness in students’ art. Statistical analysis of the quantitative data confirmed that the developed ECTA teaching approach significantly contributed to improvements in knowledge, more appropriate attitudes and behavior towards the environment, and higher environmental awareness among students in the experimental group compared to those in the control group.

Statistically significant changes in favor of the experimental group were observed across all six evaluation criteria. The average score of the experimental group’s artworks increased by 0.4 points after the ECTA teaching approach. The categorization of artworks into three groups (below average, average, and above average) showed that the majority of the experimental group’s artworks were classified as above average (51%) and average (41%), whereas most of the control group’s artworks were classified as average (44%) with a higher number of below-average works (17%).

Some other authors (Zhongbin, 2024; Papavasileiou et al., 2020; Huzjak, 2018; Birsa, 2015; Flajšman, 2008) also report on the impact of teaching methods. The correlation between environmental sensitivity and the alignment of the theme in the artworks of the experimental group students with environmental awareness, attitudes, and behavior towards the environment increases in strength from the below-average to the above-average artwork categories, with a similar trend in statistical significance, what was confirmed by Flajšman (2008) in a similar survey, but just on natural science field. In the artworks of the experimental group students, the correlation between environmental sensitivity and behavior towards the environment is more evident than in the artworks of the control group students.

While the study provides strong evidence for the efficacy of the ECTA teaching approach, the sample size was limited to a single educational context, which may affect the generalizability of the findings. Besides a small sample, the research also has a shortcoming in its duration, as it was adapted to the schedule of six grades in two primary schools. The instruments in the study were used without changes before and after teaching, which negatively impacted the implementation of the art task. Students could have shown even greater creativity in expressing environmental sensitivity in their artworks, with changes and additions to the theme and/or art technique.

The study results show that problem-based teaching with cross-curricular connections, such as the implemented ECTA teaching approach, is suitable for developing environmental awareness and acquiring knowledge about the environment and environmental art. It is also important to draw attention to the teacher’s adequate knowledge, continuous improvement, and the awareness that innovations allow students to develop an interest in various subjects, especially in natural sciences and fine arts. At the same time, it is important to emphasize that when connecting subjects, none should be in a subordinate position, especially not fine arts.

Future research should also explore the long-term impact of the implemented ECTA teaching approach on students’ environmental behavior beyond the classroom setting.

9.2 *Conclusion*

The developed ECTA teaching approach, which is at the same time problem and project-based, derives from the

natural science and technology curriculum and the fine arts curriculum. Before and after the teaching intervention, students from both groups completed the same art task. The comparison of the data collected served as the basis for determining the impact of the ECTA teaching approach on attitudes, behavior toward the environment, and environmental awareness in students' art.

Statistical analysis of the quantitative data confirmed that the developed ECTA teaching approach significantly contributed to improvements in more appropriate attitudes and behavior towards the environment, and higher environmental awareness among students in the experimental group compared to those in the control group.

Acknowledgements

The author would like to express their deepest gratitude to the late Professor Dr. Saša A. Glažar and Associate Professor Dr. Jurij Selan for their guidance and constructive discussions throughout this study. We are also thankful to Suzana Thaler for her assistance with students' artwork assessment.

Conflict of interest

The author declares that there are no financial, personal, or professional conflicts of interest that could have influenced the research, analysis, or interpretation presented in this manuscript. No funding agency or external entity was involved in the study design, data collection, analysis, or decision to publish.

References

Ahmed, H., & Aly, A. (2023). Recycled waste materials in landscape design for sustainable development (al-ahsa as a model). *Sustainability, 15*(15), 1-13.

Akins, A., & Akerson, V. L. (2002). Connecting science, social studies and language arts: An interdisciplinary approach. *Educational Action Research, 10*(3), 479-497.

Alerby, E. (2000). A way of visualising children's and young people's thoughts about the environment: A study of drawings. *Environmental Education Research, 6*(3), 205-222.

