

Training to *transform*: environmental crises, educational equity and the pedagogical challenge of sustainability

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Abstract: This essay seeks to focus on the interconnections between pedagogy, technology and sustainability, with the aim of outlining a theoretical framework for an educational path of maturation and awareness, starting in school, on the complex roles of the contemporary citizen. Through a critical and systemic approach, it examines the role of digital technologies as learning environments and the need for training geared towards recognising and valuing differences, cultural heritage and historical memory, detached from selective and instrumental use, in order to design training in terms of integral ecology. With the support of empirical research data, the aim is to show how pedagogy, as the science of human education in its entirety, must reformulate its educational models by integrating technological innovation, digital ethics and environmental sustainability for the education of the future. To be authentically humanistic, it must combine technological skills and participatory citizenship skills, which also include ecological responsibility, promoting a planetary citizenship that is also aware of cultural differences for the benefit of the quality of life of communities.

Keywords: education; technologies; sustainability; digital citizenship; interculturalism

1. Introduction

The remarkable complexity of contemporary society, at the intersection of globalization, decolonization, and daring technological developments on a global scale, inevitably raises questions and reflections for the education system as a whole. A discipline like pedagogy, if it is to reclaim its original meaning, has the duty to accompany, *to guide*, and *to direct* not only students but also teachers toward a future of increasingly competent and informed citizens. Pedagogy can offer a unique lens for rethinking citizenship and sustainability education, including through *the* digital world, fostering dialogue, shared learning, the prospect of encountering differences and cultural pluralism. This perspective, however, requires an epistemological shift: recognizing the validity of other ways of knowing and inhabiting the world, often preserved by indigenous cultures or perceived as *distant*, can enrich the educational landscape and contribute to the construction of a worldview based on relationships of interdependence and care through the competent use of media and new media. But to be equitable and truly transformative, the transition to the responsible use of digital resources requires a profound reformulation of educational systems, supported by pedagogical reflection. Indeed, the primary objective is to promote an education in complexity that helps students and citizens understand the connections between environmental, economic, and cultural phenomena, overcoming reductionist or technocratic visions. Furthermore, rapid technological evolution and the growing environmental emergency present pedagogy with a further challenge: understanding the



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changes that technologies are causing in human relationships and promoting sustainable and effective educational models. Since contemporary education can no longer be conceived separately from the digital and ecological dimensions (Rivoltella, 2021), pedagogical reflection is therefore called upon to develop a theory of education capable of integrating these two horizons, placing the individual and their relationship with the natural, social, and technological environment at the center.

In this perspective school, non-formal and informal educational agencies (Frabboni, Pinto Minerva, 2021) become crucial not only for the dissemination of scientific knowledge, but also for fostering critical thinking, civic participation, and empathy. In this sense, intercultural pedagogy, intersecting with critical environmental education and global citizenship education, contributes to building an ethic of shared responsibility and intergenerational solidarity, given that contemporary society is characterized by increasing cultural complexity and unprecedented environmental challenges (Allemann-Ghionda, 2017). On the one hand, migratory flows and globalization generate a plurality of identities, languages, and worldviews that intertwine within our communities. On the other, climate change and environmental degradation require a radical rethinking of our lifestyles and educational practices.

2. Interdisciplinary connections between pedagogy, technologies and sustainability

Since its origins, pedagogy has understood education as the harmonious development of human potential. From Plato, through Comenius, Rousseau, Dewey, to De Bartolomeis, Visalberghi, Bertolini, Morin, and Cambi, to name but a few of the great scientists in a diachronic perspective, education has been conceived as a process of continuous growth, critical re-elaboration, transformation, and construction of meaning, as well as intentionality, to form a fully aware and responsible individual (Mariani, 2022). Today, this perspective is enriched by a new dimension: that sustainability. This implies a reconsideration of the purposes of education, no longer limited to individual or socio-economic-cultural progress, but oriented towards the protection of life and the environment. In this framework, pedagogy can be configured as the science of sustainable relationships, capable of educating people to be aware of global interdependencies and to assume responsibility towards the global community.

