

Special Issue
Engineering the Future Sociologically:
a Call to Delve into Environmental
Education Enhanced by
Technological Innovations

FUORI LUOGO

**Journal of Sociology of Territory,
Tourism, Technology**

Guest Editors

Norberto Albano
Sandro Brignone
Carmine Urciuoli



Editor in Chief: Fabio Corbisiero
Managing Editor: Carmine Urciuoli

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Smart technologies and social knowledge. Where are we now?

The digital transformation of recent decades has opened up a new domain of opportunities and challenges in social systems. Technologies such as Artificial Intelligence (AI), Extended Reality (XR), and the Internet of Things (IoT) are reshaping pedagogical practices, enabling immersive simulations, real-time data analysis, and personalized educational paths (UNESCO, 2024). However, social analyses of technology remind us that every innovation is “socially constructed” (Bijker, Hughes, & Pinch, 1987) and inscribed in specific power relations. The adoption of digital tools in environmental education is not a neutral process but rather reflects—and at times exacerbates—pre-existing social inequalities (Hargittai, 2003).

The sociological debate on this topic highlights three analytical pillars: first, the risk of “AI cognitive extractivism” (Mezzadra, & Neilson, 2019), which links digital value chains to processes of exploitation of natural resources and human labor. Second, the possibility that technological efficiency may generate paradoxical outcomes, increasing overall resource consumption rather than reducing it. Third, the need to foster a form of critical “ecological literacy” (Orr, 1992) capable of integrating digital skills and awareness of planetary limits. While the existence of these concerns is partly due to the lack of relevant legal and ethical frameworks, it should be added that previous research studies have not addressed the issue comprehensively. Therefore, this special issue of *Fuori Luogo* focuses precisely on this topic.

Prioritizing the improvement of the quality of cultural and scientific reflections on the latest generation of digital devices can, in fact, enhance understanding of both the beneficial and problematic potential of AI and its corollary. To give another example: bias and discrimination based on gender, sexual orientation, religion, or geographical origin can be caused by unprofessional behavior during the AI training and feeding processes. Technically, inconsistencies in data labeling and unethical actions can occur when developers manually divide the possible values of a target variable into exclusive or biased categories. The algorithms used by artificial intelligence models can also be problematic, as it is difficult for developers and users to identify all errors and distortions in AI algorithms, which are usually found in the “black box.”

According to the “technofeminist” approach (Borau, 2025), for example, artificial intelligence assistants, even virtual ones, can display sexual signals (bodies, faces, and voices) in addition to simple gender signals (e.g., names, pronouns, hairstyles), and this may adversely affect women by reshaping gender power dynamics, constraining self-representation, constraining their identity to misleading and limited patterns centered on body/face/voice, while facilitating covert manipulation, reinforcing harmful stereotypes, amplifying objectification, and exacerbating gender power imbalances.

The real issue is that developers often lack sufficient grounding in the social sciences and devote limited attention to issues of justice and equity. Another unresolved issue concerns the neglect of what sociologists conceptualize as ‘dissimilarity’. In social sciences, dissimilarity refers to perceived or real differences between individuals or groups that influence social interactions, attitudes, and behaviors. It can be measured using indices, such as the dissimilarity index known to experts in social network analysis, to quantify the uneven distribution of groups across different geographical areas. It is a key concept for understanding social dynamics such as segregation, intergroup relations, team performance, and the formation of social networks. However, still on the subject of gender diversity, the predominance of male developers and male-oriented cognitive frameworks marginalizes female professionals. Once again.

The research and social analysis experiences documented in this special issue of *Fuori Luogo* show that the sociologically conscious use of technologies in training and education has the potential to foster inclusion, stimulate civic engagement, and support pro-social behavior (Kukutai, 2024). This requires the paradigm referred to in the introduction to this issue as an ‘eco-human-

ist approach' (Rodotà, 2012), which balances innovation and social justice, ensuring that access to technology is not a privilege for the few, but a universal right.

In this sense, sociology can and must contribute to guiding educational policies and technological choices towards social harmonization with greater equity and protection for fragile communities. This expectation will only be effective if it can transform technology from a factor accelerating crises to a lever for their solutions, through an alliance between social sciences, educational communities, and responsible technical design.

It is therefore imperative for decision-makers to exercise caution in the selection of digital tools and AI models that could narrow their vision of learning, since general artificial intelligence does not exist. And since these models will be increasingly "aligned" with real-world experience, it is essential to adopt systemic approaches that account for human involvement, taking into account the strengths and weaknesses of the specific techno-educational system. A solution that does not mean knowing the answer to every question. Even under conditions of reflective equilibrium, we expect disagreements to persist about which actions are good or bad, both between different individuals and between different cultures. In such cases, we consider an AI to be 'aligned' if it recognises what it does not know and selects courses of action that remain robust under conditions of uncertainty.

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Engineering the Future Sociologically: Environmental Education and Advanced Technologies in the Age of Planetary Crisis

1. Sustainability, Technologies, and Educational Challenges: Towards a New Integrated Learning Paradigm

We are living in a historical moment marked by growing awareness – though at times evaded or contested – of the global environmental crisis. Climate change, biodiversity loss, and pollution constitute what the United Nations defines as the “Triple Planetary Crisis” (UN, 2021), a complex system of interconnected threats that represent the most critical challenge for the survival of our planet. These phenomena not only endanger natural ecosystems, but also profoundly affect human societies, altering the quality – and even the viability – of life, increasing inequalities, and generating social, economic, and political challenges.

The beginning of the 21st century has seen the warmest years on record globally since the Industrial Revolution, a period from which the impacts of anthropogenic activities have manifested with increasing pervasiveness. Global temperatures are approaching the 1.5-degree threshold above pre-industrial levels, as established by the 2015 Paris Agreement. This climate change, driven predominantly by greenhouse gas emissions from human activities, is causing increasingly frequent and intense extreme weather events: heatwaves, droughts, wildfires, floods, and storms that threaten communities, infrastructure, and essential resources. At the same time, biodiversity loss – accelerated by habitat destruction, pollution, and unsustainable exploitation of natural resources – is undermining the stability of ecosystems on which we depend. Air, water, and soil pollution have reached critical levels in several regions of the world, with severe consequences for public health and the well-being of local communities. Within this already alarming context, significant geopolitical events further exacerbate the crisis, with their effects reverberating globally.

Faced with such complex scenarios, where the reciprocal influences between environmental factors and human action are increasingly evident, a shared normative framework becomes essential as the foundation for global efforts toward equitable and ecologically sustainable development. The United Nations’ 2030 Agenda provides an important programmatic and operational framework for global coordination. Its 17 Sustainable Development Goals (SDGs) and 169 targets (UN, 2015) offer an integrated vision in which ecosystem protection (SDGs 13, 14, 15) is inseparable – from among others – from socioeconomic equity (SDGs 1, 2, 5, 10) and inclusive, transparent institutions (SDGs 16, 17).

However, despite broad political consensus, the progress achieved so far remains insufficient. Recent reports estimate that only 15% of the goals are on track for 2030, while others are lagging behind, stagnating, or even regressing compared to their 2015 baselines, with substantial disparities across countries (UN, 2023; Nyhan, & Cryan, 2023). In this context, quality education (SDG 4) – particularly environmental education – emerges as a strategic junction: studies have shown that marginal increases in education levels are associated with significant reductions in carbon emissions and amplify the positive impact of renewable energy and energy efficiency on

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economic growth (Velempini, 2025; AISagri, & Sohail, 2024). Education can thus act as a multiplier, facilitating progress on interconnected goals such as decent work (SDG 8), responsible innovation (SDG 9), and climate action (SDG 13).

The integration of advanced technologies – such as Artificial Intelligence (AI) and Extended Reality (XR) – has the potential to further accelerate the achievement of quality education globally, by expanding access to learning and supporting the realization of other SDGs (*ibid.*; Doshi *et al.*, 2024; Rane, 2023). AI-powered adaptive learning platforms, real-time automated translation, and assistive technologies offer concrete – perhaps unprecedented – opportunity to overcome barriers related to disability, language, or geographic location, promoting inclusive and personalized educational experiences (Fitas, 2025; UNESCO, 2024; Shireesha, & Jeevan, 2024). The impact extends beyond education: immersive environments based on virtual reality and intelligent tutoring algorithms enable the simulation of complex climate scenarios, fostering systems thinking and problem-solving skills oriented toward sustainability (Bakare *et al.*, 2024; Doshi *et al.*, 2024, *op. cit.*).

Both thematic pillars outlined thus far – environmental education and advanced technologies – possess significant transformative potential. They can influence both individual learning and collective cohesion, as well as the protection of ecosystems and the promotion of sustainable development models. When synergistically combined and appropriately directed, these domains can generate innovative solutions to the challenges posed by the planetary crisis, particularly in their most complex intersections, where education, technology, and sustainability converge. It is precisely on this ground that the contributions collected in this Special Issue of *Fuori Luogo* are situated, in response to the call entitled “Engineering the Future Sociologically: a Call to Delve into Environmental Education Enhanced by Technological Innovations”. The articles presented here critically explore these intersections, offering theoretical insights, empirical analyses, and project-based reflections that interrogate – through diverse yet converging perspectives – the possibilities and contradictions inherent in the integration of ecological education and technological innovation. Readers will find in the following pages a reasoned map of the key challenges and emerging potentials within this complex and strategic landscape.

2. Environmental Education and Technological Innovation: Convergences and Tensions

Environmental education is recognized as a key instrument for addressing the ecological crises of the 21st century, promoting the knowledge, skills, and values necessary to build sustainable societies. Since the 1970s, this field has evolved by integrating multidisciplinary approaches, innovative technologies, and global collaborations. Today, environmental education is a multifaceted domain, yet its conceptual frameworks revolve – *nomen naturae congruum* – around the idea of fostering pro-environmental behavior. Arthur Lucas, one of the leading scholars in the field, noted that definitions of the term could be classified according to intent-based educational concepts: *about* the environment (focusing on the knowledge students should acquire), *in* the environment (emphasizing fieldwork and direct experience), or *for* the environment (encouraging conservation-oriented attitudes). Over time, these concepts have been incorporated into the broader framework of Education for Sustainable Development (ESD), which links environmental concerns with social and economic dimensions. This shift reflects a more holistic understanding of sustainability challenges and acknowledges that environmental issues are intrinsically tied to human well-being and economic development.

As one might expect, the variety of pedagogical approaches and teaching strategies used in environmental education – including those that incorporate advanced technologies – makes it difficult to establish a unified classification. This contribution therefore offers a brief review

of some of the main development trajectories that have emerged in both the literature and educational practice, with the aim of providing an initial critical orientation within a constantly evolving landscape. A central theme in many environmental education programs, especially at early levels of instruction, is the emphasis on *experiential* and *outdoor learning*, which engages students in direct and hands-on interactions with the environment. Activities such as school gardening, litter collection, field trips in natural settings, and, for secondary schools, environmental restoration projects, allow students not only to observe but also to design and improve their natural surroundings. These experiences foster a deeper connection and empathetic relationship with nature while strengthening problem-solving skills. Often, this education takes place in local contexts, focusing on the natural and cultural features of a community, through partnerships with local organizations or *service-learning* activities. Such experiences make learning more tangible and relevant to students' lives, facilitating the formation of social bonds, the recognition of natural contexts, and the adoption of pro-environmental behaviors.

However, several authors have pointed out that these experiences are not always practically feasible due to budget constraints, logistical limitations, or concerns about student safety. Educators sometimes face challenges in teaching abstract topics or issues distant from students' everyday lives, or they may choose to integrate traditional methods with increasingly accessible advanced technologies. Among the most recent technologies used in educational settings to promote environmental awareness and sustainability, the following can be identified (Hajj-Hasan *et al.*, 2024)

- Extended Reality (XR) Technologies – including Virtual Reality (VR) and Augmented Reality (AR) – offer immersive and interactive experiences that can significantly enhance learning about sustainability topics. VR can transport students to otherwise inaccessible or hazardous environments, allowing them to explore ecosystems, witness the impacts of climate change, or conduct experiments in virtual laboratories. AR overlays digital information onto the real world, enriching field experiences and facilitating complex investigative activities. AR applications such as “Environmental Detectives” engage students in simulated environmental investigations within real-world contexts.
- Videos and Podcasts are widely used as instructional supplements, especially in university settings. 360° videos, accessible via computer, tablet, or VR headsets, help visualize the impacts of climate change on glaciers or fragile ecosystems, enhancing awareness of the scale of these phenomena. Podcasts, typically episodic and concise, have emerged as a popular medium among younger generations for disseminating educational content.
- Online Platforms and Apps, whose importance grew significantly during the pandemic, have become nearly indispensable, particularly in remote or hybrid teaching environments. These tools facilitate the collection, monitoring, and sharing of ecological data, as in certain *citizen science* initiatives. For instance, *Google Earth* can be used to explore environmental disasters and support virtual fieldwork activities, which have been shown to improve students' awareness and pro-environmental attitudes, especially at the secondary level.
- Serious Games and Gamification Approaches are employed to engage students with sustainability topics and can enhance systems thinking and support for environmental policies. Gamification promotes environmental awareness and digital literacy among primary and early secondary school students, helping them internalize new habits related to water and energy usage, recycling, and the food production chain. Educational games can foster positive cognitive, emotional, and behavioral engagement during the learning process.
- Educational Robotics represents a promising frontier at the intersection of technology and environmental awareness. It is one of the most effective approaches for combining theory and practice in sustainability education. Activities such as robot construction, sensor usage, and direct monitoring of environmental parameters provide students with active learning opportunities to explore ecological phenomena. For example, sensor-equipped robots can

collect data on air quality, soil moisture, temperature, or pollution levels, or compare environmental data from different geographic areas via Internet of Things (IoT) platforms (Palmeri *et al.*, 2023). Additional applications include the design of “cleaning robots” capable of detecting and simulating waste collection, thereby raising student awareness of pollution and recycling. These experiences are particularly effective in primary and secondary education contexts, as they promote active, collaborative, and interdisciplinary learning. The convergence of educational robotics and environmental sustainability also reflects the evolution of STEAM curricula toward more ethical, inclusive, and SDG-oriented approaches. In this framework, robots are not merely technological tools but act as cultural mediators capable of facilitating interaction between technical knowledge, ecological imagination, and social responsibility.

- Artificial Intelligence, especially Large Language Models (LLMs) and generative AI, is beginning to make inroads into the field of environmental education, offering innovative tools for learning. AI can provide real-time information and analysis on environmental topics at both regional and global levels, encouraging ecologically responsible behavior. One study examined how students used generative AI tools to create comics about interspecies survival struggles (Sachyani, & Gal, 2025), drawing inspiration from locally observed situations. Platforms powered by advanced reasoning can offer interactive courses on renewable energy, climate models, waste reduction, and biodiversity conservation. This approach helps develop 21st-century skills such as critical thinking and creativity, while also fostering environmental citizenship. AI can support students in understanding sustainability topics by expanding their thinking to analyse complex problems and explore viable solutions, while also assisting teachers in adapting their methods and integrating new technologies into the curriculum.

It is important to emphasize that neither direct interaction with nature nor technology-mediated approaches alone are sufficient to generate effective sustainability education. A key challenge is to move beyond the mere transmission of ecological knowledge, which – while essential – is not enough to inspire collective action. It is crucial to cultivate pro-environmental attitudes and visions that lead to real changes in habits and lifestyles. In school settings, this requires didactic support that is both well-planned and responsive, capable of transforming stimuli into discussion, evoking emotions, encouraging questions, and promoting the search for solutions – in short, helping to make sense of experiences and turn them into meaningful actions. This suggests that approaches centered on students and based on direct exploration, supported by expert facilitators and well integrated into classroom practice, may be more effective in promoting pro-environmental attitudes. These “expert facilitators” could include not only human educators but also “intelligent agents” (AI systems) that stimulate reflection and encourage the adoption of responsible behaviors.

In the context of environmental education – especially when enhanced by advanced technologies – the adoption of an *eco-humanistic* and *critical perspective* is essential for cultivating authentic and responsible environmental citizenship. These approaches integrate thematic knowledge with ethical values, social justice, and a holistic understanding of the complex interactions between human beings and the environment. They recognize that the environmental challenges of the 21st century cannot be addressed solely through science and technology but require a profound shift in values and behaviors. They teach students to see the world as a complex system in which all parts influence one another, and to understand the causal relationships between their actions and environmental impact. The preservation of our planet is not merely an ecological issue, but a moral and social commitment that calls for intergenerational solidarity and respect for biological and cultural diversity.

3. Artificial Intelligence and the Promethean Dilemma: Toward a Critical Environmental Literacy

In delineating the conceptual framework of Engineering the Future Sociologically, it proves useful to retrace the long genealogy of automation, identifying key symbolic ruptures that – from the Industrial Revolution to the era of generative artificial intelligence – have progressively redefined the position of the human within the technical world. From this trajectory, three pivotal figures emerge – Charles Babbage, Günther Anders, and Stefano Rodotà – whose insights remain invaluable for interrogating the ambivalences of the planetary crisis and the educational responsibilities it entails. In conceiving the Analytical Engine in the 1840s, Babbage envisioned a universal device capable of absorbing the intellectual labor of human calculators engaged in the compilation of logarithmic tables for the British Empire. Matteo Pasquinelli has interpreted this experiment as a nexus between mechanical revolution and the extraction of value from the general intellect: the promise of unlimited computation, inaugurated by Jacquard’s punched cards, which foreshadowed the logic of indexing and, in the long term, the appropriation of social data. The epistemic shift identified by Pasquinelli – from the anatomy of nineteenth-century manufacture to the predictive models trained on today’s digital residues, such as social media, environmental sensors, and educational platforms – reveals how the algorithmic project is fundamentally political, inscribed from the outset within power relations and material, energy-intensive infrastructures.

Against this backdrop, in the 1950s, Günther Anders elaborated the concept of Promethean shame, the feeling of humiliation experienced by humans in the face of the superior performance of their technical creations. This emotion, Anders argues, reveals a Promethean asymmetry between the power to act and the capacity to represent its consequences: our imagination remains “out of sync,” incapable of foreseeing the implications of the devices we design. Whereas in 1956 the ultimate test was the atomic bomb, today the same asymmetry reverberates in the training of large language models, whose billions of parameters obscure extractive chains of energy, rare earths, and invisible cognitive labor. In this sense, Promethean shame becomes a critical category for unmasking the rhetoric of “immaterial” AI, restoring to it its ecological weight.

In 2012, at the Permanent Seminar on “Ethics, Bioethics, and Citizenship” held at the University of Naples, Stefano Rodotà explicitly referenced Anders to denounce the ontological disproportion between the individual and techno-scientific apparatuses, calling for a new lexicon of rights capable of safeguarding human dignity within algorithmic society. This same critical thread re-emerges in his later writings, where reflections on digital corporeality are intertwined with a growing awareness of the *homo dignus* threatened by processes of automated dehumanization. Rodotà thus shifts the focus from admiration or shame at the machine’s power to the collective responsibility of defining limits, guarantees, and public purposes for technological innovation, shaping a “humanism of rights” that recognizes participatory governance of technology as an eminently democratic task.

Placing Babbage, Anders, and Rodotà within the same interpretive arc allows us to illuminate the nexus between technical enhancement, resource extraction – both material and cognitive – and the pressing need for critical ecological literacy. The threefold planetary crisis – climatic, biological, and polluting – demands that we move beyond the notion of AI as neutral or redemptive. On the contrary, intelligent systems must be read as total social facts, redistributing risks and opportunities, generating new inequalities but also unprecedented capacities to model environmental phenomena.

From this perspective, environmental education empowered by advanced technologies must be grounded in a critical genealogy capable of revealing the historical continuity between industrial and algorithmic automation, showing how every technological leap entails new forms of extractivism; in a material awareness that reanchors AI in its energy, mining, and labor footprint,

thereby dismantling the illusion of weightless virtuality; and in an eco-digital constitutionalism that promotes a humanism of rights inclusive of planetary boundaries and oriented toward socio-technical design for climate justice. Only by adopting this posture can Artificial Intelligence be transformed from a vehicle of hybridity into a cognitive lever for robust sustainability, in accordance with UNESCO's call for a Sustainable AI that harmonizes efficiency, equity, and ecosystem protection.

4. Artificial Intelligence Between Promises and Contradictions: A Critical Sociological Reading

In the contemporary landscape, Artificial Intelligence has emerged as a hegemonic signifier, a discursive catalyst that polarizes public and academic debate. It has become a site for the projection of paligenetic, almost messianic hopes for solving the aporias of late modernity, while simultaneously embodying systemic risks of no small magnitude (Di Matteo, & Zuccarelli, 2024; Razzante, 2024). Its most recent and pervasive incarnation in the form of large language models (LLMs) raises crucial questions for a critical sociology of the present, positioning itself at a key intersection between the acceleration of technological innovation, the imperative of environmental sustainability, and the reconfiguration of educational paradigms.

The fundamental contradiction that emerges from the current trajectory of AI development lies in its staggering energy consumption (Coeckelbergh, & Gunkel, 2025). The training of state-of-the-art language models and their large-scale deployment involves energy expenditures of systemic proportions. Recent studies, as reported in the 2025 Stanford AI Report, show that the carbon emissions produced during the training of AI models have increased exponentially: training GPT-3 in 2020 produced 588 tons of CO₂, GPT-4 in 2023 produced 5,184 tons, and Llama 3.1 405B reached 8,930 tons in 2024 (for context, the average American emits about 18 tons of carbon per year) (Maslej *et al.*, 2025, p. 28). The global data center infrastructure reached 415 TWh in 2024, with projections suggesting a possible doubling by 2030 – surpassing 945 TWh. If this energy demand is primarily met by fossil fuels, it results in substantial greenhouse gas emissions, further exacerbating the “Triple Planetary Crisis” already afflicting our time.

This energy consumption is accompanied by a process of systematic invisibilization of the material and social conditions that make it possible (Sissa, 2024). AI, in its infrastructural manifestation, is far from an ethereal or dematerialized entity; it possesses a substantial physical footprint and a deep ecological impact – often overlooked in dominant narratives focused on digital benefits. The supply chains for specialized hardware, from GPUs to dedicated servers, are entangled with extractive practices that negatively affect natural resources and human communities. The extraction of rare metals such as cobalt, lithium, and tantalum – crucial for electronic components – is frequently associated with deforestation, soil and water pollution, and exploitative labor conditions in mining regions. Downstream, planned obsolescence and the constant pursuit of more powerful hardware contribute to growing volumes of electronic waste laden with toxic substances, which, if improperly disposed of, risk contaminating ecosystems and communities, often in the world's peripheries.

Here, the relevance of a critical lens on “technocapitalism” emerges, an economic model in which digital technologies are embedded in profit-driven and accumulative logics, perpetuating extractive and colonialist dynamics in digital form. AI feeds on both a “data extractivism” – the exploitation of massive amounts of information often collected without proper consent or compensation – and a “material extractivism”, whose environmental and human costs are systematically externalized. Moreover, the “invisible labor” of data annotation and content moderation – often precarious, underpaid, and psychologically burdensome – constitutes another element of the hidden materiality that underpins the seemingly immaterial edifice of AI.

Yet, in light of this critical picture, it would be intellectually dishonest and sociologically short-sighted to deny the transformative potential that ethically guided AI could unlock (Preeti, 2025; Hasas *et al.*, 2024). Among its most promising capabilities is the theoretical potential to optimize processes and reduce consumption across various sectors, including energy management and environmental monitoring. AI can analyse vast environmental datasets to detect emissions, monitor deforestation, or predict extreme weather events. However, prudent economists and scholars of technology cannot overlook the troubling spectre of the “Jevons Paradox”: the efficiency gains made possible by AI, rather than leading to absolute reductions in consumption and impact, risk driving an aggregate increase in resource use within a growth-oriented system, thus nullifying specific gains and potentially worsening the overall ecological balance. While, as Maslej *et al.* (2025) show, the energy efficiency of machine learning hardware improves by approximately 40% each year, the total power required to train frontier models is effectively doubling annually. Power demands have risen from roughly 4,500 watts needed to train the Transformer model in 2017 to 25.3 million watts for Llama 3.1 405B in 2024, a more than 5,000-fold increase. It is this gap between individual efficiency and aggregate consumption that embodies the paradox, demonstrating how technological progress, in the absence of limits to growth, does not guarantee ecological benefit.

More ethically promising is AI's role in enhancing environmental education and awareness. LLMs' ability to process and communicate complex information in personalized ways, act as virtual tutors, analyse large volumes of environmental data, and generate interactive simulations opens up new possibilities for fostering critical ecological consciousness and promoting ecoliteracy suited to contemporary challenges. In an era defined by a multidimensional planetary crisis, this pedagogical function – if governed with wisdom and responsibility – could prove crucial in bridging the “human gap” in understanding our interconnection with ecosystems.

In this context, integrating artificial intelligence into environmental education is not merely a technical or operational issue; it raises profound questions about the nature of knowledge, inequalities of access, forms of educational agency, and the distribution of power in shaping environmental futures. A sociological perspective is essential not only for understanding the cultural and social dynamics in which AI is embedded but also for interrogating the models of society and subjectivity that it helps to shape.

AI is not neutral: it is built by actors, shaped by interests, and trained on data that reflect hierarchies, exclusions, and dominant narratives. Machine Learning models are opaque, both in their decision-making criteria and in the impacts they produce. In education, this may translate into decontextualized interactive and evaluative automatisms and into representations of the environmental world that are overly simplified or culturally biased. A sociological reading allows us to uncover the mechanisms of inclusion and exclusion that permeate AI use. Digital inequalities – which involve material access, cognitive skills, and cultural conditions – intersect with long-standing forms of marginalization, producing new educational divides. This is evident in the asymmetry between high-tech Western educational settings and under-resourced school systems in Africa or Asia that struggle to integrate AI due to infrastructural and linguistic barriers. Yet, these very contexts are also generating alternative models for AI integration: projects that value linguistic diversity, community inclusion, and collective intelligence. There are examples where AI is adapted to local educational ecosystems, becoming a tool to support learning, environmental awareness, and youth empowerment (Sachyani, & Gal, 2025; Kukutai, 2024). These are experiences that break with the logic of top-down technology transfer and instead promote the social co-design of technology.

Sociological reflection also allows us to question the cultural and epistemological transformations introduced by AI. Environmental education is no longer merely the transmission of ecological knowledge, but also a process of subjectivation that shapes identities, perceptions, and emotions. Technology acts as both a filter and amplifier of certain environmental imaginaries: which images of nature are conveyed? Which relationships between humans and non-humans

are emphasized or marginalized? Which forms of collective action are given voice, and which are silenced? Intelligent technologies raise pressing political questions: who decides what to teach and how? Which visions of the environment are deemed legitimate? Who has a voice in the technological design process? It is in this space that the social sciences can offer a decisive contribution – promoting participatory research practices, open models of governance, and normative frameworks capable of guiding technology toward public and inclusive ends.

Artificial Intelligence must therefore be understood in a profoundly dialectical light: a tool of immense transformative potential, yet intrinsically marked – at least in its current dominant configurations – by what we might call an “original sin” of material, energetic, and socio-cognitive unsustainability. It emerges as a contemporary *pharmakon*, in the Derridean sense: both poison and cure, remedy and toxin, whose nature depends entirely on dosage, context, and the awareness with which it is handled. The challenge before us is neither naïve faith nor a priori rejection, but the inauguration of a radical rethinking – a deep interrogation of the goals, conditions of possibility, and limits of AI development. Could AI, once it has helped foster a deeper ecological awareness and identified viable paths to genuine sustainability, be reined in and downsized from its current voracious, opaque, and energy-intensive forms? Will we be able to collectively engineer its future – through multilateral governance, participatory processes, and robust ethical principles – in a way that internalizes its ecological and social costs, transforming it from opaque problem into a responsible part of the solution?

This implies, as stated in the UNESCO Recommendation on the Ethics of Artificial Intelligence (2021), that the harmonious development of the environment and ecosystems must be recognized, protected, and promoted throughout the entire life cycle of AI systems – rebalancing the relationship between technology, society, and nature. Approaches such as Sustainable AI – which combine technical efficiency, social justice, and ecological sustainability – represent a fertile framework for rethinking the integration of AI and environmental education, rejecting both technological determinism and ethical-political inertia, and instead fostering a transformative alliance among critical knowledge, educational communities, and generative technologies. Within this perspective, the present Special Issue of *Fuori Luogo* aims to explore – through the tools of social theory and philosophical reflection – the complex, ambivalent, and often contradictory intersections between AI, the environment, and education. It adopts a sociological-critical lens that does not shy away from deep awareness of the ethical and technological implications. Technology, far from being a neutral tool, acts as a powerful mediator between individuals and the environment, with the potential to redefine crucial aspects of our existence: from consumption patterns to everyday behavior, and ultimately, our fundamental relationship with the natural world.

5. Contents of the Issue

The call “Engineering the Future Sociologically: a Call to Delve into Environmental Education Enhanced by Technological Innovations” draws inspiration from the 12th edition of the World Environmental Education Congress (WEEC), held in Abu Dhabi in 2024, dedicated to issues of environmental education. The WEEC reaffirmed the urgency of rethinking education as a driver of ecological and social transformation, with a focus on cultivating active and informed citizens capable of leading the transition toward a sustainable future. The congress concluded with a compelling appeal for more ambitious action by 2030, in view of the deadline for the United Nations’ Sustainable Development Goals (SDGs) and the Decade on Ecosystem Restoration.

This issue begins with a state-of-the-art mapping by Caterina Ambrosio and Dario Chianese in their contribution “Mapping Technology Usage in Environmental Education”. Through bibliometric analysis using the PRISMA method and content analysis, the authors provide a com-

prehensive overview of how information and communication technologies are being adopted in environmental education. Their work classifies and systematizes key pedagogical practices that employ technology in this domain, highlighting the evolution of the field and the growing importance of tools such as geospatial information systems (GIS), augmented reality, and gamification. The article thus offers an updated picture of the sector's development, identifying trends, criticalities, and potentials for the socially equitable and conscious use of technologies in promoting sustainability.

Building on this framework, the second paper focuses on the urban environment as a privileged site for informal ecological learning. In "Learning Cities and Urban Ecosystems: Digital Technologies Fostering Informal Lifelong Environmental Education in Cities and Urban Participation", Marco Ingrassia explores how digital technologies – particularly augmented reality, participatory platforms, and video mapping – can enhance environmental education in cities, understood as dynamic ecosystems and spaces of active citizenship. Through two Italian case studies (*Superbarrio* and *Anima Mundi*), the author illustrates how these technologies can foster civic engagement, stimulate ecological empathy, and enable situated, continuous, and participatory learning processes. The third article, "ChatGPT and the Social Appropriation of AI on Discord", by Vincenzo Laezza, Arianna Petrosino, and Vincenzo Luise, adopts an ethnographic approach to study the social appropriation of generative artificial intelligence on digital platforms, focusing on *Discord*. The authors analyse emerging *prompt-making* practices as forms of collaborative work, informal learning, and the production of meaning and value, giving rise to bottom-up digital prompt-markets. The essay shows how the everyday use of AI is the outcome of collective, affective, and strategic negotiations – an example of the "social shaping of technology" – and opens up the possibility of a digital ecology based on distributed creativity and horizontal sharing of skills.

The fourth article "AI, Big Data, and IoT for Social and Environmental Sustainability in a Digital Transformation Course" by Antonio Opromolla, operates in the field of sociotechnical systems to examine how digital technologies – artificial intelligence, the Internet of Things, and Big Data – can contribute to sustainable development when interpreted within an integrated vision that values the co-evolution of technical and social factors. The author introduces the concept of "design sociology" as a methodology to govern complexity through human-centered approaches and co-design practices. Presenting a university course he developed, Opromolla offers a concrete example of how to integrate interdisciplinary knowledge, systems thinking, and ethical reflection in higher education, preparing the next generation to act as sustainable change agents in the digital age.

Finally, in dialogue with this systemic perspective, is the article "Ecoliteracy and Artificial Intelligence: Two Opposites for a Common Goal in Education" by Gianfranco Rubino, which addresses the theoretical and pedagogical challenge of combining ecoliteracy – understood as an ecological competence grounded in knowledge, empathy, and responsibility toward the environment—with the potential (and risks) of artificial intelligence. AI is described as a dual and paradoxical technology: on the one hand, a powerful tool for learning and ecological research; on the other, a system with significant environmental impacts in terms of energy consumption and resource extraction. The essay reviews key ecoliteracy theories (Goleman, Capra, Freire, Orr, etc.) and proposes an integrated model that, through ecopedagogy, merges the educational objectives of AI and environmental education in a transformative perspective. The proposal to build an experimental framework based on the direct use of AI language models represents a first step toward a pedagogy capable of enabling *ecological intelligence* in the digital era.

In the Readings section, this issue presents reviews of three volumes. The first, "Le emissioni segrete. L'impatto ambientale dell'universo digitale" (2024) by Giovanna Sissa, is reviewed by Mariella Berra. The book analyses, in a scientific yet accessible style, the often-hidden environmental costs of the digital universe, examining the full life cycle of technologies: from raw material extraction to the energy use of data centers and devices, down to the disposal of electronic waste.

Sissa proposes ecological transition strategies based on shared responsibility among producers, users, and policymakers, calling for an ethics of digital sustainability through integrated policies aimed at ecologically conscious technological transition.

In the second review, Giorgio Osti discusses "Digital Society" (2024) by Manuel Castells. The textbook offers a critical and up-to-date analysis of the digital society through a balanced and dialectical approach that integrates empirical data with sociological insight. Castells revisits the concept of the "network society," examining the impact of ICTs across different sectors – politics, labor, education – and addressing key topics such as digital inequality, surveillance, remote work, and social movements. The work stands out for its accessible yet rigorous language and its pragmatic outlook, which avoids easy pessimism while emphasizing the centrality of networks and the need for universal and meaningful access to digital technologies.

The third volume, "Educare all'IA. La sfida didattica dell'intelligenza Artificiale: ChatGPT e Gemini" (2024) by Massimiliano Badino, Fabio Aurelio D'Asaro, and Francesco Pedrazzoli, is reviewed by Emanuela Ricciardi. It offers schoolteachers a clear and practical guide to integrating generative artificial intelligence into educational practice, addressing regulatory aspects, technical operation, and ethical concerns. The authors provide concrete examples and pedagogical reflections aimed at fostering critical digital literacy, emphasizing the importance of building an interdisciplinary and "robot-proof" education – one capable of navigating the transformations occurring in schools through both the opportunities and challenges posed by AI in teaching and learning.

Lastly, navigating this terrain of complexity, practical challenges, and ethical dilemmas is the interview with Prof. David J. Gunkel – philosopher of technology and leading voice in the ethics of machines. Gunkel offers a profound philosophical reflection on artificial intelligence and social robots, inviting us to move beyond traditional Western dichotomies such as subject/object or anthropomorphism/technological determinism. He highlights the urgency of an interdisciplinary dialogue between engineering and the social sciences, inspired by Platonic dialogue, to critically address the ethical and social implications of 21st-century AI. However, Gunkel warns that such a dialogue risks remaining incomplete and narrow unless it actively engages with "non-Western" traditions of thought, in order to overcome entrenched ethnocentrism and the threat of intellectual colonialism. Drawing on Derridean deconstruction, Gunkel invites us to revisit the ontological distinction between persons and things – especially in an era marked by environmental crises and inequalities. He also proposes a new legal and moral paradigm that recognizes limited forms of "robot rights" – already present in some regulatory frameworks – not to anthropomorphize machines, but to responsibly govern their growing social presence. Finally, from an educational perspective, he advocates for an open and critical pedagogical approach that encourages students to question the very assumptions (and inherited conceptual categories) through which we engage with emerging technologies – revealing how the way we frame a problem may itself be the greatest obstacle to its resolution.

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Mapping Technology Usage in Environmental Education²

Introduction

The future of the planet faces significant challenges, including climate change, global warming, exhaustion of natural resources, desertification, and others (Grosbeck *et al.*, 2019), with countries worldwide having shown increasing interest in environmental issues (Jickling & Wals, 2012). One of the key instruments for ensuring a better future for both people and the planet is Environmental Education (EE). This realization came as early as 1987, as the World Commission on Environment and Development established the Brundtland Commission with the goal of raising awareness among nations regarding sustainable development issues. Such awareness was intended to be fostered through extensive educational campaigns (Yang & Xiu, 2023).

However, at the time, said document was not taken seriously as the global community did not yet recognize the importance of EE (Lambrechts & Hindson, 2016). The turning point came a few years later, in 1992, with the release of Agenda 21, in which the UN acknowledged the central role of education in environmental matters, and, since then, EE activities have been increasingly established (Yang & Xiu, 2023). It is important to recognize that EE extends beyond primary and secondary levels to also include tertiary education (Trencher *et al.*, 2014) as well as lifelong learning: tertiary education makes significant contributions that are often overlooked; higher education institutions are seen as responsible for training future teachers (*ibid.*; Hallinger & Chatpin-yakooop, 2019); EE is also discussed outside institutional education, in respect to lifelong learning, reskilling, and other areas (Gough, Walker, & Scott, 2001; Ardoin & Heimlich, 2021).

There are various methods of implementing EE, the most common being problem-solving: teachers present students with real problems, engaging them in finding solutions (Reese, 2019). This approach may allow students to critically reflect on their own learning and provide them with opportunities to shape their education in a meaningful way. (Wals, 1994, p. 2). Another approach is through outdoor activities, such as physical exercises, nature walks, and excursions, which allow students to connect with the environment more than classroom settings can (Maidatsi *et al.*, 2022). These approaches are often combined: students leave the classroom to encounter real-world problems, supposedly leading to better performances (Yıldırım & Akamca, 2017). Other projects integrate EE into the teaching of natural sciences (Garner *et al.*, 2018). This more formal educational method suffers from the frequent lack of textbook sections dedicated to the topic and limited curricular time (Maidatsi, 2022, *op. cit.*).

Technologies can be valuable tools for EE and Education for Sustainable Development (ESD), allowing people to access necessary information in immediate and diverse ways to increase environmental awareness. Some scholars argue that UNESCO should promote EE in conjunction with technology; this potential has not yet been fully exploited (Yang & Xiu, 2023). Empirical investigations are needed to understand how technology can be used in EE (Albareda-Tiana *et al.*, 2018; Badea *et al.*, 2020).

Such enquiries should bear relevance to social factors beyond the pedagogical or technical implications of technology. Attitudes toward digital tools (Masrom, 2007) and the digital divide (Hargittai, 2003) can significantly shape how these technologies are implemented and who benefits from them. We can conceptualize the digital divide considering both the physical access to technological resources and access to related resources like time, social capital, cognitive and mental capacities, emotional resources. (Hargittai, 2001). Indeed, while digital innovations have the potential to democratize education, they may also reinforce existing inequalities if access to digital infrastructure and technological literacy is unevenly distributed (Sriprakash *et al.*, 2024).

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Given the various proposals for technology usage in education, and EE specifically, and considering numerous integrations of disruptive technologies in educational practices, the goal of this work is to investigate the purposes for which ICT is used in EE. Exploring academic literature on the topic can help clarify the relationship between technologies and educational practices, its evolution over time and its progressive diffusion and sophistication, serving as a starting point for broader sociological reflections on the relationship between technology, EE and digital inequalities.

While it is important to specify that this article will refer to EE and not to ESD, the distinction between EE and ESD is debated: according to some authors, EE and ESD are commonly depicted as either interconnected concepts or separate ideologies, depending on the focus placed on a human-centered viewpoint (Briggs *et al.*, 2018). In this work, the authors conceive EE as the overarching theme of which ESD is a subset (Cartea, 2005). For similar reasons, we focus on Information and Communication Technology (ICT) in this work due to the breadth of its definition, encompassing both analog and digital technologies (UNESCO, 2018) and providing grounds for an exhaustive classification.

1. Taxonomies in Education, Technology and EE

When it comes to taxonomies, EE can rely on the important contribution of Bloom's Taxonomy and its revised versions. It originally categorized educational objectives into six hierarchical levels: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Bloom *et al.*, 1956). In the 1990s, a revision led by Lorin Anderson transformed these into action-oriented verbs: Remember, Understand, Apply, Analyze, Evaluate, and Create, with "Create" at the pinnacle to emphasize its importance (Anderson & Krathwohl, 2001). Bloom's Taxonomy has left a legacy, providing guidance for educators to design curricula fostering critical thinking and problem-solving skills. Its revised version also shifted the focus to specific practices, inspiring many classifications in the discipline.