Alper, B., Riche, N. H., Chevalier, F., Boy, J., & Sezgin, M. (2017). Visualization literacy at elementary school. In: *2017 CHI Conference on Human Factors in Computing Systems* (pp. 1-13). ACM.

Behren, R. R. (1998). Art, design and gestalt theory. *Leonardo, 31*(4), 299-303.

Birsa, E. (2015). *Medpredmetno Povezovanje Pri Pouku Likovne Vzgoje: Doctoral Disertation [Intersubject Connecting at Art Education Lesson: Doctoral Dissertation]*. Doctoral Dissertation, Univerza Na Primorskem, Pedagoška Fakulteta [Doctoral Dissertation, University of Primorska, Faculty of Education].

Blandy, D., Cangdon, K. G., & Krug, D. H. (1998). Art, ecological restoration, and art education. *Studies in Art Education, 39*(3), 230-243.

Brommer, G. F. (1994). *Collage Techniques: A Guide for Artists and Ilustrators*. Watson-Guptill Publications.

Burton, J. B., Horowitz, R., & Hal, A. (2000). Learning in and through the arts: The question of transfer. *Studies in Art Education, 41*(3), 228-257.

Colucci-Gray, L., Perazzone, A., Dodman, M., & Camino, E. (2012). Science education for sustainability, epistemological reflections and educational practices: from natural sciences to trans-disciplinarity. *Cultural Studies of Science Education, 8*(1), 127-183.

Čepič, M., Ježewska-Zychowicz, M., Millar, R., Strgar, J., Šegedin, P., Zuljan, M. V., & Skubic, D. (2007). *Elementi Vizualizacije Pri Pouku Naravoslovja [Elements of Visualization in Science Lesson]*. Pedagoška Fakulteta [School of Education].

Dewey, J. (1938). *Experience and Education*. Kappa Delta Pi.

Diković, M., & Gergorić, T. (2020). Teachers' assessment of active learning in teaching Nature and Society. *Economic Research-Ekonomska Istraživanja [Economic Research-Economic Research], 33*(1), 1265-1279.

Drake, S. M. (2004). *Meeting Standards Through Integrated Curriculum*. Association For Supervision and Curriculum Development.

Finale, R. (2021). *Spodbujanje Okoljske Ozaveščenosti Z Likovno Umetnostjo [Promoting Environmental Awareness through Fine Arts]*. Doctoral Dissertation, Univerza V Ljubljani, Pedagoška Fakulteta [Doctoral Dissertation, University of Ljubljana, Faculty of Education].

Fiordelli, M., Diviani, N., Farina, R., Pellicini, P., Ghirimoldi, A., & Rubinelli, S. (2023). Strengthening adolescents' critical health literacy and scientific literacy to tackle mis-and dis-information. A feasibility study in Switzerland. *Frontiers in Public Health, 11*, 1183838.

Flajšman, B., Tacol, T., & Muhovič, J. (2009). *Likovna Dejavnost in Ekološko Ozaveščanje [Arts and Environmental Awareness]*. Debora.

Flowers, A., Carroll, J., Green, G., & Larson, L. (2015). Using art to assess environmental education outcomes. *Environmental Education Researc, 21*(6), 846-864.

Freepik Company S. L. (2024, May 8). *FlatIcon*. https://www.flaticon.com/free-icons/ecology

Frelih, Č. (2011). Trajnostna načela likovnega izobraževanja [Sustainable development as a principle of education in art and music education and philosophy]. In *Trajnostni Razvoj Kot Načelo Vzgoje in Izobraževanja Pri Likovni in Glasbeni Vzgoji Ter Filozofiji: Zbornik Referatov in Razprav [Reports and Debates: Proceedings of Papers and Discussions]* (pp. 43-57). Državni svet Republike Slovenije [National Council of the Republic of Slovenia].

Gablik, S. (1991). *The Reenchantment of Art*. Thames and Hudson.

Graham, M. A. (2007). Art, ecology and art education: locating art education in a critical place-based pedagogy. *Studies in Art Education, 48*(4), 375-391.