There's no doubt that the sustainability of the future depends entirely on the design choices of the present, an era in which hypocrisy and superficiality are still two of the elements that demonstrate how, in a complex society, it's crucial to seek to remove pockets of resistance—a syncretic fusion of selfishness and ancestral ignorance regarding environmental issues in particular, and social issues in general. Caring for the planet we all live on is an issue whose solution can no longer be postponed. It's widely believed that the environment is our true *home*, and therefore its protection is vital. Making citizens aware and responsible for environmental policies, with a view to improving the overall quality of life, is part of the current and comprehensive vision of active citizenship (Annino, 2022). Human-environment harmony must be fully reevaluated if we are to put an end to the current drift toward apathy and indifference, which has the only result of heavily transferring the debt onto the shoulders of future generations (De Bartolomeis, 2022). Humans have always interacted with their environment, but the conditions of modern life, with its unbridled consumerism and efficiency, have radically altered the sense of proportion in the utility-respect rela-

tionship that should characterize humankind's relationship with the world around us. In this regard, the need for profound pedagogical reflection emerges, precisely to allow us to revisit environmental ethics from a cultural perspective. The term *culture* appropriately brings us back to the origins of the relationship between humans and planet Earth, since «culture itself is polymorphic. It encompasses the multitude of relationships between humans and nature: the procurement and preservation of food; the provision of shelter; the ways in which natural objects are used as tools and implements; the ways in which natural objects are used as instruments and implements ... and all the ways in which man uses and controls the natural environment that surrounds him, or is controlled by it; animals, plants, the inorganic world, the seasons, the wind and the weather conditions» (Boas, 1971, p. 102). From many quarters of civil society there is a sense of the need for a new and profound ethic based on the concept of the *common good* and widespread control of resources and their access, and consequently on the participatory and shared construction of concrete proposals for the short, medium and above all for the future.

First and foremost, a modern educational approach aimed at protecting the ecosystem must help shift *mindsets*, clearly demonstrating that the lifestyle of even a single individual has a significant and significant ethical impact on the rest of the community (Mariani, 2022). Both in the private sphere of individuals and in the public and work environment, the key aspect from an educational perspective is precisely trying to make people understand that the irresponsible actions of some individuals are still political actions in the classic sense, that is, administrative and managerial, which, through certain choices, can undermine every concept of ethics and public service. Precisely in this dimension of sustainability, pedagogy must be stimulated in its educational work, as it will increasingly be called upon to promote and encourage the expansion of the sphere of *common goods* beyond the definition used until recently, now including energy and its exploitation, as well as truly intangible assets such as communication, the secular value of democracy, the valorization of diversity and landscape, and all the human works of art and monuments that are a unique resource for understanding ourselves and our identities through cultural roots. In this sense, the profound need for genuine attention to the environment emerges, understood in the broadest sense, not only from the fundamental ecological perspective, but also according to the multiplicity and breadth of meanings and values it encompasses, since «the environment is first and foremost tradition, custom, folklore—in short, everything that is rooted in a given place and characterizes it, both physically and humanly. The environment, in this context, is what we immediately experience, what manifests itself to us, the atmosphere that surrounds us and that we breathe. [...] If culture is the critical, or at least theoretical, moment, the environment is rather the practical moment, and involves an intimate, close bond with the individual who lives in it» (Flores D' Arcais 1962, p. 73). It could be argued that in the relationship between pedagogy and civic education, and therefore also between pedagogy and interculturality, digital education and sustainability education, the element most subject to educational pressures and stimuli is individual conscience; the starting point is to act on individual conscience to form a collective *ecological conscience*, precisely because «forming an authentic ecological conscience is desirable and certainly possible through an acknowledgement of the complexity, but also of the obligations that each person has to create conditions of progress in which they can live in peace and harmony with the environment, today and tomorrow. Educating people to this ideal is