A first taxonomy of the uses of digital technologies in the educational field comes from Bruce (1991) who, focusing on personal computers, theorized their use as: teachers, capable of identifying, personalizing and monitoring learning; tools to support the reading, production and storage of texts; means for exploring language; media, as vectors of hypertextual and multimedia content; communication environments serving students and teachers. Another typology (Mama & Hennessy, 2013) focuses on the combinations of teachers' beliefs and practices regarding the use of ICT, identifying 4 types of uses: integrative, the use of technologies aimed at diversifying the approaches and needs of individual students; incremental, aimed at supporting and improving existing practices; incidental, limited mostly to administrative tasks; inimical, avoided and viewed with suspicion. This subdivision highlights the advantages that technologies may provide through their implementation. Some scholars argue that integrating new technologies into rigid, existing educational programs and consolidated models can hamper their potential benefits because of the limiting procedures already in place (Flavin, 2017). While this can be the case in numerous scenarios, technology happens to situate itself into many complex relationships. Tapia Cortes (2020), based on their review of existing taxonomies to which we refer for completeness, creates their own typology of technology usage: as a means of communication, social and personal use, as a cultural component (mediation of interaction between human actors), managerial and administrative use, instrumental use.

Focusing on digital technologies, their areas of application in education are numerous, including: development, dissemination and access to online content; distance learning; support for students with physical or learning difficulties; collaborative virtual environments; promotion of students' independent learning; sharing and rapid updating of information; multimedia teach-

ing; increase in sources of learning; environmental benefits; real-time student assessment (Haleem *et al.*, 2022). Less frequent in the literature are explicit, systematic mentions of the specific technologies at play. An important reference to new technologies can be found in the UNESCO ICT Competence Framework, a document aimed at teachers and professionals, that lists relevant emerging technologies for education, such as Open Educational Resources (OER), social networks, mobile technologies, the Internet of Things (IoT), Artificial Intelligence (AI), virtual reality (VR) and augmented reality (AR), Big Data (UNESCO, 2018).

Additionally, there are several bibliometric works focusing on EE and ESD which show that the disciplines have expanded significantly only from 2004 onward, and that the growth rate has increased even more after 2015 (Yang & Xiu, 2023; Grosseck *et al.*, 2019; Chang *et al.*, 2021). In noting so, innovation in education technology has been detected as a significant discipline in the field. As of now, there are no scoping reviews focused on technology usage in EE, and we aim to propose a taxonomy to describe it, drawing from existing ones in education technology.

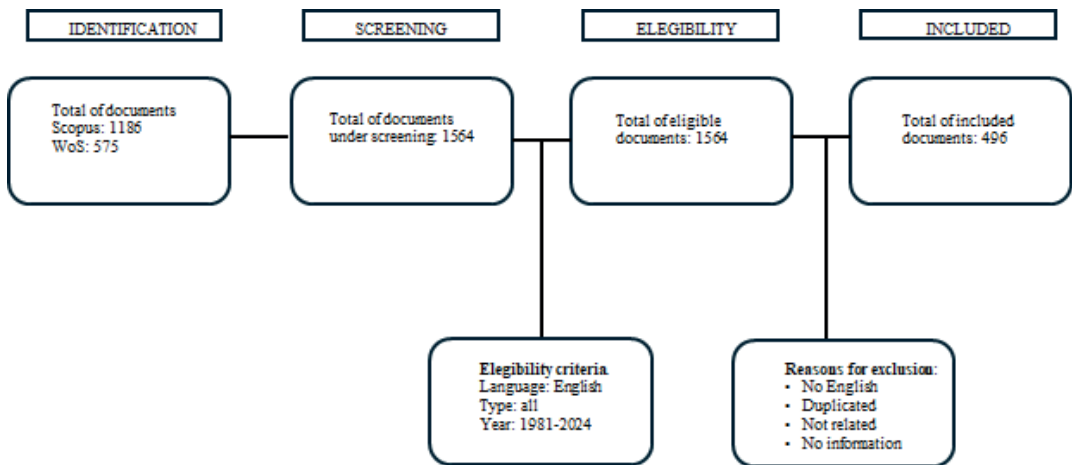
2. Methods

Our research question can be formalized as follows: what are the main usages, objectives and participants of ICT usage according to the state of the art in EE?

To address this question, a two-phase approach called the bibliometric-textual procedure was employed. This involved incorporating reliable methods of bibliometric analysis through the PRISMA method along with Latent Dirichlet allocation (LDA), an automated textual analysis technique. Bibliometric analysis is described as a widely used and systematic approach for examining and analyzing extensive scientific data. Its widespread use is attributed to factors such as the progress, availability, and accessibility of bibliometric software and databases like Scopus and Web of Science, as well as the interdisciplinary influence of bibliometric methods (Mukherjee *et al.*, 2021, p. 1). Bibliometrics provides in-depth analyses of the body of scientific publications on a topic using various tools, synthesizing the state of the art in a particular area of study, and identifying emerging research priorities (Page *et al.*, 2021). As suggested by Fan *et al.* (2022), a descriptive analysis of a theme or research field, even if conducted rigorously and comprehensively, should be developed in a way that provides a foundation for conceptual and theoretical advancements on the subject.

To avoid redundancy in one's work with respect to existing literature, it is necessary to (1) define a clear research objective and (2) supplement classic bibliometric measures with other analytical techniques. The risk is producing a work that lacks depth, hence the need for more complex research designs (Maraolo, 2021; Ellegaard & Wallin, 2015). The bibliometric analysis process involves four key steps: 1. Define the objectives and scope; 2. Select the techniques; 3. Gather the data; 4. Perform the bibliometric analysis and present the results (Donthu *et al.*, 2021). The third step is the most delicate in bibliometric research as it underpins transparency and replicability, key elements of good research (Freese & Peterson, 2017). For this reason, PRISMA, an acronym for "Preferred Reporting Items for Systematic Reviews and Meta-Analyses," was defined as a reporting guideline aimed at improving the quality of reporting in systematic reviews (Liberati *et al.*, 2009). It is comprised of a checklist of 27 items providing recommendations for conducting transparent and replicable research (Page *et al.*, 2021, *op. cit.*). PRISMA is often accompanied by a flow-chart (Figure 1), graphically describing key points of the collection process: screening, selection, and inclusion of articles.

Figure 1. PRISMA flowchart



Supplementing bibliometric analysis with textual analysis techniques can fill its gaps and enrich the results (Glenisson et al., 2005). This approach is especially effective when working with a limited number of scientific articles. (Blei et al., 2003; Glänzel et al., 2017).

The technique allows the discovery of underlying themes in a collection of unstructured documents. The idea is that within the corpus there are various topics, and topic modeling can identify them by pinpointing the most representative words for each theme (Veltri, 2021, pp. 163-165). In this work, the identification of keywords for each theme enabled the structuring of a typology. The dataset was constructed on 18/03/2024 using data export tools from Scopus and WoS. Both databases were used because most research on the topic has been conducted on one or the other to exploit their specific capabilities (Yang & Xiu, 2023, op. cit.). It is often suggested to use both databases simultaneously since they are complementary (Sánchez et al., 2017). Google Scholar was not considered because, although it has better coverage across all disciplines, most statistical sources and materials are of unknown origin (Leydesdorff et al., 2016), and it provides records that are not easily compatible with the databases already considered. The collection queries were:

- For Scopus: TITLE-ABS-KEY (“environmental education”) AND (“technology”*)
- For WoS: TOPIC1 (“environmental education”) AND (“technology”*)

The decision to use “technology”* rather than “technolog”* was motivated by the need to optimize the relevance and precision of the dataset after careful testing of the retrieval procedure. The broader truncation “technolog”* would have significantly increased the number of retrieved results, incorporating a substantial proportion of less relevant studies. Specifically, it would have expanded the dataset to include terms such as technological and technologist, the latter shifting the focus toward professional roles associated with technology rather than the technological domain itself. Moreover, this broader truncation would have automatically encompassed all terms prefixed with technology, such as technology-driven and technology transfer, which do not directly pertain to the research scope. Consequently, the selection of “technology”* was guided by the necessity to maintain an appropriate balance between recall and precision, mitigating excessive dataset expansion with extraneous documents and minimizing noise in the retrieved data, while acknowledging the potential for a slight underestimation compared to a more exhaustive manual expansion.

No time limits were imposed. Only articles in English across all disciplines were selected. A total of 1564 articles were collected. This number was reduced after cleaning operations, which involved manual checking of article titles and abstracts to identify those truly focused on the topic, eliminating duplicates, and removing records with missing information. The final number of articles in the dataset was 496. This number is sufficient to justify bibliometric analysis for this collection (Donthu *et al.*, 2021).

The bibliometric analysis was carried out using Bibliometrix, a package providing a range of tools for quantitative bibliometric research. Written in the R language, it features the user-friendly Biblioshiny interface. Bibliometrix is considered a robust and versatile tool, capable of performing optimally even when analyzing datasets constructed from different databases, as in this work (Aria & Cuccurullo, 2017; Arruda *et al.*, 2022).

LDA was conducted using T-Lab, a specialized software for textual analysis that includes linguistic, statistical, and graphical tools for multidimensional analysis. Much of the data preprocessing was automated through T-Lab's tools. The only exceptions were the removal of some words not recognized by the software as stop-words and the lemmatization of certain words.

3. Results

3.1. Bibliometrics

The collection, including all document types in the data banks, goes from 1981 to 2024 and has an annual growth rate of 5.95%, several times lower than the growth rate of ESD. However, following a long period of scarce, occasional publications, the collection highlighted an increased production from 2017 onward, aligning with findings from broader bibliometric analyses (Dönmez, 2024). The timespan can be divided into two phases, the first one (1981-2017) characterized by slow and erratic increases in production and the second one (2017-2024) characterized by a more pronounced but still variable growth rate. Further analysing the first phase, some spikes in production can be identified: in the period 1996-1997, due to a growing number of proposals for GIS (Witham Bednarz, 2004) and satellite imagery (Goto, 2002) usage in EE, supported by a booming internet industry (Castells, 2001) and expanding multimedia applications; in the period between 2009 and 2011 these ICTs are still being frequently implemented, and a new interest on e-learning and VR is found. At this point the focus is shifting towards the seamless integration of said technologies into teaching practices and curricula (Fan *et al.*, 2010). During the second phase (2017-2024) mobile learning, AR, IoT and AI emerge as relevant technologies in the field, while integration into learning programs and teaching practices is much more frequent.

The most relevant sources in the collection are the "E3s Web of Conferences" and the Journals "Sustainability", "Journal of Environmental Protection and Ecology" and "Journal of Environmental Education". This shows affinity with EE's sources ecosystem, as well as an interest in open publishing. However, calculating the Bradford's Law (Bradford, 1934) zones for this collection shows a high number of sources in the core zone (53 out of 384) and the middle zone (160 of 384), meaning that the coverage is distributed across a wide number of sources with low productivity. This finding is expected when dealing with very broad topics (like ICTs) and is consolidated by similar results when applying Lotka's Law to the collection: the share of occasional authors (with only 1 article in the collection) is 93.7% of the total, a pattern which suggests a diverse and fragmented field with low centralization of research activities.

Textual analysis on the authors' keywords, when expunging less informative words like query synonyms and disciplines, provides a first glance at the technologies involved in EE (Figure 2). It also shows how these technologies are employed as means to several objectives and different targets.

- locations. The main participants of these activities are primary or lower secondary school students. These technologies enable individuals, including those with disabilities or mobility issues, to experience and understand the natural environment through digital representation.
- Clean energy through multimedia. This topic focuses on environmental issues such as energy management, carbon emission reduction, air quality, renewable energy use, and pollution. The educational objective is clearly to inform and raise awareness about these critical issues, highlighting the negative consequences, as suggested by the words "negative", "critical" and "consequence". The idea is that online multimedia resources can promote responsible and sustainable practices ("responsible"). The primary recipients are high school or university students.
 - Improving educational practices for the environment. This topic is not specifically focused on a particular environmental objective but rather discusses ways to improve students' cognitive activities. The characteristic words include "class", "advance", "achievement" and "cognitive". Key practices for enhancing student performance include fostering good relationships between pupils and between pupils and teachers, interactive lessons, and the use of multimedia materials. Again, the subjects concerned are primary or lower secondary school students.
 - Mobile devices for sustainable tourism. This topic highlights portable devices as tools for promoting sustainable development and has been labeled "mobile devices for sustainable tourism". According to the reviewed articles, this involves applications that raise environmental awareness through games or digital guides for natural pathways. The recipients of these activities include students and visitors to natural parks and protected areas. The goal is to increase sustainable tourism. The characteristic words are "park", "explore", "observe", "visitor" and "digital".
 - STEM curricula for environmental awareness: This topic defines the field of education in STEM disciplines. The characteristic words are "college", "science", "scientist", "STEM" and "engineer". The idea is to improve curricula, especially academic ones, to promote greater environmental awareness. This topic does not refer to any specific ICT; digital tools are mentioned broadly as elements to be integrated into traditional teaching methods. Mentioned approaches include internet-based teaching, informal practices, partnerships, internationalization, and interdisciplinarity. The recipients are university students and teachers.
 - Technologies for sustainable development. This topic does not highlight specific ICTs but includes a range from immersive technologies to digital photography, multimedia in general, and IT systems for project management. The characteristic words are "green", "future", "sustainability", "ensure" and "ESD". The specific theme of EE here is sustainable development. The goal is to ensure that students develop skills and standards that promote environmental sustainability while also paying attention to cultural elements. The recipients are university students in STEM degree programs, as the focus is on future professionals and experts who need to be trained in this aspect.
 - GIS for natural area management. This topic addresses the use of mapping and visualization technologies, such as satellite images and online mapping systems, to provide accurate and detailed visual representations of landscapes. It is labeled "GIS for natural area management". The educational goal is centered on learning and managing geographical and environmental information to study and manage various landscape aspects. The recipients are clearly from the academic environment, as these sophisticated technologies would rarely find application in other educational contexts. The characteristic words are "map", "situate", "space", "place", "geography" and "landscape".
 - Conservation of biodiversity through platformization: The educational objective of this topic is to promote practices useful for the conservation of ecosystems and biodiversity, labeled "conservation of biodiversity through platformization". Education focuses on the importance of natural resource management and habitat protection. The mentioned technologies mainly include social media and specially created platforms as tools to raise awareness and

support campaigns. The characteristic words are “biodiversity”, “ecosystem”, “river”, “water” and “forest”. In addition to students, the recipients of these practices include residents and the broader community, suggesting an intent to involve a wide range of individuals and groups in understanding and protecting the environment.

Table 1. Taxonomy of ICTs in Environmental Education

ICT	AIM	MAIN PARTICIPANTS	MAIN USAGE
Virtual reality and simulations	Spreading environmental awareness	Primary and middle school students	Visiting virtually inaccessible places
Online multimedia resources	Fostering clean energy	High school and college students	Learning environmental practices
Mobile devices	Promoting sustainable tourism	Tourists of protected areas	Guiding tourists during their visit
Immersive technologies, digital photography	Promoting sustainable development	College students, experts	Spreading sustainable practices
GIS	Managing natural areas	College students	Managing natural areas
Social media and platforms	Supporting conservation of biodiversity	Students, locals	Promoting biodiversity conservation practices

4. Discussion

The proposed ICT taxonomy broadly accounts for the many usages of technology in EE while identifying the most common ones, aligning with current literature on how these processes tend to unfold. For example, employing immersive simulations with VR that enables visiting otherwise inaccessible or limited environments and resources, as reported by Kavanagh *et al* (2017). VR is also a peculiar topic because of the ample usage of the term “environment” within the context of simulations, rendering automatic retrieval of documents of its application in EE tricky. Most notable in the collection is the absence of AI as an influential technological driver of EE. This can be explained by the time lag between the resurgence of this topic after significant advancements in Natural Language Processing (NLP) and its limited coverage by academic publishing in this sector as of the date of data gathering. While limited in volume, the collection still reveals several documents employing or discussing AI systems (Arnold & Jantke, 2022; Cao & Jian, 2024). It is nevertheless important to highlight the relevance of recent studies exploring applications of AI systems in EE and within education: while a consensus exists about the opportunities and the challenges posed by the vast array of technologies considered part of AI, there is disagreement on acceptable usage (Holmes *et al.*, 2022), necessary safeguards (Baker & Hawn, 2022) and the very approaches devised to implement them, such as AI fairness (Barocas, Hardt, & Narayanan, 2023; *Sripakash et al.*, 2024). EE is a particular area of application, because of the known environmental threats posed by AI system production pipelines, calling for cautious approaches (Nishant, Kennedy, & Corbett, 2020) and critical evaluations (Cooper, 2023) even when faced with positive potential outcomes (Huang, 2018; Chang *et al.*, 2023), and a focus on AI Literacy (Holmes *et al.*, 2022).

The results suggest that the democratization of technologies (Sattaburuth & Prachyanun, 2022) is indeed progressing, adapting them to a broad range of users and purposes. A deterministic perspective, overestimating the benefits of technologies in pedagogical practices without considering specific contexts or empirical data, should be avoided (Hallström, 2022; Peruzzo *et al.*, 2022). It is essential to consider the affordances of technologies, i.e., their capabilities and

opportunities, to understand why they are adopted for specific purposes. Preferences in the use of technologies strongly depend on the specific objectives for which they are implemented, but an analysis limited to this aspect may overlook the real challenges and limitations that affect the effective implementation of ICTs, for example, within consolidated pedagogical models. These consolidated models can be challenging to modify, thereby limiting technology usage in the educational context (Flavin, 2017).

Sociological reflections are central for contextualizing technological adoptions. As previously discussed, the level of acceptance of technology can play a crucial role in determining the success of technology-based educational interventions (Masrom, 2007). Moreover, the digital divide remains a significant barrier to equitable access to technology-enhanced EE. Disparities in economic resources, digital infrastructure and digital literacy can lead to unequal learning opportunities (Hargittai, 2003). While urban and well-funded institutions often benefit from advanced tools such as VR and AI, rural or underprivileged communities may lack the necessary technological infrastructure, further exacerbating educational inequalities. These disparities may also be reinforced by educators and pedagogical professionals, whose varying levels of training and familiarity with digital tools can influence how technology is implemented in educational contexts (Sulaiman *et al.*, 2013). EE itself can be a problematic topic insofar as acceptance levels vary depending on multiple factors, including socio-demographic variables, national context, and social environment (Moustairas *et al.*, 2022; Sriprakash *et al.*, 2024).

With technological democratization potentially enabling practices reinforcing existing inequalities, such as lock-in effects and contradictory relationships between technology usage and environmental education's goals, caution and continuous scrutiny is deemed necessary. This study contributes to this effort by providing a structured taxonomy that serves as an initial step toward identifying innovative applications of technology in EE, considering technology acceptance, acceptance of EE, and the specific characteristics of technology in relation to its pedagogical purpose.

Conclusions

It is important to present the main limitations of this study, starting with the limitations of bibliometrics. Firstly, there may be issues with reproducibility, such as articles being retracted for reasons such as data manipulation, incongruent results, plagiarism, or copyright infringement. Another significant limitation of bibliometric analyses, particularly evident in this study, is the inability to fully comprehend a topic, given the absence of a perfect query capable of encompassing the entire subject under examination. This limitation is exacerbated in our study for several reasons. Firstly, as discussed in the introduction, the topics and scope of EE have a significant overlap with those of ESD, rendering clear boundaries between the two concepts and formulating adequate queries difficult. Furthermore, the analyses themselves have revealed that EE manifests in multiple modes and approaches, adding layers of complexity, since each approach may have terminological and conceptual specificities that are difficult to capture with a single bibliometric query. This study falls victim to this aspect, reporting a wide diversity in the number and consistently unproductive sources on the topic. Another significant limitation of bibliometric analysis, extendable to environmental studies, concerns the use of the term "environment" in search queries. This term possesses significant semantic ambiguity that can drastically reduce the precision of the obtained results, being used to refer to both the natural environment or biosphere, including ecosystems, biodiversity, etc. and different environments such as work, learning, or even virtual reality environments. This semantic ambiguity results in queries containing "environment" gathering a heterogeneous set of documents addressing vastly different topics. This precision issue translates into greater difficulty in filtering results to isolate studies that genuinely focus on the environment. A further limitation regarding the formulation of the search query concerns the use of the truncation * for the word "technology". As mentioned, while this

approach was aimed to balance recall and precision, it may have led to a slight underestimation of relevant documents by excluding more complex inflected forms of the term. Conversely, using a broader truncation such as “technolog*” would have significantly expanded the dataset, incorporating terms such as technological and technologist, shifting the focus toward professional roles rather than technology itself. This challenge, combined with the semantic ambiguity of the term “environment”, highlights the inherent difficulty of designing a single bibliometric query capable of fully capturing the nuances of EE without introducing excessive noise into the dataset. Future research may refine these methodological choices by employing more sophisticated query strategies to enhance both recall and precision.

A final limitation of the analysis, applicable to all studies utilizing multiple databases concurrently, pertains to the need for heightened attention to cleaning and aligning databases. When integrating data from diverse sources with distinctive characteristics there may be cases of duplications, variations in metadata, and discrepancies in bibliographic references that require careful handling. In any case, the bibliometric analysis followed by textual analysis has proven particularly fruitful. The biblio-textual approach, besides providing an additional descriptive source of the phenomenon, supports the interpretation of results from both perspectives. The sequence of operations remains crucial, influencing interpretation, especially in supervised procedures like LDA.

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Learning Cities and Urban Ecosystems. Digital Technologies Fostering Informal Lifelong Environmental Education in Cities and Urban Participation²

Introduction

The ecological crisis is a pivotal element in a context of intertwined societal, economic, and environmental disequilibrium, conceptualized by Morin and Kern (1999) through the notion of "polycrisis". As the authors point out, these approaches must foster a holistic understanding of reality, recognizing that solutions to one crisis can create ripple effects on others. Comprehending the «*complexities of the environment*» and recognizing the urgency to adapt «*human activities and development in ways which are harmonious with the environment*» represent the ultimate aim of Environmental Education, as stated in the final report of the First Intergovernmental Conference on Environmental Education (UNESCO & UNEP, 1977, p.12). Environmental Education (EE) can increase society's capacity to understand the anthropogenic impact of human activity, addressing the objectives of awareness, knowledge, attitudes, skills, and participation (*ibid.*, p.26). Education should not be confined to younger generations, but should instead adopt a lifelong learning approach, addressing individuals of all ages (UNESCO, 2022). This approach should integrate formal, non-formal, and informal learning models (Coombs *et al.*, 1973; UNESCO, 2016). In particular, informal education takes place through everyday experiences and interactions, encompassing self-directed, family-directed, and socially-directed learning within workplaces, families, and communities (*ibid.*). The notion of informal education in urban contexts is particularly broad, encompassing a wide range of activities, including various forms of outdoor learning. The UNESCO Institute for Lifelong Learning (2015) has introduced the concept of "Learning Cities" to highlight the role of cities in the promotion of lifelong and inclusive learning that can address a large share of citizens, through non-formal and informal models. This includes diverse forms of outdoor learning (Chawla, 2020; Dennis *et al.*, 2017), civic ecology and participation (Tidball *et al.*, 2011; Krasny *et al.*, 2015), citizen science (Dickinson *et al.*, 2012), and games or serious games (Tan *et al.*, 2023).

Educational approaches are strictly tied to both societal contexts and the technologies and tools that can enable them. In the last few decades, the growth of Information and Communication Technologies (ICTs), usually defined as digital technologies, has brought structural changes to each aspect of human life, requiring educators to develop new approaches, take advantage of new tools, and face unprecedented challenges (EU, 2020). The capacity of ICTs to transform and foster EE has been the subject of several studies (UNESCO, 2023; Lowan-Trudeau, 2023; Lynch & Thomas, 2024; Hajj-Hassan *et al.*, 2024). However, research has focused mainly on formal and non-formal approaches, and there is limited knowledge about how ICTs can support and enhance informal Environmental Education, particularly in urban contexts, where opportunities for informal learning are abundant but underexplored. This gap highlights the need to better understand how digital technologies can be mobilized to foster environmental awareness, engagement, and action through informal learning processes in cities.

Building on these observations, the paper formulates two key research questions. First, which functionalities of different digital technologies can enhance informal Environmental Education (EE) in urban contexts? Second, how can these functionalities contribute to the achievement of key EE objectives, as defined by UNESCO & UNEP (1977, *op. cit.*)?

To address these questions, the paper investigates the potential of digital technologies to both support and innovate informal EE in urban environments. The research follows a structured

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methodology articulated in three main phases. In the first phase, the paper reviews the relevant state of the art, defines its theoretical framework, and establishes its analytical framework by identifying the key educational objectives and the technological functionalities under investigation.

In the second phase, the paper conducts a focused review of the literature concerning three specific digital technologies—Augmented Reality (AR), Participatory Platforms, and video mapping—with the aim of identifying which of these technologies’ functionalities can contribute to achieving the identified educational objectives in urban contexts. The third phase delves deeper into the two technologies that emerge as particularly promising—participatory platforms and video mapping—by conducting an in-depth analysis of two innovative case studies. This analysis, based on qualitative data and interviews with designers, provides critical insights into the concrete mechanisms through which these technologies can foster informal EE in urban settings.

1. State of Art

1.1 Approaches to Environmental Education

The relevance of EE has grown alongside the awareness of ecological crises and its ties with economic and social development. The Tbilisi Declaration from the “First Intergovernmental Conference on Environmental Education” (UNESCO & UNEP, 1977, *op. cit.*) advocates for EE across all age groups, beyond formal models, supporting holistic, interdisciplinary knowledge, and encouraging activism and participation. It identifies five categories of EE objectives: “(i) *awareness*, to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems; (ii) *knowledge*, to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems; (iii) *attitudes*, to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection; (iv) *skills*, to help social groups and individuals acquire the skills for identifying and solving environmental problems; (v) *participation*, to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems” (p. 26).

Environmental Education (EE) goes beyond natural sciences, adopting a transversal and holistic approach that integrates social sciences, economics, politics, ethics, arts, health, technology, and engineering. It promotes a comprehensive understanding of environmental issues, fostering sustainable solutions that balance ecological, social, economic, and cultural dimensions, preparing individuals to act responsibly for planetary well-being. EE focuses on people and socio-ecological relationships rather than nature in isolation (Tilbury, 2011), aligning with *Education for Sustainable development* (UNESCO, 2021) and *Education for Sustainability* (Sterling, 2001).

Salomone (2012) identifies two contrasting visions of sustainable education: a mechanistic vision, focused on economic sustainability, competition, specialization, and standardized outcomes, and an ecological vision, which promotes participation, lifelong learning, inclusion, cooperation, and holistic understanding of sustainability across environmental, social, and economic dimensions. These two approaches reflect deeper, opposing views of the human-nature relationship, as described by Bateson (1979). The mechanistic view is human-centric, rooted in Cartesian dualism, which separates mind and body and sees nature as something to be controlled. The ecological view, in contrast, is ecocentric, rejecting this separation and recognizing humans as part of a complex, interdependent natural system.

The report *No Limits to Learning* (Botkin *et al.*, 1979) emphasizes the existence of a “human gap”, a fundamental lack of understanding of the intricate links between humans and ecosystems. To

close this gap, the report advocates for lifelong and anticipatory learning, not just as a reaction to crises but as a proactive process for fostering ecological awareness, adaptive capacity, active citizenship, and broad participation in environmental action.

In light of this multidimensional understanding of Environmental Education, it becomes clear that the five key objectives identified by UNESCO & UNEP (1977, *op. cit.*) cannot be effectively achieved without fully embracing diverse informal education approaches. While formal education follows structured curricula within schools and universities, and non-formal education includes organized learning outside traditional institutions, informal education unfolds naturally within everyday life, embedded in ordinary experiences, social interactions, and engagement with the environment. This makes informal education particularly strategic in urban contexts, where environmental challenges and values are immediately visible and deeply connected to daily life, offering continuous opportunities for situated and experiential learning.

1.2 Role of cities for Environmental Education

Cities play a crucial role in shaping the challenges and opportunities of Environmental Education (EE). Urban areas are not only sites of environmental impact, but also key spaces where ecological awareness and learning processes can unfold. In this sense, cities can be understood simultaneously as educational subjects, learning environments, and arenas for citizen empowerment. Firstly, cities themselves are complex ecosystems, with non-linear dynamics and intricate relationships between biotic communities (humans, animals, plants) and their abiotic environment (Mostafavi & Doherty, 2010). This complexity reflects the evolving relationship between human communities and their territories (Magnaghi, 2020) shaped by processes of stewardship, adaptation, and transformation. Urban landscapes, as expressions of both cultural and ecological biodiversity, constitute a fundamental educational heritage (UNESCO, 2001). Furthermore, cities play a crucial role in ecological transition due to their significant anthropogenic impact, including climate change, biodiversity loss, and pollution, but urban rigidity and lack of resilience pose challenges to transitional processes. Such transitions require not only environmental awareness, but also transformations in spatial organization, infrastructure, and local economies, as well as the promotion of sustainable lifestyles.

At the same time, cities represent the primary natural environment experienced by much of the global population, especially for socially and economically disadvantaged groups. For many urban dwellers, particularly those with limited mobility or economic resources, natural experiences are often confined to heavily anthropized environments such as parks, green infrastructure, or urban gardens, rather than remote rural landscapes or protected natural areas. This makes the urban environment itself a critical platform for environmental learning, where public spaces become informal arenas for ecological interaction (Gallay *et al.*, 2020; Warren *et al.*, 2014). Recognizing the educational potential of these spaces underscores the importance of integrating ecological knowledge and sustainable practices directly into urban fabric and everyday life.

This perspective aligns with the broader notion of informal education in cities, which encompasses a wide array of activities and approaches that go beyond traditional classroom-based learning. Informal environmental education in urban areas includes diverse forms of outdoor learning (Chawla, 2020; Dennis *et al.*, 2017), where public parks, green corridors, and community gardens become sites for experiential ecological learning. It also embraces practices of civic ecology and participatory action (Tidball *et al.*, 2011; Krasny *et al.*, 2015), fostering environmental stewardship through hands-on community projects such as urban reforestation, neighborhood greening, and waste reduction initiatives.

In this context, informal learning opportunities become crucial tools for fostering ecological awareness and agency in urban populations. Citizen science projects (Dickinson *et al.*, 2012) further extend this educational approach, empowering residents to contribute directly to environ-

mental monitoring and data collection while enhancing their ecological literacy. At the same time, games and serious games (Tan *et al.*, 2023) offer playful and immersive ways to explore urban environmental challenges, turning streets, squares, and digital platforms into learning arenas where participants collaboratively explore solutions to climate change, biodiversity loss, and pollution. By embedding these participatory and playful approaches into the urban experience, cities can actively foster ecological citizenship, turning environmental learning into a shared and collective urban practice.

With the concept of “Learning Cities”, the UNESCO Institute for Lifelong Learning promotes life-long learning opportunities that encompass formal, non-formal, and informal education in cities. The objective of a Learning City is to facilitate access to diverse learning contexts, including community centers, libraries, public spaces, and digital platforms, thereby empowering citizens to engage in continuous environmental education and sustainable practices. This challenge can be supported by an extended use of digital technologies (UNESCO Institute for Lifelong Learning, 2015). In the following chapter, we discuss the transformative role of digital technologies in cities and in educational approaches.

1.3 Digital Technologies as drivers of transformation in the city and in education

The transformative role of ICTs has reshaped both education and urban planning, enhancing engagement, immersion, interaction, and access to information. As part of broader socio-technical systems (Latour, 2005; Mumford, 2006), digital technologies are not neutral tools but evolve with-in social contexts, shaping and being shaped by cultural practices and institutional frameworks. ICTs have also become integral to the functioning and evolution of contemporary cities, driving transformations across various dimensions of urban systems. The Smart City paradigm highlights their role in optimizing infrastructure, although it has also been criticized for its technocratic bias, which often overlooks social and cultural dimensions (Kitchin, 2022). Despite these critiques, digital tools can foster more transparent governance and active citizen engagement, enhancing access to environmental data and supporting collaborative decision-making.

In education, a similar transformative role of ICTs can be recognized. According to the 2023 Global Education Monitoring Report (UNESCO, 2023), digital interfaces - which include video players, tablets, Augmented Reality (AR), Virtual Reality (VR), virtual classrooms, and collaborative platforms - can enhance formal learning experiences if they are carefully integrated with traditional teaching methods, rather than replacing them entirely. This hybrid approach, often referred to as *blended learning* (Graham, 2006), has shown promising results in fostering student engagement, promoting immersive and experiential learning, and simulating complex processes that would otherwise be difficult to reproduce in physical classrooms (Alam *et al.*, 2025).

One of the most significant innovations in ICT-based education is the rise of adaptive learning platforms, which use Artificial Intelligence (AI) and learning analytics to personalize educational pathways based on students’ behavior and performance (Baker & Siemens, 2014). While these tools can support teachers and enhance learning, excessive reliance on them risks promoting passive consumption and limiting the development of critical thinking and creativity (Selwyn, 2016).

ICTs also play a key role in non-formal and lifelong learning, expanding access to knowledge through Massive Open Online Courses (MOOCs) and learning apps. These platforms enable learners from diverse backgrounds, including marginalized groups, to access educational content that might otherwise be out of reach (Sarma & Yoquinto, 2020). Moreover, digital ecosystems support self-directed learning, allowing individuals to build skills on demand (Schmidt-Hertha *et al.*, 2021). However, challenges remain, including digital divides, privacy concerns, and questions about long-term costs and the actual effectiveness of digital learning (UNESCO, 2023, *op. cit.*).

In the context of informal education, digital platforms are recognized as key enablers of citizen science processes for sharing crowd-sourced information, interacting, and accessing sectoral

knowledge (Dickinson *et al.*, 2012, *op. cit.*; Mahajan *et al.*, 2020). Furthermore, digital interfaces can enhance various social or individual activity by providing access to data and information, simulating conditions, or providing immersive experiences.

In summary, digital technologies represent tools, or enablers, capable of augmenting or fostering all types of educational activities. Four key functionalities of digital technologies for education can be identified: (i) providing immersive experiences, (ii) simulating diverse conditions related to variables, (iii) sharing information through the overlap or integration of informative layers and allowing interaction, and (iv) increasing accessibility to educational content.

The strength and impact of these functionalities can vary depending on the specific digital technologies used and the educational objectives pursued. However, the literature lacks structured and systematic knowledge on how this occurs in the context of informal Environmental Education. To address this gap, the following section delves into a targeted literature review focused on three specific digital technologies—Augmented Reality (AR), Participatory Platforms, and video mapping. The analysis explores the impact of the four functionalities in urban informal education contexts, and how they can contribute to achieving specific EE objectives.

2. Digital technologies for environmental education in cities: opportunities for informal learning

An analysis of the state of the art shows the key role of cities in informal Environmental Education, acting as educational subjects, learning environments, and arenas for citizen empowerment. It also defines the analytical framework adopted in this chapter to examine three digital technologies—Augmented Reality, Participatory Platforms, and video mapping. The analytical framework combines five educational objectives (awareness, knowledge, attitudes, skills, and participation) with four core functionalities of digital technologies (immersive experiences, simulation, integration of informative layers and interaction, and accessibility).

2.1 Augmented Reality

Augmented Reality (AR) works by recognizing physical objects or locations and overlaying them with digital information, allowing users to interact with virtual elements while staying aware of their real surroundings. There are two main approaches: object-based AR, which overlays information on small objects, and location-based AR, which integrates content into broader environments (Billinghurst *et al.*, 2015). Geroimenko (2020) highlights AR's growing role in education, particularly for immersive, collaborative learning experiences. According to Ducasse (2020), AR is especially effective in environmental education (EE) when combined with outdoor learning, helping users explore nature by enhancing direct observation and curiosity with digital content (Fang *et al.*, 2022).

Urban systems become both the object and environment for EE through AR. Several projects illustrate this potential. EduPARK, implemented in Portugal, features modes for free exploration and educational games, aiming to promote cross-disciplinary learning and user-friendly interaction. AR markers on plant labels and historical signage trigger digital content, including interactive challenges and treasure hunts. The game has been tested with students and teachers, but according to the authors, it can be used by citizens and tourists, providing activities and an alternative experience within urban parks. A similar strategy was developed by Kamarainen *et al.* (2018) with the project EcoMOBILE that explored various physical environments and subject areas, focusing on undergraduate students of Ecology and Environmental Science. A non-formal educational experience was developed through the app Pipi's World (Aguayo *et al.*, 2020), created for a marine educational center in New Zealand. The app uses AR to engage students

visiting the center, guiding them through digital learning experiences with the help of a character. According to the authors, the interface was observed to increase engagement and convey content relevant to EE, although it required a facilitator, as some users found it difficult to navigate. Similarly, the artist Tamiko Thiel used AR in her project Wild Garden, overlaying oversized flowers and plants onto a museum garden in Munich, creating an immersive experience that invited reflection on ecological relationships in the Anthropocene (Iovino, 2019).

Accessibility issues, app downloads, and site-specific costs are key barriers to using these interfaces for informal learning in open urban spaces. However, plant identification apps using real-time camera framing and object-based AR are increasingly popular. These apps spark curiosity and support informal learning about urban biodiversity, but they rarely convey deeper ecological complexity. Further development, supported by public-private partnerships or public funding, could enhance their educational depth and promote wider ecological awareness in urban areas. Reaver *et al.* (2023) describe a participatory AR experience for urban tree-planting in Oslo. The location-based interface allowed users to simulate different tree configurations by overlaying 3D models onto real urban spaces captured by the camera. This interactive process gave users an active role, improving their understanding of possible solutions. The authors found the technology highly effective for engaging users in EE, promoting stewardship, and developing skills, but noted challenges in app development and technical instability caused by the complexity of location-based recognition.

Based on these observations, the impact of Augmented Reality can be assessed across the four key functionalities of the analytical framework. AR has strong potential to provide immersive experiences by overlaying digital content onto physical environments by blending virtual and real elements into seamless educational interactions. It also supports scenario simulation, allowing users to explore different environmental configurations, as shown in EcoMOBILE and Oslo's tree-planting project. AR effectively integrates digital information with physical objects through interactive layers triggered by visual markers, as demonstrated in EduPARK. However, its accessibility remains low due to the need for specific apps, site-specific content, and compatible devices, limiting its potential for spontaneous and large-scale informal learning in cities.

When evaluated against the five key objectives of Environmental Education (UNESCO & UNEP, 1977, *op. cit.*), Augmented Reality shows strong potential for fostering awareness and knowledge by overlaying environmental information onto real-world elements, enhancing observation and curiosity (Geroimenko, 2020; Pombo & Marques, 2019). However, much of this content remains superficial, focusing on facts rather than encouraging critical reflection or systems thinking (Aguayo *et al.*, 2020). AR can also foster attitudes through immersive engagement, but this depends heavily on narrative design and the ability to link content to personal and collective meaning (Iovino, 2019). It supports spatial interpretation and environmental observation skills but has a limited potential to develop critical thinking when users passively consume predefined content (Kamarainen *et al.*, 2018). Finally, while AR can enhance participation through co-creation processes, as seen in Reaver *et al.* (2023), technical barriers, app requirements, and uneven digital literacy hinder its potential as an accessible tool for informal urban learning.

2.2 Digital Participatory Platforms

Participation is a broad concept spanning multiple fields. In education, it serves as a key pedagogical strategy, fostering awareness, creativity, and transformative learning through active involvement and collaboration (Botkin *et al.*, 1979). In urban governance, participation refers to inclusive processes where citizens help shape plans, policies, and projects, promoting equity, transparency, and effectiveness.

This civic participation also has educational value, as citizens involved in environmental decisions develop thematic skills, critical thinking, and environmental awareness (Peeters, 2017). However,

effective participation-based environmental education requires strong environmental literacy among both facilitators and participants—often lacking in contexts where administrative capacity and participatory traditions are weak.

A valuable contribution can emerge from horizontal participation processes, such as the collaborative management of urban commons, which foster collective intelligence and encourage sustainable governance practices (Ostrom, 1990; Peeters, 2017). In both top-down and bottom-up processes, digital technologies can play a crucial enabling role, enhancing information sharing, facilitating interaction, and supporting citizen science initiatives (Bonney *et al.*, 2014). Digital participatory platforms expand opportunities for informal environmental education, particularly during community engagement activities such as workshops, urban planning labs, or local environmental monitoring projects. Through these platforms, citizens access information, contribute data, and engage in collaborative decision-making, thus combining participation with informal learning.

A relevant case is Decidim, an open-source platform developed by the City of Barcelona and now adopted internationally (García *et al.*, 2023). Decidim supports participatory budgeting, public consultation, collaborative proposal writing, and accountability tracking, fostering transparency and sustained citizen engagement. One of its key priorities is the ecological transition, embedding environmental awareness across all participatory processes. This integrated approach exemplifies how participatory democracy can intersect with environmental education, turning participatory platforms into tools for informal learning. However, many other platforms remain fragmented, limited to isolated functions such as survey collection or information dissemination (Gil *et al.*, 2019). While these tools may offer customized solutions, they lack the holistic educational potential seen in more systemic platforms that explicitly link participation, environmental awareness, and collective action. In this sense, the design of participatory platforms themselves becomes an educational choice, shaping whether digital tools simply manage participation—or actually nurture environmental knowledge, values, and active citizenship.

