

Environmental and sustainability education through participatory redesign: Empirical insights from a secondary school case study

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► ABSTRACT

As global educational priorities increasingly shift toward Sustainability Citizenship (SC), there is a growing need for pedagogical methodologies that move beyond theoretical climate literacy and enable meaningful student participation. This paper proposes a pedagogical framework for "Green Classroom Redesign", a project-based learning initiative that conceptualizes the classroom as a living laboratory for participatory ecological action. By transforming the learning environment into a site of applied intervention, the framework seeks to bridge the gap between environmental awareness and civic engagement. The methodology is grounded in a participatory model for secondary education and was tested through a primary diagnostic study involving 46 students at the Zanneio Model High School of Piraeus. The research investigated student perceptions of their physical learning environment and their perceived influence over institutional change. The findings reveal a stark "Agency Gap": while 74% of students express high environmental concern, a staggering 91.3% identify as "passive observers", and 0% strongly believe that school authorities value their opinions on infrastructure. These results highlight a profound disconnect between student awareness and institutional inclusion. The proposed framework addresses this gap by operationalizing student agency through a participatory pathway, positioning Green Classroom Redesign as a necessary intervention. By moving from textbooks to hands-on structural change, the initiative equips the next generation with the democratic tools to evolve into empowered Sustainability Citizens.

Keywords: Sustainability Citizenship, Project-Based Learning, Student Agency, Classroom Redesign, Whole-School Approach.

► INTRODUCTION

In an era defined by accelerating climate destabilization and compounding ecological crises, the mandate for robust Environmental and Sustainability Education (ESE) has transitioned from a localized curriculum elective to an urgent global imperative. Traditional educational structures have historically prioritized the dissemination of ecological facts, focusing heavily on theoretical climate literacy. While expanding student awareness is essential, this information-centric paradigm frequently fails to foster the actionable competencies required to navigate and mitigate complex socio-environmental challenges. Consequently, a pronounced dissonance emerges

within school environments, where students are thoroughly informed about global crises but remain structurally disempowered from enacting meaningful change within their immediate physical surroundings.

To address this critical limitation, contemporary pedagogy must pivot toward experiential, participatory models that position learners as active stakeholders. This paper introduces a comprehensive framework for "Green Classroom Redesign", an approach that operationalizes sustainability values by turning the static classroom into a dynamic, student-led living laboratory. By engaging directly with the spatial, aesthetic, and ecological dimensions of their immediate learning environment, students can bridge the conceptual division between environmental knowledge and civic responsibility. To explore the empirical validity of this approach, primary research was conducted with secondary school students at the Zanneio Model High School of Piraeus. The study explicitly investigates how students' environmental awareness, their well-being in the classroom, and their ability to make changes in their school connect with each other. Ultimately, this paper argues that structural, hands-on interventions in school infrastructure provide an essential democratic pathway, transitioning students from passive observers of environmental degradation to active agents of sustainability citizenship.

► LITERATURE REVIEW

Global educational objectives

The contemporary educational landscape faces immense pressure to prepare students for a world defined by environmental crises and global interdependency. As ecological and social challenges intensify, schools must increasingly cultivate engaged citizens who can address these multifaceted issues through both local initiatives and a globalized perspective (Abidjanova, 2025). This trend was significantly catalyzed by the United Nations' 2015 adoption of the Sustainable Development Goals (SDGs), particularly Target 4.7. This mandate stipulates that by 2030, all students should possess the requisite competencies to advance sustainability, encompassing eco-friendly living, human rights, gender parity, and a non-violent ethos, while emphasizing the role of cultural diversity in enduring development (UNESCO, 2016).

Consequently, there is a widespread international consensus that the educational sector serves as a vital mechanism for mitigating the detrimental industrial and consumer behaviors currently threatening the planet. Educational intervention is thus viewed as a fundamental strategy for rectifying the systemic inefficiencies that drive environmental degradation (Ghosn-Chelala & Akar, 2021). Furthermore, Sustainable citizenship is connected to the recognition, safeguarding, and advocacy of human rights, with a particular emphasis on economic, social, cultural, and environmental dimensions. These entitlements were formally established by the United Nations including access to labor, healthcare, education, nutrition, potable water, housing, and a secure, healthy environment. The realization and exercise of these rights are often contingent upon societal progress, particularly advancements in science and technology, which continuously redefine the parameters of human well-being (Cabello et al., 2024).