Göktuğ Kılıç, A., & Parsıl, U. (2023). Perspective of gestalt theory and art education. *Journal of Pedagogy and Educational Sciences, 3*(1), 1-12.

Hauser, A. (1961). *Socialna Zgodovina Umetnosti in Literature [Social History of Art and Literature]*. Cankarjeva Založba.

Hadzigeorgiou, Y., & Skoumios, M. (2013). The development of environmental awareness through school science: problems and possibilities. *International Journal of Environmental and Science Education, 8*(3), 405-426.

Holmes, T. (2006). Environmental awareness through eco-visualization: Combining art and technology to promote sustainability. *Reconstruction, 6*(3). http://www.neme.org/texts/environmental-awareness

Huzjak, M. (2018). *Vpliv Medpredmetnega Povezovanja Na Uspešnost Učencev Pri Pouku Likovne Vzgoje [The Impact of Interdisciplinary Connections on the Performance of Students in Art Education]*. Doctoral dissertation, Univerza v Ljubljani, Pedagoška fakulteta [Doctoral dissertation, University of Ljubljana, Faculty of Education].

Kavčič, B. (2011). Pomen filozofije in umetnostne vzgoje pri ozaveščanju o pomenu trajnostnega razvoja. In *Trajnostni Razvoj Kot Načelo Vzgoje in Izobraževanja Pri Likovni in Glasbeni Vzgoji Ter Filozofiji [Sustainable Development as a Principle of Education in Art and Music Education and Philosophy]* (pp. 9-11). Republika Slovenija Drzavni Svet [Republic of Slovenia].

Keller, A., Sommer, L., Klöckner, C., & Hanss, D. (2020). Contextualizing information enhances the experience of environmental art. *Psychology of Aesthetics Creativity and the Arts, 14*(3), 264-275.

Klöckner, C., & Sommer, L. (2021). Visual art inspired by climate change-an analysis of audience reactions to 37 artworks presented during 21st un climate summit in Paris. *Plos One, 16*(2), 1-18.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

Krek, J., & Metljak, M. (2011). *Bela Knjiga O Vzgoji in Izobraževanju V Republiki Sloveniji [White Paper on Education in the Republic of Slovenia]*. Ljubljana: Zavod RS za šolstvo [Ljubljana: Institute of the Republic of Slovenia for Education].

Le Habel, F., Montpied, P., & Fontanieu, V. (2014). What can influence students' environmental attitudes? Results from a study of 15-year-old students in France. *International Journal of Environmental and Science Education, 9*, 329-345.

Liao, X. (2024). Protecting the environment through art: The significance of environmental art design in raising awareness about environmental pollution among universities in China. *Current Psychology, 43*(32), 26548-26570.

Lin, L., Sperrin, M., Jenkins, D. A., Marti, G. P., & Peek, i. (2021). A scoping review of causal methods enabling predictions under hypothetical interventions. *Diagnostic and Prognostic Research, 5*(3), 1-16.

McGuire, N. M. (2015). Environmental education and behavioral change: An identity-based environmental education model. *International Journal of Environmental and Science Education, 10*(5), 695-715.

Mesec, B. (1998). *Uvod V Kvalitativno Raziskovanje V Socialnem Delu [Introduction to Qualitative Research in Social Work]*. Ljubljana: Visoka Šola Za Socialno Delo Univerze V Ljubljani [Ljubljana: School of Social Work, University of Ljubljana].

Negro, F., Heddad Masson, M., & Beuers, U. (2024). EASL schools of hepatology: Pioneering the flipped classroom model and blended learning in medical education. *JHEP Reports, 7*(1), 1-10.

Neperud, R. W. (1997). Art, ecology, and art education: Peractices and linkages. *Art Education, 50*(6), 14-20.

Orr, D. W. (1992). *Ecological Literacy: Education and the Transition to a Postmodern World*. Albany: State University of New York Press.