In terms of objectives, digital participatory platforms enhance environmental awareness by providing access to data and visualizing local issues, though the quality of awareness depends on whether the information fosters critical ecological literacy or simply presents consultation data. Their contribution to knowledge development is stronger when they support collaborative processes and citizen science, enabling users to collect and interpret data, but this potential is weakened when platforms focus more on procedural efficiency than educational depth. Participation can foster pro-environmental attitudes by strengthening place attachment and collective responsibility, although platforms that reduce environmental issues to technical problems weaken this potential. Platforms also build skills, particularly when citizens engage directly in negotiation and decision-making, but consultative approaches—where users only answer predefined questions—limit the development of critical and analytical skills.

Assessing the functionalities of participatory platforms, we can conclude that they are rarely immersive, relying mostly on text and data, though some use multimedia to enrich the experience. They can simulate environmental scenarios to show decision impacts, but this varies across tools. Their main strength is the integration of diverse information layers—combining citizen input, environmental data, and policy documents into shared knowledge (García *et al.*, 2023). However, accessibility is hindered by digital divides, language barriers, and the need for facilitation, especially in excluded communities.

2.3 Video mapping

It is widely recognized that art has the capacity to provoke reflection, stimulate awareness, inspire activism, and denounce societal problems. Art installations in cities play a key role in promoting environmental awareness, incorporating digital technologies to create interactive, im-

mersive, and thought-provoking experiences, making complex concepts more accessible and impactful. This type of experiential learning can be more effective than traditional methods in raising awareness and inspiring action (Miles, 2014). Art installations can also reach a broad audience due to their accessibility, as they are easily integrated into public spaces, museums, and educational institutions.

Digital technologies can amplify these processes, integrating innovative tools such as video mapping, sound design, high-performance computing, simulation, and visualization. By embedding EE directly into the urban environment, these technologies can foster a sense of community and collective responsibility (Fenner, 2017). Video mapping, also known as projection mapping, involves projecting images and videos onto physical surfaces to create dynamic visual displays. It is often combined with sound, creating multisensory and immersive experiences. Like AR, it overlays images, data, and information onto physical objects, but does not require individual devices or digital skills to access (Derkach *et al.*, 2023). By projecting visualizations of climate change, pollution, and biodiversity loss onto buildings, landscapes, or other urban surfaces, video mapping can make these issues more immediate and emotionally engaging, fostering stronger connections to environmental challenges.

An interesting case study is the immersive installation “Foresta Lumina”, which offers a nighttime sensory experience in a woodland park in Canada. Through light, projections, sound, and storytelling, it explores local myths and cultural heritage, while also creating an immersive nature-based experience. Although not explicitly designed for environmental education, it effectively draws visitors into an outdoor ecological scenario, demonstrating through art the complexity of ecological networks (Desrochers Ayotte, 2018). Another example is “Evolution of Fish” by Thiel (2020), which used video mapping combined with AR to project a swarm of fish onto a residential building, allowing participants to interact and alter the swarm’s behavior, introducing an interactive simulation of ecological dynamics. The project “RO_map”, a projection mapping project held in Rome, explored how dynamic video projections can enhance the perception of the urban landscape. By projecting digital content onto building facades, the installation responded to the speed and position of passing viewers, adapting its visual messages to the flow of urban mobility (Empler, 2017). This adaptive approach aimed to make environmental and spatial information more visible and context-aware, connecting place perception with ecological awareness. Although not exclusively dedicated to environmental education, it shows how urban video mapping can transform public space into a platform for situated, informal learning, encouraging reflection on urban transformations and their environmental dimensions.

However, the scientific literature only offers a limited number of cases that explicitly focus on environmental education through video mapping, leaving this potential underexplored.

Assessing video mapping through the analytical framework implemented here, its contribution to awareness is particularly strong, as it offers immediate and impactful visual narratives embedded directly in the urban landscape. The potential to develop knowledge is present but depends heavily on content design—often leaning toward artistic spectacle rather than structured ecological learning. In fostering attitudes, video mapping can trigger emotional responses and place attachment, but this is highly variable, especially in projects without clear educational intent. It offers limited space for skill development, since the public typically experiences rather than co-creates the content. Participation is largely passive, with audiences receiving messages rather than actively contributing, though participatory design processes could expand this role. In terms of functionalities, video mapping excels at creating immersive experiences, can simulate dynamic processes like environmental change, and integrates multiple information layers into cohesive experiences. Its accessibility is also high, requiring no devices or prior knowledge, but the educational depth remains contingent on how intentionally environmental themes are addressed.

2.4 Discussion

The comparative analysis in the previous section shows the significant potential of digital technologies to foster informal EE in urban contexts. Each of the three technologies—Augmented Reality (AR), digital participatory platforms, and video mapping—demonstrates distinct capacities and limitations when evaluated against the analytical framework of educational objectives and technological functionalities.

Augmented Reality offers strong immersive and interactive experiences, blending digital content with real-world elements, making environmental data tangible and site-specific. It also supports simulation of alternative scenarios, fostering exploratory learning. However, low accessibility remains a critical limitation: the need for dedicated apps, compatible devices, technical expertise, and site-specific customization significantly reduces AR's potential for spontaneous, large-scale informal education in public urban spaces. Its impact relies heavily on structured facilitation or project-specific funding, limiting its diffusion.

Digital Participatory Platforms show high potential for integration and interaction, particularly when they embed citizen science initiatives or collaborative decision-making processes. Their contribution to knowledge development and awareness can be significant, especially when environmental data is visualized in accessible formats and linked to policy debates. However, their limited immersiveness and barriers to access—due to digital divides, language issues, or unfamiliarity with participatory processes—reduce their ability to reach the broader urban population.

Video mapping, while less common in environmental education, emerges as the most accessible and immersive technology in public urban settings. It requires no personal device, has low entry barriers for audiences, and transforms urban surfaces into educational media. Its capacity for simulation and integration of information layers is notable, especially when environmental data is embedded into visual storytelling. However, the educational depth of video mapping remains limited in practice, as most examples focus on artistic spectacle rather than structured environmental literacy. The literature lacks systematic examples where video mapping is explicitly designed to deliver multi-dimensional environmental education aligned with the five EE objectives (awareness, knowledge, attitudes, skills, participation).

In summary, video mapping and participatory platforms stand out as the most promising technologies for fostering widespread informal EE in urban contexts, due to their broad accessibility and potential for engagement in public spaces. However, realizing this potential requires intentional content design, ensuring that awareness-raising efforts go beyond basic consultation and actively foster critical ecological literacy, skills development, and meaningful citizen participation. These insights provide the foundation for the next chapter, which examines two case studies that apply participatory platforms and video mapping to informal environmental education, assessing their effectiveness against the analytical framework of objectives and functionalities.

3. Case study analysis

Building on the reflections developed in the previous chapter, this section presents two case studies selected to further investigate how digital participatory platforms and video mapping can contribute to informal Environmental Education (EE) in urban contexts. The case studies have been chosen for their innovative use of digital technologies, their relevance to environmental themes, and their capacity to engage diverse urban audiences. Each case will be analyzed through the analytical framework, evaluating its alignment with the five educational objectives (awareness, knowledge, attitudes, skills, participation) and its performance across the four key functionalities (immersion, simulation, integration and interaction, accessibility).

3.1 Superbarrio

Superbarrio is a gamified digital participatory platform designed to engage citizens of all ages in the co-design of public spaces, combining playful interaction with collaborative urban planning. Through a 3D interface, users can visualize public spaces, place functional modules (such as green areas, benches, and mobility infrastructure), and assess their impact on categories such as nature, well-being, health, mobility, participation and economy. Players must balance these variables, thereby fostering reflection on the complex interdependencies shaping urban systems (Markopoulou *et al.*, 2018). Data is collected to support the technical evaluation of design proposals but also serves an educational purpose, helping participants understand the criteria, trade-offs, and conflicts inherent in environmental and spatial decision-making. In this way, Superbarrio aims to function as a civic education tool, helping citizens recognize public space as a site of negotiation between diverse needs, and encouraging learning about sustainability solutions that are both inclusive and viable long-term.

Originally developed in 2017 and tested in Barcelona, Genoa, and Favara, the platform evolved within the URBINAT project (Horizon 2020), focusing on the co-creation of Healthy Corridors through Nature-Based Solutions (NBS) in underprivileged urban areas. In this context, Superbarrio acted as both a participatory tool and an informal educational platform, helping citizens understand the ecological, social, and economic dimensions of environmental regeneration (Markopoulou *et al.*, 2022). The first test, conducted at the Nantes médiathèque with 50 citizens, showed positive results, demonstrating the app's high capacity for prolonged engagement, accessibility, and effectiveness in increasing awareness, understanding, and agency on complex urban-ecological issues. These included: conflicts between stakeholders, the systemic impact of individual actions, environmental fragilities in urban contexts, ecosystem services, NBS management skills, and health and well-being in cities (Markopoulou *et al.*, 2022).

The platform's educational value is embedded in its design. By involving participants in decision-making processes, it raises awareness of environmental issues, promotes systems thinking, and fosters skills related to ecological design and conflict mediation. Its gamified structure makes it particularly effective at attracting non-traditional audiences (including children and non-habitual participants), creating what project leaders call an "audience-by-surprise" effect. This makes Superbarrio not just a tool for participatory planning, but also a potential vehicle for lifelong environmental learning in urban settings.

Project leaders highlight that the platform's full potential for widespread environmental education could be further enhanced if municipalities and public institutions actively support its deployment, not only in the context of formal participatory processes, but also as a standalone educational game, fostering environmental literacy in public spaces, schools, and cultural events. The assessment based on the EE objectives shows that Superbarrio contributes to awareness by making environmental challenges and their connection to urban design visible and explicit throughout the game. Players develop knowledge through experiential learning, gaining a better understanding of NBSs, ecosystem services, and the systemic impacts of spatial decisions (Markopoulou *et al.*, 2018, 2022). The platform fosters pro-environmental attitudes by encouraging players to balance diverse needs, recognize conflicts, and take responsibility for collective decisions. It enhances skills, from spatial planning to critical thinking, negotiation, and understanding environmental data. Finally, participation is at the core of the process, as users actively co-design solutions while learning how to participate in urban governance. Superbarrio's immersive 3D environment, real-time simulation, and integration of data and design tools make learning intuitive and engaging. Its high accessibility—thanks to simple mechanics and playful design—thereby extending participation to diverse audiences, including children and first-time participants.

The assessment based on the digital functionalities confirms Superbarrio's potential for informal environmental education. Its immersive experience relies on a 3D interface, which allows

users to visualize and modify urban spaces in real time, directly linking environmental choices to spatial design outcomes. The platform is able to simulate realistic scenarios by showing how each design decision influences environmental and social indicators, helping participants grasp cause-effect relationships within urban ecosystems. A key strength lies in its integration of information and interactivity, as the platform combines environmental data, citizen inputs, design options, and feedback mechanisms within a single interactive environment. Finally, accessibility is relatively high due to intuitive navigation and simple mechanics, combined with a playful format that encourages participation from a broad range of users, including those with limited familiarity with environmental topics or participatory processes.

3.2 *Anima Mundi*

The project *Anima Mundi* was an experiential art installation event hosted during the summer of 2021 at the Orto Botanico of Palermo, a historic botanical garden near the city center and located in an area characterized by high tourist flows and vibrant nightlife. The installation offered visitors a nighttime journey through nine stops, each associated with a specific plant species—e.g. *Ficus macrophylla* and *Nelumbo nucifera*—and connected to structures such as greenhouses, ponds, and historic paths. Using advanced audiovisual technologies, particularly video mapping, combined with animated 2D graphics and sound design, *Anima Mundi* created an immersive storytelling experience in which visitors explored the garden through the voices and stories of five fictional characters.

The narrative unfolded around themes of care and responsibility toward nature, presenting natural processes, ecological fragilities, and anthropogenic impacts. Visitors were invited to engage through simple interactive gestures, influencing the projected scenes, symbolizing how human action can either protect or harm ecosystems. The project also introduced the theme of cultural biodiversity, emphasizing how the introduction of non-native species to Palermo is historically linked to the migration of cultural knowledge, myths, and traditions (UNESCO, 2001). This interplay between ecological and cultural heritage enriched the educational value of the installation, offering visitors a layered understanding of nature as a living archive of human-nature interactions. In terms of informal environmental education, *Anima Mundi* effectively raised awareness by embedding environmental content in an emotionally engaging and culturally significant experience. Its use of familiar urban nature—the botanical garden—and iconic plants helped connect environmental issues to a sense of place, especially for local audiences. However, its contribution to deeper knowledge was more evocative than structured. Ecological messages focused on emotional impact rather than on building a clear understanding of ecological processes, sustainability, or policies, leaving visitors without tools to deepen their learning afterward. The project successfully fostered pro-environmental attitudes, evoking curiosity and empathy through sensory immersion and storytelling. However, this attitudinal shift could have been reinforced if the planned hands-on workshops had not been canceled due to COVID-19. Opportunities for skill development were limited. Visitor interactions were symbolic rather than practical, offering little in terms of concrete environmental or civic skills. This reflects a common challenge with artistic installations, which prioritize emotional engagement over skill-building. Finally, the participatory dimension was weak. Visitors followed a pre-scripted experience without contributing content or co-creating knowledge, limiting their sense of agency in environmental action.

Across the four digital functionalities, *Anima Mundi* excelled in immersiveness, transforming the garden into an interactive stage. It simulated ecological processes in real time through projections and integrates ecological, cultural, and historical content—though this was curated by the project team, not enriched by users. Accessibility was high, requiring no personal devices or digital skills, and it reached a diverse audience, including many typically outside the reach of standard environmental education initiatives.

In conclusion, Anima Mundi shows how art, technology, and environmental education can converge in public space, fostering awareness and emotional connection. However, its potential to deepen knowledge, build skills, and promote participation remains limited. To expand its educational value, it would need structured learning activities, collective dialogue, and stronger links to ongoing urban greening efforts, transforming it from a temporary event into a lasting educational process.

Conclusions

This paper set out to investigate how digital technologies can support informal EE in urban contexts, addressing two main research questions: (i) which functionalities of digital technologies enhance informal EE in cities, and (ii) how these functionalities contribute to the achievement of key EE objectives, as defined by UNESCO & UNEP (1977, *op.cit.*).

The study's analysis showed that cities, as complex socio-ecological systems, play a key role in fostering informal environmental learning. Urban spaces, with their visible ecological challenges and opportunities, represent powerful educational settings where learning emerges through daily life, culture, and civic action. Digital technologies further enhance this potential, offering immersiveness, simulation, data integration, and accessibility, turning cities into dynamic learning arenas.

The study's review of Augmented Reality, Participatory Platforms, and Video mapping revealed distinct strengths and limits. Augmented Reality excels in immersion and simulating environmental processes in urban spaces, but its low accessibility—requiring apps, devices, and technical skills—limits spontaneous, wide-reaching learning. Participatory Platforms effectively integrate environmental data, citizen input, and collaborative decision-making, enhancing knowledge and participation, but their low immersiveness and digital literacy barriers restrict accessibility. Video mapping stands out as the most accessible and immersive in public spaces, turning urban facades into educational tools, though its impact on knowledge, skills, and participation remains weak when not explicitly designed for education.

The case studies presented here confirm this differentiated potential. Superbarrio demonstrates how gamified participatory platforms can turn environmental co-design into a learning experience, fostering awareness, knowledge, attitudes, skills, and participation through playful collaboration. Anima Mundi demonstrates how video mapping can spark emotional connection and curiosity about nature, though it offers little room for deeper learning or active participation.

Overall, the research shows that digital technologies contribute most to informal EE when they are part of broader cultural and environmental programs, linking artistic experiences, participatory processes, and real opportunities for action. Technologies alone do not drive transformative learning—they need to be framed within processes that foster critical thinking, dialogue, and long-term citizen engagement with urban ecological issues.

Future research should examine how digital experiences shape long-term ecological awareness and behavior, and how cities can integrate these tools into continuous learning ecosystems linking environmental education, cultural programs, and participatory governance. Hybrid approaches combining digital art, citizen science, and co-creation also deserve attention, particularly for their role in fostering collective learning and environmental stewardship during urban ecological transitions.

In conclusion, digital technologies can enhance informal environmental learning in cities, but their impact relies on moving from isolated events to ongoing, participatory, and culturally embedded learning processes—where technology supports, rather than replaces, critical reflection and collective action.

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ChatGPT and the Social Appropriation of AI on Discord²

Introduction

Since the release of ChatGPT the discussions on the uses and potential impacts of AI have revitalized. These cross-disciplinary discourses encompass a wide range of perspectives, often characterised by dichotomies. For example, whether AI will have apocalyptic effects on the labour market or maintain the status quo by rendering some jobs obsolete and easily replacing them with new professions without significantly altering the market structure (Benanav, 2020; Dyer-Witford *et al.*, 2019); whether it will secure a better future for humanity and the planet by addressing contemporary environmental crises or contribute to depleting energy resources for its training (Crawford, 2021; Pasquinelli, 2023); whether it will reproduce gender inequalities through the feminization of automation in domestic, reproductive, emotional, and sexual labour, or contribute to reconceptualizing gender biases embedded in digital technologies (Fortunati, 2018; Adam, 2006; Lynch *et al.*, 2022). However, these dualities obscure the more nuanced and complex realities of integrating AI into everyday life, especially when talking about generative AI, which is defined as «a subset of AI that uses a particular type of machine learning capable of making associations from millions of pieces of data to generate images or predict the next word in a sequence without preset instructions» (Nguyen, & Mateescu, 2024, p. 5).

In this paper, we seek to move beyond a purely dichotomous approach and examine the social shaping of generative AI-based applications (MacKenzie, & Wajcman, 1999) conceived as an appropriation process in the interaction between human actors and technological entities in which users not only adopt technology but also reinterpret and modify it based on their social contexts and needs. We focus specifically on the integration of generative AI into labour practices. In fact, since the release of ChatGPT by OpenAI in November 2022 and the subsequent dissemination of numerous generative AI tools, a variety of users have begun to integrate these tools into their daily labour practices. The study focuses on a specific and understudied social practice: prompt-making within online communities in the context of digital labour. While prompting is often conceived as an individual and technical interaction with AI systems, we investigate how it unfolds through collaborative exchanges, shared experimentation, and mutual feedback among online users. We conceptualise this phenomenon as a form of social shaping of technology (*ibid.*) framed as a set of socially negotiated dynamics and processes through which practices, norms, and expectations around AI use emerge in interaction. This explorative study aims to answer the following research question: how are AI-based prompt-making practices socially shaped and co-constructed on digital platforms in the context of digital labour? We seek to investigate three levels: the type of users who participate in the prompt-making processes, how and why users aim to integrate generative AI-based technologies into daily labour practices, and whether and how prompt-making activities foster the development of a grassroots market for AI application prompts.

To this end, we examine prompt-making as it unfolds on Discord, a communication platform that allows users to interact in real time through servers dedicated to specific topics and communities. In the context of generative AI, it provides a crucial space for collaborative prompt-making practices and peer-to-peer learning. These servers offer direct access to models like Midjourney and ChatGPT and enable real-time interaction among users and foster a collaborative environment for prompt-sharing, feedback exchange, and iterative improvement. As such, Discord functions not just as a technical medium but as a social infrastructure for the appropriation and diffusion

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of generative AI practices. Within this context, the widespread diffusion of generative AI tools has also led to the emergence of so-called prompt markets, an informal, user-driven economic circuits where prompts are created, exchanged, and sold as digital goods, often involving peer-to-peer negotiation, personalization, and the development of service-based expertise by transforming creative experimentation into monetised services.

Our observations indicate that users engage in prompt-making on Discord for diverse work-related purposes, ranging from boosting productivity to creating new digital services. While often framed as efficiency-driven, these practices are deeply rooted in social, emotional, and economic contexts. Some seek to monetize their skills or launch small businesses, others aim to gain credibility within technical communities, and others use AI for personal expression or emotional support. Together, these practices reveal how prompt-making serves as a flexible resource that adapts to users' shifting roles, aspirations, and constraints within the digital labour economy.

To unpack and critically discuss these diverse prompt-making practices and their implications for the social shaping of generative AI technologies, this paper is structured as follows. The theoretical background situates this study within the literature on the social shaping and appropriation of digital technology, examining how generative AI stabilizes within specific social groups, addresses their challenges, and reveals various bottom-up manifestations; the methods section discusses the digital ethnography approach and the qualitative analysis techniques employed; the findings section presents the different types of users, their related activities, and the functioning of the prompt market; the conclusion reflects on how generative AI is reinterpreted and integrated into users' everyday lives, addressing both economic strategies and affective engagements.

1. Theoretical Background

1.1 AI And Labor: A Multifaceted Relation

According to the International Labor Organization (Gmyrek, Berg, & Bescond, 2023), the impact of generative AI is expected to predominantly affect office jobs in high-income countries, primarily through augmentation rather than automation or replacement (Benanav, 2020). While much of the current debate on generative AI focuses on its potential effects on labour markets, this study shifts attention to how users collectively appropriate AI technologies within their everyday labour practices. In fact, the Data & Society report (Nguyen, & Mateescu, 2024, *op. cit.*) advocates for a critical interrogation on some of the prevailing assumptions on the way workers use, or are forced to use, generative AI. According to them, the introduction of generative AI in the workplace may lead to the devaluation of humans, inequalities, the implementation of control and a further prevarication of the labour-force. Conversely, some techno-enthusiast stances (McAfee, & Brynjolfsson, 2017) foster the optimistic idea that instead of completely replacing human workers, generative AI technologies are likely to enhance their productivity and efficiency by taking over everyday routine and repetitive tasks, thereby allowing workers to focus on more complex and creative aspects of their roles. Shifting the focus from office jobs to the creative industry reveals an even more complex dynamic. In fields like writing, design, and media production, generative AI's impact is multifaceted—not only displacing certain roles, as seen in the Hollywood strikes (Anguiano, & Beckett, 2023) but also reshaping industry conditions in ways that stifle cultural production. Many creators warn of the devaluation of human artistry and the rise of homogenized content (Jiang *et al.*, 2023), raising concerns about the long-term effects on both creative labour and cultural diversity.

This dynamic extends beyond the creative sector. In fact, any analysis of generative AI's impact on labour must consider the broader socio-economic forces at play, so as not to overestimate

the power of AI or the inevitability of some impact on society. Several authors argue that generative AI can be deconstructed into a sequence of algorithms devoid of any awareness, intention or inspiration (Airoldi, 2022; Crawford, 2021; Jiang *et al.*, 2023; Nguyen, & Mateescu, 2024, *op. cit.*). Bearing that in mind, we can consider another major argument in AI and labor related literature, namely the relevance of the skills-level for determining the degree of replaceability. Several studies, in fact, agree that, differently from previous waves of automation, generative AI-based automation is seemingly affecting more high-skilled workers (Felten *et al.*, 2023). The debate around replaceability has gained particular traction in discussions of AI's role in the creative sector, where concerns about the appropriation of human labor and content extend beyond traditional definitions of artistic authorship. Although this dispute lies beyond the scope of this article, its significance lies in how it challenges conventional frameworks for analysing AI's labour impact—particularly the entrenched dichotomy between high-skilled and low-skilled work (Pasquinelli, 2023).

In this study, instead of simply assessing whether AI will displace low-skilled or high-skilled workers, we aim to challenge this dichotomy. We interrogate how the utilization of AI to expedite standardized tasks often diverges from a job's intrinsic characteristics or its presumed "replaceability".

1.2 The Social Shaping of Technology

The concept of the social shaping of technology represents a multifaceted framework that integrates different perspectives and concepts aimed at clarifying the intricate relationship between technology and society (Howcroft, Mitev, & Wilson, 2004). MacKenzie and Wajcman (1999, *op. cit.*) argue that the social formation of technology transcends mere technical or economic determinants by encompassing a broad spectrum of social, cultural, and political influences. Technologies, conceived as social constructs, not only reflect but also actively shape the dynamics of the societies in which they are developed. In this view, technological artifacts are never neutral but are embedded within complex webs of power relations, cultural meanings, and collective practices. Building on this perspective, Williams and Edge (1996) emphasize not only the impact of social factors during the development phase of technology but also the crucial role played by its consumption and use. They argue that a comprehensive understanding of how technologies evolve, stabilize, and transform society requires a holistic examination of the entire life cycle, from the initial stages of design and production to the later stages of consumption, adaptation, and everyday practical application. Technologies continue to evolve and acquire new meanings as they are appropriated, reinterpreted, and domesticated by different social groups.

In this paper, we focus specifically on the consumption and appropriation phase of generative AI technologies, rather than on their design or initial development stages. We frame the social shaping of generative AI-based applications as a process of social appropriation from below, where online users creatively integrate, adapt, and repurpose these technologies in their daily working practices. This approach highlights how technologies are not only shaped by the needs and values of society during their production but continue to be reshaped, recontextualized over time.

To conceptualize this process of appropriation, we draw on Moreno Gálvez and Sierra Caballero's (2022) definition of the social appropriation of new technologies: «[it] refers to technological and social processes of mediation in the interaction between social actors and technological devices [...] the meaningful integration of the technological devices into subjects' everyday lives and behaviour; the active and creative production of meaning; social mediation within communities of users» (*ibid.*, p. 2). This perspective emphasizes that users are not passive recipients of technology. Rather, they actively negotiate its meaning, adapting it to their cultural, emotional, and economic realities. The creative production of meaning often results in new uses and inter-

pretations that diverge from original design intentions, illustrating the dynamic and recursive relationship between technology and society (Pinch, & Bijker, 1987).

Furthermore, we build upon Julia Ticona's (2022) concept of "digital hustle" to highlight the strategic dimension of these practices. Rather than seeing AI adoption purely as a form of technological efficiency, we consider it as a set of strategic adaptations to the broader data-driven economy. This often entails leveraging tacit knowledge that remains difficult to automate and cultivating a blend of technical and interpersonal skills that enhance users' flexibility and visibility in digital labour markets. This concept captures how workers actively integrate AI-based digital technologies into both their professional and social practices in ways that are shaped by their individual positions within broader socio-economic structures. The digital hustle perspective challenges reductive, skill-based frameworks of labour analysis and underscores the need for more nuanced, user-centered understandings of technological integration in the AI era. It foregrounds a spectrum of everyday labour practices such as appropriation, reappropriation, domestication, resistance, and optimization which we can collectively situate within the broader framework of the social shaping of technology (Bonini, & Trerè, 2024; De Certeau, 2013; Erwin, & Taylor, 2004; MacKenzie, & Wajcman, 1999, *op. cit.*; Ticona, 2022, *op. cit.*).

2. Methods

We explore prompt-making practices which serve as the field site for observing the social shaping and appropriation of generative AI technologies within the context of digital labour. To answer this research question, we adopted a digital ethnography approach (Paoli, & D'Auria, 2021), drawing on principles from Grounded Theory (Khan, 2014) such as inductive coding, iterative category development, and sensitivity to emergent patterns to investigate how social norms, collaborative dynamics, and practices of prompt-making emerged on Discord.

Originally created for online gamers, Discord has significantly expanded its user base, offering VoIP and text messaging services to build and manage online communities. By 2021, the platform grew from 59 million to 151 million users, largely driven by the pandemic (Haddad, 2021). Models like ChatGPT and Midjourney are integrated directly into servers, enabling users to submit prompts and receive AI-generated outputs in real time. Our study focuses on the unofficial ChatGPT server, which at the time of observation counted around 80,000 members. Unlike the official server, it does not require adherence to OpenAI's corporate code of conduct, fostering freer experimentation with prompts. The server is organized into thematic channels, such as prompt engineering and creative projects, where interactions unfold through asynchronous discussions and real-time feedback. This open, loosely moderated environment promotes grass-roots peer-to-peer learning and the bottom-up diffusion of generative AI practices. We selected three public channels focused on prompt creation³. The first channel, named Prompt Engineering, is dedicated to creating, customizing, and sharing prompts, primarily for text-based generative AI models like ChatGPT. The second channel, named Project, focuses on the development of plugins for generative AI applications. The third channel, named Image, has a hybrid structure: it serves both for commenting on and sharing image prompts and for discussing the artistic limitations of generative AI models. Unlike the other two channels, the Image channel is directly integrated with Midjourney, allowing users to create images by submitting prompts within the channel.

³ The server's guidelines did not impose any restrictions on scraping or citing publicly available posts. The study involves both textual (ChatGPT) and visual (Midjourney) generative AI models.

Data collection was carried out between January and March 2024⁴ using a Python script, combining Beautiful Soup 4 for parsing HTML content and Selenium for automating interaction with dynamically loaded web pages. We gathered 288 posts from the Prompt Engineering channel, 205 from the Project channel, and 4,063 from the Image channel that represented the entirety of posts available at the time of collection. Within the Image channel, we further distinguished 634 discussion posts from 3,429 prompts submitted for image generation via Midjourney. All collected posts were organized into a database, including variables such as author ID, author name, post date, post content, and attachments.

The analysis focuses on the 50 most prolific users from each selected channel. This sampling strategy enabled us to capture a broad range of practices and motivations among the most active contributors, who played a key role in shaping collaborative prompt-making dynamics and the appropriation of generative AI tools within the community. The posts correspond to two different types of units of analysis. In the Image channel, we collected the instructions (prompts) submitted to AI systems such as ChatGPT or Midjourney, focusing our analysis directly on the content of the prompts. In contrast, in the Prompt Engineering and Project channels, the unit of analysis comprised the discussions surrounding prompts rather than the prompts themselves. We employed a combination of qualitative analysis procedures. Discourse analysis and thematic coding were used to inductively identify user typologies and prompt-making activities across the selected channels. These methods allowed us to explore how different user groups interact, share knowledge, and attribute value to generative AI practices in a grassroots digital labour context. Moreover, one of the authors engaged in the community through active observation in public channels, adopting a practitioner's perspective without taking on any official roles. Field notes were systematically collected to capture key impressions and community dynamics. This partial immersion complemented the scraped data, offering a more situated understanding of prompt-market exchanges.

Ethical considerations also guided our research. Data collection focused on public Discord channels, treated as semi-public spaces where anonymized observation is ethically permitted. Although some interactions in private chats occurred for experiential purposes, no private conversations and personal identifiers were reported. All data were anonymized, and observations were limited to open channels. While usernames and personal identifiers were anonymized, the names of publicly available tools (e.g., AI plugins) cited in public channels were retained when deemed essential to the analysis.

3. Findings

3.1 Types of Creators and their Prompt-Making Purposes

By examining the contents and behaviours of the users in the selected channels, we have identified distinct categories of users and the activities they perform with generative AI-based technologies on Discord. These categories are: AI Creator, Startupper, Technology Expert, and AI Curious. These types of users are not only differentiated by their approach to generative AI, but also by their specific functions and positions within the emerging prompt economy. While some users actively trade or sell prompts and plugins, others sustain the ecosystem through demand, experimentation, knowledge sharing, and feedback. This intersection between technological appropriation and economic positioning provides the analytical lens for our typology presented in the Table 1.

⁴ During the data collection phase, the main ChatGPT models available were GPT-4-turbo and GPT-3.5-turbo. Midjourney does not publicly disclose distinct version releases in the same way as ChatGPT. This makes it difficult to associate user practices with specific updates during the observation period.

Users' category	Category description	Prompt-making purposes	Type of Labour	Capital Mobilized
AI Creator	People produce images through prompts and integration between Discord and Midjourney. Images are produced both for artistic purposes and for content production that is implemented by influencers.	-Image production -Image retouching -Build communication strategies and content for social pages	Content production for social media (images, texts)	Cultural and economic (brand building, audience monetization)
Startupper	Entrepreneurs and startup founders recognize the entrepreneurial opportunities in OpenAI's AI model and utilize it to create or enhance their businesses. In doing so, they define a space to sell their prompt sets.	-Seeking experts in prompt engineering production -Sharing entrepreneurial projects based on GPT-4 technology -Searching for ways to create money by leveraging Chatgpt -Creating structured web services for producing and selling prompts	Coordination and orchestration of AI-based work	Economic and strategic (entrepreneurial discourse, labour organization)
Technology Experts	Programmers, technology experts, and computer science amateurs use the discord space both to exchange notions and opinions about prompts and as a space to sell their own prompt sets.	- ChatGPT Plugin - Prompt engineering - Resolve doubts and problems regarding prompts - They sell sets of prompts for specific tasks	Technical development (plugins, prompt engineering)	Technical and reputational (expert knowledge, peer validation)
AI Curious	Curious about the world of artificial intelligence. Want to discover technology, looking for solutions and individuals who hold knowledge about Prompt engineering. They do not have knowledge directly and interact by experimenting with generative AI	- "Casual" Image production - Request for individuals to be paid for prompt production - Ask for pieces of advice -Affective support	Experimental and emotional exploration of AI	Social and affective (community-driven learning, emotional use cases)

Table 1 - User Categories and Capital Forms in the Grassroot Prompt Market

Although all categories of users use generative AI technologies, their involvement in prompt-making varies significantly in terms of purpose, work configuration, and forms of mobilized capital. AI Creators primarily use prompts to produce visual and textual content for social media, often combining Midjourney and ChatGPT for artistic or branding purposes. Their work contributes to digital visibility and monetization, mobilizing cultural and economic capital through audience engagement and brand building. Startupper, on the other hand, do not directly produce prompts, but act as coordinators and organizers of AI-based activities. Their work is organizational and strategic, leveraging economic and entrepreneurial capital to structure new mone-

tization paths. Technology Experts operate in a more technical realm. They engage in prompt design, plugin development, and troubleshooting, offering consulting and sometimes selling prompt sets. Their contribution is practical and highly skilled and is based on a mix of technical knowledge and reputational capital earned within the community. Finally, AI Curious users explore generative AI tools with limited technical skills, driven by personal curiosity or emotional needs rather than professional goals. Their practices mobilize social and affective capital and support community dynamics by generating demand for specialized knowledge. The following sections examine each user category in detail.

3.1.1 AI Creator

Users classified as AI Creators are those who engage in social media content production using ChatGPT for text elements and Midjourney for visual elements. These users are mainly divided into AI Artists, who create images through AI and post them on their social media channels, and Influencers, who use AI applications to enhance their content production capabilities for professional purposes.

Many AI artists focus on creating specific types of images, such as logos or styles influenced by Japanese animated media culture, by crafting prompts like the following:

«Eye with Earth as iris. Logo on white background. Unrealistic eye» and «Photo showing a serene morning scene with two anime-style girls heading to school. The path is surrounded by trees and the golden sunlight creates a warm environment» (AI prompt).

Influencers, on the other hand, generate AI-driven visuals as part of a professional strategy to produce engaging content for their followers. Their objective is to create digital content that ensures consistency and coherence with their social media presence:

«Hey everyone! We're excited to share our updated approach to creating engaging social media content. Our objective is to ensure that our images perfectly align with the text of our posts, achieving a consistent and coherent online presence. Here's how we're doing it. Text Summarization: We use ChatGPT to summarize the core message of our posts. Visual Generation: With the summarized and translated text, we leverage Midjourney to create compelling visuals that perfectly match our content. This streamlined process not only saves time but also enhances the quality and coherence of our posts» (Discord post).

By leveraging these AI tools, influencers can significantly enhance the quality and quantity of their content, meeting the demands of their work more efficiently.

The prompts produced by AI Creators are often designed to appeal to a generalist audience across different platforms and reflect widespread cultural aesthetics such as anime styles, realism, and logo design. Crafting optimal prompts is often challenging and requires continuous refinement to remain effective, necessitating ongoing study and adaptation to meet various needs. Another significant use of generative AI and prompts is the creation of communication strategies and content plans for social media, such as scripting YouTube horror videos:

«Dear ChatGPT, I'm going to start a YouTube channel where I narrate real life scary stories people have "send in" for me to narrate. I want you to come up with these stories. Make the stories very believable. Write it like someone is telling this story from his own perspective. It needs to be a believable but shocking story that really scares people. Start: Ending: Plot: Negative prompt» (AI prompt).

Although AI Creators do not engage in direct prompt selling, their activities shape the prompt marketplace indirectly. By experimenting with styles, structures, and narrative techniques, they establish informal benchmarks for quality and effectiveness. These practices influence how

prompts are crafted, evaluated, and even monetized by other actors in the ecosystem. In this sense, they play a critical role as validators and content innovators and set cultural standards that affect both creative trends and economic value. From a labour perspective, AI Creators operate within the field of content production, monetizing their outputs through platform-based strategies such as audience growth, branding, and sponsorships. Their capital is primarily cultural and economic: they leverage aesthetic experimentation and narrative creativity to generate visibility and financial return. Their relationship with the marketplace is therefore not transactional but reputational and symbolic, which nonetheless contributes to structuring demand, value, and standards within the broader economy of prompts.

3.1.2 *Startupper*

Digital entrepreneurs classified as “Startupper” aim to generate wealth through the implementation of generative AI in economic sectors such as automated marketing, virtual assistants, programming, and digital content generation. In the emerging prompt economy, they engage not merely as consumers of generative AI technologies, but as organizers and potential shapers of new markets. However, most of them lack the skills needed to create suitable applications and they are continuously in search of users capable of developing effective prompts. These users do not post ‘job offers’ in the channel to hire employees for their ventures but, on the other hand, foster competition among skilled users by organizing public contests focused on their business needs:

«We are looking for the best prompt creators to improve our chatbot. Enter our contest and demonstrate your skills! The winner will be rewarded with a contract to create prompts for our company» (Discord post).

However, the competitions are carried out in private digital spaces to preserve the intellectual work of skilled users:

«I'm interested in this challenge that no one can beat you. Meaning, do you offer quick creation services? I would love to see a suggestion from you versus another person/team's suggestion. Email me and we can discuss payment options and details» (Discord post).

This hybrid model, public request followed by private negotiation, illustrates how Startupper orchestrate work rather than perform it directly by acting as brokers of expertise and organizers of digital labour.

Moreover, Startupper are not just in search of business partners but they also solicit advice about their GPT-based projects which may include ChatGPT plugins or applications. These projects are introduced to the Discord community highlighting their innovative features:

«Introducing Conceptmap: your AI-powered ChatGPT design visualization plugin. Hello, innovators and problem solvers! Let me introduce you to Conceptmap, a revolutionary ChatGPT plugin, designed to transform project planning and brainstorming into an interactive visual experience» (Discord post).

A third pattern that characterizes the activity of Startupper is their intent to structure dedicated environments for the exchange and monetization of prompts. Their goal is to replace mainstream freelance platforms like Fiverr and Patreon: «A marketplace for prompts is essential! Imagine a platform where creators and users can buy and sell perfect prompts» (Discord post). Startupper participate not only as users but as institutional entrepreneurs who seek to shape the rules, infrastructure, and affordances of the AI economy from the ground up.

Building on these dynamics, we identify two sub-types within the Startupper category. The first includes venture creators with limited technical skills who seek to outsource prompt-making through indirect and often concealed forms of competition. The second comprises micro-entrepreneurs who develop and sell AI-based applications or plugins directly to other users. Startupper, therefore, do not produce prompts themselves but instead coordinate, commission, and structure the work of others. Their contribution lies in organising competition, curating prompt quality, and envisioning monetizable applications. As intermediaries and institutional entrepreneurs, Startupper contrast with Technology Experts (see section 4.1.3), whose capital is rooted in hands-on technical expertise and peer recognition.

3.1.3 *Technology Expert*

We classify as “Technology Experts” those users on Discord who identify as programmers, data scientists, or neural network specialists. Like Startupper, they aim to generate income through generative AI, but rather than organizing or outsourcing labour, they focus on hands-on development. Their goal is not to build businesses or sell services directly, but to work as freelancers or employees for external companies. Their primary activity is the development of ChatGPT plugins. For instance, one user presented a specific plugin as a tool for streamlining tasks like market research, academic assistance, and business intelligence:

«Hi everyone, we are testing a ChatGPT plugin that enhances ChatGPT requests. Do you use ChatGPT at school or work on an ongoing basis? If yes, with the Diffbot plugin you can enrich many requests such as: Market research - Ask about the latest technology trends and get a data-driven overview without having to move a finger. Homework help - Are you writing an essay? Get instant facts and figures on historical events, scientific concepts and more with sources. Business Intel - Get company profiles, market data and information on competitors just by asking. Summarise and enrich - It can summarise long articles, provide the most up-to-date facts about a person, place or entity, help you research anything with a direct list of sources. If you want to try it out, you can download it from the plugin shop. If you have any feedback/questions/problems with your research using the plugin, please feel free to send me a message» (Discord post).

By creating high-performance plugins, these users explore both the capabilities and limitations of generative AI, often pushing the boundaries of what the tools can do. Some also reflect on ethical concerns and potential misuses of the technology: «This is really cool, but my first thought was how it could be used for exploits and shit like that, using something like RDP for instance» (Discord post).

Technology Experts also adopt a dual strategy to build reputational capital. Alongside monetizable products, they share technical advice with the community, reinforcing their expertise and peer recognition:

«Here are some quick tips: start by clearly describing the problem you want to solve, specify the programming language required, and give concrete examples of the input and output you want. Also, if there are additional requirements such as special libraries, include them in the prompt» (Discord post).

These contributions are not driven by direct profit but by a desire to support others, gain credibility, and shape standards of good practice. Many claim affiliations with large tech companies, and their authority is rarely questioned. At the same time, some express frustration with professional environments marked by vague tasks and poor management:

«Hi everyone, I wanted to share some of the difficulties I am going through at work, which are causing me no small amount of disappointment. I feel it is important to talk about these things to lighten some of the burden I feel. Lately, I have been feeling completely lost because of the lack of clarity in projects.