From awareness to action competence

Global policy frameworks increasingly emphasize the necessity of citizen engagement to mitigate climate emergencies and construct more resilient, sustainable societies. They consistently highlight the pivotal function of both formal and non-formal educational systems in equipping the public to confront these global crises. Nevertheless, a significant scholarly and practical gap remains: the requirement for robust evaluative instruments to measure the efficacy of educational initiatives. Such tools are vital for assessing shifts in individual knowledge, attitudes, and behaviors—the core dimensions of the "action competence" necessary for individuals to evolve into environmental citizens and proactive agents of change (Ariza et al., 2021). Considering the current unprecedented environmental crisis, there is an escalating urgency for educational institutions to cultivate environmental citizenship within their student bodies. Educators remain the primary catalysts in fostering the agency and competencies required for this civic transition. Rooted in the 1977 Tbilisi Declaration, Environmental Education serves as a primary vehicle for this transition. Its framework moves beyond mere awareness, emphasizing the development of students who actively adopt and maintain pro-environmental behaviors (Georgiou et al., 2021).

Education for Environmental Citizenship serves as a sophisticated, synthesized, and practical framework that aligns with the expansive scope of Education for Sustainability by providing the essential curriculum and competencies required to effectuate substantive societal transformation. To realize this more equitable and sustainable global future, it is imperative that educators, mentors, and the scientific community also cultivate these principles, engaging more substantively with diverse societal sectors to facilitate the systemic transformation required for a sustainable global society (Parra et al., 2020). Within this context, Education for Sustainability (EfS) is frequently conceptualized as a holistic expansion of environmental education. In this model, the traditional ecological focus of environmental studies is robustly augmented by social and economic perspectives, creating a more multidimensional approach (Kopnina, 2014). According to this framework, an environmental citizen must advocate for ecological health, sustainability, and social equity beyond their immediate social circle, prioritizing the well-being of future generations. Achieving this requires the capacity for critical reflection on the systemic drivers of sustainability crises and an active commitment to resolving and preventing environmental issues through the exercise of civic rights and responsibilities (Ariza et al., 2021).

Pedagogical strategies and systems thinking

It is undeniable that the ecological system exhibits extreme fragility, necessitating the immediate implementation of educational frameworks designed to cultivate "informed, dedicated, and capable agency". Such an approach must empower students to actively participate in the development of innovative strategies and resolutions aimed at mitigating contemporary environmental challenges (Seatter, 2011). UNESCO has iteratively advocated for the integration of EE, ESD, and Global Citizenship Education to embed these socio-environmental challenges within the core curriculum. However, the practical implementation of these interdisciplinary frameworks within classroom environments has remained protracted (Yianniris, 2021). Pedagogical approaches must therefore inspire learners to implement sustainable

transformations within their immediate social circles to be truly effective (Westheimer & Kahne, 2004).

To facilitate the transition toward sustainable structures, students must be catalysts for climate advocacy by disseminating their expertise across familial, communal, and professional networks. Furthermore, integrating these pedagogical initiatives with broader civic participation can foster restorative ecological relationships, prioritizing biodiversity preservation and nature-based solutions to bolster climate resilience and sustainable resource management (Beck, 2010). This requires a shift toward "systems thinking", where educators guide students in exploring how variables fluctuate under varying conditions, utilizing games and models as illustrative tools. Instruction should encourage the identification of associations beyond the immediate curriculum, prompting students to analyze how interconnected systems influence one another. By evaluating case studies or current events, learners can actively uncover both explicit and latent connections within complex global issues (Warren et al., 2014). Global citizenship education focuses on equipping students with the essential competencies -including specialized knowledge, values, and ethical frameworks- required for meaningful engagement within a globalized society (Abidjanova, 2025).