the task of education, not limited to certain ages, but concretely ensured in every stage of life» (Rosati, 1998, p. 32). Pedagogy essentially has the duty to promote a decisive reconciliation of the value and ethical platform and to foster a strong awareness of the duties towards citizens of the present and those of the future. Also and above all with the help of digital and AI, as the *Digital Education Action Plan 2021-2027* clearly states that «Strengthening digital skills at all levels contributes to increasing growth and innovation and building a more equitable, cohesive, sustainable and inclusive society. Digital skills and digital literacy can enable people of all ages to be more resilient, to participate more in democratic life and to navigate online safely» (EU Commission, 2020, p. 15). It is therefore clear that within a general context of raising awareness and empowerment aimed at reevaluating the dynamics between individuals and their environments, «educational interventions aimed at establishing and implementing a truly new environmental culture acquire fundamental importance, based not so much on fads or occasional emotions as on structural skills that produce informed and consistent behaviors over time» (Frabboni, Guerra, Scurati, 1999, p. 123). Pedagogy today, then, is truly called upon to act more than ever within social and cultural contexts as a transformative force, to design a massive empowerment effort that allows for concrete action to protect the rights to health and the psycho-physical well-being of individuals through *shared responsibility* of all towards all, seeking to eradicate a certain indifference and lack of interest that are no longer acceptable from the perspective of promoting human rights and the most basic democratic practices of this part of the 21st century.

3. Considerations on some data from an empirical research

In support of what has been previously stated, are summarized here some data, that emerged from an exploratory survey of the project *PLATONE, Common Heritage, Legality, Otherness and Territory as foundations for Orienting to a New Civic Education, part of the "Starting Grant" Research Plan of the University of Catania*, for which the writer is PI, conducted among the teachers responsible for civic education in the schools of Catania and its province, precisely to investigate their priorities attributed to the issues of participatory citizenship, digital education, legality, environmental sustainability and the valorization of differences in the various educational contexts, both formal and non-formal, and the related planned actions, in compliance with the provisions of law 92/2019. The survey was conducted through a *non-probabilistic avalanche sampling* (Cadei, 2025, Asquini, 2019, Trincherò, Robasto, 2019), and involved the administration of a semi-structured questionnaire in electronic form, via a form on the *Office platform Microsoft Forms*, with *closed and open-ended questions*, to offer respondents the opportunity to explain the reasons for some answers or express personal opinions. The questionnaire for teachers consists of 22 *items*, with a prevalence of *closed questions* based on the *Likert scale*, some of which allow for multiple-choice answers given the importance of the individual variables. Regarding the *open-ended questions*, the responses obtained were aggregated and assigned to *labels* representing the most frequent and ideal typologies for topics and categories, thanks to the analysis developed according to *descriptive frequency statistics, a function of the SPSS Statistics* statistical processing program v.30 IBM. The *labels* resulting from the aggregation, in this case, represent the most recurring types of responses for each question. A total of 110 questionnaires were completed by the civic education teachers; their administration to the teachers was

preceded by a *pilot test* with five primary school teachers and five lower secondary school teachers, with a reliability rate of 82.64%.

The data considered show that the teachers involved have a certain experience in teaching, 78% have between 15 and over 25 years of service, while with regards to the chosen teaching approaches, the answers given clearly highlight the following : *Class discussion* (102), *group activities* inside and outside school (98) and *activities supported by ICT* (95); followed by the *frontal lesson* (92), *role-playing games, simulations* (88), *laboratory activities with the various arts* (87), followed by *visits to local and national institutions* (86), and *participation in debates on education to differences and new media* (52). They then combine activities such as *sporting events* (45), *twinning with Italian schools* (44), *voluntary work* (39), *outdoor teaching* (36) and *interdisciplinary lessons integrated with colleagues and external speakers* (25), *school newspaper activities* (16) and *visits to places of worship* (12). In relation to racism, for 87% of those interviewed it is *very widespread*, against 11% according to whom it is *not very widespread*, while for 67% such diffusion is now on a *global level*. It should be noted that, since some questions have the possibility of multiple choice, the data relating to them are reported in this summary in pure numbers. A significant percentage of teachers, 77%, have organised and/or participated with the pupils in *initiatives on intercultural education*, 96% habitually deal with *the integration of foreigners and ethnic or religious problems in class*; 72% address *the issue of anti-Semitism*, and 95% believe that dialogue with the families of foreign students is *important to support an open discussion regarding learning and cultural issues*, also thanks to the latest generation of media. Teachers are aware that education for sustainable citizenship, legality, digital literacy, and equity must involve the entire class (98%), and for 87% it is a cross-disciplinary approach. Essentially, the questions about the activities planned and implemented by teachers to foster *problem-solving learning processes* (De Bartolomeis, 2022) offer answers that paint an active, dynamic picture, demonstrating the pedagogical focus on change in teaching methods and approaches, through workshops, trips, and excursions in the local area and to companies and public and private institutions, further strengthening the network of collaborations between various educational agencies.