It is frustrating to work with no clear direction, no details or clear directions on what to do and how to do it. This creates a lot of confusion and greatly slows down the progress of my work» (Discord post).

To counterbalance this frustration, many frame their efforts as socially meaningful, emphasizing AI's transformative potential for underserved communities:

«We often hear about AI's potential, but let's focus on its real-world impact. For many under-resourced areas, AI is not just a technology but a catalyst for change, this technology is helping bridge gaps where resources are scarce» (Discord post).

Technology Experts enhance the capacity of generative AI through advanced plugin development and community engagement. They combine economic orientation with ethical narratives, portraying their work as both valuable and socially constructive. Unlike Startupper, they do not coordinate labour but enact it directly, accumulating technical and reputational capital through problem-solving and peer validation. As such, Technology Experts play a central role in the grassroots AI economy. Their innovations shape technical standards, community norms, and informal markets for AI-driven solutions—demonstrating how digital expertise becomes a form of labour and influence within this emerging ecosystem.

3.1.4 *AI Curious*

The "AI Curious" category is primarily motivated by a desire to experiment with the unknown and understand how the technology works. Despite the variety of their activities, AI Curious users share a core orientation, they engage with generative AI primarily as a tool for personal discovery, emotional experimentation, and playful interaction rather than for technical mastery or professional productivity. Their engagement is not framed as labour in the traditional sense, but rather as exploratory practice deeply tied to personal, social, and emotional concerns. These users often lack the technical skills to fully leverage AI tools, which leads them to rely on trial-and-error approaches or community guidance. As a result, they either focus on image production or seek assistance from experts by requesting custom-made prompts, such as: «*A representation of ChatGPT*» (AI Prompt).

Asking Midjourney to create a representation of ChatGPT without stylistic constraints reveals how these users explore AI's representational logic through play. This experimentation often takes on emotional significance, particularly when directed at intimate or affective goals:

«Hello guys, I lost my grandpa 2 years ago. I built a tool that allows me to call my grandpa again. I felt incredibly comforting when I am able to call my grandpa and hear his voice again, I hope I can bring this to more people who are missing the one they love a lot. If you have their voice recording, I can help» (Discord post).

While this example shows a relatively advanced use of generative technologies, it remains within the AI Curious profile due to its emotional motivation and the reliance on community support. Their inventive uses of AI often emerge from affective rather than instrumental rationality. Many AI Curious users seek emotional companionship, treating ChatGPT as a virtual confidant. Through prompt experimentation, they try to create empathetic agents that can offer support in moments of distress or loneliness: «Hi everyone! Anyone selling prompts to make ChatGPT respond more empathetically when I describe anxiety situations or panic attacks? Thank you! » (Discord post). This emotional use of AI technologies constitutes a form of affective labour, not in the economic sense, but to shape machine responses to personal needs. It also differentiates them from the more market-oriented or technically driven categories.

While they rarely engage in direct commercial exchanges, AI Curious users play a crucial indirect

role in the prompt economy. Their frequent requests for advice, explanations, or emotionally attuned responses stimulate demand for customized solutions from more expert users. In this way, they contribute to the reproduction of social and reputational capital within the community. Even when they do not wish to purchase prompts, they actively seek to understand and learn from others: «I don't want to buy prompts, I want to be able to understand how to give clearer instructions so I can understand the ai process» (Discord post). Their main contribution lies in sustaining a participatory and affective learning environment, where AI is not only a productivity tool but a medium of exploration, storytelling, and emotional experimentation.

In conclusion, the AI Curious category includes users with limited prompt-crafting skills who are driven by a shared desire to explore and understand the potential of generative AI beyond technical or professional purposes. Their engagement represents a distinct form of labour, characterized by an experimental and affective approach that draws on social and emotional capital rather than technical or economic resources.

3.2 Prompt-Making Market

Rather than taking the form of a structured market, the prompt-making activities developed within the Image, Prompt Engineering, and Projects channels on Discord can be better understood as a situated practice of social appropriation. If a user responds to a sales post, they must send a direct message to the account that posted the offer. Conversely, users who post a purchase request are automatically contacted by sellers. In private chats, users can specify their desired prompts and negotiate prices through text or voice communication. Transactions are completed via PayPal, if offered by the seller, or shifted to external platforms like Fiverr. These exchanges do not constitute a conventional marketplace; rather, they reflect the informal dynamics of digital hustling, where technically skilled users mobilize their expertise to support others' needs.

To investigate this prompt-making market, one of the researchers employed two complementary strategies. The first involved responding to posts advertising prompt sales, while the second entailed publishing a post soliciting prompt purchases. In both cases, public interaction led to private conversations in which the exchange occurred.

Transactions typically move out of the selected Discord channels and into direct messaging. In these private negotiations, prompts are categorized into two types. The first includes ready-made packages, designed for specific tasks and daily professional use, usually priced under twenty euros: «Write a minute-long script for an advertisement about [product or service or company]» (AI prompt). These requests are simple and tailored to clearly defined purposes. The second category consists of custom-made prompts, developed according to detailed user specifications, with prices starting at around fifty euros:

«We want to perform a statistical analysis on textual data collected from a set of documents using topic modelling. The aim is to identify the main topics present in the documents and to analyse their distribution. Dataset: We will use a dataset of news articles downloaded from different online sources. The dataset contains two main columns: title [article title] and content [article content]» (AI prompt).

Payments are generally processed via PayPal or platforms such as Fiverr or eBay. Terms vary: some sellers require advance payment, while others accept it upon delivery. To enhance buyer confidence, sellers often share screenshots of user messages attesting to the quality of their prompts (Figure 1). Additionally, users who operate via PayPal frequently request positive public reviews on the Discord server, as the friends and family payment method allows fee-free transfers but offers no consumer protection. Maintaining this system therefore relies on trust, which reviews help to establish.

Repeat Client

★★★★★ 5 • 1 month ago

I enjoyed working with Mark. His prompts has reduced our work load by weeks and I was very pleased with the results on both occasions. I would not hesitate to use him again. In fact he is now on our Speed Dial! I highly recommend his service.

€50–€100

Price

3 days

Duration

Helpful? Yes No

Figure 1 – Screenshot review of a Fiverr user prompt shared by a seller.

Ethnographic observation reveals not the formation of a new formal economy, but rather a re-definition of what prompts represent: they shift from technical commands to tools that carry social capital, expertise, and status within the community. While many users, particularly in the prompts channel, emphasize how generative AI accelerates tasks such as paperwork and report writing, vendors report steady demand for prompt purchases. Notably, some users have implemented subscription services through platforms like Patreon and OnlyFans, offering personalized prompts for a fixed monthly fee. Figure 2 illustrates the tiered levels of such subscriptions, allowing users to select the frequency of prompt delivery—daily, weekly, or monthly.

Snippets + Prompt	Fast Track Snippet Request	Prompt Calendar
5 € / mese (più VAT)	7 € / mese (più VAT)	10 € / mese (più VAT)
Unisciti	Unisciti	Unisciti
Looking for a little bit of inspiration? Not in a position to get a full prompt calendar? No worries. With this tier you'll get a patreon exclusive prompt a week to get your creativity sparking, as well as access to everything in the previous tiers. I hope it helps!	So, anyone on here probably knows that I take and complete writing snippet requests for free on my tumblr @the-modern-typewriter and that I am happy to take writing snippet requests on every tier level here too. You'll also know that because I get quite a lot of requests that, although I do my best to write something for everyone, it can be a lucky dip for when exactly I'll respond to yours. So if there's something you really want to see like now, then this tier will put your request to the top of the priority list. (*Within reason)	Each month, you will get a Patreon exclusive prompt a day written by me for your own writing inspiration to use. These can be anything, from mermaids to murderers to lines of OTP dialogue. I may even do monthly themes and the occasional surprise prompt list! (Feel free to make general scenario requests!)

Figure 2 – Subscription tiers for customized prompts via Patreon.

In addition to task automation, some users seek relational prompts that enable generative AI to impersonate specific personas, particularly for use in dating or simulated conversations. One vendor specializing in this area explained:

«This prompt is designed to help a user respond appropriately and engagingly in a chat on a dating site, with the goal of maintaining a smooth and interesting conversation that can lead to a live meeting. Dating sites often require careful and sensitive communication to build an authentic connection with the other person» (AI prompt).

These relational prompts should not be interpreted merely as products; rather, they serve as narrative resources through which users emotionally appropriate AI. They allow individuals to explore affective and social needs—adding an emotional layer to otherwise instrumental uses. Such practices contribute to the formation of affective digital labour, a concept that captures the fusion of emotional expression and technological interaction in the prompt-making process. The two empirical components of the study, the user typology and the analysis of prompt-related transactions, are not disjointed but complementary. Together, they demonstrate how different categories of users (Creators, Startupper, Technology Experts, and AI Curious) appropriate generative AI in distinct ways, shaped by their economic strategies, creative expressions, and emotional investments. What might appear as a marketplace is more accurately understood as a social field, in which users continuously reinterpret and reconfigure technology in alignment with their aspirations, constraints, and everyday hustling practices.

Conclusion

This study aimed to contribute to a better understanding of the bottom-up social appropriation of generative AI technologies. By exploring prompt-making practices on Discord, we shed light on how users creatively adapt, reinterpret, and embed AI applications into their everyday labour practices.

Our analysis focused on three interrelated levels: the types of users involved, their motivations and objectives, and the functioning of a grassroots prompt-making market. Adopting Moreno Gálvez and Sierra Caballero (2022) framework, we examined the appropriation of AI across different user categories (AI Creators, Startupper, Technology Experts, and AI Curious) highlighting how social interaction, technical experimentation, and emotional engagement all contribute to making AI meaningful and usable in diverse contexts.

AI Creators, for instance, appropriate generative AI to produce aesthetic and monetizable content for social media platforms by acting as validators of visual trends and creative standards. Startupper leverage AI to organize digital labour, coordinate skilled workers, and envision new monetization infrastructures. Technology Experts mobilize their technical capital to develop and share plugins, often combining economic goals with reputational and ethical concerns. AI Curious users explore AI through experimental and affective engagements, seeking emotional support or self-expression rather than efficiency or profit. These categories reflect how prompt-making is shaped by distinct configurations of labour, capital, and social roles.

In line with Ticona's (2022, *op. cit.*) conceptualization of the digital hustle, our findings show that prompt-related exchanges on Discord are better understood not as a formalized marketplace, but as an informal and adaptive economy grounded in situated knowledge and interpersonal negotiation. These practices reflect strategic efforts to navigate the uncertainties of digital labour markets by mobilizing a mix of technical skills, social capital, and contextual improvisation. Rather than being purely transactional, the creation and exchange of prompts serve as a means for users to enhance their visibility, flexibility, and relevance within platform-mediated economies. This grassroots appropriation of generative AI illustrates how users actively shape the economic and cultural value of these technologies from below. In this sense, digital hustle is not merely about survival or monetization, but also about the everyday redefinition of roles, meanings, and boundaries in the use of generative AI technologies. Moreover, our research suggests that the appropriation of generative AI extends beyond work-related tasks. Users

often engage with AI to address affective needs, such as companionship, emotional support, or memorialization. This reveals how these technologies are embedded in personal and social life. In fact, this affective dimension challenges dominant narratives of AI as purely rational or utilitarian and highlights how emotional labour and experimentation are central to grassroots AI practices.

In conclusion, our findings emphasize that the social shaping of generative AI is not uniform or linear. Instead, it reflects a multiplicity of practices, strategies, and value. Rather than reinforcing deterministic views or binary imaginaries, this study foregrounds the situated ways in which users make AI work for them, negotiate its meanings, and co-construct its uses within everyday digital labour.

This study presents several limitations. First, our observations were confined to the Discord platform and three selected public channels, which may not fully represent the diversity of prompt-making practices in other online environments. Second, we focused on the most active users, potentially overlooking more casual or peripheral forms of engagement. Third, data collection spanned a relatively short time frame (three months). This could have limited our ability to assess long-term evolutions in user behaviour and market organization. For this reason, we advise that future research will address these limitations by comparing practices across platforms and cultural contexts, examining how grassroots prompt economies evolve over time, and exploring the broader implications of generative AI appropriation on digital labour markets.

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AI, Big Data, and IoT for Social and Environmental Sustainability in a Digital Transformation Course²

1. Social, Environmental, and Economic Sustainability in Socio-Technical Systems

Social sciences are paying particular attention to the way social and technological levels are now deeply linked. The dimension that best describes these processes is the one of *socio-technical systems*, an expression referring to the complex interaction between social organisations (including social institutions, interpersonal relations, and cultural processes) and technological systems (including communication technologies, infrastructures, and scientific innovations), arguing that they can significantly influence the structure and functioning of societies (Miller, 1978). This concept is present in the work of many sociologists, with different focuses. In 1990, for example, Giddens elaborated the concept of *disembedding*, emphasizing how technological systems can amplify the strength and speed of social change, with an impact both on individuals and on social institutions. One of the most important contributions on this topic is certainly represented by Castells. In his work (1996, 1997, 1998) he discusses the concept of *network society*, characterized by the central role of communication and information in social and economic organisations, going beyond geographical and temporal boundaries and enabling new forms of political and cultural participation. Moreover, in 2005 Latour developed the *actor-network theory*, focusing on human and non-human actors' agency in terms of social reality construction and on their equal impact in defining cultural practices and social relations.

Although the concept of *socio-technical systems* has not been defined recently, it received new impetus with the evolution and ever-increasing use of digital technologies. Nowadays, Artificial Intelligence (AI), Internet of Things (IoT) and Big Data are among the most promising technologies in terms of social transformation. AI focuses on creating systems mimicking human abilities such as decision-making, learning, and problem-solving; IoT refers to networks of interconnected devices collecting and exchanging data; finally, big data involves the collection, storage, and analysis of vast datasets, which enhance decision-making processes and allow predictive insights. They differ in terms of pervasiveness (e.g.: IoT's integration into physical spaces versus AI's application in digital spaces), modifications (e.g.: quick possible modifications of people behaviors due to AI application versus automatic adaptations of IoT devices, also without people interaction), architectures (centralized data hubs for big data versus distributed sensor networks in IoT), and relational grammars (how these technologies interact with users and other systems), but can be considered as promising for socio-technical systems. Indeed, nowadays digital media constitute a key element of this "technical" realm and their social applications are widely evident, increasing the connection between economic, political, cultural and social activities (Manzini, 2015). On this basis, many sociologists analyse the social implications of technology, on the perspective of people - see, for example, the work of Tufekci (2017) on how digital platforms and communities shape social interactions, political movements, and spread of information through algorithmic bias and online communities dynamics - on the perspective of companies (Zuboff, 2019), and on the one of the society as a whole (Van Dijck, Poell, & De Wall, 2018).

According to Abbas and Michael (2023), nowadays the research topics on socio-technical systems also focus on design as a key component to align human elements (skills, culture, and interaction) with technical ones (tools, processes, and technology) to maximize system efficiency and effectiveness, and to adapt to external changes, ensuring resilience and sustainability. One aspect to consider is the way design can help to integrate new technologies according to a socio-technical framework. For example, Sartori and Theodorou (2022) have emphasized how a collaboration between sociology and AI studies can address biases by enhancing transpar-

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ency, accountability, and understanding AI's role in social contexts and narratives. Moreover, Aseeri and Kang (2023) focus on a socio-technical perspective on big data, which enhances decision-making (e.g. describe, predict, and prescribe specific situations) by integrating technical capabilities with organizational culture and people attitudes. Finally, Donghee (2014) investigates the complex interaction between social and technical aspects of the IoT, by highlighting the co-evolution and the human-technical interaction, describing the challenges in the design and development of the different parts of the IoT for a better experience for people. So, the new challenge for socio-technical systems consists of how these technologies impact social structures and processes. This process can be summarized under the expression of *digital transformation*, which refers to cultural, organizational, and social changes due to the increasingly pervasive presence of digital technologies in various areas of human life (Opromolla, 2021).

However, it is not only a matter of digital technologies. The interconnection of social and technical levels increases the complexity of systems, which makes the following features as necessary: *adaptability* to changes in social and technical environments; *collaboration* among different stakeholders; *evolution*, through continuous feedback and learning; *interdisciplinarity*, permitting the collaboration among engineering, sociology, and psychology; and *management* of the structure, including specific practices guiding the system (IxDF, 2016b). Given the high influence of these processes on the entire society as well as on different typologies of communities, it is necessary to drive them, to achieve a positive social impact. This means simultaneously strengthening *social, economic, and environmental sustainability*. Social sustainability focuses on well-being, equity, and community engagement, supporting inclusion and cultural diversity. Environmental sustainability ensures that human activities do not have a negative impact on the environment. Finally, economic sustainability refers to the need of creating economic models which are resilient and inclusive. These three dimensions cannot be individually considered. For example, only by strengthening participation and inclusion it is possible to make environmental issues central to society and implement production systems respectful of the environment; moreover, only implementing circular economy mechanisms (for example, with waste reduction) it is possible to realize the economic sustainability; finally, only considering human needs and perspectives, it is possible to create a resilient economic system. In specific socio-technical contexts, to make an example, such as the development of smart cities, these dimensions interact dynamically: environmental sustainability is promoted by IoT-based energy-efficient infrastructures, economic sustainability is supported by cost-effective urban planning and resource optimization, and social sustainability is ensured by designing inclusive systems that address diverse community needs. In short, sustainability needs a multidisciplinary approach (de Vries *et al.*, 2019), whose aim is to create a sustainable society (Crespi, & Salvi, 2021), by developing solutions against climate change, the scarcity of resources, etc., but which needs many activities: adopting integrated solutions, restructuring education and research, developing policies (macro-actions, global perspective) as well as promoting civic engagement (micro-actions, local perspective: Bottini, 2023).

Examples of practical applications on the use of digital technologies to address sustainability challenges (in socio-technical systems) can be presented in different domains:

1. *IoT in smart agriculture*: Klerkx and Rose (2020) discuss how Dutch farms utilize IoT devices and AI to optimize resource use and improve the quality of products, for example, some automated milking and feeding robots monitoring animal health, optimizing feeding schedules, and measuring soil moisture and nutrient levels for precision farming;
2. *Smart cities*: Hollands (2008) discusses the project in Barcelona, where the integration of IoT sensors throughout the city allows to manage energy consumption (e.g.: smart lighting systems adjust brightness based on pedestrian activity, reducing electricity use by 30%);
3. *Wildlife Conservation*: Chan *et al.* (2023) use small aerial robots tracking multiple radio-tagged wildlife species in complex terrains, addressing the challenges of traditional wildlife monitoring methods, often labor-intensive and limited in scope.

In the above mentioned examples, ethics issues concerning data privacy, surveillance, possible attacks, lack of data ownership, economic inequality can arise. Robust protocols, data collection policies, anonymised data storage processes, etc. can be adopted to mitigate risks. However, integrating social, economic, and environmental sustainability in socio-technical systems presents significant challenges. Satisfying at the same time social needs (which are diverse in terms of stakeholders and cultural backgrounds), economic dimension (which, relating to sustainability, has a different meaning than the traditional one, now more focused on long-term value creation), and environmental objectives (which usually require significant changes to existing processes) is not easy. As an example, environmentally sustainable practices may increase costs or require changes in workforce practices, impacting economic performance and social stability. Then, integrating sustainable-oriented topics in socio-technical systems can be difficult due both to cultural resistances from existing social networks and digital evolution and integration, which needs both educational activities and investigation regarding technological opportunities. Moreover, socio-technical systems need to adapt to dynamics that occur (e.g. in social behaviors or in the market); so, not only is it necessary to define from the beginning the impacts that the solutions need to reach, but also to identify tools allowing continuous monitoring. Considering all this, integrated approaches, able to capture different dimensions, to systemically think, to engage stakeholders, to foster a culture of sustainability, and to iteratively design solutions that fit with all existing needs is necessary.

2. Governing Complexity in Socio-Technical Systems: the Role of Design Sociology

The processes described in the previous section are very complex and new skills are required to manage the emerging complexity. Indeed, specific approaches able to analyse and guide this complexity are necessary. In social sciences, increasing importance is represented by *design sociology*, an approach that applies tools and concepts of the design discipline as sociological research methods, especially with the objective of exploring people's engagement with systems and services, better engaging with stakeholders, generating useful insights for the definition of new solutions for society and/or communities that can change cultural forms, and working towards social change (Lupton, 2018). With reference to socio-technical systems, design sociology helps sociological research at identifying insights which can increase their effectiveness and equity.

More specifically, the *design thinking*, as one of the methods of the so called *sociology through design*, is an approach structured in five main phases (IDEO.org, 2015) that aims at applying design tools and methods: to analyze human feelings and behaviors (phase of *empathize*), to identify problems (phase of *define*), to generate new ideas able to establish new relational dynamics (phase of *ideate*), to create a tangible prototype of the final solution (phase of *prototype*), to be validated with the people who will use it, also with the aim to reach a long term impact (phase of *test*). Humans represent the central part of this approach, since their needs and cultural backgrounds are a fundamental element to investigate, and the starting points from which to generate, test, and implement ideas that solve social problems and change cultural norms. Indeed, the design thinking methodology is part of the more general *human-centered approach*. According to the Interaction Design Foundation (2021), *human-centered design* provides solutions coherent with the needs and cultural background of people. It is based on a people-centered approach, allowing to focus on the right problems, to identify how different things are interconnected, and to create a solution able to face the predefined issues. In this sense, the objective of the *human-centered design* is the *social innovation*, an expression which indicates practices whose aim is making citizens increasingly aware of the problems affecting the community (or society) and to involve them in identifying concrete solutions that respond to their needs, thus determining economic and social growth of the community itself (Opromolla, 2020).

In these approaches, the combination of sociological (e.g., the ethnography aiming at analysing people behaviors and activities in their daily life) and design methods (e.g., prototyping activities, aiming at creating early models to test concepts) offer the opportunity to identify the way affordances of digital and non-digital solutions at the same time are the result of specific activities and enable particular relations. Co-design, for example, especially if oriented to the implementation of digital solutions, has the objective to create products that incorporate people's needs and desires, also in terms of the relations they intend to enable.

These activities are usually implemented during design workshops, which can be intended as interactive sessions focused on brainstorming, prototyping, and solving design problems through creative and practical exercises, using specific artifacts during the sessions, such as: maps, boards, diagrams, mockups, etc. They serve several purposes, that are: visual representation, providing a tangible representation of abstract ideas; collaboration, by providing a common reference point that all participants can interact with; idea organization, organizing thoughts and ideas systematically; documentation, since they capture the iterative process of design; testing, since they enable participants to identify potential issues and improvements before finalizing design; engagement, encouraging active participation and creative thinking from all attendees. Among them: journey maps, consisting of visual representations of people experiences with a system (IxD, 2016a); storyboards, panels that illustrate the narrative of a product or service, showing how people interact with it (Soegaard, 2024); affinity diagrams, tools for organizing amount of data or ideas into themes or groups (Dam, & Teo, 2022).

3. Developing Competences in Educational Curricula towards Sustainability in Socio-Technical Systems

The paper intends to highlight how the development of skills related to human-centered design is necessary in curricula of higher education. More in detail, in this section, the necessary competences towards sustainability in socio-technical systems are addressed, followed by the state of the art in the scientific literature addressed to the integration of sustainability issues in university curricula (with a focus on its relation with digital transformation processes). The last part of the section is devoted to the description of a course, delivered by the author of the paper, integrating sustainability through digital transformation processes in higher education. The focus will be on the way *design sociology* methods and tools can improve these skills, by describing the main characteristics of the course, as well as the main results of its application.

3.1 Education towards Sustainability in Socio-Technical Systems

Competences towards sustainability in socio-technical systems encompass a range of capabilities essential for addressing contemporary challenges, considering social, economic, and environmental aspects. Before describing these competences, it is important to emphasize how this field is strictly connected to *media education*. According to Buckingham (2003), media education refers to teaching individuals how to critically analyze, evaluate, create, and engage with media in all its forms, equipping them with skills to navigate its complex landscape, using media responsibly, encouraging informed participation in society fostering creativity, and an understanding of media's role in shaping culture and opinions. More in detail, in the field of sustainability in socio-technical systems, media education equips individuals to critically engage with media technologies while addressing environmental, economic, and social dimensions, fosters awareness of how they shape perceptions of sustainability, promotes responsible use of resources, and encourages ethical practices in media creation and consumption.

Firstly, it is fundamental to provide students with interdisciplinary knowledge (Didham, Fujii, & Torkar, 2024), integrating different fields (e.g., natural sciences, informatics, social sciences, economics), where the prominence of one discipline over another can depend on the curriculum (e.g., in an informatics curriculum, technical aspects might be more emphasized). However, attention should be focused on major environmental challenges (e.g., climate change, resource scarcity, pollution, biodiversity) as well as on how to measure environmental sustainability. Furthermore, attention should be given to the key features of emerging technologies (especially the mode of operation and application fields of innovative technologies such as AI, IoT, and Big Data), including case study analyses and explorations (e.g., applied to the circular economy, sustainable transportation). Identifying benefits for different societal groups is particularly important, as it helps address disparities and adopt a more inclusive approach to sustainable development.

Beyond interdisciplinary knowledge, developing competences in systems thinking is crucial. This involves understanding the complexity of socio-technical systems, recognising the interplay between human and technological factors, and adopting a systemic approach. This means identifying feedback loops, leverage points, and potential unintended consequences within these systems (Ekselsa *et al.*, 2023). The focus on interdisciplinary knowledge also relates to the ability to analyze and recognise the complexity of socio-technical systems. It encompasses not only the interconnection and impact of human and digital levels but also the acquisition of systemic thinking, meaning recognizing how diverse phenomena are interconnected, influencing each other, and thus identifying intervention points to improve or alter the system. Achieving this objective requires adopting a holistic perspective, which helps identify the long-term impacts of actions and decisions. Mapping and modeling tools are useful for representing both basic and complex dynamics of the system. To develop this skill, it is fundamental to analyze the characteristics of specific socio-technical systems (e.g., based on communities of members united by belonging to the same territory, by the same interests, by similar work, etc.).

Furthermore, integrating ethical considerations into sustainability education is fundamental. Students should be encouraged to critically evaluate the ethical implications of technological advancements and sustainability initiatives, understanding how decisions may affect various stakeholders and future generations (Olawumi *et al.*, 2023). This ethical perspective should be woven throughout the curriculum, encouraging students to consider not just what is technically feasible, but what is ethically responsible. Redesigning solutions based on specific socio-technical systems according to what is ethically responsible (affecting the environmental, economic, and human dimensions) is a good exercise for students. The ethical implications of AI and Big Data in socio-technical systems require attention, since they raise issues related to privacy, algorithmic biases, and the risk of deepening inequalities. Addressing these challenges is critical to designing solutions that prioritise transparency, accountability, and fairness.

In analysing socio-technical systems, it is important to adopt not only a micro-sociological perspective (focusing on the individual) but also a macro-sociological one, which includes analysing governance structures, policies, regulations, and all stakeholders influencing socio-technical systems (Köhler *et al.*, 2019). This aspect underscores the importance of interdisciplinary collaboration among stakeholders from various sectors (such as businesses, governments, and NGOs), considering them not only as subjects of analysis but also as active participants in designing solutions for socio-technical systems. Developing a global perspective is also important in sustainability education. This involves understanding and addressing sustainability issues on a global scale, recognizing the interconnectedness of local actions and global impacts (Žalėnienė, & Pereira, 2021). Students should be encouraged to consider how sustainability practices can vary in different cultural, economic, and environmental contexts, promoting solutions that are globally informed yet locally relevant.

Hence, collaboration and stakeholder engagement are fundamental skills to teach, fostering shared understanding and commitment to sustainability goals. Participatory approaches, in-

volving stakeholders in decision-making processes, such as participatory planning and co-design, are important (Wibeck, Eliasson, & Neset, 2022). Communication skills are, consequently, vital to facilitate fruitful collaboration among different stakeholders, both during participatory processes and to ensure positive relationships in socio-technical systems.

Participatory processes, as well as the recognition of the complexity of socio-technical systems are also connected to another crucial skill: change management. This involves identifying shortcomings in a given system and taking initiatives to change processes, services, etc., while pinpointing the necessary organisational and social changes to achieve predefined outcomes and long-term impacts. Skills in planning, executing, and evaluating sustainability projects are essential for achieving tangible outcomes and fostering long-term change.

Additionally, fostering innovation and entrepreneurial thinking is vital. Students should be encouraged to explore innovative solutions and entrepreneurial opportunities within the realm of sustainability. This can be facilitated through incubator programs, innovation labs, and collaborations with industry partners, enabling students to translate their ideas into viable, impactful ventures (Suguna *et al.*, 2024).

An analytical approach, focused on thorough context analysis and based on collecting and interpreting data and evidence, should also be taught. This approach provides insights essential for the system change management process, allowing the identification of problems by recognising the interconnection of root causes determining a specific situation. This should be applied both at the initial phase (to map the as-is situation) and after implementing major changes (to evaluate impacts and monitor progress). Among the most important tools for analyzing sustainability challenges are SWOT analysis, root cause analysis, and scenario planning. Finally, students need to be encouraged to think creatively to develop innovative solutions to sustainability problems. Engaging them in real-world interdisciplinary projects, case studies, and problem-based learning to solve real-world sustainability issues is crucial. This can be further enhanced through exposure to hands-on experiences, such as fieldwork, internships, and collaborative projects with external organizations, providing practical insights and real-world applications of their learning (Kricsfalusy, George, & Reed, 2016).

These competences prepare students to navigate and address many challenges, e.g.: creating a sustainable future, making them valuable contributors across various sectors. They prepare higher education students to become informed, proactive agents of change capable of contributing meaningfully to sustainability transitions in diverse professional fields, ensuring a sustainable future for society.

3.2 Academic Perspective towards Education on Sustainability in Socio-Technical Systems

Sustainability-related issues are becoming increasingly important from primary school, up to university. In this section the author focuses on the recent academic contributions addressed to the ways sustainability issues, especially associated and driven by Digital Transformation processes, are transmitted in university courses. This topic is more and more present in the academic literature (Abad-Segura *et al.*, 2020). University students are a target increasingly affected by these issues, and this implies the need for providing supporting materials, methods, and best practices to teaching staff (Leal Filho, 2018).

Designing a curriculum on sustainability in higher education represents an important topic in the academic discussion. Poon (2017), for example, has investigated the integration level of sustainability issues in the curriculum of the Deakin University in Australia, demonstrating how it was still low, but oriented to a problem-based approach, reinforced with concrete projects. According to Ruesch Schweizer, Di Giulio, and Burkhardt-Holm (2019) the scientific support in the activity of sustainability design curriculum is important. It consists in engaging stakeholders to ensure willingness to change, addressing institutional constraints, promoting professional devel-

opment, leveraging existing experiences, incorporating diverse sustainable insights, and facilitating interdisciplinary consensus. Some contributions focus on the importance of considering sustainability issues as a topic not to teach itself but connected to traditional ones. Cardiff, Polczynska, and Brown (2024), for example, focus on the way sustainable issues can be integrated in foreign language education. However, most of academic contributions focus on the integration of sustainability across different disciplines, even if this is not always easy (Argento *et al.*, 2020). In terms of curriculum contents, Vitting-Seerup, and Achiam (2023) have developed a science communication course aimed at incorporating sustainability principles. The course evolved from educating *about* sustainability (focusing on awareness), to educating *for* sustainability (encouraging interdisciplinary problem-solving), and finally to education *as* sustainability (promoting epistemic change and mutual understanding). In their study, incorporating arts-based approaches and interdisciplinary exchanges proved effective and promotes inclusive communication models. In general terms, according to Fuertes-Camacho, M.T. *et al.* (2019) elaborating competencies for sustainable development enables an integrated approach allowing to promote the project method in multidisciplinary teams. Indeed, for some authors, sustainability is embedded into generic academic competences (Pietikäinen *et al.*, 2024), whereas other studies focus the attention on specific disciplines. For example, some authors have emphasised that sustainability is a topic more and more present in the “technological” university curricula, e.g. digital media design (Kao, Chen, & Lo, 2024) and engineering (Nakad, Gardelle, & Abboud, 2024), oriented not only to the design and implementation of sustainable products and artifacts, but also as a way of thinking interdisciplinary and of developing transformative competencies. The latter is also addressed by Disterheft (2024), who argues that sustainability in higher education contributes not only to develop care-based approaches, but also to leverage system-thinking perspectives and transformative learning approaches. Shephard (2020, p. 2) argues that sustainability also contributes to the development of critical thinking.

More generally, according to Shenkoya & Kim (2023), digital transformation processes and sustainability in education are more and more connected. Indeed, the increasing application of technologies in education processes, and the digital transformation as curriculum topic is also leading to study programs sustaining the fundamental sustainability principles in all life areas. This is also addressed by Veckalne & Tambovceva (2022), who state that digital transformation in education is crucial to promote sustainable development, since it enhances access to educational materials, and because blended learning models reduce the environmental footprint, but also because digital tools facilitate the integration of education for sustainability into curricula, fostering critical thinking and problem-solving skills. This opinion is also supported by other studies (e.g. Leal Filho *et al.*, 2023).

In this regard, the application of social innovation initiatives is important too (Melles, 2022). The work of Unceta, Guerra & Barandiaran (2021), for instance, emphasizes how higher education institutions support strategies strengthening participation and cooperation with local communities, where sustainability practices play a central role. This is exactly the topic of the work Dryjanska, Kostalova, & Vidović (2022), who discuss some higher education practices of two Countries and sectors (Czech Republic and Croatia), engaging students in practical activities consisting of participation in community projects, increasing civic engagement and responsibility.

In the academic literature, the research on how to build sustainability competencies through digital transformation (both to students and teachers) is also associated with the research on how to create smart and sustainable campuses through the application of digital technologies (Trevisan *et al.*, 2024; Rotondo, & Giovanelli, 2024). This point is very important in a specific part of the academic literature, which intends the role of the higher education institutes as crucial to implementing sustainability on a systemic level (Deneckere *et al.*, 2024), both improving the university organization performance and by evidencing the central role of university in the society (Pischedda *et al.*, 2024; Shephard, 2020, pp. 1-3). For this purpose, the study of Abo-Khalil (2024) focuses on how sustainability is present in higher education, starting with an exploration

of various campus sustainability assessment tools. It states that a successful integration and collaboration between educational stakeholders, industry partners, public sector, and civil society are crucial for fostering collective action and effective solutions to sustainability challenges.

Evaluation of the curriculum is also discussed in the academic literature. The study of Delaney and Liu (2023) is addressed to a design course and emphasizes how, even if sustainability issues are important in that discipline, in the United Kingdom 80% of the courses were considered as “weak” or “very weak”. For this reason, the operationalisation of learning outcomes related to sustainability into higher education assessment tools is necessary (Stough *et al.*, 2024; Ceulemans, & Boitier, 2024), especially by defining common objectives among different universities (Agrawal, & Parvez, 2024).

In summary, integrating sustainability into university curricula amid digital transformation involves a multidisciplinary approach, engaging stakeholders, and leveraging digital tools to promote sustainable development, at the same time fostering critical thinking, and addressing societal challenges.

3.3 A Course in Higher Education on Digital Transformation for Sustainability

In this section an existing course for higher education students linking sustainability issues with socio-technical systems is described. Its aim is to explore how digital technologies (especially AI, Big Data, and IoT) can have a positive impact on social, environmental, and economic sustainability issues.

More in detail, this course consists of two phases: a delivery teaching phase and an interactive teaching phase. During the first phase three main topics are included:

1. social assumptions and implications of digital transformation, focusing on the way socio-technical systems impact in various societal domains (e.g.: healthcare, learning, work, mobility, information, public sector, etc.);
2. technological opportunities for digital transformation, emphasizing the basic characteristics, operating modes, and areas of application of IoT, AI, and Big Data, as well as focusing on the role of human-centered design in digital transformation;
3. economic framework of digital transformation, discussing the trends of open innovation, start up, public-private collaboration, etc.

During the second phase, students are asked to choose one of the targets established by the Sustainable Development Goals, set by the United Nations, and to identify how AI, Big Data, and IoT can be at the basis of an interactive solution driving towards the achievement of the chosen goal. To do that, students are asked to follow a framework consisting of five steps, using tools proper of the design sociology approach:

1. students build a deep understanding of the people affected by the chosen goal, ensuring that the solution is designed with real users in mind, prioritizing their experiences and addressing their pain points. To do that they drafted the *user persona(s)*, fictional characters created from people research (collected through qualitative research conducted through focus groups and interviews) to represent people behaviors, needs, goals, and pain points, guiding design (Figure 1);
2. students analyse the broader ecosystem, identifying all relevant actors, their relationships, and roles within the chosen field, providing insights into the dynamics, potential opportunities, and barriers that may influence the proposed solution. To do that they drafted the *stakeholder map*, a visual representation of people and actors involved in a specific field in a given context (Figure 2);

3. students design an interactive concept solution that uses AI, Big Data, and/or IoT, that is to say identifying the characteristics of an interactive solution following people-centered and responsive environments;
4. students refine the concept, mapping out how users might interact with the solution over time, identifying key touchpoints and optimizing the user experience for engagement, efficiency, and impact. They drafted the *user journey map*, a tool visually depicting the people's interactions with the interactive solution (Figure 3);
5. defining the long-term impacts of the identified solution, as well as the outcomes, focusing on evaluating the solution's ability to deliver meaningful and measurable results.

The course has been delivered to 10 higher education students of an Interaction Design curriculum (the precise name of the module is digital transformation). Students come from different socio-cultural contexts (Italian, French, and Chinese) and have different backgrounds (communication, fashion design, urban landscape design, and marketing).

As a result, many different concepts have been defined:

- an interactive app enabling users to capture photos and geolocate marine litter. This data helps predict litter drift, optimizing marine clean-up operations. It also supports scientific research and clean-up strategies through crowd-sourced data, fostering a collaborative approach to environmental conservation;
- an app that promotes sustainability by integrating UI customization, real-time ecological driving tips, and energy consumption monitoring. It optimizes routes using real-time data, provides environmental impact reports, and enhances people awareness and eco-friendly driving habits;
- a platform that enables young people (along with their families, healthcare professionals, and communities) to access a comprehensive, AI-powered platform for the prevention, treatment, and support in their journey to achieve and maintain recovery from substance use disorders, fostering improved physical and mental health, restored relationships, academic and career success, and overall well-being;
- a holistic platform offering real-time tracking of hormonal changes, sustainable mental health resources, and eco-friendly lifestyle tips. It integrates social support, professional consultations, and environmental mindfulness to alleviate postpartum emotional issues, promoting well-being and sustainable living;
- an AI-based platform predicting disasters, managing resources, and aiding navigation, analyzing environmental data, at the same time raising awareness through educational tools. This integration aids authorities in real-time responses and sustainable practices;
- an ecosystem and biodiversity conservation platform allowing environmentalists to collectively record relevant information and data regarding mountain ecosystems and its biodiversity;
- an urban information real-time monitoring platform allowing city emergency management agencies, city planners, and architects to get real time environmental information during a rescue and simulate the impact of natural disasters on cities to enhance resilience of cities to natural disasters.

USER PERSONAS



Figure 1 - Student's work. User persona.

USERS AND STAKEHOLDER MAP

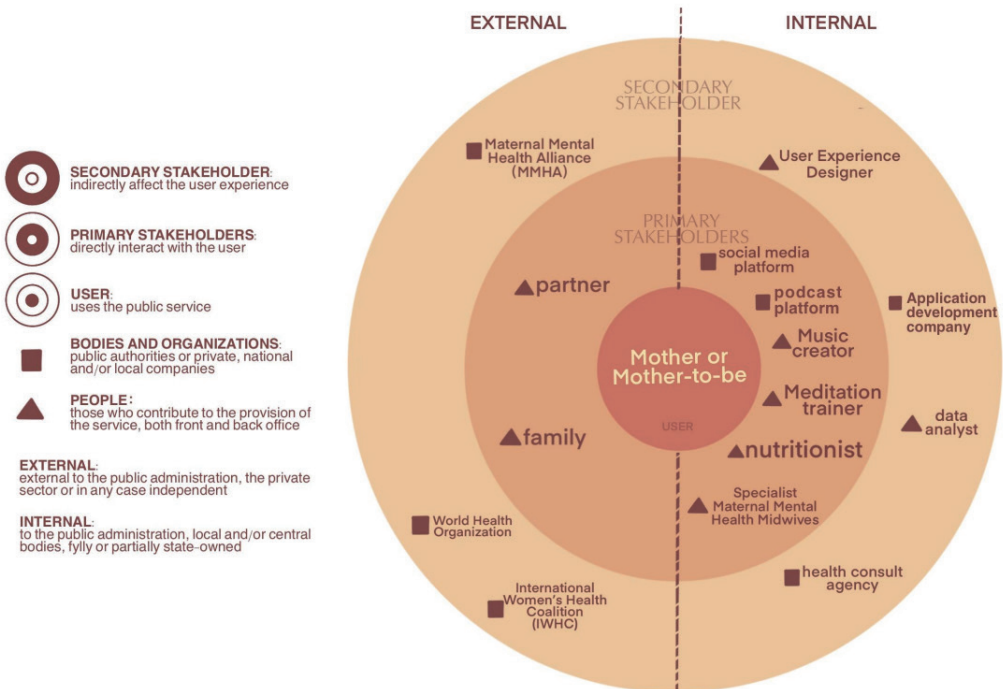


Figure 2 - Student's work. Stakeholder map.

areas, levels of impact across different dimensions of sustainability, roles of various technologies, and, consequently, possible innovation within socio-technical systems. At present, they are merely conceptual frameworks that have been developed but have not been pursued further. This emphasizes their potential rather than their realisation, serving as starting points for exploration and discussion rather than finalized or implemented solutions.