The teacher as catalyst in transformative spaces

Educators remain the primary catalysts in fostering the agency and competencies required for this civic transition (Georgiou et al., 2021). However, teachers have historically perceived youth as passive subjects navigating a flawed reality rather than proactive agents of change. Effective sustainability education, however, necessitates authentic pedagogical contexts that reflect the complexities of actual public discourse. To advance this field, practitioners would benefit from specialized in-service professional development designed to encourage the adoption of innovative methodologies. Such training should enable teachers to inspire students to critically identify, evaluate, and resolve environmental and social (ES) challenges. There is a need for specialized in-service professional development and continuous guidance to improve teachers' environmental knowledge and strategies. Through the cultivation of teacher-led professional networks, educators can reach a consensus on defining and implementing transformative spaces that equip young people with the agency required for sustainable citizenship (Ghosn-Chelala & Akar, 2021).

To facilitate the transition toward sustainability, environmental education serves as a primary vehicle for bridging gaps in active citizenship. It focuses on disseminating ecological knowledge and cultivating the civic and cognitive competencies necessary for an ecologically responsible lifestyle. Within formal frameworks, this involves building scientific literacy and strengthening the student-nature relationship through active learning strategies, such as fieldwork and immersive outdoor experiences (Parra et al., 2020).

► METHODOLOGY

To provide empirical evidence for the proposed theoretical framework, this paper incorporates primary research conducted through a structured field study. By gathering first-hand data from a specific student population, the study moves beyond secondary analysis to offer original insights into the contemporary "agency gap". This primary data

collection ensures that the suggested "Green Blueprint" is grounded in the lived experiences and authentic perceptions of the learners themselves, thereby enhancing the practical validity and academic rigor of the research. The research followed a quantitative approach to investigate student perceptions regarding sustainability within the school environment while the methodology was designed to ensure both pedagogical relevance and ethical integrity.

Participants and setting

The study was conducted at the Zanneio Model High School of Piraeus, involving students from the 3rd Grade of Gymnasium (Lower Secondary Education, ages 14-15). Specifically, two classes (C1 and C2) were selected for the sample. This group was chosen to use purposive sampling, as the researcher serves as their instructor for the course "Social and Political Education". This curricular alignment was vital, as the course modules cover themes of active citizenship and social responsibility, ensuring that students were already familiar with the conceptual framework of "Sustainability Citizenship" and could engage meaningfully with the survey instruments.

Ethical considerations and consent

Adhering to strict ethical guidelines for research involving minors, a comprehensive informed consent process was implemented. Prior to the data collection, detailed consent forms were distributed to parents and legal guardians via the students. These documents explicitly outlined the study's purpose, the procedural steps, the anticipated educational benefits, and the rigorous measures taken to ensure participant anonymity. Furthermore, students were informed of their right to refuse participation or withdraw from the process at any stage without any academic or personal consequence.

Data collection procedure, participation and sample validity

Following the collection of signed parental consent forms during the first week of March 2026, the survey administration took place between March 9th and March 13th, 2026. The questionnaires were distributed during regular school hours within the "Social and Political Education" sessions, according to each class's timetable. To guarantee absolute anonymity, the survey did not collect identifiable personal data such as names, specific ages, gender, or class designations. Upon collection, the questionnaires from both classes were intermingled to prevent any possibility of tracing responses back to specific groups or individuals, thereby fostering an environment of honest and uninhibited expression.

The student body demonstrated high levels of engagement and willingness to express their views on classroom redesign. In class C1, 22 out of 25 students participated (88% participation rate), while in class C2, 24 out of 26 students participated (92% participation rate). The final research sample consists of N=46 completed questionnaires. Given the high participation rates and the students' specialized background in citizenship education, the resulting data is considered highly representative and provides a valid basis for the subsequent analysis of results.

► RESULTS

The primary research conducted among forty-six students (N=46) at Zanneio Model High School provides a clear picture of how high school students perceive sustainability within the Greek educational system. The findings show a strong contrast between the students' high environmental awareness and their lack of actual power to influence their school environment. By analyzing the responses, we can see that students are deeply concerned about the planet but feel excluded from the decision-making processes of their own schools.

Student awareness and the impact of the environment

The first part of the analysis looks at the students' feelings and awareness, showing a generation that is very well-informed about ecological issues. In response to Q1 (I am concerned about the impact of climate change on my future), a significant 73.9% of the participants expressed a clear sense of worry, with 21.7% choosing the highest possible level of concern. This indicates that for 14-15-year-old students, climate change is seen as a major threat to their own lives and future.