From a pedagogical perspective, the majority of teachers involved in this sample converged the skills they consider necessary for contemporary citizenship education with the great potential offered by technology, expressing curiosity about the TPACK model, known and used by 26% of those interviewed, while 30% indicated they use AI for teaching purposes. In international studies on the use of technology in teaching, the *Technological Pedagogical Content Knowledge* (TPACK) offers a perspective for experimenting with teachers' knowledge and skills to integrate technology into daily teaching practices. Teachers can combine disciplinary content (CK) with technological content (TK) and pedagogical content (PK) to plan their subject teaching. Consequently, basic disciplinary knowledge will have diverse and dynamic intersections with *technological-pedagogical knowledge* (TPK) (*how to best use technologies to promote learning*), with *pedagogical knowledge* (PK) (*how to best use technologies to promote learning*), and with *pedagogical knowledge* (PK). of contents (PCK), (choosing the most appropriate educational methodology), and with *knowledge of technological contents* (TCK), which will allow for the improvement of the learning of *disciplinary contents thanks to pedagogical and technological knowledge* (TPACK) (Herring, Koehler, Mishra, 2017). The transformative potential of the TPACK model can constitute a very effective support in the design of a truly interdisciplinary vertical curriculum, allowing for a more structured sharing of

contents with students and their constant updating, leveraging the resources of the *internet* together with the ideas and creativity of each individual.

What has just been stated reflects one of the major peculiarities with which schools must necessarily interface today: the web and digital are not just simple tools, they are not *backgrounds*, but they are fully-fledged *figures*, in Rubin 's full sense (Rubin, 1921), that is, they are characterizing elements of reality. In this regard, Maragliano argues that the web and digital «are infrastructures. Indeed, they constitute the most powerful and extensive technological infrastructure on which our being and acting as humans is based today» (Maragliano, 2025, p. 33). At the same time, if human action entails responsibility and awareness, education for environmental sustainability has developed to respond to the ecological crisis and the objectives of the United Nations 2030 Agenda. It aims to train individuals and communities capable of understanding the interdependence between natural, economic and social systems, adopting responsible behaviors oriented towards the well-being of future generations. In this regard, its distinctive features are: the interdisciplinary dimension, which connects scientific, social and humanistic knowledge; attention to individual and collective responsibility in daily choices; the valorization of active, laboratory-based, and participatory methodologies; the promotion of values such as environmental justice, intergenerational solidarity, and global equity. From a perspective of participatory citizenship education aimed at grasping the *holos*, the whole, intercultural pedagogy and environmental sustainability education are not separate worlds, but rather intertwined paths (Portera, 2022). Both, in fact, invite us to recognize the interdependence between cultures, peoples, and environments, to deconstruct ethnocentric or anthropocentric logics that justify exploitation and inequality, and to develop an ethic of responsibility toward others and the planet. Therefore, an integrated approach allows us to understand, for example, how environmental crises unequally affect communities and countries, highlighting issues of climate justice and human rights. At the same time, the world's cultures preserve knowledge and practices of sustainable relationships with the environment, which can become valuable educational resources. Digital technologies are transforming educational processes, introducing new languages, environments, and forms of interaction. According to Laurillard (Laurillard, 2012), technology-mediated learning allows for more dynamic and personalized experiences, but requires informed pedagogical guidance. The educational use of technology must be interpreted critically and reflectively, overcoming technocentric enthusiasm and the idea of the tool's neutrality. Sustainable *digital literacy* (Pérez Tornero, 2020) thus becomes a fundamental skill, aimed not only at technical mastery but also at ethical and environmental understanding of the use of digital devices. In this sense, pedagogy must contribute to developing citizens capable of using digital technology responsibly, evaluating the ecological and social impact of their technological practices.