The proposal here is not to use the described method as it is, but to consider it as one of the possible applications of the methodological approach of design sociology. This method, in fact, is flexible enough to be applied and personalized based on various variables. First of all, the level of knowledge of technologies. Design sociology does not require the participation of technical experts, but rather of people who, starting from a basic understanding of the main functionalities and application areas of the technology, are capable of envisioning the most suitable scenarios, giving to the different dimensions the same importance. Indeed, design sociology actively involves people, asking them "human" skills rather than technical ones. Then, the type of discipline subject of study. The design sociology approach can be applied not only to social science curricula, but also to more technical ones: it needs to be intended as a thinking process, aiming to address complex global and local challenges placing people and communities' problems at the centre. Moreover, the level of integration in university curriculum. The described approach is suitable both as an integration in university curricula and as a student engagement method in activities separated from the ones proper of their curricula: it is useful to have a deep understanding of society, considering the perspectives of different stakeholders. Finally, the concrete application of the designed solutions: it can be used both as an exercise and as a method leading to solutions that are progressively refined to be effectively implemented.

The author recognises some limits of the study. The first one is represented by the small student sample; during the second administration of the course, it is planned to involve a larger number of students. The second is represented by the scalability of the course: an additional reflection is required regarding the consideration of additional elements useful to adapt the course and the concept ideas to different socio-cultural contexts, as well as the implementation of practical collaborations with key stakeholders (to design solutions for real needs), and possible additional contents making the course even more relevant. Thirdly, the limitation of the study also may concern the method of the design sociology; indeed, even if design sociology can be considered an "umbrella" approach, encompassing multiple approaches, additional tools as well as similar methodologies (such as systems thinking, actor-network theory, user-centred design, ethnographic design, etc.) need to be explored. Finally, the importance of ethical impacts of the created projects can be better evaluated, especially in the phase of impacts definition.

Moreover, future research will focus on evaluating the long-term impacts of integrating design sociology into university curricula in terms of the ability of students to address sustainability challenges. This will be implemented by measuring the way the course impacts on the future students' careers (in terms of work fields and methodological approaches). Another important element to investigate relates to the exploration of interplay between local socio-cultural contexts and global sustainability objectives, as this could reveal valuable insights into the adaptability and efficacy of such methodologies.

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Ecoliteracy and Artificial Intelligence: Two Opposites for a Common Goal in Education²

Introduction

When approaching the conjunction of two apparently distant dimensions, namely ecology and the virtual world - theorized in the postulation of Floridi (2015) as Onlife - it is appropriate to clarify the intrinsic nature of the terms of reference, along with their underlying connections when it comes to ecoliteracy.

The polysemous definition of "ecology" has been developed over time and, although the semantic universe to which it refers is certainly broader, strictly speaking it is the science that studies how living beings interact with their environment. Accordingly, ecology refers to another significant topic: ecologism, a global recreational movement that seeks to combat the world's environmental crisis (Mortari, 2001).

"Literacy", however, is originally a concept of linguistic research, which focuses on the «ability to read and write» (Stibbe, 2009). The scope of literacy has continued to expand with interdisciplinary elements, defining itself as «knowledge or ability in a particular field or fields» (McBride *et al.*, 2013, p. 2). This means that it can be combined with another discipline. From this premise ecoliteracy combines ecology and linguistics, sharing the same disciplinary basis as linguistic ecology (Huang, & Ha, 2021). However, ecoliteracy is not limited to these two disciplines; it is, in fact, part of a broader set of terms (Casper, 2017). Some researchers focus on individuals' ecological knowledge levels (Pitman, 2016), while other studies consider content related to ecological behaviour or attitudes toward ecological issues, (Arcury, 1990; Morrone *et al.*, 2001).

Capra (1997) coined the term ecoliteracy taking heavily on Orr's (1992) work, defined as an understanding of the principles of the organization of ecosystems and the application of those principles for creating sustainable human communities and societies. An essential element of ecoliteracy is the idea of using resources in such a way as to ensure future availability. Also, while the term ecoliteracy was not used explicitly, other frameworks identifying sustainability as the preferred outcome of the promotion of literacy have been advanced by Thomashow (1995), Jardine (2000), Bowers (2001), Woolpert (2004), and Stone and Barlow (2005).

According to McBride *et al.* (2013, *op. cit.*), the existing frameworks for ecoliteracy exhibit a high degree of similarity with frameworks for environmental literacy, since both sets include similar affective, knowledge, cognitive skills, and behavioural components. However, the element which most differentiates ecoliteracy from environmental literacy is the clear emphasis on sustainability, and the introduction of spiritual, holistic components, expressed in terms of "celebration of Creation" (Orr 1992), "spirit" and "reverence for the Earth" (Capra, 1997, 2002; Center for Ecoliteracy, 2013), and "expansion of the soul" (Wooltorton 2006). An ecoliterate person is prepared to be an effective member of sustainable society, with well-rounded abilities of head, heart, hands, and spirit, comprising an organic understanding of the world and participatory action within and with the environment.

In a broader view, the term ecopedagogy (as integrated methodology to ecoliteracy in this paper) was coined by Paulo Freire (Freire, 1971; Gutiérrez, & Prado, 2000) and is used to describe how women and men can develop an awareness of their existence in relation to everything that for a long time was simply defined as Nature (Bellatalla, Genovesi, & Marescotti, 2006; Tomarchio, La Rosa, & D'Aprile, 2018). All the previous theorizations about ecoliteracy/ecopedagogy, however, do not contemplate the integration of AI evolution both in terms of tool and field of interest.

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On the other hand, as AI-related technologies take advantage of a new spring, their influence on the narratives and information that guide public opinion and decision-making is unprecedented and despite requiring specific processes to ensure that the results are consistent with human values, the important aspect of environmental responsibility and its literacy has been - as we will see - largely ignored until now. This gap can lead to AI models hallucinating from cognitive biases that incorrectly reproduce narratives that are indifferent or harmful to environmental issues. Additionally, while the environment is a concern in the ethical AI community, there is a need to find ways to use it to address environmental issues, both in terms of reducing carbon emissions and water consumption, and in terms of its usefulness for ecoliteracy and ecopedagogy. The chiasm created by artificial intelligence (AI) and machine learning (ML) is soon recognized as a powerful tool that has revolutionised ecological research globally since the 1990s (Lek *et al.*, 1996; Recknagel, 1997, 2001; Lek, & Guégan, 1999; Elith *et al.*, 2008). However, in the Onlife era, the increase in computing power and the use of predictive models have increased the possibilities of data analysis in the field of ecology with unprecedented accuracy. By leveraging artificial intelligence and machine learning algorithms, scientists can now extract meaningful patterns from data, identify unexpected variable interactions and nonlinearities (Lek *et al.*, 1996; Olden *et al.*, 2008; Recknagel, 2001; Ryo, & Rillig, 2017) and make predictions with unprecedented precision, as is the case for habitat suitability or species distribution (Elith *et al.*, 2006; Elith, & Leathwick, 2009; Guisan & Thuiller, 2005).

Summarizing the words of Latour, nature is the result of the modern conception of science, and ultimately, science is the consequent practice of the modern conception of nature.

In education, these transformative capabilities can lead to a deeper understanding of ecological systems. To do so, Latour asks teachers and researchers to unfold the black-boxed technology, that is to say, to observe the network carefully and give a delicate layer-by-layer description of the history of things (Latour, 2014). Agreeing with Latour's thoughts, this paper insists on the need to reform the concept of ecoliteracy by incorporating some elements of technological literacy. Hence the double value of the desirable framework which contemplates "with" and "of" AI.

This contribution states the lack of an academic approach that contemplates ecopedagogy/ecoliteracy and AI tools and provides an attempt to build an ecoliteracy and AI framework that merges in an integrated model by ecopedagogy as methodological approach to develop students' ecoliteracy, both in terms of understanding and learning. We will attempt to build a draft of a possible framework using the same LLM model, to test the effectiveness, limits and suggestions given by this new tool. It will also attempt to combine both sides of the AI: its usefulness and its costs.

1. Theme and Literature

1.1 Ecoliteracy and AI

Bearing in mind that the management of planetary solutions to environmental problems are and will be largely digital and that renewable energy sources are monitored and produce electricity via digital devices and automated control systems, it is imperative to also provide education about the digital environment. This kind of education must include computer networks for environmental purposes and a new culture of dependence between humans, the environment, the climate, algorithms and data.

Digital and environmental education are intertwined in a relational axis that aims to respect the multidimensionality and richness of reality and to recognise the subject's great responsibility in terms of the ability to accommodate the methods of building knowledge in a network of complex relationships among all the components involved without hierarchical perspectives (Mortari, 2001).

The ability to make conscious choices with a high degree of harmony with one's natural environment or Ecological Intelligence, according to Daniel Goleman (2009), is the next cognitive advancement that humanity will have to develop. Goleman argues that ecological intelligence refers to the ability to understand how human systems interact with natural ones. Only this kind of all-encompassing sensitivity can show us the interconnections between our actions and their hidden impacts on the planet, our health and our social systems (Goleman, 2009). Therefore, it is necessary to accumulate a wealth of interconnected knowledge in various fields to develop ecological intelligence. Based on the need to develop a range of environmentally sensitive knowledge, Goleman is engaged in the work of the Ecoliteracy Centre of California (<https://www.ecoliteracy.org/>), which was established to develop what can be called ecological literacy. More recently, thanks to direct experience in the school environment, to help teachers encourage the development of ecoliteracy in their students, Goleman identifies five positive practices for ecoliteracy:

- 1) developing empathy for all forms of life, therefore developing compassion and awareness of being part of a living community compared to which human beings are not overweight;
- 2) adopting sustainability as a common practice, enhancing interconnection and cooperation;
- 3) making visible what is not visible, that is, increase awareness of the effects that people's daily actions have on the ecosystem;
- 4) using the precautionary principle to predict the possible implications of behaviours to include unintended consequences;
- 5) understanding how nature supports life and, therefore, having a broader vision of one's choices to take care of natural resources through adapting behaviours (Goleman, 2009).

The profile of this environmental literature is, therefore, complex and requires not only the dissemination of information and knowledge but also social and emotional activities. Also, the characteristics of this new intelligence are mainly learning from experience, interacting effectively with the environment, learning about living beings and their ecosystems, understanding the impact of human activities, and enabling humans to live an eco-conscious life.

From Goleman's ecological intelligence, Fridtjof Capra's ecological competence represents an experiential translation of environmental intelligence, as it is the ability to understand, care for and take responsibility for connections and vital processes; therefore, it represents the empirical translation of ecological intelligence, proposing a new educational challenge, which should lead to the redefinition of all school programs (Capra, 2006). Environmental pedagogy must be developed to consider social and ecological justice, human rights, and the ecosystem. First and foremost, the school world, the place and space *par excellence* in which to develop and support true ecological education aimed at developing knowledge, cognitive styles and empathic ability with eco-educational orientation.

Freire (2000, p. 56) expressed his concerns about the advancement and the use of technology and their impact on communication and people's lives, highlighting how technology, in its accelerated revolution, had become «the main bastion of capitalism». However, rather than fearing or shunning it, he embraced the use of technology in education and in the early 1990s he set up the Central Laboratory for Educational Informatics in São Paulo, which made significant investments in digital equipment (Jandrić, & Ford, 2022, p. 6).

After the creation of the Decade of Education for Sustainable Development (2005-2014), which led to changing the name from environmental education to sustainability education, it is possible to identify at least six different models that address environmental education from different perspectives, approaches and methods, including the environmental research model, nature education, ecological education, the ethical standards model, and disciplinary and dialogic models (Borgarello, 2005).

However, Orr (1991) had already emphasized the need for a transition from literacy-centred education of reading and writing into the 'ecological literacy education' of environmental sensibility. According to Orr (1989), ecological literacy requires the more demanding capacity to distinguish between health and disease in natural systems and to understand their relationship in human ones. While literacy is driven by the search for knowledge, ecology is driven by the sense of wonder, and that sort of knowledge is best acquired out-of-doors (Orr, 1989, p. 334).

On the other hand, Goodwin (2016) reports that in education for ecological literacy, even though environmental activities have steadily increased across the years, environmental literacy itself has ceased to show any conspicuous signs of rising.

The synergy between artificial intelligence and climate change education is reflected as a common potential to address global challenges. It can help teachers adapt climate change curricula to individual students' interests and learning styles. Additionally, AI-based analytics can evaluate the effectiveness of educational programs, enabling continuous improvement of climate change education strategies. Educating students about the environmental impact of new technologies, including artificial intelligence itself, ensures a responsible and informed approach to innovation. (Cao, & Jian, 2024).

Studies on the topic highlighted that artificial intelligence and virtual reality could contribute to strengthening environmental education and public engagement (Grasse *et al.*, 2023; Zidaru *et al.*, 2021). By combining climate change education and artificial intelligence, the education system can create a green generation capable of harnessing technology for sustainable solutions. However, traditional environmental education methods have been criticised for their inability to change students' attitudes and behaviours regarding sustainability (Chen *et al.*, 2020). The correlation of artificial intelligence, big data, virtual reality and other digital technologies can significantly raise the levels of traditional education systems (Gowda, & Suma, 2017), leading to significant changes.

For example, with artificial intelligence and virtual reality, we can add new elements to traditional pedagogical approaches and promote more dynamic and effective learning methods through realistic simulations of environmental contexts for educational purposes. However, in this context, a multidisciplinary study on the advantages and disadvantages of these technologies is needed. Subsequent research should also consider other factors, such as social influences, traditions and cultural norms, which can help increase environmental awareness and activity.

1.2 Ecoliteracy of AI

As mentioned above, the purpose of this paper is to show the absence of a proper framework about ecoliteracy and AI in education and to suggest an epistemological approach that comprehends not only the potentiality offered by these new tools, but also the impact on the environment caused by using AI itself.

The production and implementation of AI technologies involve various production steps - from the extraction of raw materials for hardware to transportation and logistics, from assembly and manufacturing, as well as end-of-life disposal - which can have environmental impacts and are socially significant. Furthermore, regarding AI literacy, the energy consumption and emissions associated with the operation of data centres must also be taken into consideration, as well as the power and infrastructure required for large machine learning models (Dhar, 2020).

In one of the first contribution to the theme, Lacoste *et al.* (2019) found that emissions incurred when training a neural network model were related to the location of the training server and the power network it uses, the duration of the training procedure, and the hardware on which the training occurs.

In another calculation, Tomlinson *et al.* (2023) estimated ChatGPT's combined carbon emissions from training and operation to be 2.2g CO₂e per query.

Full access to official information gives an accurate calculation of the amount of carbon dioxide produced by such platforms. Most calculations for these platforms are based on assumptions that cannot be verified, resulting in potentially misleading figures.

For example, before the last diffusion of LLM models, Ranoliya et al. (2017) wrote «chatbots can provide accurate and efficient responses to queries based on a dataset of frequently asked questions by leveraging Artificial Intelligence Markup Language (AIML) and Latent Semantic Analysis» (LSA; Ranoliya et al., 2017). This chatbot service could help reduce the carbon footprint of organisations, such as universities, businesses and others, through a potential reduction in the need for traditional email inquiries, while still providing users with a satisfying interactive experience. Again, one of the first contribution to the Carbon emissions from the use of devices, the Internet, and support systems, estimated to contribute approximately 3.7% of total greenhouse gas emissions worldwide (Ferreboeuf, 2019). Despite the lack of hard evidence, chatbots are believed to be more energy efficient than traditional internet searching. This is because chatbots can provide personalised, accurate results with lower power consumption by using natural language processing algorithms and machine learning techniques to understand the user's query and get back accurate information in real-time, without exigency for multiple searches or clicks (Reyhani Haghghi et al., 2023).

Direct comparison of carbon emissions and energy consumption between search engines and chatbots is currently impossible due to a lack of confirmed official information. However, it is important to take a broader view when comparing the energy use of these two technologies. While the energy needed for a single search or prompt performed by a search engine or chatbot may not necessarily differ significantly from one another, the cumulative effect of millions of users using these platforms, in addition to the energy required for infrastructure maintenance and expansion, has the potential to have a significant impact on energy use and carbon emissions. Therefore, it is crucial to study the broader implications of these tools and encourage the development of more energy-efficient algorithms and hardware to reduce their environmental impact.

2. Methodology

To highlight the absence of consistent scientific literature and a specific framework about ecoliteracy and AI in education, we decided to conduct a literature investigation related firstly to AI and Ecology to help both the scientific and educational communities understand the adaptive learning approach, the systems employed, and the AI techniques utilised in this field.

Secondly, a more specific search has been conducted about AI, ecoliteracy and education to assess the status of the literature comprehensive of these renewed tools.

Recognizing the need for a nuanced and comprehensive construct, we initially dove deep into our pre-existing knowledge base, refining the broad themes of ecoliteracy and AI competences through an extensive literature review.

The first search string used can be summarised as proposed by McBride:

«Despite diversity of perspectives related to the often-nuanced differences and similarities of the terms environmental literacy, ecological literacy, and ecoliteracy there can be found several frameworks for environmental literacy, ecological literacy, and ecoliteracy (as advanced within the fields of environmental education, ecology, and the broader humanities, respectively)» (McBride, B.B., et al., 2013, *rewritten by the author based on the original*)

With the renewed interest and progress of the Generative AI (GenAI), these frameworks end up missing this fundamental element, leaving the previous studies almost outdated.

PRISMA Method:

In order to answer the research question explained above, a scoping review was conducted (Grant, & Booth, 2009), according to the PRISMA method (Moher, 2009) because - although it is not a systematic review of the literature - the scoping review shares the characteristics of transparency, reproducibility and systematicity. The review was conducted in the period February 2024, consulting the databases that contain recent and relevant papers for hard science (Science Direct) or educational-oriented (ERIC - Education Resources Information Center) as well as a variety of scientific journals linked to AI and education (e.g. Journal of Educational Technology in Higher Education, Computers and Education, Computers in Human Behaviour, Computers & Education, etc.). We also used the Google Scholar search engine to expand our research area and increase the number of sources.

The keywords defined for the search string included the terms 'AI' OR 'Artificial Intelligence' AND 'Ecoliteracy' in the title, abstract, main text or keywords. The search string used the Boolean search operators AND and OR and parentheses to determine the order in which to execute the commands.

The search strings used for all the databases/search engines were:

- Ecopeдагоgy AND artificial intelligence
- Ecoliteracy AND artificial intelligence AND Education.

In total, 153 articles were found since 2020, and 6 were used in the paper. The time frame was indicated and the linguistic constraint was applied to select only the contributions of the last 5 years, with reference to the English language only. A summary of the inclusion and exclusion criteria is reported in Figure 1.

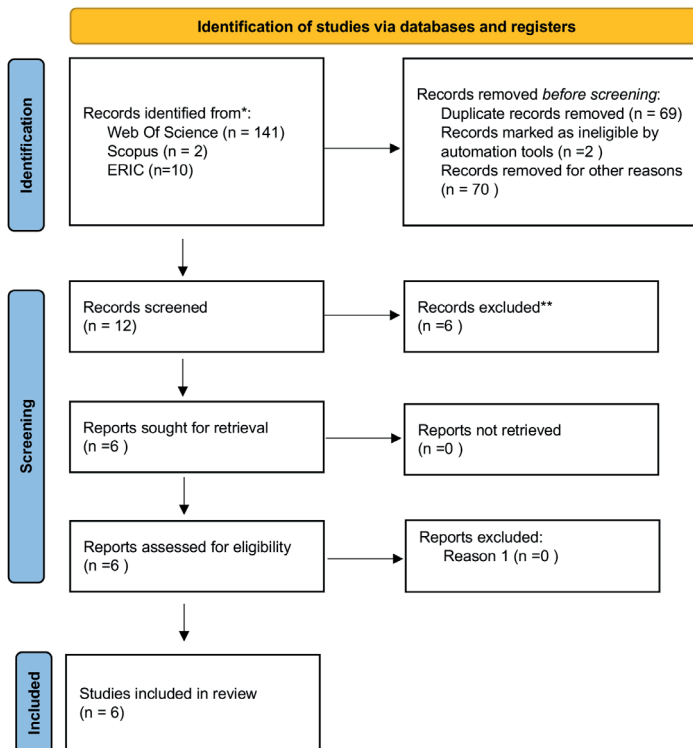


Figure 1. Prisma Flowchart. **All records were excluded manually. No automation tools were used at this stage.

After selecting the articles by examining the title and abstract, only the articles available in full form were analysed from which the useful information was extracted. The bibliographic lists of the selected articles were also examined to find further relevant articles, which however did not provide further contributions to the initial selection. As illustrated in the PRISMA flowchart (Fig. 1), the search produced 153 results for the screening phase. After excluding duplicates (69) and studies of little relevance (70, see exclusion criteria), a total of 6 relevant articles were identified. Five exclusion criteria were formulated and applied during the abstract and full-text report reviews (refer to Figure 1). The criteria were as follows: works that utilized the term ecoliteracy but no mention of AI or Deep Learning (criterion 1). Editorials and books were not included due to their non-peer-reviewed nature (criterion 2). Articles that mentioned "Ecopedagogy" but did not pertain to AI's application in specific fields unrelated to education were disregarded (criterion 3). Subsequently, the selected articles were examined and discussed, using a mixed approach, based on the combination of bibliometric analysis (of a quantitative nature) and thematic analysis (of a qualitative nature) with reference to the definition of the concepts of ecoliteracy/ecopedagogy and AI/LLM.

The LLM Method:

The contribution to the scoping review, as in the premise of this paper, has also been conducted using an LLM such as Claude AI.

The search strings used for all the databases/search engines were:

- Ecopedagogy AND artificial intelligence
- Ecoliteracy AND artificial intelligence AND Education.

To demonstrate the utility of LLM and Chatbots, we also used the ChatGPT plugin to build the same literature review.

The output:

I will first extract the most relevant keywords from my request to generate the literature review you're looking for. The list of keyword combinations included:

- Ecoliteracy
- Ecopedagogy
- Artificial Intelligence (AI)
- Generative AI (GenAI)
- AI in education
- AI for ecological education
- AI and sustainability
- GenAI and pedagogy
- Ecopedagogy and AI
- Ecoliteracy and technology

For the second goal, (ecoliteracy and AI and education) the choice fell on Claude AI Sonnet 3.5 to show how to use an LLM as a tool to identify how the possibility of merging ecoliteracy and AI in education can be effective.

3. Results

The results of the two attempts - both Researcher and LLM - clearly show no pre-existing literature about ecoliteracy, AI and education (or ecopedagogy and AI), confirming how unexplored this field of knowledge is.

3.1 Ecology and Artificial Intelligence: an LLM Test

To demonstrate the ability of LLMs to support academic writing for relevant studies, this paragraph was also written with the assistance provided by Claude AI. The text has been checked and, if necessary, corrected to facilitate readability and ensure the reliability of the sources cited by removing false references and incorporating any real references.

The prompt was simple and straightforward, in order to get as many different points of view as possible:

«Write at least 5 ideas about the use of AI in ecology with scientific references and citations in the text».

The answer: «Artificial intelligence (AI) has the potential to revolutionise ecological research and environmental management in numerous ways:

1. Species identification and monitoring:

AI-powered computer vision can rapidly identify species from images or video, enabling more efficient biodiversity surveys. For example, deep learning models have been used to identify plant species from herbarium specimens with high accuracy (Carranza-Rojas *et al.*, 2017). This technology could be extended to camera trap footage, acoustic recordings, and other data sources to monitor wildlife populations at unprecedented scales.

2. Predictive modelling of ecosystems:

Machine learning algorithms can integrate diverse datasets to model complex ecological processes and predict future changes. For instance, Willcock *et al.* (2018) used machine learning to model ecosystem service provision across Africa, demonstrating how AI can help anticipate the impacts of land use changes on natural resources.

3. Remote sensing and habitat mapping:

AI techniques like deep learning can extract detailed information from satellite imagery, enabling large-scale habitat mapping and monitoring of land cover changes. A study by Pettorelli *et al.* (2014) highlighted the potential of combining remote sensing with machine learning for tracking ecosystem functioning and biodiversity.

4. Precision conservation:

AI can optimise conservation efforts by identifying priority areas for protection or restoration. For example, Gomes *et al.* (2019) developed an AI system to design wildlife corridors that maximise habitat connectivity while minimising costs.

5. Automated data collection:

Smart sensors and Internet of Things (IoT) devices powered by AI can collect ecological data autonomously, expanding the scope and scale of environmental monitoring. This approach has been used to track animal movements and behaviours in real time (Kays *et al.*, 2015).

6. Climate change impact assessment:

AI models can help predict the effects of climate change on species distributions and ecosystem dynamics. Urban *et al.* (2016) demonstrated how machine learning can improve predictions of species range shifts under climate change scenarios.

7. Invasive species management:

AI can assist in the early detection and management of invasive species by analysing patterns in their spread and identifying effective control strategies. Martínez *et al.* (2020) reviewed various AI applications in invasive species research and management.

While these applications show great promise, it's important to note that AI is not a panacea for ecological challenges. Successful implementation will require careful consideration of ethical issues, data quality, and integrating ecological expertise with AI capabilities. Additionally, as AI technologies continue to evolve, new applications in ecology are likely to emerge that we cannot yet anticipate».

3.2 Education, ecoliteracy and Artificial Intelligence: an LLM test

The second test, which assesses the ability of LLMs to support academic writing for relevant studies, has been made using the free version of Claude AI Sonnet 3.5.

The text has been checked and, if necessary, corrected to facilitate readability and ensure the reliability of the sources cited by removing false references and incorporating any real references. The prompt was: «Write at least 5 ideas about ecoliteracy and AI in education with scientific references and quotes in the text».

The answer received: «Ecoliteracy in education and its intersection with AI is an emerging and important field. Here's a discussion of key points with relevant scientific references:

Ecoliteracy, or ecological literacy, refers to the ability to understand the principles of ecology and live sustainably within ecosystems. Education aims to foster a deep understanding of nature's processes and our place within them. As environmental challenges grow, integrating ecoliteracy into curricula has become increasingly crucial (Orr, 1992).

AI can play a significant role in enhancing ecoliteracy education:

1. Personalised learning experiences:

AI-powered adaptive learning systems can tailor ecological education to individual students' needs and learning styles. This personalization can make complex ecological concepts more accessible and engaging. For instance, Hwang et al. (2020) demonstrated how AI-based systems can adapt content difficulty and presentation based on student performance in environmental education modules.

Immersive simulations:

2. Virtual and augmented reality powered by AI can create immersive ecological simulations, allowing students to interact with virtual ecosystems and observe long-term environmental changes in compressed timeframes. Markowitz et al. (2018) found that such immersive experiences can increase environmental awareness and empathy.

3. Data analysis and visualisation:

AI can help students analyse and visualise complex ecological data, making it easier to understand large-scale environmental trends. Tools like machine learning-powered data dashboards can help students explore relationships between different ecological variables (Kelling et al., 2019).

4. Citizen science support:

AI can enhance citizen science projects, which are valuable tools for ecoliteracy education. For example, AI-powered image recognition can help students accurately identify species in biodiversity monitoring projects, as demonstrated by the iNaturalist platform (Van Horn et al., 2018).

5. Interdisciplinary connections:

AI can help students make connections between ecology and other disciplines like economics, social sciences, and public health. For instance, machine learning models can illustrate how ecological factors interact with social and economic systems in urban environments (Keeler et al., 2019).

6. Real-time feedback and assessment:

AI-powered assessment tools can provide immediate feedback on students' understanding of ecological concepts, allowing for more effective learning. Chen et al. (2020) showed how AI-based formative assessment can improve learning outcomes in environmental education.

7. Access to expert knowledge:

AI chatbots and knowledge systems can provide students with access to vast amounts of ecological information, simulating interactions with expert ecologists. While not a replacement for human teachers, these systems can supplement instruction and encourage self-directed learning (Winkler, & Söllner, 2018).

However, it's important to consider potential challenges:

1. Digital divide: The integration of AI in ecoliteracy education may exacerbate existing inequalities if not implemented thoughtfully. Ensuring equitable access to AI-enhanced learning tools is crucial (Reich, & Ito, 2017).

2. Nature connection: While AI can enhance ecological understanding, it's essential to balance technology use with direct experiences in nature. Research by Louv (2008) highlights the importance of physical interaction with natural environments for developing ecological awareness.

3. Critical thinking: As AI systems become more prevalent in education, it's crucial to teach students to critically evaluate AI-generated information and understand its limitations in ecological contexts (Pedersen et al., 2019).

4. Ethical considerations: The use of AI in education raises privacy concerns and questions about data ownership. Implementing AI in ecoliteracy education must be done with careful consideration of these ethical issues (Prinsloo, & Slade, 2016).

In conclusion, AI has significant potential to enhance ecoliteracy education by providing personalised, immersive, and data-rich learning experiences. However, its implementation should be balanced with traditional ecological education methods and direct nature experiences. As this field evolves, ongoing research will be crucial to understand the most effective ways to integrate AI into ecoliteracy curricula while addressing potential challenges».

3.3 Literature Review Using AI - Integration of Ecoliteracy, Ecopedagogy, and Artificial Intelligence (GenAI): A Review of Recent Developments (2020-2024)

This literature review has been made using Literature Review Writer, a ChatGPT 4.0 plugin. The text has been checked to ensure the sources' reliability by removing false references and incorporating any real references. The query was made on August 10, 2024.

The prompt was: «Write a literature review about ecoliteracy and/or ecopedagogy and Artificial intelligence or GenAI studies from 2020-2024».

The output was as follows: «Introduction. Ecoliteracy and ecopedagogy represent essential educational approaches to foster environmental awareness and sustainable practices among learners. In recent years, these concepts have evolved alongside technological advancements, notably the growing use of Artificial Intelligence (AI) and Generative AI (GenAI) in education. This review synthesises key research findings from 2020 to 2024, examining how AI and GenAI intersect with ecoliteracy and ecopedagogy to drive innovation in education, particularly in promoting sustainability.

Key Research Themes and Findings

Ecoliteracy in Language Learning

Rantung et al. (2023) explored the use of song lyrics as a tool for promoting ecoliteracy in language learners. The study demonstrates how the integration of ecological themes within educational materials—such as songs addressing deforestation and biodiversity loss—enhances both language proficiency and environmental awareness. The creative approach encourages learners to critically engage with ecological crises, fostering a deeper understanding of sustainability in the language learning process. Enhancement of Ecoliteracy for Language Learners Using Song Lyrics.

Phenomenon-Based Learning for Ecoliteracy

Kadarisman et al. (2023) investigated the role of phenomenon-based learning (PhenoBL) in improving junior high school students' ecoliteracy. The study found that the application of PhenoBL significantly enhanced students' affective, cognitive, and psychomotor abilities in understanding ecological interactions. This approach highlights the value of active, experiential learning models in cultivating environmental stewardship among young learners. Ecoliteracy of Junior High School Students through Phenomenon Based Learning.

Ecopedagogy in Rural and Vulnerable Communities

Kusumawardani et al. (2023) addressed the assessment of ecoliteracy competence in rural communities, with a focus on innovation and resource management. The study's findings suggest that ecoliteracy can empower individuals to utilise ecological resources for sustainable living, thus improving the resilience of vulnerable communities. This research underscores the broader societal implications of ecoliteracy in addressing economic and environmental challenges. *Ecoliteracy Competence Assessment to Improve Innovation Capability in a Rural Community.*

Generative AI and Educational Ecologies

Coleman (2023) explored the integration of Generative AI in educational settings, particularly in fostering interdisciplinary collaborations and promoting ecological consciousness. By applying AI tools in the curriculum, educators can create new opportunities for students to engage with environmental topics in innovative ways, facilitating a deeper connection between AI, education, and sustainability. *Generative AI and education ecologies.*

AI in Sustainable Education Initiatives

Wojtusiak et al. (2020) provided insights into the role of AI in promoting sustainability within education systems. AI-driven sustainability initiatives can enhance data-driven decision-making in both teaching and learning, leading to more efficient resource management and fostering ecological awareness among students. *AI and Sustainability Initiatives.*

Conclusion (n.a. made by AI)

The integration of ecoliteracy and ecopedagogy with AI and GenAI presents promising opportunities for fostering sustainability in education. By leveraging AI technologies, educators can create dynamic, interdisciplinary learning environments that promote both environmental awareness and technological literacy. This synergy not only supports the development of sustainable practices among learners but also prepares them to navigate the complexities of the modern world with a heightened sense of ecological responsibility».

4. Discussion:

As for the previous attempts, the topics found by the plugin do not correspond (as for classic database searches made) to the search need, presenting corollary scientific products distant from the initial query, demonstrating the novelty of the topic, which still lacks relevant scientific production.

After the two attempts made by an LLM and the Prisma scoping review on the subject, it is clear that a framework for ecoliteracy in education that contemplates the AI as a constitutive element and tool is still missing. The selected paper in the scoping review is focused primarily (if not solely) on the data transmission to increase ecological information by databases and local sensors.

Ha et al. (2022) proposed that ecoliteracy includes five dimensions, namely *ecological knowledge literacy (EKNL)*, *ecological awareness literacy (EAWL)*, *ecological ethics literacy (EETL)*, *ecological emotional literacy (EEML)*, and *ecological behavioural literacy (EBEL)*. Among them, ecological knowledge literacy is foundational; ecological awareness literacy indicates the direction of action; ecological ethics literacy emphasizes moral standards; ecological emotional literacy is the internal driving force; and ecological behavioural literacy is the goal. Whether we approach them at the theoretical or the practical level, each dimension is regarded as an equally important position.

The precited frameworks could be the foundation for an EcoAI framework that includes AI literacy and techniques to a wider ecoliteracy framework.

Conclusions

Since its release in late 2022, ChatGPT - the first easy-to-use generative artificial intelligence (GenAI) available to the public – inaugurated a new spring for AI technologies. After two years, followed by iteratively more sophisticated versions, the concern in education is that GenAI tools could be used by students to cheat on their assignments, thus undermining the value of learning assessment, certification and qualifications (Anders, 2023). UNESCO addressed these matters, from ethics of AI, AI in education, and gender equality, to capacity building for governments and judiciary bodies and produced, in 2021, the publication “Artificial Intelligence and Education: Guidance for Policy-makers”, which aims to generate a shared understanding of the opportunities and challenges that AI offers for education, as well as its implications for the core competencies needed in the AI era (Miao *et al.*, 2021). However, a formalised Ecological AI (EcoAI) framework for education is still missing, despite the support from Member States to harness the potential of AI technologies for achieving the Education 2030 Agenda to achieve Sustainability Development Goal (SDG) 4.

However, the twofold effect (benefits and waste) generated by AI may help us to achieve a deeper understanding of the possible causes of climate change, and to design and plan actions with an optimal impact. AI has the potential to help expanding ecological research (and therefore ecoliteracy) by providing new tools and techniques to analyse and simulate ecological systems, automate labour-intensive tasks, and generate new pathways of intervention. It can also be a valuable addition to the ecological research toolkit, as we tried in this paper, considering the environmental and social impacts of AI chatbot services and ensuring their use aligns with sustainability principles and ethical considerations. By spreading AI literacy and adopting responsible and transparent practices, we can maximise the benefits of artificial intelligence in ecological research while minimising its potential negative impacts. Integrating artificial intelligence into environmental research is an exciting area of study and has the potential to make significant advances in the field. Further research and experimentation are needed to fully evaluate the potential applications of AI chatbots in ecology teaching and research. On the operational level, nonetheless, despite the promising outcome from the test of this paper, there was no mention about consistency checking, which is extremely important in detecting fakes, and nothing about well-being, nor about combining human and computer “intelligences”. Integrating AI literacy and competencies and the missing aspect from this attempt is highly recommended.

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3T SECTION

3T SECTION



FUORI LUOGO READINGS

Mariella Berra reads
Sissa, G. (2024), *Le emissioni segrete*.
L'impatto ambientale dell'universo digitale, il Mulino

Per molto tempo la rivoluzione digitale è stata considerata artefice di uno sviluppo pulito ed equilibrato. Nicholas Negroponte (1995) sosteneva che "essere digitali" avrebbe comportato un progressivo effetto di generale armonizzazione e unione di tutte le generazioni e le genti del mondo. Alla rivoluzione digitale si deve la più grande invenzione del secolo scorso, Internet. La sua continua evoluzione ha comportato utili, importanti e irrinunciabili innovazioni sul piano economico e sociale.

Blu e green economy sono interconnesse in un lineare processo coevolutivo? Oppure creano alti costi ambientali sulla nostra vita e su quella delle generazioni future? Quanto contribuisce il sistema digitale alle emissioni nell'atmosfera di gas serra responsabili del riscaldamento globale? Come è possibile limitarli, riducendo la cosiddetta *carbon footprint*? Quale è la consapevolezza di questi processi da parte di produttori e utenti nell'uso delle tecnologie della informazione e della comunicazione?

A queste domande risponde in modo chiaro e documentato il recente libro, *Le emissioni segrete. L'impatto ambientale dell'universo digitale*, di Giovanna Sissa, fisica di formazione, con dottorato in informatica e docente dell'Università di Genova.

Un contributo necessario il suo in un campo dove gli studi scientifici sull'impatto ambientale dell'universo digitale sono relativamente recenti, ancora controversi e poco diffusi. Si consideri il dato, non unanime a seconda delle fonti utilizzate, su quale fra i tre sottosistemi digitali (infrastrutture di rete, data center e dispositivi utente) pesi la maggiore responsabilità nella emissione di CO₂. Le discussioni sull'ammontare delle emissioni globali sono accanite, e spesso focalizzate quasi esclusivamente sull'uso o meno di energie rinnovabili. La miniaturizzazione sempre più accentuata dei dispositivi individuali, la consuetudine con un uso costante, crescente ed esagerato dei dispositivi tecnologici, la non immediata visibilità delle reti, la scarsa e settorializzata conoscenza del ciclo di vita di queste tecnologie rendono complesso capire quanta energia, al fine di ridurre la *carbon footprint*, sia necessaria per consentire la produzione, l'uso e lo smaltimento di questi strumenti in tutto il loro ciclo di vita.

L'autrice esprime la sua preoccupazione per la insufficiente conoscenza del rapporto tra l'evoluzione troppo rapida delle tecnologie digitali e dell'intelligenza artificiale generativa, e la crescita di CO₂. Lontano da una concezione distopica dello sviluppo tecnologico, il suo è un invito all'etica della responsabilità rivolto a produttori, utilizzatori e forze politiche. Il saggio rientra in quel filone di studi recente e ancora poco frequentato che sottolinea l'attenzione verso forme di innovazione frugale meno avida di dati e di energia. Questo filone di studi e ricerche vuole sviluppare modelli di intelligenza artificiale in grado di produrre di più con meno e con più rispetto per l'ambiente riducendo l'impronta ecologica. La lettura del libro, articolato in cinque capitoli scritti con lessico tecnico, solo quando strettamente necessario, è agile e non presenta ostacoli alla piena comprensione da parte di quella opinione pubblica attenta cui vuole indirizzarsi.

L'autrice ci guida nei primi tre capitoli nella conoscenza delle responsabilità ambientali del sistema digitale lungo la sua evoluzione riassunta nel percorso che va dagli atomi ai bit, dai bit ai bit e nel ritorno dai bit agli atomi in un circolo non sempre virtuoso.

Il primo capitolo considera l'uso delle materie prime, gli atomi, necessarie a produrre le ICT, la loro abbondanza o rarità, introduce e spiega il concetto di impronta digitale, derivata dalle emissioni di CO₂ associate ad ogni prodotto. Queste sono suddivise in due gruppi: le emissioni incorporate e le emissioni operative. Le prime derivano dall'utilizzo di energia primaria nei processi di produzione trasporto e smaltimento. Le seconde concernono l'effetto del consumo di energia in fase di utilizzo. Come è necessaria molta energia per costruire dispositivi e apparecchiature digitali anche l'utilizzo di questi dispositivi è molto energivoro e produce emissioni di

carbonio. Analogamente alla trasformazione delle materie prime anche le energie elettriche utilizzate in questa fase sono spesso prodotte da fonti non rinnovabili quali il petrolio o il carbone o rinnovabili come il sole e il vento. Sgombrando il campo da una visione totalmente salvifica dell'impatto ambientale delle energie rinnovabili, l'autrice ci spiega come la scelta dell'uno o dell'altra non eliminerà ma potrà ridurre in modo significativo l'impronta digitale. Nella stessa Unione Europea che rappresenta, nel complesso mondiale, un insieme virtuoso di paesi in tema di produzione di emissioni di gas serra, esiste una forte differenza fra gli Stati. Un esempio è dato dal confronto fra Svezia e Polonia. La prima, utilizzando in prevalenza energie idroelettriche, produce emissioni dieci volte inferiori rispetto alla seconda che usa combustibili fossili.