This high level of awareness also applies to their daily surroundings, as shown by the responses to Q2 (I believe that the physical classroom environment affects my focus and mental well-being). Here, 78.2% of students agreed that the quality of their classroom space directly influences how well they can study and how they feel mentally.

However, an interesting point appears in Q3 (I would feel more motivated to learn in a classroom that integrates nature-based solutions - e.g., plants, natural light), where a large portion of the sample (45.6%) remained neutral. This suggests that while students know their environment is important, they have not yet experienced "green" classrooms in practice, likely because most public-school buildings follow a very traditional and standard design.

The "Agency Gap" and lack of communication with authorities

The most important part of this study is the evidence of a "gap" between student concern and student power. This gap is very clear when we look at how much influence students believe they have. When asked in Q4 (I feel that I have the power to change how my school manages its energy, waste, or design), only 13% of the students felt they had any power to make changes. This feeling of helplessness is made worse by the fact that students do not know how to approach school authorities; in Q5 (If I had a great idea for a "green" improvement, I would know which teacher or authority to speak to), nearly 56.5% of students were either unaware of or unsure about the correct way to propose environmental improvements.

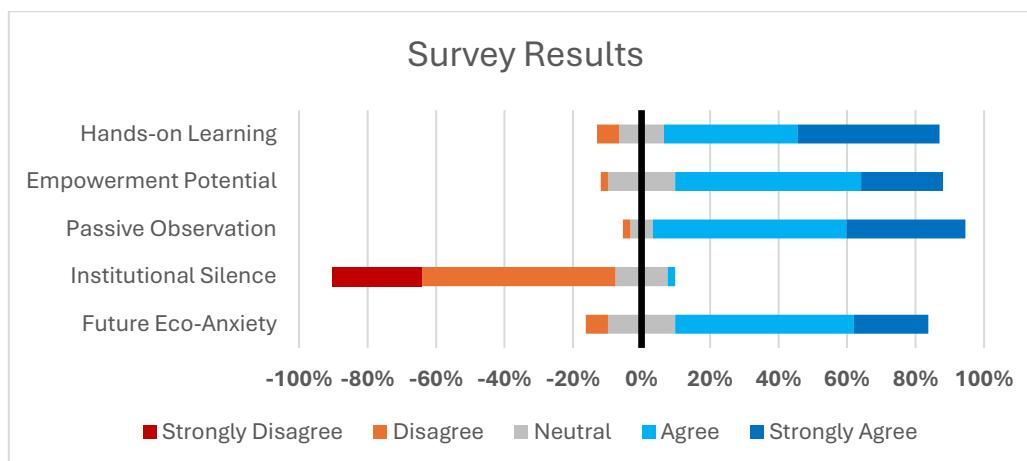


Figure 1. Visualizing the “Agency Gap” and the mandate for change

As shown in Figure 1, the contrast between concern and perceived influence is mathematically significant. The most shocking result of the research comes from Q6 (I believe that school leaders and local authorities value student opinions regarding school infrastructure). Not a single student (0%) strongly agreed with this statement, while 82.6% explicitly disagreed. This shows that students feel their voices are completely ignored by those in charge of the school and the local community. As a result, in Q7 (I currently feel like a "passive observer" rather than an "active participant" in my school's sustainability efforts), a huge 91.3% of students described themselves as passive observers. This proves that sustainability at school is currently something students just hear about in lessons, rather than something they actually do.

The demand for practical action and student participation

The final part of the research shows that students are ready and willing to change this situation. Despite the barriers they face, they want to turn theory into action. Regarding Q8 (Our current classroom design reflects the sustainability values we are taught in lessons), nearly 59% of the participants noticed that their actual classroom does not match the "green" values they learn about in class. There is a strong desire to fix this through collaboration, as seen in Q9 (I would be willing to work with parents and local experts to redesign our learning space), where 78.2% of students said they are ready to work with the wider community.