4. Education and the times of man

The UN 2030 Agenda establishes sustainability education (Goal 4.7) as a global priority. It requires an education oriented toward complex thinking (Morin, 1999), capable of integrating environmental, economic, social, and cultural dimensions. Technologies can play a crucial role in this process, acting as mediators and catalysts for knowledge and skills for ecological awareness. Through digital *service learning*, *citizen science*, and sustainable innovation labs, students can experience active learning that

combines knowledge, skills, ethics, and action. Schools and universities thus become digital educational ecosystems, where technology serves the community and the planet. In this regard, the very recent *Guidelines for the Introduction of Artificial Intelligence in Educational Institutions* establish social, economic and environmental sustainability as key principles for the use of AI, to promote inclusive tools that foster educational, emotional and human relationships (MIM, 2025).

From the intersection of pedagogical reflection, digital culture, and sustainability, the potential prospect of a pedagogy of technological sustainability emerges. It is based on three main pillars:

1) Ecological teaching, which promotes flexible, participatory, and low-impact learning environments; 2) Digital ethics, which develops critical thinking, empathy, and responsibility in the use of technology; 3) A culture of slowness, which counters technological acceleration by fostering reflection, cognitive depth, and psychological well-being (Cassano, 2017; Iavarone, 2004; De Masi, 2002).

This pedagogical perspective encourages evaluating each innovation not only in terms of effectiveness and efficiency, but also in terms of social, environmental, and human sustainability. Above all, a strong awareness emerges that the local area will only be respected if its diverse realities are understood, and therefore, responsible and informed participation in the various activities offered must be encouraged, including in those yet to be developed, where, in terms of a pedagogical utopia, the full educational and formative potential lies. The local area is an invaluable resource because it offers diverse opportunities for learning and growth through the assumption of responsibility in concrete situations such as meetings, discussions, and events in parks, squares, and near sites and monuments, which become significant learning environments thanks also to the inexhaustible initiatives of schools, volunteer associations, parishes, and public and private entities. From this perspective, the local area and local and national institutions must be instruments of education as an example of working for the common good. Law 92/2019, in point g), focuses on education in the respect and valorization of cultural heritage and common public goods as a key factor for participation and integration, forcefully emphasizing that the use of heritage within the school system is a fundamental objective that necessarily requires integrated *governance* and ongoing exchanges between schools and the local area, between museums, archives, and libraries, and between intangible heritage and cultural landscape. Similarly, the *Charter for Biodiversity Education*, an important document that both recognizes and implements schools' direct commitment to environmental protection, is a prerequisite for the education of contemporary citizens (MIUR, 2022). In light of the findings, a framework could be outlined that includes, among the characterizing paths for education in participatory and sustainable citizenship, a series of activities such as:

- Promote transformative paths that foster knowledge, skills, and responsible, virtuous behavior to build a society attentive to the needs of the environment and biodiversity;
- Meetings with international students and representatives of migrant associations;
- Autobiographical storytelling and active listening workshops;
- Act systematically on environmental education issues by activating collaborations to involve institutions, local authorities, protected areas and all stakeholders in the educational and social community in school projects.

- Guided discussion on the relationship between everyday behaviors and global policies;
- Insights into climate justice, environmental migration, and social equity;
- Teamwork to design micro-projects to raise awareness and engage in local initiatives (communications campaigns, intercultural events, environmental initiatives).

5. Conclusions

Twenty-first-century pedagogy is called upon for radical renewal: from education in technical skills to education in global citizenship. The integration of technology and sustainability represents the key to building a truly humanistic education, capable of combining progress and responsibility. Only a systemic, critical, and sustainable pedagogical approach can make technology a tool of emancipation rather than alienation, of equity rather than inequality. The process is based on various active and participatory methodologies: cooperative learning, to enhance everyone's skills; peer education, which recognizes the role of students as protagonists; the use of narrative methods, to foster mutual recognition; and problem solving and project work, to connect theory to action. By virtue of this clearly *evolving process*, it emerges that the connection between active and intercultural citizenship and education in environmental sustainability represents a highly topical educational challenge, but at the same time there is a need for critical and practical tools to transform awareness into action. Hence the fundamental importance of orienting education toward an experiential path that intertwines knowledge, reflection, and practice. Only through concrete and shared experiences can we build an education capable of producing citizens ready to face the global challenges of our time.

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