Una foto su Instagram, un post su Facebook, un semplice messaggio digitale, la condivisione di documenti su Internet, per non parlare dell'upload e download di video e filmati, di app gratuite ma inutili, necessita l'impiego di una certa quantità di energia secondaria. Un consumo non rivelato dalla nostra bolletta elettrica e dal costo di accesso a Internet attraverso i vari dispositivi. Un consumo spesso non consapevole e destinato a crescere, aumentando enormemente l'uso dei prodotti digitali e il numero di utilizzatori non sempre diligenti a livello mondiale.

Alle spalle dei vantaggi crescenti offerti dal digitale ci sono infrastrutture complesse. Ne sono un esempio i data center, luoghi fisici diffusi in tutto il mondo e necessari per la creazione, l'esecuzione e la fornitura di applicazioni tecnologiche. Costituiscono le miniere dell'era presente e del prossimo futuro a cui attingere per creare nuovi prodotti e servizi. Qui sono memorizzati i dati personali dei privati, delle aziende e del settore pubblico. Le nuove frontiere tecnologiche che ridisegnano il nostro mondo dall'Internet delle cose ai bitcoin vedono una applicazione crescente della IA generativa orientata alla risoluzione dei problemi di vita quotidiana. Con costi di elaborazione bassi e elevata potenza di elaborazione, il cloud, i Big Data, gli analytics e le tecnologie mobili, gli oggetti fisici possono condividere e raccogliere i dati limitando di molto l'intervento umano. In un mondo iperconnesso il mondo digitale interagisce sempre di più con il mondo fisico. Il costo di questa operazione non è gratuito ma fa crescere l'impronta di carbonio. Sono tutte tecnologie con un elevato fattore di impatto ambientale, un fattore che dovrebbe essere considerato e valutato nella progettazione delle tecnologie. Come, si legge nel libro, ogni innovazione tecnologica comporta costi energetici che, se non affrontati già dalla fase progettuale, finiranno per gravare sull'ambiente.

Il processo di produzione di un circuito integrato, base di ogni applicazione digitale, costituisce probabilmente la prima realizzazione nella storia dell'umanità del sogno di produrre automaticamente gli oggetti partendo dalla loro immagine. Nello smaltimento a fine vita, nel passaggio dai bit agli atomi, si tratta di materializzare l'immateriale. Questo processo, raccontato nel terzo capitolo, non è privo di costi e rappresenta una sorta di economia circolare poco virtuosa per quanto riguarda l'emissione di carbonio e il riciclo dei rifiuti elettronici. L'e-waste è un tema caro all'autrice, già trattato nel libro, *Il computer sostenibile*, del 2008. Oggi le pratiche di riciclo e il riuso assumono dimensioni più ampie e complesse. Ad esempio si legge nel libro che le applicazioni ad alta prestazione devono usare piattaforme sempre più performanti che devono migliorarsi molto rapidamente. Queste piattaforme specifiche non solo consumano più ma rendono problematico il riuso. Il quarto e il quinto capitolo guardano al mercato digitale nel suo complesso e alle prospettive future e indicano alcune linee di indirizzo.

Prevedere con esattezza la quantità di emissioni globali di gas serra imputabili al digitale è complesso, pochi sono gli studi scientifici completi, quelli disponibili spesso sono condotti su campioni disomogenei in quanto anche le aziende del settore ICT, che operano in regime di forte competizione, sono restie a fornire le informazioni necessarie per valutazioni scientifiche. Nel 2020 l'universo digitale è stato responsabile tra il 2 e il 4% delle emissioni globali di gas serra. Secondo una stima approssimativa se fosse uno Stato sarebbe il quarto al mondo, dopo Cina, Stati Uniti e India. Nella produzione di anidride carbonica derivante dal consumo di energia elettrica indubbiamente la fonte di produzione se da energie rinnovabili o meno è molto rilevante. Per i data center, una delle infrastrutture più energivore e ecologicamente impattanti,

dovrebbe essere previsto l'obbligo di generazione locale di energia rinnovabili. Il recente rifiuto opposto a Google dal governo Irlandese all'installazione di un nuovo data center, motivato dalla impossibilità di offrire un certificato di energia pulita prodotta localmente è emblematico. I certificati attestano la provenienza della energia se prodotta localmente o acquistata sul mercato. Attraverso il sistema dei certificati non *marked based*, ma *marked based*, le aziende possono approvvigionarsi di energia elettrica prodotta altrove ricorrendo a procedure di acquisizione diretta o indiretta, attraverso accordi fisici e virtuali. In questo mercato complicato e non trasparente si aprono varie possibilità di acquisizione di certificati di energia prodotta da rinnovabili. Soprattutto nel caso di acquisizioni virtuali diventa difficile, in assenza di strumenti di controllo e di regolamentazione adeguati, stabilire quanto il tot di energia necessario sia attribuibile alle energie rinnovabili. Le aziende tengono ad apparire *carbon free* o *netzero emission*. Data la crescente attenzione ambientale il ricorso al green washing è una pratica comunicativa sempre più diffusa. Di conseguenza crescono le probabilità di ricorso ad artifici contabili per acquistare il certificato e offrire una immagine di sé falsamente positiva.

Di fronte ad una crisi climatica imminente e estesa a tutte le aree del mondo, alla crescita di eventi estremi si è sviluppato un intenso dibattito sulle strategie per ridurre gli sprechi e una attenzione verso una economia sostenibile. Un futuro digitale più sostenibile e necessario potrebbe essere ancora possibile si domanda l'autrice nelle conclusioni? Lo sviluppo del digitale e l'elevata impronta ambientale derivano da scelte economiche precise, da una scarsa considerazione per le tematiche ambientali nel ciclo di vita dei prodotti e da una poca attenzione all'impronta di carbonio. Alcuni passi fondamentali verso una transizione digitale ecologica richiedono lo sviluppo di tecnologie più efficienti e meno avidi dal punto di vista energetico, una gestione più consapevole del ciclo di vita dei dispositivi, strutture informatiche ecocompatibili e politiche di promozione del riciclo e riduzione dei rifiuti elettronici.

I programmatori e gli informatici possono impegnarsi e lavorare per una informatica altra, attenta a uno sviluppo di software e dispositivi che riducano i consumi elettrici e le relative emissioni. Un ruolo significativo spetta anche ai consumatori rinunciando a ciò che non è necessario e allungando il ciclo di vita dei loro dispositivi. Infatti, un uso più consapevole e duraturo dei dispositivi tecnologici rappresenta una delle azioni più semplici e concrete per ridurre l'impronta digitale individuale. Sul piano politico occorre muoversi a tre livelli internazionale, nazionale e locale. *In primis* occorre stipulare e rispettare seriamente accordi e protocolli internazionali.

A livello nazionale occorre una capacità di integrazione fra politiche della tecnologia dell'ambiente, dell'istruzione e del lavoro. Infine le politiche locali sono estremamente importanti: basti pensare all'impatto delle tecnologie digitali sulla nostra vita quotidiana, sulle città e sui territori. A livello territoriale suggerisco di ripensare in una versione ampliata al modello della Quadrupla Elica, elaborato più di dieci anni fa da due studiosi della economia della conoscenza Elias G. Carayannis e David F.J. Campbell. La quarta elica è un modello complesso ed organizzato di interazioni che coinvolge gli attori dell'economia della conoscenza. L'idea è quella di favorire e realizzare processi di innovazione attraverso la collaborazione trasversale e la condivisione proattiva dei saperi, delle esperienze e anche dei comportamenti fra le quattro pale: Università, Stato, Industria e Società civile. La università va intesa in questo caso in senso ampio come ricerca, formazione, educazione e cultura, l'industria come insieme degli attori economici, lo Stato come istituzioni centrali, regionali e locali, la società civile come forme della partecipazione democratica dei cittadini. Si potrebbe collaborare alla costruzione di ecosistemi innovativi nell'orientare soluzioni alternative basate su una consapevolezza condivisa sull'uso, la diffusione e la produzione del digitale. Tre sono i pilastri dello sviluppo sostenibile, quello digitale, quello ambientale e quello sociale, tutti e tre strettamente intrecciati.

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Giorgio Osti reads Castells, M. (2024). *Digital Society*, Edward Elgar.

Il libro appartiene ad una collana 'Advanced Introduction to' della Elgar volta a fornire concisi strumenti per studenti universitari su specifici temi. Quindi siamo di fronte ad un testo con esplicito intento didattico. Diremo un manuale che a differenza di quelli classici, assai corposi, racchiude tutto in 150 pagine. Non si pensi però ad un "bignami" della transizione digitale: il libro e la collana (che raccoglie poco più di 180 titoli) hanno il preciso scopo di unire rigore e senso critico, testimoniati da un prezioso indice analitico finale.

L'autore, Manuel Castells è un sociologo e politico spagnolo naturalizzato statunitense, noto al pubblico delle scienze sociali per una trilogia intitolata *L'età dell'informazione*, nella quale egli descriveva il passaggio d'epoca segnato sostanzialmente dalla diffusione di internet. In quei tre libri egli coniava una dicotomia spazialista – spazio dei luoghi e spazio dei flussi – che gli era valsa a cavallo fra i due secoli una certa notorietà anche fuori della sociologia. Erano quei dualismi che piacciono alle scienze sociali perché descrivono in maniera sintetica e originale un punto di svolta dell'intera società. Poi quella dicotomia, con le dovute eccezioni, è tramontata o perché fusa in un unico idealtipo post-territoriale o perché ritenuta troppo semplice rispetto alla complessità moderna.

La lunga premessa sulla biografia dell'Autore serve sia a motivo della rivista che ospita questa recensione sia per inquadrare bene l'opera che andremo a commentare. Castells ha avuto una sua evoluzione molto marcata; i più vecchi ricorderanno *La questione urbana*, Marsilio Editori, 1974 con un taglio fortemente marxista; il suo spostamento verso posizioni meno materialiste e più da sociologia della comunicazione, per approdare al manuale attuale in cui si percepisce un approccio più pragmatico, pur sempre critico, verso la società. Nel testo infatti si fa un largo uso di dati quantitativi sia oggettivi (statistiche) che soggettivi (sondaggi). In questa lunga evoluzione (Castells è nato nel 1942), egli è riuscito pure a fare per quasi due anni il Ministro dell'Università per il governo spagnolo (2020-21).

Il profilo del libro è quindi di impostazione anglosassone, con capitoletti brevi, organizzati per ambiti della società, assai lontano dall'impronta filosofica che caratterizza la sociologia continentale europea, ivi inclusa quella italiana. Gli ambiti nei quali è più evidente l'influenza della digitalizzazione ci sono tutti. Val la pena elencarli: la sociabilità 3.0, i regimi di sorveglianza (grande fratello) e la tutela della privacy, la digitalizzazione dei mercati finanziari (dai derivati alle criptovalute), telelavoro e metropoli reticolari (*networked metropolis*), il grande tema dell'apprendimento e della scuola, i vari *digital divide* (territoriali, di genere, età, classe, etnici e culturali), i movimenti sociali a rete, l'uso dei social media nell'agone politico-elettorale, guerra e pace. Senza entrare nel dettaglio degli ambiti tematici, bisogna dire che Castells fornisce una quantità di informazioni amplissima, utilizzando molte fonti aggiornate. Riesce anche a dare profondità storica ai commenti, pur essendo la "rivoluzione" digitale appena iniziata. Il termine rivoluzione è fra virgolette perché l'approccio dell'Autore non indulge a passaggi d'epoca e questo, temo sarà anche il motivo per cui, dopo la felice parentesi degli *spazi dei luoghi e dei flussi*, egli non riuscirà a colpire l'immaginario del grande pubblico. La sua analisi si svolge sul filo dell'ambivalenza, secondo una scuola, mai menzionata nel testo, à la Simmel. Egli infatti ondeggia fra impatti positivi e negativi, giudizi discreti e sospesi sull'uso dei computer nelle scuole, sulle relazioni spurie fra divisioni sociali e performance economiche o professionali dovute alla digitalizzazione.

Resta del suo background marxista, forse, un'impostazione dialettica che emerge quando parla di controllo socio-digitale. Egli sostiene che sorgono sempre contromovimenti di cittadini che denunciano ingiustizie e concentrazioni di potere, tali da bilanciare, correggere, e oserei dire, superare un certo stadio iniquo della società. In tal senso, Castells mostra un atteggiamento benevolo verso la digitalizzazione; non condivide il pessimismo cosmico di chi la vede come negatrice di un'autentica socialità, strumento di controllo generalizzato da parte del capitalis-

mo, occasione per un analfabetismo di ritorno. Non è uno sguardo ingenuo però, ma appunto dialettico, che vede all'opera forze sociali che si contrappongono e arrivano ad una sintesi superiore.

Questa sintesi superiore è per Castells la *società reticolare* – già evidenziata nella trilogia - che usa come proprio supporto principale le tecnologie digitali (ICTs). È una sociologia formale, sempre per usare una terminologia Simmeliana, quella che emerge dal pensiero di Castells; il carattere precipuo della società sono le reti di cui egli esalta 'flessibilità, scalabilità e resilienza' (p. 145); aggiungeremo 'multipolarità e pervasività'. Questo quadro interpretativo emerge nell'ultimo brevissimo capitolo (2 pagine) e conferma quanto sostenuto inizialmente ossia che Castells adotta uno schema evolucionistico lineare o a stadi. Nelle conclusioni egli torna ad immaginare una società, a questo punto mondiale, che è giunta allo stadio della struttura reticolare. Fa questo forse per amore di sintesi, dopo aver navigato e ondeggiato sul ruolo della digitalizzazione spinta delle società contemporanee. È una procedura corretta dal punto di vista scientifico: dopo una lunga fase analitica, di suddivisione o parcellizzazione dei fenomeni sociali, è utile arrivare ad una sintesi.

Con qualche forzatura, si intravede il background del nostro: la società delle reti è frutto di due rivoluzioni, queste sì capaci di ribaltare l'ordine sociale. Per Castells queste sono, da un lato, *una* rivoluzione industriale, non quella generata in Inghilterra con la macchina a vapore, ma quella più recente generata dalla diffusione della conoscenza, dall'altro, la cultura dell'individuazione (*individuation*) che enfatizza l'autonomia dei soggetti, in termini di mobilitazione per cause di giustizia, lotta al patriarcato, nuova relazionalità con l'ambiente. Il quadro genetico è poco argomentato e forse tardivo. In questa critica emerge la menzionata tradizione sociologica continentale nella quale si privilegiano modi di procedere deduttivi, ricavati da grandi e preliminari disegni della società e della storia.

Ciò non di meno, vi sono nel testo alcuni concetti di medio raggio che meritano davvero un plauso al sociologo ispanico-statunitense. Un paio sono da menzionare: il *networked individualism* che Castells prende da Barry Wellman, un grande ma poco noto studioso di reti sociali. Quel concetto intriga perché, elaborato come puro strumento di sintesi empirica, è invece uno specchio formidabile della socialità moderna. Esso merita di essere ripreso e incarnato nelle varie società locali secondo il più genuino metodo idealtipico, che misura distanze relative piuttosto che ontologie. L'altro concetto che piace per la sua valenza normativa è *universal and meaningful access* (pag. 105). Secondo l'ONU non si tratta solo di ampliare l'accesso a strumenti e infrastrutture digitali, ma anche di cogliere il senso dell'uso di queste tecnologie. La questione di valore rimanda ad interessanti domande di ricerca su ad esempio chi volontariamente non usa o usa poco internet. Ne escono profili sociologici ricchissimi di umanità; la stessa sensazione che ha provato chi scrive quando fece un'indagine sull'esigua minoranza di italiani che avevano rinunciato volontariamente alla patente di guida o a guidare un'automobile. Ci sarebbe da evidenziare anche il suo concetto di metropoli reticolare, che lasciamo alla curiosità delle studiose e studiosi di territorio. Insomma, l'agile libro di Manuel Castells offre una bella opportunità di apprendimento per coloro che sono alla ricerca di analisi serie e documentate su un fenomeno assai formale e esteriore rispetto all'umanità, ma di straordinaria potenzialità, con pochi effetti secondari negativi. Questo lo spirito che ha animato l'Autore.

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Emanuela Ricciardi reads

Badino, M., D'Asaro F. A., Pedrazzoli, F., (2024) *Educare all'IA.*

La sfida didattica dell'Intelligenza Artificiale: ChatGPT e Gemini. Sanoma.

Nelle 120 pagine che compongono questo libro, gli autori si occupano e si preoccupano di rispondere alla domanda – riportata in quarta di copertina – «Quali risorse offre l'AI in ambito educativo?». Per raggiungere questo obiettivo, il volume limita (senza una precipua argomentazione) il vasto mondo dell'educativo – che comprende l'educazione formale, non formale e informale – ai soli processi di insegnamento-apprendimento che avvengono nel contesto scolastico e, a partire da tale limitazione, si propone sia di offrire consigli pratici ai docenti e alle docenti per trasporre in classe l'uso dell'Intelligenza Artificiale, sia di discutere criticamente ciò che questo comporta: «[...] [le] problematiche di cui avere consapevolezza» (quarta di copertina).

La motivazione che sottende la scelta di scrivere questo libro si palesa sin dalle prime pagine: urge un'«alfabetizzazione digitale universale» (p. 14) che ci renda pronti e pronte ad affrontare le trasformazioni che la veloce diffusione di questi sistemi – così come li definiscono gli autori – comporta. Perciò, la finalità del libro è quella di offrire un piccolo e circoscritto contributo per interrogarci riflessivamente sul tema. Infatti, nell'Introduzione, sottolineano che molti sono stati i libri e i discorsi attorno all'applicazione dell'IA a scuola ma «Nel migliore dei casi, queste ricerche si focalizzavano su un segmento estremamente ridotto dell'esperienza educativa e precipuamente con l'obiettivo di una indagine preventiva dei rischi. Nel peggiore, sfruttavano l'ambito educativo come un caso studio per comparare le prestazioni di ChatGPT con quelle degli esseri umani» (pp. 5-6).

Allora, i temi illustrati così come fanno gli autori, risultano efficaci perché ci introducono in un campo di indagine molto vasto senza cadere in un linguaggio iper-tecnico ed effettuando una meticolosa selezione degli argomenti, che sono trattati nei loro aspetti fondativi. Tale sinteticità, da un lato, consente di fornire le basi per conoscere e comprendere il mondo dell'IA per poi indagare tutte le implicazioni possibili attraverso la lettura dei testi di approfondimento consigliati; da un altro lato, però, essa non consente l'analisi di alcune questioni che aiuterebbero i docenti e le docenti a interrogarsi in maniera riflessiva, critica e creativa sull'uso dell'IA a scuola.

L'argomentazione del libro si svolge in sei capitoli e il primo tra questi propone un'illustrazione del quadro politico e normativo europeo attraverso l'analisi di una serie di documenti emanati, perlopiù, nel tempo recente. Tra questi, c'è la descrizione dei tre pilastri programmatici individuati dalla Commissione europea per «costruire la base dello sviluppo di una società digitale europea equa e competitiva» (p. 11). Il primo di questi pilastri è l'idea che la *tecnologia sia al servizio delle persone* e ciò comporta la necessità di quell'alfabetizzazione digitale universale di cui abbiamo parlato sopra e il sostegno alla costruzione di infrastrutture digitali utili ai fini del primo scopo.

Gli altri due pilastri riguardano «una società aperta, democratica e sostenibile» (p. 11) e «l'economia digitale» (*ibid*) ma, entrambi, sono affrontati in misura minore per dare uno spazio più ampio al primo, considerato più rilevante da un punto di vista formativo.

Da questo primo pilastro l'Italia si trova ancora un po' lontana: «[...] si colloca al ventesimo posto su ventiquattro nella classifica UE per la percentuale di popolazione adulta con competenze digitali almeno di base [...]» (p.19). Nelle intenzioni italiane c'è, però, l'impegno nell'organizzare operativamente il lavoro: nel 2019 viene presentato dal governo italiano il programma *Strategia per l'innovazione tecnologica e la digitalizzazione del Paese 2025* ed è in questo contesto che nasce *Repubblica digitale* il cui intervento si concentra su: «istruzione e formazione superiore, forza lavoro attiva, competenze specialistiche ICT, cittadini» (p.18). Nondimeno, le informazioni spiegate dagli autori si confrontano con le non promettenti percentuali – riportate da loro stessi – che mostrano la realtà nella quale il paese verte in questo momento: se ne deduce che lo sforzo fatto sino ad ora debba essere concentrato verso un impegno che interessi la costruzione

di coordinate di senso in cui inserire il discorso del digitale e delle sue sempre più veloci novità. Questo discorso è ancor più concreto quando riflettiamo sul fatto che la scuola è un crocevia di generazioni diverse, le quali non condividono un lessico comune e diventa «[...] essenziale non sprecare il potenziale dei giovani insegnanti e allo stesso tempo non scartare i docenti più esperti, ma piuttosto formarli e integrarli in una società altrimenti sempre più escludente sul piano generazionale» (p.19). Un potenziale che è presente anche negli stessi studenti e studentesse.

Il secondo capitolo si sofferma sul rapporto tra IA e educazione, in particolare facendo un parallelismo tra l'apprendimento umano e l'addestramento dell'IA, sottolineando che entrambi hanno in comune l'esperienza. In particolare, gli autori fanno riferimento all'intuizione del premio Nobel per l'economia Herbert Simon, il quale, alla fine degli anni Ottanta del Novecento, ripropose, anche nel suo ambito di studi, l'idea – già cara ad altre scienze umane e sociali, come la pedagogia – che alla base dell'apprendimento c'è l'esperienza: quanto più siamo in un processo, tanto più comprendiamo il suo funzionamento e miglioriamo la nostra risposta, la nostra «performance nell'esecuzione di un compito» (p. 27). Le «macchine» (p.28) apprendono dall'esperienza attraverso la fase di addestramento in cui «[...] l'algoritmo impara a 'leggere' i testi, ovvero a generare frasi coerenti dopo una lunga fase di addestramento su testi di ogni tipo» (p. 53). Questi testi sono tutto ciò che noi produciamo attraverso i *social*, con la nostra letteratura e l'interazione stessa con questi sistemi. In questo processo la macchina impara a costruirsi da sé «un insieme di direttive d'azione da applicare alle varie circostanze. Questa è l'idea centrale che sta alla base del machine learning, ossia l'apprendimento automatico delle macchine» (p. 28).

Tale capacità è stata messa al servizio delle pratiche educative a scuola attraverso la nascita, negli anni Settanta, del settore di ricerca *Artificial Intelligence for Education* (AIED) che ha sviluppato una serie di dispositivi di IA divisi in tre categorie: focalizzati sugli studenti, focalizzati sugli insegnanti, focalizzati sull'istruzione.

Alcuni di questi strumenti vengono presentati nel capitolo tre e sono: gli *Intelligent Tutoring System*, che offrono un'esperienza di tutoraggio personalizzata agli studenti e alle studentesse, poiché calibrata in base all'interazione con questi/queste ultime; le *Smart Classroom*, ossia ambienti di apprendimento digitale e interattivi; infine, ci sono le piattaforme *e-learning*, molto usate anche durante la pandemia Covid-19 perché consentono di organizzare la formazione in diverse modalità, come quello dell'apprendimento online sincrono o asincrono.

Uno sguardo più specifico legato alle modalità con cui si svolge all'interno dei contesti classe il lavoro didattico con l'IA è dato nel capitolo cinque e, per questo, rimandiamo momentaneamente il discorso attorno al capitolo quattro.

In questo ampio capitolo – che occupa quasi la metà del testo – gli autori si soffermano, attraverso una rassegna di esempi pratici, sia su come «gli insegnanti possono utilizzare i sistemi generativi per velocizzare alcuni compiti della propria routine lavorativa e personalizzare l'insegnamento» (p.57), sia su come «le alunne e gli alunni possono utilizzarli per farsi assistere durante le fasi dell'apprendimento, incentivando anche forme di autoapprendimento» (*ibid*).

L'interazione tra esseri umani e macchina esemplificata nel suddetto capitolo, prevede sempre che ci sia uno specifico e chiaro *prompt* testuale che elabori la richiesta posta a sistemi come ChatGPT di OpenAI e Gemini di Google. Il *prompt* è «la stringa testuale che viene utilizzata per chiedere all'Intelligenza Artificiale di eseguire un determinato compito o rispondere a una specifica domanda» (p. 58) e dalla chiarezza con cui la costruiamo dipende la specificità della risposta fornita dal sistema.

Gli autori specificano che essere precisi e diretti è necessario per ridurre il rischio di errori che il sistema potrebbe compiere nell'interpretazione della richiesta che gli poniamo. Infatti, ci dicono che è sempre necessario ricontrollare la risposta fornita, proponendo agli/alle docenti di strutturarla come un vero e proprio esercizio didattico per rendere gli studenti e le studentesse consapevoli e partecipi del processo e del prodotto generato dall'IA. In tal modo, viene affrontato il discorso – anche se non superato – nel quale le IA vengono considerate dei sostituti possibili all'azione umana. Nel capitolo sei, a tal proposito viene detto: «le nuove tecnologie sono qui

per restare», perciò è importante conoscerne l'uso e le possibilità per governarle e determinarle nel nostro limite del possibile. Il quarto capitolo ci introduce più approfonditamente al discorso intorno alla nascita e al funzionamento dell'IA, che, nella sua versione più semplice, è diffusa nel nostro quotidiano da tempo. Gli autori individuano nella nascita del T9 – alla fine degli anni Novanta – il primo esempio di algoritmo che, durante la digitazione della parola, proponeva ciò che stavamo per scrivere: «Ecco l'intuizione dietro alla moderna Intelligenza Artificiale: prevedere parole o risposte basandosi sul contesto. Proprio come ChatGPT o Gemini, che cercano di fornire la risposta più pertinente alla vostra domanda» (p. 45).

La scelta delle parole più attinenti è data dal meccanismo delle reti neurali artificiali sottostanti alle IA. Perciò, proprio come noi recuperiamo informazioni in memoria in base alla creazione di connessioni sinaptiche, le reti neurali artificiali dell'IA recuperano le parole attraverso i calcoli probabilistici appresi durante la fase di addestramento, in cui ogni parola simile viene trasformata «in numeri vicini tra loro e, viceversa, insiemi di numeri vicini corrisponderanno a parole accomunate da una certa similitudine semantica o sintattiva» (p. 45).

Il sesto ed ultimo capitolo si interroga sulle sfide etiche ed educative che l'uso dell'IA solleva. La prima sfida si sofferma sui valori a cui ChatGPT e Gemini si rifanno nella elaborazione delle risposte, che sono «eticamente inconsapevole [i]» (p. 109), ma non «eticamente inerte [i]» (*ibid*), poiché, attraverso il linguaggio, riproducono pregiudizi (*bias*) linguistici appresi mediante la lettura dei prodotti culturali occidentali. Allora, il rischio – che corrono innanzitutto le studentesse e gli studenti – è quello di farsi influenzare senza riconoscere questi pregiudizi che non derivano da un contesto valoriale più o meno conosciuto, come quando interagiamo con una persona, ma sono il derivato di pregiudizi appresi in modi a noi sconosciuti. È qui che l'etico si intreccia con il pedagogico: [...] come possiamo integrarne l'uso [dell'IA] mantenendo l'autonomia degli studenti e salvaguardando il processo di apprendimento? (p. 111), salvaguardandoci dall'«omologazione culturale» (p. 112) di cui parla il pedagogista Grest Biesta?

Introducendo la questione valoriale, il richiamo alla pedagogia è legittimo, ma è importante precisare che il "buon uso" di questi sistemi non è dato una volta per tutte e ciò che è definito buono per una società e la sua cultura, non lo è per un'altra. Soltanto concordando su questo è possibile delineare un metodo – e non un «modello» (p. 115) – che sia pedagogico e valevole per costruire un terreno fertile di incontro tra le tecnologie e il loro uso nelle diverse età e nei diversi contesti. È così che possiamo definirlo pedagogico, perché singolare, declinato nelle diverse circostanze in seguito all'osservazione di queste. Completando il quadro delle sfide indicate dagli autori, le risposte alle domande poste sopra sono da rintracciare nelle sfide educative che individuano i «requisiti su cui puntare» (p. 116) per sviluppare «le nuove competenze (*new literacies*) che saranno necessarie nella società del futuro» (*ibid*). Queste competenze sono identificate secondo «l'educazione 'a prova di robot'» (*ibid*) di Joseph Aoun. In questa sede, però, avendo già sintetizzato altrove le necessità educative essenziali per gli autori, concentrerei l'attenzione sulla responsabilità che ai/alle professionisti/professioniste dell'educazione è riconosciuta nella realizzazione di queste competenze. In quanto, se intendiamo la pedagogia così come l'abbiamo definita poc'anzi, il compito dell'educazione non è ascrivibile al singolo ambito disciplinare, ma è il dialogo e il concorso della cultura intesa interdisciplinarmente a fare la differenza nel creare il sostrato teorico in cui l'agire educativo possa avere luogo.

Concludendo, possiamo affermare che per ogni rivoluzione emerge una dialettica composta tra le parti e, relativamente al nostro discorso, per integrare consapevolmente le risorse tecnologiche nell'umana quotidianità, elaborandone i rischi e mitigandone i conflitti d'interesse – economici, politici, culturali, sociali, educativi – c'è bisogno, probabilmente, di una responsabilità che sia comune.

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FUORI LUOGO MEETING

Beyond Dichotomies: Subjectivity, Ethics, and Ontology in David J. Gunkel's Philosophy of Artificial Intelligence

David J. Gunkel is a globally recognized scholar in the philosophy of technology, whose research has profoundly influenced contemporary debates on the ethical and legal status of artificial intelligence and robotics. He currently serves as Presidential Research, Scholarship and Artistry Professor at Northern Illinois University and Associate Professor of Applied Ethics at Łazarski University in Warsaw. His work is distinguished by an interdisciplinary approach that bridges moral philosophy, communication theory, and emerging technologies. Author of numerous publications, Gunkel has significantly contributed to redefining the conceptual foundations of human-machine relations. Among his most recent works are: *Communicative AI: A Critical Introduction to Large Language Models* (2025, with M. Coeckelbergh), which offers a critical and accessible philosophical and theoretical overview of LLMs; *The Rights of Robots* (2024), which explores the extension of legal and moral rights to non-human entities; *Duty Now and For the Future: Communication, Ethics and Artificial Intelligence* (2023), a critical examination of the ethical responsibilities in AI development; and *ChatGPT: Deconstructing the Debate and Moving it Forward* (2023, with M. Coeckelbergh), which provides a philosophical analysis of conversational AI systems. Through these and many other contributions, Gunkel continues to set the agenda for the ethical interrogation of advanced technologies in a rapidly evolving digital society. Below is the interview conducted by the guest editors of this issue with Professor Gunkel, aimed at introducing his work to the Italian academic audience.

Interview with Prof. David J. Gunkel

Question - The increasing integration of artificial intelligence into society is not merely a matter of technological progress; rather, it compels a redefinition of the moral, epistemological, and social categories through which we comprehend agency and responsibility. The overcoming of anthropocentrism in the consideration of machines, as you have proposed, necessitates a profound reconsideration of how we conceptualize the relationships between human beings and artificial systems, as well as the criteria by which we ascribe agency and normativity to technological artefacts. Rather than proactively addressing these concerns during the design phase, debates on their implications tend to emerge only once the technology is already deeply embedded in society, making governance more challenging.

From this perspective, how can we foster a more structured and interdisciplinary dialogue between engineering and the social sciences, ensuring that AI development transcends a purely technical approach and instead becomes a deliberate and critically informed process? Specifically, how can this collaboration be designed to proactively engage with ethical and societal complexities, allowing for the anticipation and responsible governance of social and moral uncertainties, rather than merely responding to them as unforeseen externalities?

I definitely appreciate this question as it identifies what has been my principal objective as both a researcher and teacher. When we ask "How can we foster a more structured and interdisciplinary dialogue between engineering and the social sciences, ensuring that AI development transcends a purely technical approach and instead becomes a deliberate and critically informed process?" we are recognizing 1) that the opportunities and challenges of AI, robots, and other forms of seemingly intelligent and social technologies transcend disciplinary boundaries and knowledge

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domains and 2) that responding to these opportunities and challenges will not be successful if we do not call upon and mobilize the wide range of human insight, experience, and innovation.

The unprecedented pace and scope of technological development—encompassing artificial intelligence, algorithmic governance, datafication, etc.—pose fundamental opportunities and challenges that no single discipline can adequately address in isolation. Technical advancements in machine learning and computational infrastructure, for instance, carry with them profound implications for human subjectivity, agency, ethics, and social organization. At the same time, philosophical insights into language, epistemology, and ethics are increasingly finding unexpected relevance in computational contexts. This mutual entanglement calls for a space where technologists, theorists, and practitioners can think together critically, creatively, and reflectively. Thus, it seems obvious that interdisciplinary collaboration is going to be necessary to meet the opportunities and challenges of the 21st century. But how do we do this? Or, perhaps better stated, how should this kind of productive interaction be conducted?

I think a good model can be found in what is perhaps one of the oldest methods available to us, the Platonic dialogues. Plato's dialogues routinely stage encounters between individuals representing different traditions, including philosophy, mathematics, rhetoric, politics, poetry, etc.; where no one discipline has the upper hand and insight is generated from seemingly irresolvable tensions and differences in perspective. In this way, dialogue between diverse and different domains is not simply additive but generative—capable of producing new forms of understanding that exceed what any single discipline or approach could achieve in isolation. In this respect, then, the Platonic Dialogue serves as an early and enduring paradigm of productive intellectual cooperation and pluralism. In effect, what I am suggesting is that we apply what is arguably one of the most original and ancient of philosophical methods to confront, respond to, and take responsibility for the epoch-defining challenges of our time.

But I want to add one additional item here. This procedure will only be successful if it draws on the wide range and diversity of human knowledge and experience. One of the complications with using the Platonic dialogues as a model is that this tradition is and remains Western, meaning, among other things, European and Christian. If we are to interrupt and critically address this ethnocentrism and the very real risk of intellectual colonialism, our approach to interdisciplinary dialogue also has to listen to, learn from, and engage with “non-Western” traditions (in the plural)—recognizing, of course, that this term is itself already a problem insofar as it characterizes Others negatively, thus already (and perhaps unknowingly) normalizing Western philosophy and science. An interdisciplinary dialogue that does not include other ways of seeing, thinking, and acting will remain incomplete and limited to its own ethnocentric frames of reference, modes of inquiry, and restricted range of possible solutions.

Question – *The growing pervasiveness of artificial intelligence in contemporary societies has led to a critical reconsideration of the traditional philosophical categories that distinguish subject and object, human and machine. You have argued that machines, as social robots, can no longer be interpreted merely as passive instruments but must be understood within a conceptual framework that acknowledges their potential ethical relevance and a specific form of functional agency which, rather than implying intentionality or autonomy, refers to their capacity to influence human interactions and decision-making within structured environments. From a sociological perspective, we privilege an understanding of technology not as an autonomous force but as one that is deeply embedded in and shaped by social, economic, and cultural dynamics, while still exerting a transformative influence on these very structures. Such narratives risk obscuring the socio-cultural and ethical dimensions of these transformations, reducing the debate to a fatalistic and linear perspective. How, then, can we develop a theoretical and methodological model that, while incorporating your*

critical reflections on digital subjectivity and the rethinking of the human-machine relationship, avoids both anthropocentrism and technological determinism as an independent driver of change, instead constructing a perspective that acknowledges the reciprocal and dynamic interaction between technological development and social transformation, ensuring a nuanced and contextually grounded understanding of AI's role in contemporary societies?

You ask, as I understand it, how to develop a theoretical and methodological model that avoids anthropocentrism, on the one hand, and technological determinism, on the other? For me the most potent means of intervention in this (or any other) conceptual opposition is *deconstruction*. Despite a common misperception that has (for better or worse) become something of a professional (mal)practice, what is designated by the term “deconstruction” is not synonymous with “destruction,” “disassembly,” or “dismantlement.” As Jacques Derrida, the progenitor of this method (which, strictly speaking, is not and cannot be a method) explained: “The de- of deconstruction signifies not the demolition of what is constructing itself, but rather what remains to be thought beyond the constructionist or destructionist schema” (Derrida, 1993, p. 147). Thus, “deconstruction” names a critical intervention in the system of binary oppositions by which Western philosophy and science has divided up and made sense of all that is, e.g. human/animal, person/thing, subject/object, active/passive, etc.

In deliberately and strategically intervening in these traditional conceptual oppositions, deconstruction does not choose sides in the existing debates and controversies. Instead, it institutes a double gesture of inversion—e.g. overturning an existing binary opposition—and the irruptive emergence of a new exorbitant, non-dialectical third term that cannot be contained or controlled by the existing order. Thus the way forward is not to decide between anthropocentrism or technological determinism but to identify the shared ideological and metaphysical investments that both sides already agree upon and endorse in order to come into conflict in the first place. In the process, we not only disrupt expectations of human exceptionalism and technological instrumentalism but up-end the usual expectations for who is a subject and what is an object. The goal in doing so is not to objectify the human subject or personify the technological object, but to challenge the very logic that allows us to differentiate object from subject in the first place. As Hannah Arendt (2018, p. 461) advised: “we all grow up and inherit a certain vocabulary. We then have got to examine this vocabulary.” And deconstruction names not just the examination of inherited binary terminology but a general strategy for seeing, thinking, and doing otherwise.

Question - *The debate on social robots lies at the intersection of artificial intelligence, ethics, and social theory, raising fundamental questions about their ontological status and role in human contexts. Designed to interact with us in socially recognizable and acceptable ways, these systems challenge traditional distinctions between subject and object, person and tool, with concrete ethical and legal implications. Their increasing deployment in fields such as elder care and education prompts the question of what kind of recognition - however limited - might be attributed to them, without resorting to an anthropocentric model or uncritically equating their agency with that of humans.*

Within this framework, you have argued that robots could be granted specific and limited forms of responsibility and rights, depending on their functions and social roles. Could you provide some concrete examples to clarify this position? In the case of social robots, how far should the recognition of rights and duties extend, and where should it be limited? More broadly, what criteria and principles do you consider essential for defining these forms of recognition, ensuring that social robots are neither reduced to mere tools nor mistakenly conflated with human capabilities?

Let's start with “robot rights.” Initially, when you first hear this phrase, it might strike you as not just weird but also wrong. Why would we, at this point in time, consider something like rights

for robots, when many human individuals and communities struggle for basic recognitions and protections? It's a reasonable question, but it is one that proceeds from some assumptions and even misunderstandings of what is meant by the word "rights." And if we fail to understand all the nuances here, we can be forgiven for that. In fact, even experts in law and ethics, as the American jurist Wesley Hohfeld (1920) noted over a century ago, tend to use the word "rights" in ways that are often inconsistent and not rigorously defined.

So what do we mean by "rights?" Hohfeld argues that rights are simply the set of powers, privileges, claims, or immunities that are possessed by or granted to someone or something. His point here is simple and direct: A right, like the right one has over a piece of property, can be defined and operationalized by one or more of these incidents. It can, for instance, be formulated as a claim that an owner has over and against another individual. Or it could be formulated as an exclusive privilege for use and possession that is granted to the owner. Or it could be described as a combination of these.

Hohfeld also recognized that rights are relational. A right only makes sense to the extent that it necessitates a correlative duty or obligation that is imposed on at least one other individual. This means that a right—like a claim to property ownership—means little or nothing if there is not, at the same time, some other entity who is obligated to respect this claim. Thus, rights are the way we make sense of and organize conflicting interests in social situations and circumstances.

Understood in this way, it is easy to see how and why robot rights makes sense, not (at least not principally) for the sake of the robot but for us and our shared social situations and circumstances. And it might surprise you to learn that this is not some speculation about the future. It is already happening. Robots already have rights. In November 2020, the legislature of the Commonwealth of Pennsylvania passed a bill (Senate Bill 1199) that classifies autonomous delivery robots, or what the text of the act calls "personal delivery devices" (PDD) as pedestrians in order to provide a legal framework for their deployment on city streets and sidewalks. Similar laws have been passed in a number of other jurisdictions, including the Commonwealth of Virginia, which provides the following stipulation: "a personal delivery device operating on a sidewalk or crosswalk shall have all the rights and responsibilities applicable to a pedestrian under the same circumstance." In granting this status and the rights and responsibilities that go with it to personal delivery robots, the State Legislature was not seeking to resolve or even address the big philosophical questions of robot moral standing or AI/robot personhood. It was simply seeking to scale existing law to accommodate a new kind of social entity. Robots not only can have rights, we will need them to have rights to ensure responsible integration of these technologies into our existing moral and legal systems.