While Q10 (I feel confident in my ability to present a "Green Blueprint" or proposal to a panel of adults) showed that some students still feel nervous about presenting their ideas, the overall goal is clear. The value of the proposed framework is confirmed by Q11 (Transforming our classroom would make me feel more like an "agent of change" in my community), where 78.2% of the sample agreed that redesigning their classroom would make them feel more powerful and responsible as citizens. Finally, the very strong support for Q12 (Hands-on classroom redesign is a more effective way to learn about sustainability than traditional textbooks) -with 80.4% of students preferring practical work over books- shows that we need to change how we teach. The data proves that by letting students redesign their space, we can help them move from being "passive observers" to becoming active and capable "Sustainability Citizens".

► DISCUSSION

The primary research conducted in this study fully validates the initial hypothesis regarding the necessity of a student-led "Green Blueprint". The data reveals a generation of learners characterized by profound environmental concern; students are deeply troubled by climate change and perceive it as a defining factor for their future. However, a significant contradiction emerges. Despite this high level of awareness, students feel systematically excluded from the decision-making processes that govern their immediate educational environment. There is a clear perception among the youth that school leadership, local authorities, and the state do not value their input regarding school infrastructure or the redesign of learning spaces.

This lack of institutional inclusion results in students viewing themselves as "passive observers" of environmental developments rather than active participants in sustainability efforts. The research highlights that current classroom designs fail to reflect the sustainability values taught in the curriculum, creating a disconnect between theoretical knowledge and physical reality. Consequently, students express a strong desire for practical, hands-on engagement. They believe that taking initiative to improve their school environment -making it more friendly, healthy, and conducive to academic performance- is the key to transitioning from passivity to becoming a true Agent of Change.

The findings of this study are closely aligned with contemporary systemic educational frameworks that advocate for a "Whole-School Approach" to sustainability. According to these paradigms, schools should not merely teach environmental science as an isolated subject but should transform into institutional "Living Labs" where sustainability is actively practiced through every aspect of school life, including the physical infrastructure. This transition requires educators who are well-equipped to lead; as Georgiou et al. (2021) suggest, to effectively integrate Education for Environmental Citizenship, schools must provide teachers with continuous guidance and comprehensive training to enhance their ecological literacy and pedagogical strategies.

Furthermore, international research by organizations such as UNESCO and the European Commission emphasizes that "Sustainability Citizenship" cannot be achieved through textbooks alone. Current educational trends suggest that when students are given the agency to redesign their learning environments, their "Self-Efficacy" -the belief in their ability to make a difference- increases significantly. To align education more effectively with sustainable development, practitioners must cultivate a global perspective that connects international challenges to local contexts, empowering students to transition from passive learners to proactive agents capable of implementing tangible solutions (Monzo-Martinez et al., 2024).

The "Agency Gap" identified in the Zanneio Model High School sample mirrors a broader challenge where awareness does not always translate into action. While initiatives in formal and informal curricula have successfully increased awareness, they often struggle to effectively produce lasting pro-environmental behaviors or significant attitudinal shifts (Manfredi et al., 2021). This highlights the importance of moving beyond individual behaviors, such as recycling or energy conservation (Hollweg et al., 2011), toward structural changes like classroom redesign.

► CONCLUSIONS

The shift from passive observation to active participation necessitates a fundamental reimagination of the school infrastructure itself. School administrators and educators are increasingly advocating for versatile, modern classroom designs that can be easily reconfigured to support active learning strategies (Pedro et al., 2017). Integrating art and design into this process allows students to explore how elements like composition, symmetry, and color influence space, fostering personal expression and visual problem-solving (Hasio & Crane, 2014). This aesthetic and functional redesign is essential for creating an environment that matches the sustainability values taught in class.

In conclusion, experiential learning through classroom redesign is proven to be far more effective than traditional instruction. While textbooks often fail to adapt to the specific needs and unique characteristics of individual school environments, a practical redesign framework allows students to acquire meaningful, localized knowledge. By acting as Agents of Change within their local school community, students do not just learn about sustainability; they embody it.

To bridge the identified Agency Gap, it is recommended that educational policies shift toward participatory design models. Transforming the classroom from a static space into a student-led project not only improves well-being and academic performance but also equips the next generation with the democratic tools necessary to navigate the climate crisis as empowered Sustainability Citizens.

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