Papavasileiou, V., Nikolaou, E., Andreadakis, N., Xanthacou, Y., & Kaila, M. (2020). The role of art in environmental education. *IJAEDU-International E-Journal of Advances in Education, 6*(18), 287-295.

Pedretti, E. (2014). Environmental education hegemony, traditional knowledge and alignment. *Revista Brasileira de Pesquisa em Educação em Ciências, 14*(2), 305-314.

Pečjak, V. (2006). *Psihološka Podlaga Vizualne Umetnosti [Psychological Basis of Visual Art]*. Debora.

Permanasari, G. H., Suherman, S., & Budiati, L. (2021). The implementation of environmental education to achieve sustainable development: Literature review. *E3S Web of Conferences EDP Sciences, 317*, 01069.

Rauhala, O. (2003). *Nature, Science and Art*. Otava Publishing Company.

Sagadin, J. (1993). *Poglavja Iz Metodologije Pedagoškega Raziskovanja [Chapters from the Methodology of Pedagogical Research]*. Ljubljana: Zavod Republike Slovenije za šolstvo in šport [Ljubljana: Institute of the Republic of Slovenia for Education and Sport].

Sagadin, J. (2003). *Statistične Metode Za Pedagoge [Pedagogy Statistical Methods]*. Obzorja d.o.o.

Selan, J. (2022). Likovnoteoretska analiza obravnave likovnih pojmov s področja barve v osnovnošolskih učbenikih za likovno umetnost [Analysis of the treatment of visual concepts from the field of colour in elementary school textbooks for fine art]. *Kakovost Učbenikov V Sloveniji: Izzivi in Priložnosti [Quality of Textbooks in Slovenia: Challenges and Opportunities], 1*, 187-203.

Şeren, N. & Gül, S. (2022). An innovative and interdisciplinary perspective on environmental issues through ecological art projects: A mixed methods study. *Romanian Review of Geographical Education, 11*(1), 73-91.

Song, Y. (2009). Community participatory ecological art and education. *International Journal of Art and Design Education, 28*(1), 4-13.

Song, Y. (2012). Crossroads of public art, nature and environmental education. *Environmental Education Research, 18*(6), 1-17.

Stuart, E. A., & Rubin, D. B. (2008). Best practices in quasi-experimental designs: matching methods for causal inference. In V. J. Osborne. *Best Practices in Quantitative Methods* (pp. 155-176). Sage.

Summers, D. (2003). *Real Spaces: World Art History and the Rise of Western Modernism*. Phaidon.

SURS. (2024, July 13). *SURS*. https://www.stat.si/statweb

Schüßler, D., Richter, T., & Mantilla-Contreras, J. (2019). Educational approaches to encourage pro-environmental behaviors in madagascar. *Sustainability, 11*(11), 1-20.

Taverna, A., Manciaracina, A., Cipriani, L., & Mattioli, F. (2023). Investigating the perimeter of innovation in design education through mapping of experimental practices. In *DS 123: Proceedings of the 25th International Conference on Engineering and Product Design Education* (pp. 493-498). Politecnico di Milano, Italy.

Tereso, S. (2012). Environmental education through art. *International Journal of Education Through Art, 8*(1), 23-47.

Van Boeckel, J. (2009). Arts-based environmental education and the ecological crisis: Between opening the senses and coping with psychic numbing. In B. D. Milgrom & L. Kirstinä (Eds.), *Metamorphoses in Children's Literature and Culture* (pp. 145-164). Enostone Turku, Finland.

Woldt, A. (2009). Gestalt pedagogy-creativity in teaching. *Gestalt Review, 13*(2), 135-164.

Yumusak, A., Sargin, S. A., Baltaci, F., & Kelani, R. R. (2016). Science and mathematics teacher candidates' environmental knowledge, awareness, behavior and attitudes. *International Journal of Environmental and Science Education, 11*(6), 1337-1346.

Zhongbin, Z. (2024). Innovative approaches to art education by integrating environmental awareness in art curriculum in beijing. *International Journal of Academic Research in Progressive Education and Development, 13*(1), 2075-2082