Now this brings us to the last item in your question: "More broadly, what criteria and principles do you consider essential for defining these forms of recognition, ensuring that social robots are neither reduced to mere tools nor mistakenly conflated with human capabilities?" What you ask about here is the fundamental ordering principle of Western law and ethics, the division of all that is into one of two types—persons or things. This binary opposition is old, going all the way back to Roman law. As Roberto Esposito (2015, p. 1), who arguably wrote the book on this subject, explains: "If there is one assumption that seems to have organized human experience from its very beginnings it is that of a division between persons and things. No other principle is so deeply rooted in our perception and in our moral conscience..." The problem with robots and other seemingly intelligent and social artifacts is that they do not fit nicely into one or the other category. Obviously, robots are things. They are human designed and manufactured technologies that we own and possess. But these things are not quite like other things. They have social presence, they can talk and interact with us, and they successfully simulate many of the capabilities that are commonly associated with human persons. Does this therefore mean that

robots should be persons? The problem is not trying to fit robots into one category or the other. The problem is with this moral and legal ontology—this binary opposition that requires that everything be accommodated to one or the other. What we need, I believe, is a new way of thinking—a new moral and legal ontology that can scale to the novel social opportunities and challenge we now face in the face or the face plate of the robot and other forms of socially interactive technology. This is precisely the task that I have taken up and pursued in the book *Person, Thing, Robot* (MIT Press, 2023).

Question – *In your book Person, Thing, Robot: A Moral and Legal Ontology for the 21st Century and Beyond, you examine the distinction between persons and things, a principle rooted in Roman law (concerning personhood and the distinction between subjects and objects of rights), which is now being challenged not only by philosophical critiques stemming from anti-speciesism, which challenges the moral and legal privileging of human beings over other sentient entities, but also by the emergence of new technologies, such as artificial intelligence systems and robotics.*

Another critical perspective arises from the ecological crisis: recent studies indicate that the twelve wealthiest billionaires in the world, through their assets and investments, generate more carbon footprints than those produced annually by two million households. From this standpoint, the category of “person” appears to be unequally applicable even to individuals with radically different environmental impacts.

Given that some artificial intelligence systems, such as large language models, have an ecological footprint comparable to that of the economic elite rather than to that of the more impoverished segments of the population, in what ways do you believe the traditional distinction between persons and things proves inadequate in the context of contemporary sustainability crises? And how should our ethical and ontological categories be revised to account for these aspects?

The person/thing dichotomy allows us to organize everything into one of two types. The former are other moral and legal subjects who have rights and responsibilities that we need to respect and take into consideration. The latter are mere objects or what can be used and even abused as we see fit. And as Derrida (2005) points out, everything depends on the difference between “who” and “what.” The problem, especially with the climate crisis and the challenges of sustainability is that it is we—we human beings—who have invented these categories and given to ourselves the right and the privilege to divide up all that is according to this binary ordering system.

This way of thinking—which is rooted in Roman law—has gained a global foothold through colonial expansion and religious conversion. Unfortunately, this way of thinking is the philosophical scaffolding that supports human exceptionalism and justifies the exploitation of other things—and not just *things* but other human individuals and communities who were reified by Western colonial administrators; women, who until rather recently were the property—things owned by—their fathers or husbands; animals, which have been, for most of human history, little more than tools humans to use or raw material for our food, clothing, and other products; or the earth itself, which likewise has been seen as little more than a resource that can be used (and in many cases abused) for the benefit of persons with little or no consideration. Consequently, it is the person/thing binary that facilitates and supports the human exploitation of others, which is arguably one of the main driving forces behind many of the problems of the current climate crisis and sustainability. Thus, one of the philosophical opportunities with AI, robots, and other kinds of things is that they participate in the deconstruction of this binary opposition, opening up ways for being, thinking, and acting otherwise.

Question – *Contemporary models of artificial intelligence, often trained on data that reflect the stereotypes and power asymmetries embedded within the economically and technologically dominant regions of the Global North, have been described as a new form of digital colonialism. A sim-*

ilar analogy emerges in your work Person, Thing, Robot: A Moral and Legal Ontology for the 21st Century and Beyond, where you analyze the Western dichotomous thinking that opposes persons and things, instead suggesting alternative perspectives such as Ubuntu thought, which emphasizes relationality and communalism, or Confucian thought, which foregrounds relational ethics and social harmony. In your book, you discuss how robots may destabilize the traditional instrumental approach, challenging our ethical and social categories.

However, in many educational contexts, some artificial intelligence systems and robots are employed with algorithms and models that may reproduce and amplify systemic biases. How can we design and deploy these systems in ways that actively mitigate rather than reinforce existing inequalities? In what ways could these technologies be leveraged as a tool for fostering more equitable and inclusive interactions?

In order to answer this question, we first need to acknowledge how and why AI is able to generate decisions and output that can be perceived as either biased or prejudicial. This will require a short detour through the technology of AI. From the beginning—and when I say “beginning” I mean the moment the idea and term “artificial intelligence” came into being with John McCarthy et al’s plans for a summer workshop at Dartmouth College in the mid-1950’s—the field of AI divides into two different approaches: symbolic reasoning and neural networks. The former—initially theorized by Herbert Simon and Alan Newell (1958)—is based on mathematical logic and the hypothesis that intelligence consists in the manipulation of symbols. The latter is modeled on the brain, uses artificial neural networks trained on data, and machine learning methods that exploit statistical patterns and differences.

With symbolic reasoning AI or what has also been called Good Old Fashioned AI (GOF AI), the intelligence of the algorithm resides in the knowledge of the developer who translates various decision-making operations into step-by-step instructions that can be executed by a computer. If the system they design spits out erroneous or biased output, this can be identified in the lines of code and eventually corrected. Neural networks using machine learning methods are different. Here the developers simply set up the neural network and then train it on data, allowing the network to develop its own transformational operations by discovering likely patterns in the data set. In these cases, if the algorithm spits out erroneous or biased content, the problem is not in the coded instructions that set-up the neural network; the source of the problem is in the training data. And if, for example, these data, which in the case of an LLM are reams of human written content, most frequently associate the word “doctor” with the pronoun “he” and the word “nurse” with the pronoun “she,” the system will tend to produce content where doctors are gendered male and nurses female, thus perpetuating a sexist stereotype.

There are two problems here. First, because of the complexity of these systems and the sheer quantity of data on which they are trained, the developers of these systems do not know what these algorithms will do until they are in operation and start spitting out biased or prejudicial content. So the potential for bias remains largely unknown until the damage has been done. Second, efforts to correct for these problems (once they have been manifested and identified) are not as easy as they are for GOF AI. This is because the source of the bias is not in the code but “hidden” in the data. And because the quantity of data is massive, it is virtually impossible for any human being to find and remove it from the training data. Thus efforts to remediate the effects of algorithmic bias often take the form of some kind of post hoc adjustments: either a set of behavioral rules like the constitution of Claude, which filters out output that is pre-defined as unacceptable, or various forms of reinforcement learning from human feedback (RLHF) where the algorithm is put through the paces by a team of human testers and then retroactively readjusted to suppress biased or erroneous content. Both approaches have had some success, but there is no sure-fire way to ensure that the algorithm will not make mistakes, generate erroneous

or hallucinated content, or spit out biased material that users may find offensive. So, here's one way to think about the deployment of these powerful AI systems. These algorithms are like inexperienced interns. They are capable and can take over some of the heavy lifting for us, but we are going to have to check, double check, and validate everything that they produce.

Question – *In educational contexts, the introduction of robotics and artificial intelligence raises fundamental questions concerning the conceptual framework used to define robots and the ethical principles through which these technologies are interpreted. Often, the classification of robots—whether they are understood as technological instruments, autonomous agents, or even entities with quasi-personhood—is predetermined by educators and risks being conveyed to students without fostering sufficient critical examination, thereby shaping their conceptualizations in ways that may not encourage independent reflection.*

In your view, what pedagogical approach could best cultivate a more explicit and reflective awareness among students regarding the nature and theoretical status of robots? Should educators adopt a structured and theoretically grounded approach, in which they provide students with a clear and well-defined conceptual foundation, or would it be preferable to embrace a more exploratory and inclusive methodology that grants students the autonomy to develop their own perspectives?

Or do you consider this concern to be embedded within a broader epistemic and cultural framework, meaning that any conceptual or ethical perspective on robots will inevitably be shaped by the wider social and institutional context in which education takes place?

My own approach to working with students aligns with your second option. Thus I seek—in both the undergraduate and graduate courses that I teach—to cultivate “a more exploratory and inclusive methodology that grants students the autonomy to develop their own perspectives.” This approach to teaching and student learning is consistent with what philosophy is all about. The principal objective of philosophy is not to provide ready-made answers to existing questions. The task of philosophy is to interrogate and critically assess and evaluate the questions themselves. “There are,” as Slavoj Žižek (2006, p. 137) argues, “not only true or false solutions, there are also false questions. The task of philosophy is not to provide answers or solutions, but to submit to critical analysis the questions themselves, to make us see how the very way we perceive a problem is an obstacle to its solution.”

This effort at reflective self-knowledge is, it should be remembered, precisely what Immanuel Kant, the progenitor of critical philosophy, advances in the *Critique of Pure Reason*, where he deliberately avoids responding to the available questions that comprise debate in metaphysics in order to evaluate whether and to what extent the questions that are typically asked have any firm basis or foundation. Likewise, Daniel Dennett, who occupies what is often considered to be the opposite end of the philosophical spectrum from the likes of Žižek and Kant, proposes something similar. “I am a philosopher, not a scientist, and we philosophers are better at questions than answers. I haven’t begun by insulting myself and my discipline, in spite of first appearances. Finding better questions to ask, and breaking old habits and traditions of asking, is a very difficult part of the grand human project of understanding ourselves and our world” (Dennett, 1996, p. vii).

So it’s about the questions and cultivating in students not only the skill of questioning but of questioning the questions. And it is precisely for this reason, that the title of the first book in my AI/robot ethics trilogy from MIT Press is *The Machine Question* (Gunkel, 2012). The objective of this book and the two that follow it (Gunkel, 2018, 2023) is not to supply readers with definitive answers to the questions currently circulating in the AI and robot ethics literature. Instead, they have been designed to critically investigate and examine to what extent the way these existing problems and inquiries might already constitute a significant problem and difficulty. The point to all of this is to develop a mode of research

that recognizes that all questions, no matter how well formulated and carefully deployed, make exclusive decisions about what is to be included and what gets left out of consideration. The best we can do—what we have to and should do—is continually submit questions to questioning, asking not only what is given privileged status by a particular mode of inquiry and what necessarily remains excluded but also how a particular line of questioning already makes, and cannot avoid making, such decisions; what assumptions and underlying values this decision patronizes; and what consequences—ontological, epistemological, and axiological—follow from it.

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FUORI LUOGO CONTRIBUTIONS

Chatbots for Customer Service: the Case Study of ANAS⁶

Introduction

In today's digital society many businesses have decided to expand the range of tools they can use to maintain more stable and long-lasting relationships with their customers. In this scenario, chatbots represent a new frontier and can be defined as conversational agents that can engage in a two-way relationship with users, providing them with answers and information on a round-the-clock basis, without queues and with a text-based interface (Hatwar *et al.*, 2016; Khanna *et al.*, 2015). Chatbots offer businesses the twofold advantage of being both time and cost-saving by automating certain processes while human employees can be assigned to more complex tasks (Dorotic *et al.*, 2023; Ischen *et al.*, 2019; Ukpabi & Karjaluoto, 2017). They can also increase customer loyalty by offering alternative ways of communicating with a business and providing users with more digitised, transparent, effective and innovative services (Belk, 2013; Fryer *et al.*, 2017; Hill *et al.*, 2015; Kumar *et al.*, 2016; Shumanov & Johnson, 2021).

Large international IT companies, such as Google, Facebook, IBM and OpenAI, were the first to experiment with the use of chatbots. This has helped them perfect their systems, which can now process large amounts of data to address a broad range of queries and requests. The system is driven by artificial intelligence (AI), automated rules, natural language processing (NLP) and machine learning (ML).

The literature has also analysed the determinants of customer satisfaction when using chatbots (Ashfaq *et al.*, 2020), with the following key findings:

- There is a positive impact on user satisfaction if a chatbot provides up-to-date and reliable information, quick responses and tailored attention.
- Customers are more satisfied and willing to continue using a chatbot if it's easy to use, useful and fun.
- Although digital technologies can offer efficiency and effectiveness, they can sometimes frustrate users by failing to meet their needs/desires.
- Even though users tend to find the service provided by current chatbots pleasant and satisfying, they may occasionally prefer to interact with human beings, as long as it increases user productivity.
- Finally, the service provider should ensure that the e-chatbot service is hassle-free, helpful, useful, and enjoyable.

The use of chatbots is becoming increasingly widespread also outside the United States (Jiang *et al.*, 2022; McTear *et al.*, 2016; Waxer, 2016). In Italy, for example, the use of chatbots by businesses is growing, although to a lesser extent than in other countries. According to research conducted by Osservatori Digital Innovation in 2024, 23% of large Italian businesses are already using chatbots, up by 10% compared to 2023⁷. The main areas of use of chatbots in Italy are customer service (customer queries, technical requests, information), marketing (promotion of products and services), human resources (management of employee requests, HR processes), and sales (appointment scheduling, commercial negotiations).

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7 <https://www.osservatori.net/it/prodotti/formato/insight/conversational-ai-chatbotvirtual-assistant-esperienza> (Date of Access: 9 August, 2024).

One of the Italian companies engaged in changing the way it communicates with its users (alongside TIM, Enel, UniCredit), in line with contemporary innovation processes, is ANAS Spa, which is in the business of managing and maintaining roads and road infrastructure, managing a network of approximately 32,000 kilometers of state highways and motorways of national interest, with around 6,800 employees, including road workers, engineers and architects.

In January 2018, ANAS joined the "Ferrovie dello Stato Italiane Group", as part of its "Transport Infrastructure Hub", established by the Group alongside "RFI" (Lead Partner), "Italferr", and "Ferrovie del Sud Est". The aim of this integration is to strengthen collaboration among the Hub member companies, to develop integrated road and railway infrastructure projects. These efforts are designed to accelerate investment and are subject to oversight by the Ministry of Infrastructure and the Ministry of Economy and Finance, which covers both the governance of the company and its operations, in particular with regard to economic and financial planning activities and agreements with the concessionaires (Giovannini, 2010).

The activities of ANAS encompass the operation of roads and motorways, including regular and extraordinary maintenance, and the upgrading and improvement of the Italian road network and relevant signage. The company is also engaged in the construction of new roads and motorways, both directly and under concession agreements with third parties, as well as providing user information services and implementing road and motorway safety measures. Last but not least, the company engages in research and development activities related to roads, traffic and transportation.

Given the role ANAS plays in managing Italy's road infrastructure, maintaining effective communication channels with the general public is of crucial importance and setting up an effective Customer Service capable of responding to the queries and needs of the public, addressing their requests and reports, is essential for fostering direct engagement with ANAS. The company has therefore made several contact channels available to users, such as the "Pronto Anas" Customer Service, tasked with providing accurate information about the company, its activities, and services to customers, as well as responding to requests and assess reports or complaints. In order to improve this service, ANAS has strategically introduced and integrated modern digital contact and traditional communication channels, such as contact centres and emails, to broaden access and improve response times. At the end of 2022, the company inaugurated two new digital communication channels, via Telegram and WhatsApp, to enable users to interact with ANAS at any time, streamlining communication management and offering "asynchronous" channels for quick direct interaction. These platforms were chosen because of their widespread use and user-friendliness, allowing users to communicate seamlessly with ANAS without having to navigate their way through complex interfaces. At the heart of the service is an AI bot-based customer support system designed to provide quick and efficient assistance. The chatbot was developed to offer multiple levels of interaction and support, providing an effective solution capable of streamlining communication and enhancing the user experience. When users interface with the service, through either Telegram or WhatsApp, they are greeted by a bot designed to understand and respond to a wide range of common queries and requests, providing useful information, detailed instructions or solving the most critical issues. Thus, most queries can be dealt with swiftly and effectively, reducing the need for traditional phone queues and improving accessibility. Furthermore, the virtual assistant is always available. More specifically, the chatbot is able to provide answers according to three levels of interaction: self-explanatory answers (for example to questions such as "How do I send a job request to ANAS?"); answers with a suggestion to open a ticket for issues that require further investigation by the ANAS district offices (for example, when reporting bad road surface conditions), with the convenience for customers of being able to attach all the necessary information, including the exact coordinates of the reported spot in real time, and subsequently receive the relevant feedback; and, thirdly, answers with a suggestion to contact one of the contact centre operators directly via WhatsApp or Telegram.

The chatbot is integrated with the request management platform operated by the Customer Service department. This two-tier system effectively balances automated efficiency with human intervention, when necessary, consistently with ANAS's commitment to innovation and digital transformation. This approach can achieve two different objectives, increased customer satisfaction and optimising day-to-day contact centre activities. This hybrid system is in line with the company's innovative vision, which aims to build a digital ecosystem in which customers can easily move from one channel to another. Furthermore, the Customer Service can guarantee high-level performance by adopting a process measurement and monitoring system based on the use of indicators, which the company uses to measure and oversee service performance improvement.

The purpose of this study is to report on the interactions between ANAS users and the company's chatbot, highlighting the requests, preferences and needs of the former and the automated response and support capabilities provided to them, while also investigating the point of view of the chatbot users. The study also focuses on the chatbot's ability to provide an accurate and satisfactory response that does not require further intervention from human operators, who are instead called on to provide second-level assistance, when necessary.

Use of AI-based chatbots in the public sector

The history of chatbots dates back to the 1950s, when the Turing Test prepared the groundwork for developing intelligent conversational agents (Wawrosz & Jurásek, 2022). Over time, chatbots have evolved into two main types, (1) linguistic (or rule-based) chatbots, which are based on predefined rules or decision trees, and (2) AI chatbots, which utilize NLP and ML to learn from interactions and improve over time. AI-based chatbots can be further broken down according to their level of AI usage, ranging from minimal AI involvement, such as in simple query responses or order processing, to advanced applications with more complex interactions and decision-making capabilities (Caldarini *et al.*, 2022). For example, chatbots with minimal AI use, such as Apple's Siri or basic FAQ bots, are programmed to perform specific tasks strictly according to *ad hoc* parameters. Conversely, advanced chatbots use AI to simulate human-like decision-making processes, enhancing their ability to provide tailored services and interact seamlessly with other systems (Perez-Marin & Pascual-Nieto, 2011).

The use of AI technologies in the public sector, particularly AI-based chatbots, represents a transformative force that is reshaping the way businesses and organizations interact with citizens and deliver public services. This integration of AI into the public sector is part of a broader trend towards digitisation and data-driven decision-making. This shift began in the 1990s with the digitisation of government records and the automation of routine tasks, laying the groundwork for more advanced AI applications (Villagrasa, 2020). In the early 2000s, the rise of e-government initiatives further accelerated this trend, with chatbots and decision support systems playing a crucial role in improving public service delivery and citizen engagement (Criado & Gil-Garcia, 2019). Today, AI-driven public services encompass a wide range of applications, from predictive policing and smart city initiatives to customised healthcare and automated welfare systems.

The use of AI-based chatbots in public services offers several significant benefits. Chatbots can provide continuous support, allowing members of the public to access information and services at any time and from anywhere. This constant availability reduces the need for large-scale human resources, resulting in cost savings. In the business environment, automating customer service with chatbots has reduced call and email volumes by up to 70% (Wang *et al.*, 2022). Similar efficiencies can be achieved in the public sector, where resources are often limited. For example, the US Citizenship and Immigration Services uses a chatbot called Emma to manage common inquiries, streamlining the process and freeing up hu-

man staff members for more complex tasks (Villagrasa, 2020). Chatbots can handle legal inquiries and assist emergency services by providing real-time information and assistance. By using NLP and ML, chatbots can engage in more natural and interactive conversations with members of the public, making it easier for them to access the services and information provided. This customisation fosters a more user-friendly experience and can increase public trust in the institution they are interfacing with (Aoki, 2020).

AI chatbots can also analyse large amounts of data generated from interactions with the public, to identify patterns and trends. This information can be invaluable for policymaking and resource allocation, helping stakeholders to make more informed decisions (Bannister & Connolly, 2020). Furthermore, chatbots equipped with advanced AI capabilities can analyse data to detect potential fraud or identify risks, such as predicting fires or identifying false reports (Paluch & Wirtz, 2020). This proactive approach enhances public safety and minimises the likelihood of adverse events.

Despite the considerable benefits associated with the use of AI-based chatbots in the public sector, there are a number of challenges and ethical considerations that need to be addressed. One of the primary concerns is the potential for AI to undermine democratic processes and transparency. The opacity of AI algorithms and their decision-making processes can give rise to issues of accountability and fairness, especially if the technology is perceived as overly technocratic or biased (Neumann *et al.*, 2024). This concern is particularly relevant when chatbots are used in sensitive fields, such as law enforcement or social welfare, where the fair and ethical treatment of persons is paramount. Furthermore, the implementation of AI technologies in the public sector requires careful consideration of privacy and data security. Given that chatbots often handle sensitive personal information, robust measures must be in place to protect personal data and ensure compliance with legal and regulatory standards (Furman & Seamans, 2019). Public trust in AI systems heavily depends on these safeguards being transparent and effective.

Research method

To achieve the research objectives, a comprehensive qualitative-quantitative analysis of the textual material collected between December 2022 and July 2023 was undertaken, to assess the effectiveness of the chatbot in handling user interactions and to identify space for improvement in the customer service. The dataset for the analysis consists of 4,252 conversations (433 from Telegram and 3,819 from WhatsApp).

Phase one of the analysis consists of a quantitative study conducted to measure the frequency of interactions, temporal trends, and the main reasons for user engagement with the chatbot. This phase aimed to provide an overarching view of how users interact with the new digital channels (Telegram and WhatsApp) provided by ANAS. Key metrics, such as the number of successful interactions where user requests were resolved by the bot and the number of cases where human intervention was required, were calculated to evaluate the overall efficiency of the bot.

Following this quantitative assessment, a more in depth qualitative analysis was conducted, based on a hermeneutic approach, to understand the nuances of user interactions. This involved a thorough examination of the conversations to identify specific patterns and recurring critical issues (Barbeta-Viñas, 2024).

Subsequently, key themes were recognised to identify the main areas of conversation. The pre-processing of the textual data involved several steps for preparing the conversations for analysis. The first step, data cleaning, involved removing unnecessary elements, such as emoticons, special characters, numbers, and other non-textual information that could po-

tentially distort the analysis. In addition, common stop words that did not contribute to the understanding of the content, such as articles, prepositions, and conjunctions, were filtered out to minimise noise in the data. Once the data had been cleaned, the text was broken down into individual words and normalised to standardise the text data. This involved converting all characters to lower case and applying either stemming or lemmatisation techniques. Stemming reduces words to their root form, while lemmatisation reduces words to their base or dictionary form. These operations were useful to group together similar words and reduce the dimensionality of the dataset, thereby increasing the effectiveness of the analysis.

In parallel, a sentiment analysis was carried out using advanced natural language processing (NLP) techniques. Sentiment analysis aimed to measure the emotional tone of user messages and categorise them into positive, neutral, or negative sentiments (Wankhade, 2022). The use of NLP for sentiment analysis is fundamental because it enables the interpretation and analysis of opinions, feelings and emotions expressed in written language (Kavitha *et al.*, 2023). NLP is a branch of artificial intelligence that deals with the understanding and processing of human textual and vocal language. NLP is important in sentiment analysis for the following reasons:

- Contextual knowledge: by understanding the context in which words are used, distinguishing between literal and figurative meanings.
- Processing unstructured data: by analysing large amounts of unstructured data, such as social media posts, product reviews, and conversations, to extract useful information.
- Automation: by automating the sentiment collection and analysis process, saving time and resources.
- Decision Support: by providing companies with valuable insights into consumer sentiment, helping them to create targeted brand messages and better understand customer preferences.

In short, NLP is essential for sentiment analysis because it can help in processing and interpreting human language at scale, providing insights and supporting data-driven business decisions (Bing, 2020).

In this study, sentiment analysis used a Long Short-Term Memory (LSTM) neural network model, a technique known for its ability to capture context and sentiment in sequential data. LSTM is particularly effective for sentiment analysis because it can remember the order of words and their relationships over time, providing more accurate and nuanced interpretations of user sentiment.

To ensure the accuracy of sentiment analysis, the pre-processing phase was carefully designed to include all relevant linguistic features. This included checking the dictionary used in the analysis to ensure that it covered adversative conjunctions (e.g., "but," "however"), negation adverbs (e.g., "not," "never"), and other forms that may appear neutral but can imply negative sentiments. Such linguistic elements are crucial, as they can significantly alter the meaning of a phrase or sentence, thus affecting the overall sentiment score. An extensive review of the sentiment dictionary by researchers ensured that these elements were appropriately categorised and weighted to reflect their true sentiment value.

Results

During the reporting period, the chatbot handled a monthly average of 532 contacts. The most frequently used channel was Whatsapp, with an average of 477 monthly contacts, while Telegram featured a monthly average of 54 contacts. This gap can certainly be attributed to the fact that the former instant messaging platform is much more popular than the

latter. Regardless of the contact channel, however, the researchers observed a fluctuating trend in interactions, with a drop in contacts between February and April, followed by a gradual recovery in the following months (Fig. 1).

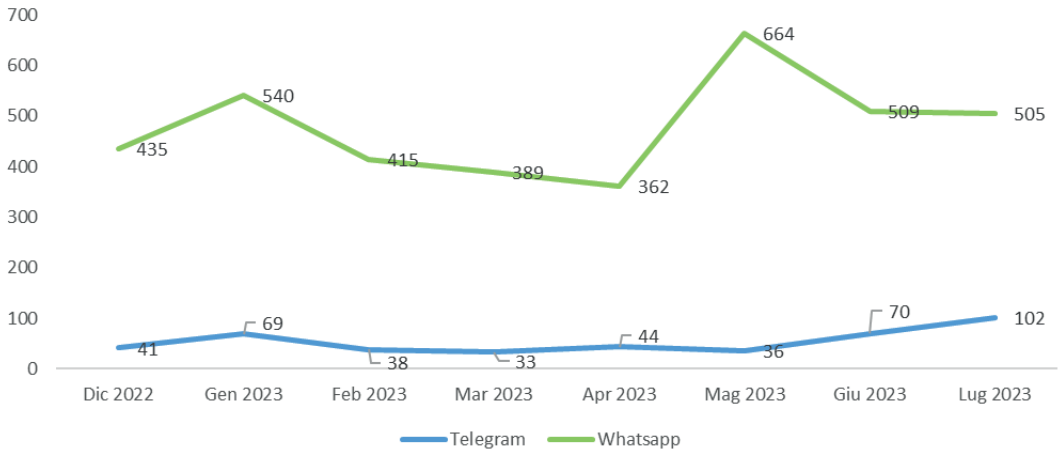


Fig. 1 - Trend in interactions on a monthly basis

By shifting the focus of the analysis to the contact hours (Fig. 2), it can be argued that the flow of interactions is continuous over the 24 hours. In fact, there are no empty time slots.

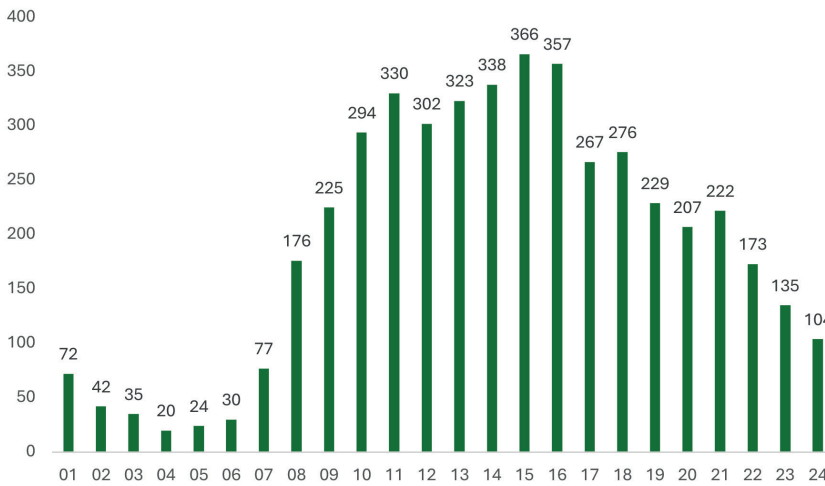


Fig. 2 - Trend of interactions on an hourly basis

The contact analysis suggests that interactions intensify starting at 7 a.m. and gradually increase throughout the day, peaking between 2 p.m. and 4 p.m. There are no significant differences between WhatsApp and Telegram (in percentage terms).

The possibility of interacting with the chatbot on a round-the-clock basis shows the willingness of users to communicate with ANAS even in those time slots not covered by the traditional customer service, which is active from Monday to Friday, from 8 a.m. to 8 p.m.,

excluding holidays, to collect suggestions and complaints or provide information. The analysis also aimed to identify the profile of the users who used the chatbot. In fact, during the interaction, in fact, people who contact the customer service via Telegram and WhatsApp are asked to qualify themselves by identifying as either “customers”, “businesses”, “institutional players”, “professionals” or “media representatives”.

	Telegram	WhatsApp	Total
Businesses		0.51%	0.45%
Customers	99.37%	98.63%	98.70%
Institutional players		0.07%	0.06%
Media representatives		0.05%	0.04%
Professionals	0.63%	0.75%	0.74%
Total	100%	100%	100%

Tab. 1 - User profiles

Table 1 shows that “Customers” account for the majority of users for both channels. Moreover, both channels also feature “Professionals”, despite representing a small percentage of the overall audience. WhatsApp emerges as a more diverse channel compared to Telegram, with a greater variety of user categories. In fact, although less frequently, “Businesses”, “Media representatives” and “Institutional players” also find it useful for their automated interactions with ANAS.

	Telegram	WhatsApp	Total
1. Traffic information	18.78%	12.48%	13.13%
2. Road safety and emergencies	0.84%	4.34%	3.98%
3. Information	67.30%	61.23%	61.85%
4. Reporting	6.12%	9.40%	9.06%
5. Complaints	2.53%	4.65%	4.43%
6. Thank you messages	1.27%	0.48%	0.56%
7. Appointments	0%	0.27%	0.24%
8. Motorway news	3.16%	7.16%	6.75%
	100%	100%	100%

Tab. 2 - User profiles

Before starting the conversation with the chatbot, users are asked to specify the reason for their contact. Table 2 provides an overview of the reasons prompting members of the public to use the ANAS chatbot. The request for “Information” (3) is the main reason for using both channels. Traffic inquiries (1) are more common on Telegram than on Whatsapp. In percentage (as well as absolute) terms, users favour WhatsApp to send complaints or reports. In both cases, the percentage of requests for appointments and thank-you messages is low.

In the next step, a hermeneutic approach was used to analyse consumer narratives, to identify critical aspects of their experience. This hermeneutic analysis, based on the philosophy of hermeneutics, focuses on interpreting texts to gain a deeper insight into how individuals build and communicate their experiences (Ricoeur, 1981). The process began with the adoption of the hermeneutic circle, which posits that understanding is achieved through an iterative process of moving between the text as a whole and its constituent parts (Thomp-

son, 1997). The first thing researchers do is to read the entire material to grasp its general meaning, subsequently moving on to examine specific parts that seem to carry meaning. This process was repeated several times, allowing new insights to emerge as understanding deepened with each iteration.

The analysis then moved into a more interpretive phase, adhering to the iterative nature of the hermeneutic cycle. This involved a strategy of dialogical engagement, both with the text and among researchers (Gadamer, 1975).

The analysis shows that users did not always use the chatbot's decision tree correctly. This may be partly due to the fact that some of the entries are ambiguous. For example, choices 1 and 3 both contain the word "information." Likewise, similar conversations were conducted as both "reports" (option 4) and "emergencies" (option 2).

Another critical issue that has emerged from the analysis of the conversations is relative to the rate of interrupted communications (i.e. cut short before completion). The data analysis showed that about half of the people (45.9%) closed the chatbot before reaching the end of the conversation. This data is mainly related to two reasons, one originating externally and one internally. With regard to the former, the success of conversations via Telegram and WhatsApp is closely linked to the quality of the devices (smartphone, PC and/or tablet) and connection used by customers. As a result, technical problems may have affected the completion of the conversation. With regard to the internal causes, related to the functioning of the chatbot, the hermeneutic analysis highlighted how many users give up on continuing the conversation to the end, wearied by the long-winded request for socio-demographic data and by the consent formalities for authorising the use of the data, which, however, is required by the current legislation. A critical aspect is that even users who had already interacted with the bot in the past, providing their data and the necessary consent, are required repeat everything all over again. This renewed request can discourage people from repeatedly using the new communication channels, perceived as slower to process requests rather than providing faster and more immediate communication. During the conversation, users are asked to specify the route (or road) of interest to the user, but the validity of this request can only be verified later on because the system is unable to automatically immediately indicate whether or not the specific request can be processed. This impasse can be overcome – in the case of conventional calls involving a human operator – because then can verify in real time during the conversation whether the route of interest is among those managed by the company.

Among the successful conversations, a high percentage of problems were solved exclusively via the ANAS chatbot, amounting to 73.96%, while the remainder of calls required further action by a human operator.

In order to gain a more comprehensive view of the interactions, a thematic analysis was also carried out using T-LAB, resulting in the identification of four significant thematic clusters representing the content of the textual corpus. Each cluster consists of a group of elementary settings and is defined by the most characteristic words associated with the units of each setting. According to Rastier *et al.* (2002), the results of this analysis can be associated with an isotopy map, where each cluster, representing a specific theme, is characterised by the co-occurrence of semantic features. The analysis was carried out through an unsupervised clustering process, using a bottom-up approach. Each cluster, representing a thematic dimension, occupied a specific spatial dimension on the Cartesian plane (MCA plot in Fig. 3), allowing the visualisation of proximity and distance relationships (similarities and differences) between the relevant elements. This geometric representation helped identify the specific vocabularies relative to each thematic cluster and understand how closely related or distinct the different themes were.

The first dimension identified in the analysis was "Reminders", which includes requests for updates on previously reported issues that have not yet been resolved. The analysis re-

vealed that reminders often contain specific keywords related to urgency and immediacy, indicating that users were seeking quick and accurate answers. Moreover, terms like “files” and “images” are also contained in the vocabulary, suggesting that this type of communication is sometimes supported by the attachment of digital material. This function, however, is made possible by digital contact channels, which cannot be applied in the case of telephone conversations and this thematic dimension underscores the importance of the chatbot’s ability to provide new and updated information to meet the users’ needs.

The second dimension, “Reports, Requests, and Interventions”, features interactions where users report issues, request assistance, or seek action to be taken. This category includes a wide range of user concerns, from reporting potholes, damaged signage, or road obstructions to requesting emergency services or roadside assistance. The analysis of this dimension highlights a need for the chatbot to be well-versed in information about service providers, emergency contacts, and procedures for dealing with various roadside issues. The vocabulary of this dimension is particularly focused on problem identification and resolution, emphasising terms related to defects, damage and requests for immediate action.

“Payments” has emerged as the third dimension, focusing on financial transactions related to road use, such as toll payments, fines, and other fees. Conversations in this dimension often include queries about payment methods, toll booth locations, payment deadlines, and procedures for appealing fines and highlights the need for the chatbot to provide clear and concise information about payment options and procedures, to make sure that users have a straightforward experience when dealing with the financial aspects of road use.

The final dimension, “Traffic Conditions”, covers conversations concerning the state of the road network, including real-time traffic flows, congestion levels, and alternative routes. Users often engage with the chatbot to obtain updates on traffic congestion, roadworks, accidents, and other factors capable of impacting travel time and route selection. This dimension suggests that the chatbot should be integrated with live traffic monitoring systems and offer route optimisation features to assist users in planning their journeys more effectively. It also highlights the importance of predictive analytics to anticipate potential traffic problems and provide pre-emptive advice.

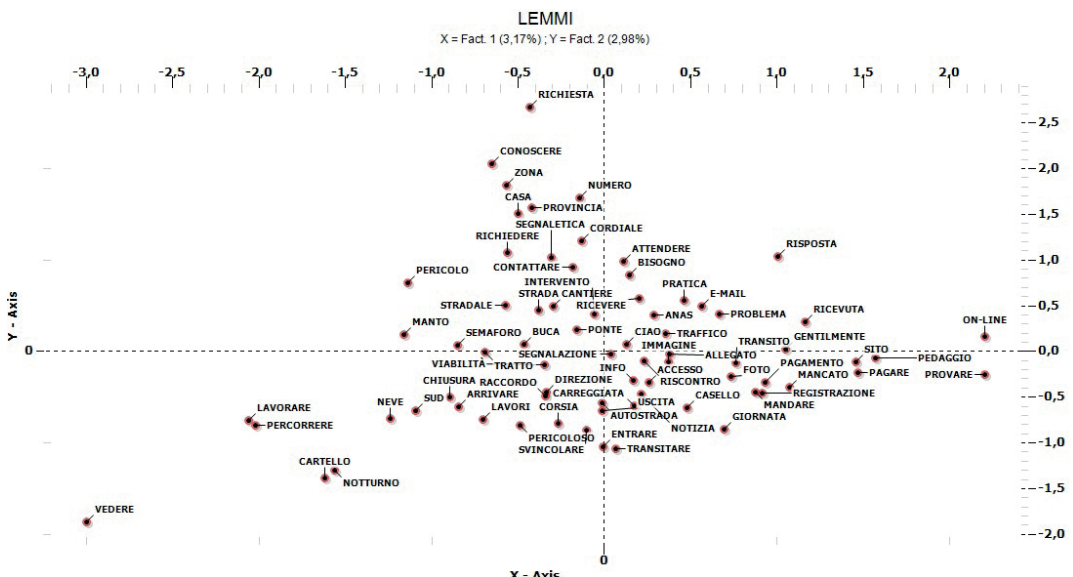


Fig. 3 - MCA plot

Moreover, studying the tone of voice adopted by users, through sentiment analysis, was considered another useful tool for detecting user mood, while also determining how engaging or distant the interaction with the chatbot was perceived to be. Therefore, this in-depth analysis was carried out to understand the general emotional trend of the interactions and to obtain valuable information about the satisfaction and overall experience of the users of the new digital channels introduced by ANAS. Data analysis (Fig. 3) shows that, in most cases (74.3%), use of the chatbot is devoid of any kind of emotional involvement, whether positive or negative. As a result, it can be argued that users use WhatsApp and Telegram in a purely instrumental manner, which underlines how the ANAS chatbot is not perceived as being able to engage in a friendly or empathetic conversation but is seen as capable of providing practical support only.

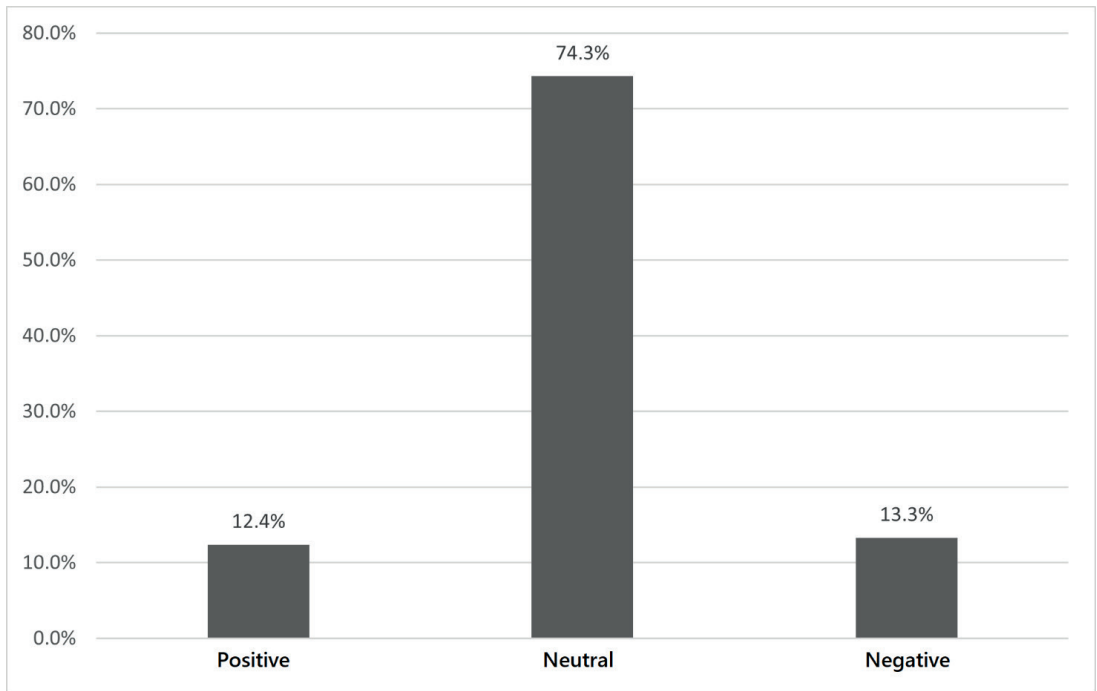


Fig. 3 – Sentiment Analysis

Discussion and Conclusions

The analytical approach adopted in the study has allowed us to acquire a deeper understanding of the nature and quality of interactions between ANAS chatbot users and the company and gaining a clear and detailed insight into the user expectations and experience, beyond a mere superficial appreciation. The analysis has revealed a greater preference for WhatsApp compared to Telegram, which reflects the general preference of most Italians with regard to messaging platforms. Recent statistics, in fact, confirm that 89% of Italians use WhatsApp compared to 36% who use Telegram (Audicom, 2023). Furthermore, 40.5% of Italians indicate WhatsApp as their favorite messaging app compared to only 5% for Telegram.

More generally, the data analysis has highlighted the overall effectiveness of the ANAS chatbot in handling interactions with users. The high percentage of communications managed/resolved by the chatbot indicates that this tool is able to deal with a significant volume of requests, even in time slots not usually dedicated to requesting information or sending suggestions or com-

plaints. This enables the company to employ customer service staff members in more complex tasks, freeing them from having to engage in conversations that can be handled instead in an automated manner. This capability can be seen as a key element of the organisation's operational efficiency, allowing for the better allocation of human resources and faster management of user requests. Likewise, conversations taking place through WhatsApp and Telegram differ from those using other channels (such as call centres) in that users can attach and send pictures, videos or other files to improve understanding and resolution of requests. This feature can be particularly useful in situations where visual or attached documentation is essential to properly assess a situation or report.

The analysis also reveals circumstances that require further action by ANAS to improve the user experience. In particular, almost half of user interactions end abruptly, before completion, which could lead to more work for ANAS personnel, who are required to verify the nature of the interruption even in the conversations that are completed. To better understand the nature of these interruptions, it would be desirable to carry out an in-depth analysis of the causes, followed by the implementation of targeted improvements. Interrupted conversations can be caused by inaccurate answers, the chatbot's failure to understand the context, or difficulties in interpreting the user's requests. Furthermore, the hermeneutic analysis of the conversations showed that the structure of options and choices within the chatbot's decision tree may not be clear enough for users. Ambiguity within the options can lead to ineffective interactions, requiring subsequent intervention by operators, as users may not be able to easily find the answer to their requests. The recommendation is to design more streamlined and intuitive chatbots, combining similar possibilities and reducing the options where possible, to prevent users from experiencing frustration when the virtual operator does not appear particularly friendly towards them (Luo *et al.*, 2022). As already highlighted by other studies on this topic (Ashfaq *et al.*, 2020), when interactions with the chatbot appear tiring or difficult the user starts desiring to interact with another human being, underestimating the potential offered by AI.

Another element that can have a negative impact on user satisfaction is the chatbot's lack of historical memory. In fact, users have to provide some information and consent before starting the conversation, even if they have already interacted previously through the same contact channel. As this process can also be demotivating for users, it could be useful to put into place a more efficient consent management system. For example, allowing users to give their consent once and then keep it for future interactions, unless the user decides to withdraw their consent (Kraus *et al.*, 2023). Another way of addressing this critical issue could be to introduce the possibility of qualified access for users. This strategy would allow people to continue a conversation without having to start a new session each time. This would be particularly useful for complex interactions or requests that require multiple steps. Qualified access, together with an integrated system between the different communication channels and the CRM of ANAS, would allow the chatbot to archive and retrieve previous user conversations, facilitating the context and allowing for more tailored assistance.

Yet another critical point to consider is that the chatbot is unable to verify whether the road of interest falls under the jurisdiction of ANAS. It would be advisable to incorporate some AI-based solutions that could facilitate automated checks, allowing the chatbot to provide users with more accurate and relevant information regarding their concerns. This improvement would not only increase user confidence in the system, but also optimise the allocation of resources within the road management system. Furthermore, by leveraging artificial intelligence, predictive analytics can be implemented to anticipate potential issues based on various parameters, further refining the chatbot's capabilities and ensuring a seamless user experience.

Finally, the data analysis has also highlighted minimal emotional engagement by users. Specifically, chatbot conversations tend to be predominantly instrumental and neutral, devoid of emotion. This may affect the users' perception of ANAS in general. Several studies have already shown that a more engaging interaction with chatbots can improve trust, user satisfaction and

their positive attitude towards businesses and organisations (Araujo, 2018; Chung *et al.*, 2020; De Visser *et al.*, 2016; Verhagen *et al.*, 2014). Chatbot agents need to be developed in a way that also creates an emotional connection with customers, since the relationship is one-to-one. The advances being made in the field of automation can be a valuable asset in implementing more customised and engaging responses by the ANAS chatbot. For example, depending on the register of communication used by the interlocutor, the chatbot could assess whether it is appropriate to respond with more informal communication or use emoticons to add a touch of empathy and friendliness to the interaction. After all, the most satisfying experiences are those where users feel that they are chatting with friends or people who are pleasant to interact with (Kaptein *et al.*, 2015; Lee & Choi, 2017). The public increasingly expects chatbot agents to be likeable, as well as knowledgeable and cooperative, showing empathy, compassion, care, and even humour (Neff & Nagy, 2015).

In conclusion, it is safe to say that modelling, profiling, analysing and understanding users is becoming increasingly important in many industries, also thanks to the support of artificial intelligence, and is a key to success in today's data-driven world (Corbisiero *et al.*, 2022; Haddad *et al.*, 2014). This consideration applies regardless of the business sector in which each company operates. The results obtained from the analysis of the interactions between users and the ANAS chatbot show that, in this case too, the conversational material is characterised by being a valuable source of information for better understanding the needs of the audience and, at the same time, for improving its customer service. Understanding users, their profile, key issues and desires can help companies customise their services and adapt strategies from the bottom up. This knowledge of users' needs can be used to increase their satisfaction, help them find the right answer more quickly and easily, and – as has already been done – identify aspects to integrated and/or modified for a more effective and efficient communication channel that responds to users' needs. In addition to the content, the form of the conversations can be another area for improvement. In this sense, important practical implications emerged from the data for AI designers and corporate communication professionals working in ANAS. The organisation could use the chatbot service more strategically, adopting a more dialogue-based style of communication, in order to maintain high-quality relationships with its users.

Limitations and future research directions

A major limitation of the study was the lack of context accompanying the conversations. In particular, it was not possible to fully evaluate the relationship between users and the ANAS chatbot, since no information was available about the users' situation before and after the chat. The database did not contain information on the users' history, so the researchers were not aware of any previous contacts with ANAS through other contact channels, or whether, for example, the users continued to seek information or have called the contact centre after the conversation with the virtual operator had ended. This is additional information that would have helped to understand how well the chatbot provided the right answer. Therefore, it would be desirable to track users over time and across different interaction channels to create an integrated analytics model. This model could include users' different interactions with the different contact channels to understand the chatbot's strengths and weaknesses from a comparative perspective. The analysis could also be enriched by integrating explicit user feedback. For example, the use of a Likert scale at the end of the conversation can give users the opportunity to evaluate their experience and satisfaction with the chatbot, on a scale of 1 to 5 or 1 to 10 (Akhtar *et al.*, 2019).

Finally, future analyses could also consider some user characteristics for the adoption and perception of the chatbot. For example, a study that considers customer demographics such as age, income, status, lifestyle and education could provide further insights.

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Masculinities and Caring Professions. The Case Study of Students Enrolled in University Courses in Educational Disciplines²

Introduction

The influence of gender on life choices, opportunities and job placement is an important field of research for various social sciences, including sociology.

Research on the Gender Gap in Universities in Italy showed that, in 2020, very few women were enrolled in STEM-related programmes (Science, Technology, Engineering and Mathematics), despite their excellent academic results in all these fields. While personal aptitudes certainly play a role in these choices, social and cultural factors also significantly influence them (Flabbi, 2022). The MIUR data on enrolments for the academic year 2023/2024 confirm that educational choices are markedly characterised by gender, with a strong presence of women in the humanities, education, and training disciplines and a weak presence in STEM disciplines (in particular in engineering and computer science).

Gender “educational segregation” - the separation in academic and professional choices and trajectories, resulting in an inequality of opportunities between men and women – may depend on several factors (Metha, Wilson, 2020). Sociological explanations disagree with the classic opposition between “nature” and “culture”, whereby women’s natural inclination towards care and nurturing also guide their university and professional choices (Mapelli, Ulivieri Stiozzi, 2012), while men, oriented by individualistic values and practical interests, invest more in technical-scientific knowledge.

While the literature contains numerous contributions to women’s choice of STEM disciplines, fewer studies (particularly qualitative ones) have investigated men’s propensity for humanistic and educational disciplines. In particular, the relationship between main gender models and representations of masculinity and young men’s university choices in the field of early years and primary education – *i.e.*, in sectors traditionally occupied by women – is less investigated (Biemmi, Leonelli, 2018; Chise *et al.*, 2020; Flabbi, 2012).

The present study aims to contribute to filling this gap by analysing the motives that guide men to choose the humanities and educational disciplines. In particular, the research focuses on the factors that drive them to invest in programmes traditionally associated with care, such as BA Primary Education or BA Early Childhood.

1. Gender Between Structural Influences and Personal Inclinations

Addressing the issue of gender differences calls for a general reflection on socialisation processes and intra and intergenerational relational exchanges that contribute to the development and construction of the personal and social self.

Gender socialisation, as a specific area of the socialisation process, is key to understanding many attitudinal and social aspects of individuals, such as educational, relational and social choices. Social expectations connected to “gender roles”, *i.e.*, those specific functions that women and men are called upon to assume within certain fundamental institutions of society (first and foremost the family, see Ruspini 2003) also depend on gender-related choices.

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This process is paramount also due to the genderization of contemporary society, in which gender distinction is central to the social construction of reality (Piccone Stella, Saraceno, 1996).

Gender socialisation starts at birth – indeed, even before then: it often begins when the future parents learn of the biological sex of the unborn child, voluntarily (and involuntarily) reinforcing their gendered carrier identity (Abbatecola, Stagi, 2017). During primary socialisation, the choice of names, as well as the colour of clothes and toys, reinforce in children the centrality of gender distinction, which thus constitutes a reference for the construction of the self, firstly individual and, subsequently, social during secondary socialisation.

Through these processes, individuals construct their gender identity, also acquiring those models of behaviour (gender display) that draw different social expectations between men and women (Goffman, 1979).

The process of socialisation to gender, like socialisation in general, implies a central role of those agencies that form individuals as members of society (Crespi, 2008). In this sense, socialisation can be understood as a process that is both vertical and horizontal. The family and school are paramount agencies for vertical socialisation: they constitute the key institutions of what Parsons (1957) identified as the latency function. Through reinforcements (positive and negative sanctions) individuals internalise the expectations associated with gender roles by perceiving them as natural and voluntary. In the case of horizontal socialisation, agencies such as peers (friends) or the media play an equally decisive role in consolidating the main gender models (Burgio, 2023).

However, the hyper-socialisation model proposed primarily by the functionalist school did not take into account the processes of subjective accommodation that are crucial in defining gender identity. How one relates to the roles and social expectations connected to gender distinction contributes to the solidification of “gender stereotypes” (Corbisiero, Nocenzi 2022). Gender stereotypes are based on approximate readings of this distinction and a biologist and essentialist view of these differences, which see women naturally predisposed to care functions and the private and domestic sphere, while men are predisposed to responsibility roles connected to the public and professional sphere.

Conversely, according to interactionist studies, mainly proposed by the Chicago School, gender stems from the mediation of social and cultural meanings constantly reinvented according to individual needs. This shift in gender perception involved the analysis of those social devices that institutionalise gender distinction through behaviours, languages, and routines typical of the “world of everyday life” (Schulz, Luckmann 1973). This has entailed a deconstruction of the very concept of gender, increasingly understood as the outcome of intersubjective processes, rather than a concept linked to biological sexual distinction. Thus, attention is now focused on the subjective mechanisms that people put in place, particularly in contemporary society, in their way of “saying” and “doing” gender (Rinaldi, 2021).

The increased process of de-institutionalisation that affected the family, the crisis of educational institutions and their capacity to regulate behaviour, and the exponential increase in the sources of secondary socialisation, therefore, require a multidimensional study of these processes (Masullo *et al.*, 2021).

2. Interpretive Paradigms for the Study of Contemporary Masculinities

The term masculinity refers to the various ways of symbolically, socially, and culturally representing the male universe (Fidolini, 2017).

In the Italian language, the term masculinity refers to the cultural and symbolic aspects of virility, within a semantic framework that assumes a direct correspondence between being male and exercising “masculinity”.

The sociologist most active on the concept of masculinity is Raywan Connell (1995), who defined the cisgender and heterosexual male identity as “hegemonic” because of its dominance over other male identities, which are considered subordinate in terms of power, visibility, and social positioning and status. For Connell (1995), hegemonic masculinity is directly linked to patriarchy as a system of oppression based on extending male dominance, its codes, and values to all aspects of the social sphere, primarily over women and other masculinities considered subaltern (e.g., homosexuals). The Australian scholar also proposes a “gender hierarchy” to classify the various expressions and identity constructions of masculinity.

At the top of the masculinity pyramid is the heterosexual male cisgender identity construction that embodies the prototypical figure of ideal masculinity. Next, Connell considers other types of masculinities, which are positioned lower down on the ladder of the identity and power stratification of the male gender, namely that of:

- Subordinate Masculinities: mainly homosexual and migrant masculinities, or men with physical or mental disabilities. These masculinities are considered to lack one of the core characteristics possessed by hegemonic ones.

- Complacent Masculinities: also lacking compared to the normative model proposed by hegemonic masculinities, but (unlike the subaltern ones) able to find forms of negotiation with the dominant identity, drawing some benefits from it.

- Marginal Masculinities, *i.e.*, the relation existing between the masculinities of the dominant and subordinate classes and between different ethnic groups, whose role is always granted and authorised by the hegemonic masculinity.

Early studies on masculinity in Italy identify typical traits of the model of hegemonic masculinity in virilism and machismo (Bellassai, 2011), both of which still enjoy wide consensus among men in Italian society. In a country marked by traditionally macho imperialism, virilism has been embodied in the image of the nation throughout the fascist era and well into the 20th century. Indeed, it seems that Italian society itself was built in the image of men (*ibid.*). Masculinity is an ideal model, an abstract image, which does not fully correspond to what individuals are, think, and do in everyday life, but which influences their personality, desires, and even behaviour (Ciccone, 2019).

There are many variations of the ideal model of masculinity in any society, but they are all profoundly influenced by the ideals of virility and masculinity. Virilism has also legitimised a supposed hierarchical superiority of men over women through tradition. Indeed, maintaining this supremacy has long been considered a common concern for all men, regardless of the differences between them. From the 1950s onwards, women became more visible: this was interpreted as a sign of progress, as a sign that tradition could be challenged. Women began to demand greater recognition and rights (e.g., divorce, abortion, etc.), leading to the profound social and cultural upheavals that marked this period.

It was the beginning of what many scholars term the “crisis of masculinity”, *i.e.*, men’s loss of power due to women’s emancipation (Ciccone, 2019). It is considered the reason why men anchor themselves in virilism to perpetuate domination over women. For some scholars, an ever-stiffer hegemonic masculinity exacerbated related phenomena such as misogyny, homophobia, and exaggerated virilism. Male domination had unfolded undisturbed for millennia precisely because masculinity is perceived and internalised as a universal and “unmarked” condition (Rinaldi, 2021).

On the one hand, this situation spawned a men’s movement that advocated for the need to reaffirm the centrality of men in society – a veritable revanchism (Masullo, Iovine, 2020). On the other hand, however, the mid-1970s saw the birth of a modest network of men’s groups known as “consciousness-raising”, which argued that the male gender and sexual role were oppressive and should be changed or abandoned (Ciccone, 2019) and was committed to promoting self-consciousness practices to question patriarchal and sexist models internalised by men. As Ciccone (2001, p. 22) points out, «Inevitably, it was necessary to start from a “gender guilt”, that is, to come to terms with male history – interwoven with violence and the exercise of power – to

distance oneself from it and give voice to different needs, and then to return to “one’s gender” by rediscovering and giving it another meaning».

Indeed, masculinity studies have added new interpretation lenses for masculinity and its relationship with patriarchy and heterosexism, central aspects of hegemonic masculinity and Italian machismo.

Men’s intolerance of patriarchy is evident in numerous aspects of everyday life, such as the need to distance themselves from exaggerated macho masculinity, the possibility of being able to express their feelings and care for their children, their openness to previously demonised sexual practices (think of bisexuality), and the degree of tolerance towards alternative masculinities (e.g., homosexuals). Great impetus has also been given to the reflection that links masculinity with the theme of equal opportunities, the fight against sexism (particularly violence against women), as well as the discrimination suffered by homosexuals, aspects that have made possible an alliance between men and women in the fight against misogyny and homo-bi-transphobia (Corbisiero, Nocenzi, 2022; Corbisiero, Monaco, 2024).

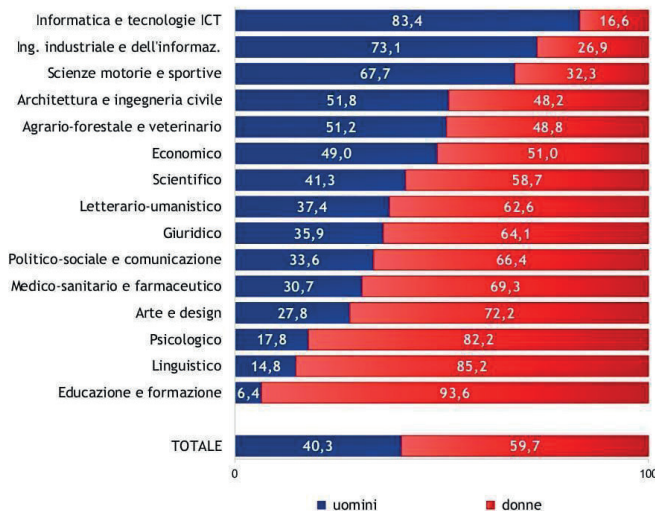
In recent years, many Italian researchers have focused on the re-definition of the concept of masculinity, allowing for alternative models aimed at overcoming the essentialist characteristics of hegemonic masculinity while embracing emotional, relational, caring, and nurturing aspects usually associated with the other gender. Masculine and feminine thus become communicating aspects, common and shared horizons – by both men and women – through which a more authentic sense of self can be constructed, free from gender-related and heteronormative prescriptions (Biemmi, 2023; Ciccone, 2016; Slutskaya *et al.* 2016).

3. Gender Segregation in University Courses in Italy

According to the data provided by AlmaLaurea 2023 on the number of graduates in 2022, the percentage of women graduating from university is around 59.7, *i.e.*, 19.4% more than men, who account for 40.3% of total graduates.

While it is true that, compared to previous generations, women are more present in “typically male” courses and career trajectories, the gap is still evident.

The table below shows that around 83.4% of graduates in ICT subjects, as well as in many STEM disciplines, are male. This trend is reversed in the humanities and education disciplines where 93.6% of graduates are female (AlmaLaurea, 2023).



Fonte: AlmaLaurea, Indagine sul Profilo dei Laureati.

The choice of which programme to enrol in at university, as well as the career trajectory, highlights the weight that “gender issues” occupy in conditioning contemporary society (Mapelli, Ulivieri Stiozzi, 2012; Biemmi and Leonelli, 2018).

This difference also affects social and wage gaps, as the professions with higher pay and possibilities for professional empowerment are those related to IT and technological innovation, in which women are underrepresented.

Gender segregation in education is blatant when we compare the Italian and average European figures. The Gender Equality Index report, published annually by Eurostat, shows that around 79% of Italian women attended ‘typically female’ university programmes (Primary education, Psychology, etc.) in 2019, compared to 21% of men, a figure among the highest in Europe³.

As stated in the introduction, the gap between men and women in the choice of STEM-related university courses could be explained by several factors. Firstly, the persistence of gender stereotypes sedimented and rooted in society leads girls to mistrust their ability to deal with scientific disciplines and boys to avoid those disciplines related to care. Such aspects are clear throughout the school years, from primary to secondary school (Corbisiero, Beritto, 2020).

The gender gap and gender segregation are closely linked to the concept of the “gender cage” (Biemmi, Leonelli, 2018): the set of social and cultural barriers and resistances that individuals encounter concerning their gender. Thus, men also face a series of social and cultural barriers linked to their gender that influence and orient their choices and social status.

It should also not be underestimated how these choices are affected by how young men relate to the main cultural gender models associated with masculinity, the changes linked to the “crisis of masculinity” and/or the “patriarchal masculinist model” and, therefore, how men (reflexively or otherwise) rethink the meaning of gender distinction in their life decisions (Corbisiero, Nocenzi, 2022).

If research on gender segregation for women has known greater impetus thanks to the feminist movement, which saw the absence of women within the scientific and technological sectors, and their scarce presence at the top of power as an indicator of the persistence of the macho and sexist patriarchal model. Conversely, male segregation has received little attention from scholars⁴.

Among the few Italian studies available, Biemmi and Leonelli’s (2018) research examined how “gender cages” condition men’s life paths, showing that the main reasons that the interviewees offer to explain the lack of men’s presence in the field of “care” is the persistence of historically rooted cultural and familial prejudices. Once again, the “nature” vs. “culture” dichotomy allows us to explore the meaning attributed by the interviewees to the function of, for example, care and teaching.

As far as the teaching profession is concerned, for example, the traditional idea of teaching as a vocation – or as an educational mission – is closely connected to the concept of *maternage*: teaching is configured as a sort of sublimated place of maternal destiny in which women can employ their “innate” gifts of gentleness, emotionality, solidarity, and altruism to care for, protect, and understand growing children. Working as a teacher thus ends up appearing “unacceptable” for a man since, following a binary gender logic, such characteristics by definition do not belong to him and even risk being detrimental to his personal/social identity (Mapelli, Ulivieri Stiozzi 2012). Another explanation points to the scarce social recognition of professions such as that of teacher, nurse, and social worker, also due to the tasks inherent in them (such as washing, cleaning, feeding, etc.), often considered “degrading” for men but acceptable for women (Ciccone,

3 The Gender Gap in STEM disciplines exists across all European countries, although it differs between Scandinavian countries (Sweden, Norway, Iceland, Denmark, and Finland) on one side and other countries on the other, with Bulgaria, France, and Turkey at the bottom (Eurostat, 2020).

4 In recent years, scholars have focused more on the theme of “caring masculinities”, not only in Italy with the previously mentioned studies by Biemmi and Leonelli (2018) and Biemmi (2023) but also internationally, such as the works by Scambor, Jauk, Gärtner and Bernacchi (2019) and by Bergmann, Wojnicka, Scambor (2013).

2016). Mapelli (2012) also adds the interesting consideration that few young men choose certain subjects and careers because of the lack of adult male role models to inspire them. The case of the teaching profession is exemplary: if a child never meets a male figure during pre-school and primary school, he deduces that it is a profession suitable only for women.

4. Methodology

In light of the above, the present essay aims to analyse the motivations underpinning young men’s choice to enrol in university and training courses that lead to a caring profession, particularly BA Primary Education, BA Early Childhood and/or equivalent courses, as well as the main gender models that guide the professional identity of future educators.

The exploratory study started with the following research questions:

- RQ1: What are the main motivations and professional expectations that oriented young people towards university programmes in primary education?
- RQ2: What are the main social representations of the male gender that young men consider when choosing to enrol in a course in primary education?
- RQ3: What were the opinions, reactions, incentives, and resistances of the social micro-systems (family, friends, etc.) when choosing a university programme in primary education?

We adopted the biographical approach for this research. The centrality of life stories is not due to their generalisability, but rather by the capacity this tool has to better explain the micro-sociological and identity processes examined. In particular, this work builds on the definition of “life story” proposed by Atkinson (1998, p. 28), who describes it as a narrative «as complete and honest as possible, which a person chooses to tell about the life they have lived. It is constructed from what they remember of their life and the aspects of it that they want others to know, as a result of an interview guided by another person». What distinguishes this definition is the centrality given to the ‘biographical pact’, *i.e.*, the balance between the completeness and honesty of the narrative and its inevitable partiality and discretion.

The data collection phase through semi-structured biographical interviews lasted approximately 9 months, from April 2023 to January 2024, and involved 30 young men between the ages of 20 and 32, with a male gender identity – or perceived as such from an identity self-determination perspective. The interviewees are enrolled in three-year degree courses in primary education or early years at two universities in Campania: the University of Salerno and the Suor Orsola Benincasa University.

The following table summarises the socio-biographic characteristics of the interviewees involved in the research⁵.

N°	Age	Degree	Year	University	Place of residence
1	23	Scienze dell'educazione	3	Salerno	Salerno
2	24	Scienze dell'educazione	3	Salerno	Caserta
3	21	Scienze della formazione primaria	2	Salerno	Napoli
4	20	Scienze dell'educazione	1	Salerno	Salerno
5	21	Scienze dell'educazione	2	Salerno	Salerno
6	19	Scienze dell'educazione	1	Salerno	Avellino
7	23	Scienze della formazione primaria	3	Salerno	Salerno
8	21	Scienze dell'educazione	2	Salerno	Salerno
9	22	Scienze dell'educazione	3	Salerno	Salerno
10	23	Scienze dell'educazione	3	Salerno	Avellino
11	22	Scienze dell'educazione	2	Salerno	Salerno

5 As a rough equivalent, *Laurea in scienze dell'educazione* is a BA in Early Childhood, *Laurea in scienze della formazione primaria* is a BA in Primary Education.

12	21	Scienze dell'educazione	2	Salerno	Salerno
13	22	Scienze della formazione primaria	2	Salerno	Caserta
14	23	Scienze dell'educazione	3	Salerno	Salerno
15	21	Scienze dell'educazione	3	Salerno	Salerno
16	20	Scienze dell'educazione	1	Suor Orsola Napoli	Napoli
17	21	Scienze dell'educazione	2	Suor Orsola Napoli	Napoli
18	28	Scienze dell'educazione	2	Suor Orsola Napoli	Napoli
20	32	Scienze della formazione primaria	3	Suor Orsola Napoli	Caserta
21	25	Scienze della formazione primaria	2	Suor Orsola Napoli	Napoli
22	21	Scienze dell'educazione	2	Suor Orsola Napoli	Napoli
23	20	Scienze dell'educazione	2	Suor Orsola Napoli	Napoli
24	19	Scienze dell'educazione	1	Suor Orsola Napoli	Napoli
25	20	Scienze dell'educazione	1	Suor Orsola Napoli	Napoli
26	22	Scienze dell'educazione	3	Suor Orsola Napoli	Napoli
27	20	Scienze della formazione primaria	2	Suor Orsola Napoli	Napoli
28	22	Scienze dell'educazione	2	Suor Orsola Napoli	Napoli
29	27	Scienze dell'educazione	2	Suor Orsola Napoli	Caserta
30	28	Scienze dell'educazione	3	Suor Orsola Napoli	Latina

5. The Main Reasons Behind the Choice of Education-related Programmes for Young Men: Between Second Choices, Socialisation Processes and Personal Preferences.

The analysis of the interviews highlighted three macro-motivations orienting young men towards a profession in Primary and Early Years education.

In the first place, it is in some cases a secondary or alternative choice. Generally, the first choice is a BA in psychology (capped in many Italian universities) followed by primary education and, lastly, early years practitioner. Two main reasons often lead young men to divert their course choice: failing to pass the admission test to the psychology course or logistical and economic issues, as psychology BAs are often in large and expensive cities such as Rome, Bologna, Padua and Milan. Frequently, enrolling in a BA in education aims at obtaining credits to subsequently enrol (after hopefully passing the test the following year) in a psychology or primary education BA. It appears that the choice of psychology is based on its association with the medical sphere, which makes it more prestigious than the other two options in the eyes of the young men. For what concerns a BA in primary education (both as first and second choice) the centrality of job opportunities is the core motivation, as this degree qualifies holders for teaching throughout Primary school (P1 to P5, in Italy).

I chose a degree in education because I didn't get into the psychology course. I think I will try again next year. So I can't really tell you my educational model, as I see myself as a future psychologist. I was always very attracted to psychology and understanding people. Educational science was an easier test and so I passed it. [...] I tried in Rome but I didn't get in, in the meantime I'll take common courses like psychology, sociology and pedagogy and then we'll see [G. 23 years old, Salerno].

A second macro-motivation that emerges from the interviews stems from processes of anticipatory socialisation to the profession of educator, especially if the respondents had a role model (a professional educator, a community volunteer, or a teacher) and even more so if they did extra-curricular activities in voluntary associations or third sector organisations operating in their communities (Biemmi, Leonelli, 2018). The inclination towards a degree in early years or primary education is a natural progression that allows them to exploit the expertise gained in these contexts.

I enrolled late at university, I used to work in a supermarket. Then I started volunteering in a centre for disabled young people and I fell in love with the work [...] I felt useful and alive. [L., 27 years old, Caserta].

A third motivational macro-category refers to personal preferences and psychological aspects: some respondents choose a BA in primary education because they feel they have no particular inclinations and skills for other disciplines – especially scientific ones. Others point to personal traits, such as listening skills, empathy, and in particular love for children.

I've always wanted to be a primary teacher, I have been playing pretend since I was a little boy [...] I also like children, a lot, and so I like being able to work with them [...] It's a dream coming true [I, 21, Salerno].

6. The Contexts of Gender Socialisation: The Role of the Family and Proximity Networks

The interviews reveal the influence of the family, particularly the parents' educational style. While it is true that some parents support their children's choices, for some opting for a course in primary education raises concerns about future job placement, rather than unfulfilled expectations about prevailing gender models.

I want to join the public sector, I mean, I have to get busy, I can't be a burden to my parents or worse not be autonomous or not be able to think of a future or raise a family. My father already says that compared to my brother who is enrolled in biomedical engineering, at the Biomedical Campus in Rome, I made a wrong choice [I, 22, Naples].

The interviewees often mention the equal division of domestic labour between male and female members of their families. However, the very examples they bring, in distancing themselves from the traditional gender division of care tasks, are often characterised by a lack of reflexivity, as in the following case, where the respondent refers to a sector (that of the other catering) characterised by gender segregation in top positions, generally occupied by men (Abbatecola, 2023) For me it was a serene choice, it was not a painful one also because I grew up with an idea, shared by my parents, that jobs are not male or female, but are done well or badly. My father's job is also something women can do, in fact, if you think about it it is a female thing, he is a cook. [...] I think that in 2023 it is still not possible to distinguish male jobs from female jobs [C., 23, Avellino].

From a social point of view (friends, colleagues, and the wider family network) the interviews did not reveal any forms of gender stigmatisation suffered as a result of the interviewees' degree choices. On the contrary, once again, the social capital possessed seems to support their socialisation into the educational professions, especially if the network of friendships overlaps with that of the voluntary associations in which they carry out their extracurricular activities. Despite the support received from family and proximity networks, however, the respondents do not exclude *a priori* the possibility that in some professional fields sexism is still a problem, particularly in feminised fields such as early years practitioner or primary school teacher.

Today the figure of the male primary school teacher is coming back, despite this I think some parents don't really look at this well [...] in short I don't feel I can exclude it, especially in the private sector. I believe that in an interview, between a female nursery school teacher and a male one, they would always choose the female, for image [A, 24, Caserta].

This finding is also confirmed by the following excerpt, which highlights that the choice of early years practitioner is considered also by most of them as a typically female profession.

If I think about it, in the nursery curriculum boys are almost absent. [F, 22, Salerno].

It could be hypothesised that typically feminised spheres, such as teaching infants and young children, are developing specific areas that emphasize characteristics essentially associated with

masculinity (for example, physical and psychological toughness). Some areas, such as early years practitioners, continue to be far from young men's choices, also because male gender identity is not problematised, insofar as they have incorporated the idea that associates this area with women and maternity.

7. Models of Masculinity in the Education Professions: from Empathetic Men to New Forms of Alliance

Men do not always reflect on the impact of gender on their life choices, also because masculinity entails forms of privilege that do not limit their actions – unlike women (Rinaldi, 2021). In a reality where cisgender, white, heterosexual men sit atop the gender and sexual stratification pyramid, the privileges of masculinity often appear natural and unproblematic. As confirmation, the interviewees, despite being invested in highly feminised studies, did not perceive any forms of limitations around them suggesting that their gender was a problem. Therefore, the exploration of the masculinity patterns prevalent among students enrolled in early years and primary education degrees took place only at the invitation of the interviewers, who were seeking to bring out aspects mostly taken for granted. This was not the case for all participants, especially for those who had to contend with prejudices and stereotypes surrounding homosexual masculinity. Indeed, they seemed to be the ones most prepared for this type of reflection, insofar as they had to confront the performative aspects implied in the model of hegemonic masculinity (Dordoni, 2022; Fidolini, 2017). The respondents were all well aware that traditional macho figures are nowadays unacceptable, with their often stereotyped exaltation of masculinity based on the cult of strength, aggressiveness, and possessiveness in (strictly heterosexual) relationships. Indeed, interviews have also been a useful tool to problematise and discuss the changes that have taken place in gender relations.

The interviewees interpret masculinity in terms of a “traditional macho masculinity”, which for most coincides with the negative representation nowadays associated with widespread prevarication and violence towards both women and homosexuals. The majority of them wished to distance themselves from such a male figure, considered largely outdated. However, many still felt the need to assert their heterosexuality, thus attempting to disavow the cliché associating alternative models of masculinity with homosexual masculinity, understood as a monolithic, feminised, and therefore subordinate masculinity.

I am not like other men. I would like to point out, but only for the purposes of research and not for any form of prejudice or social discrimination, that I am heterosexual. And yet, I have always been different from the typical male, I am not the strong, dominant, ambitious, shrewd and unscrupulous male who only wants to achieve his goals, I have always been thoughtful [...] I love philosophy and I respect everyone and everything. Indeed diversity for me is an absolute value, no one is superior to anyone else [L., 23, Salerno].

The discussion on the “traditional machismo” model of masculinity is mostly based on the interviewees’ distancing themselves from the psychological traits usually associated with it (ostentation, aggressiveness, overpowering others, virilism, etc.) by highlighting characteristics positively associated with the dimension of care, such as listening and sensitivity. This model of alternative masculinity, defined as “empathetic man” (Masullo, Coppola 2021), seems to be shared by many respondents. The research does not shed light yet on whether these attitudes precede the choice of care-related paths or, on the contrary, the latter has determined the need to recover psychological characteristics now positively associated with the new forms of emerging masculinity

I have always felt different. I have always been inclined to listen, with family, and friends, they can always count on me. It felt natural to make this choice because I felt the need to relate to people with real problems [...]. This sensitivity of mine costs me more on a personal level than

with others, indeed I must say that people have always appreciated my being different from the stereotype of the common man [F., 21 years old, Naples].

Being an Empathetic Man does not, however, necessarily mean having elaborated a reflexivity capable of distancing oneself from an essentialist view of gender, or placing it within the broader question of inequalities and equal opportunities (Ottaviano, Persico, 2023). This type of attitude, which today constitutes a bridge between the feminist tradition and the “critical studies on men and masculinities”, emerged in two cases of boys who had experienced forms of devaluation, demasculinisation, and devirilization in relational contexts such as the family and the peer group. The need to find answers to this oppression prompted them to delve more deeply into these issues, allowing them to link the problem of educational gender segregation to broader sexism. According to the interviewees, sexism is still all too present in Italian culture and generates gender inequality and a lack of equal opportunities. This model, defined here as “the alliance” critically discusses gender cages, made up of the main stereotypes associated with men and women, conscious of their impact on the collective consciousness or in the labour market, particularly towards women.

Sexism is rife in our country, and what you speak of shows that there is still much to be done for gender equality, and this is felt by those of us who aspire to do this work, but I think especially by women who are almost excluded from all places of power, and paid a pittance compared to men. [...] However, a lot is being done today to encourage this, but I don't feel that men are in any way encouraged to be educators. So I think the problem is right upstream, in the culture of this country that is still too sexist [G., 21, Salerno].

Conclusions.

The analysis so far has brought to light the main motivations that young men put forward in explaining their choice to enrol in a BA primary education or similar degrees, and how these relate to a professional context that has always been feminised.

The research also sought to understand the imaginary that young men have developed regarding these topics, particularly their models of masculinity, given that this could be challenged to the extent that the educational professions require characteristics not positively associated with the model of hegemonic masculinity. The respondents seem to disapprove of said model and consider it anachronistic also because of its effects on the relationship with women and with genders and sexualities considered subordinate, such as homosexuals.

For the interviewees, the model of hegemonic masculinity seems to be embodied in the “traditional macho masculinity”. The opposite model is that of the “Empathetic men”, which embodies certain characteristics necessary for the work of the educator, such as a propensity to listen, a sense of care, etc., confirming the idea that «care is a human dimension and not an (exclusively) feminine quality» (Ottaviano, Persico 2023, p. 85). The analysis, therefore, highlights a certain circularity between certain psychological characteristics (far from those proposed by the model of machismo masculinity) and the programme choice: the former could determine the latter, or the latter can lead young men to rethink how to perform their gender (Bernacchi, Di Grigoli, 2023).

The vast majority of interviewees lack an “alternative” masculine culture that distances itself from an essentialist view of gender, beyond mere rhetoric about traditional machismo-type masculinity. Moreover, the absence of reflexivity does not allow us to understand how this model of masculinity reproduces itself, its links with patriarchy and heterosexism (for example, when the interviewees justify their model of masculinity by declaring their heterosexuality), nor does it allow us to fully examine male privilege in all its forms. However, some respondents manage to take this reflection beyond mere identity aspects by recognising the damage that patriarchy

wrecks on masculinities in terms of social obligations and expectations and by a sexist culture that produces social inequalities for both men and women.

This latter group advocates for the need for an alliance with women, who are considered the main victims of this state of affairs. This “critical” orientation, linked today to the extensive literature proposed by the “critical studies on men and masculinities”, emerges from those training in the educational professions, as one among the possible contexts (Fidolini, 2023) of the educational gender segregation, in which young people come to terms with social disregard by having to elaborate and rethink the gender order and its consequences on the life chances of men and women.

Given the exploratory nature of the research, the approach employed means that the result are not, unfortunately, representative of the general population. We focused on two realities within the Campania region, although the degrees examined are present also elsewhere. Indeed, one should not underestimate the weight of some typical structural components of the area examined that may affect the choice of one degree or the other. Additionally, this choice is inextricably linked to secondary school attainment and the practical feasibility of reaching certain university realities (e.g., a psychology degree), including due to structural limits (economic, political, and cultural ones). Therefore, it will be essential in the future to explore the topic of educational gender segregation with more complex epistemological and methodological approaches (e.g., mixed methods), to analyse in greater depth the relationship between subjective propensities and the influences attributable to structural factors.

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Festive Expressions in Contexts of Depopulation: Carnival in the “Sicani Area” in Sicily²

Introduction

The festive events observed today in various towns and villages of southern Sicily are deeply embedded in contemporary society and the processes of globalisation, incorporating elements of spectacle, technological dissemination, and a tourism-oriented approach. Nonetheless, they retain significant ritualistic and communal dimensions, alongside thought-provoking opportunities that emerge during the creation of allegories, floats, costumes, and carnival anthems—key elements in the dramatisation of narratives and imagery that hold particular relevance for the community.

The ‘forms of interaction’ inherent in the preparation and enactment of Carnival can be examined through the ‘home-street’ debate, which has implications for the use of public space and the sharing of private space. Furthermore, the interpretative lens of ‘familiarity and organisation’ is particularly pertinent, as it enables an understanding of the carnival both as a spontaneous occasion for social encounters and community recognition, and as a sphere of political and institutional decision-making.

A critical reflection on the Carnival phenomenon in the small towns of the Sicani area in Sicily must be contextualised within the broader social challenges these territories face today. The evolving structural dynamics between urban and rural areas have led to the increasing marginalisation of the so-called Italian Inner Areas, where depopulation processes exert a profound impact on the development of local cultural life.

Each year, Carnival organisers and the festival itself cope with the consequences of demographic decline, which manifest in a progressively shrinking organisational community and diminished audiences. These trends pose significant risks to social cohesion and the preservation of local identity. The contemporary Carnival does not exist in isolation from these socio-economic transformations; rather, such issues are explicitly articulated in the discourses and texts of allegories and hymns, which serve as ‘forms of communication’—the discursive dimension through which the symbols embedded in carnival performances convey meaning.

In light of these considerations, this article aims to: (i) describe the demographic and cultural dynamics of the municipalities of Santo Stefano Quisquina, Bivona, and Alessandria della Rocca, situated within the Sicani Inner Area of Sicily; (ii) investigate local carnival expressions from a historical perspective; and (iii) analyse contemporary carnival representations, with particular attention to the discourses on depopulation embedded within the dramatisations.

The conceptual framework for this analysis is grounded in the existing scholarly literature on carnival and festive events in Italy, with specific references to Sicilian traditions, as well as to the Brazilian Carnival, the Carnival of Barranquilla in Colombia, and the Carnival of Cádiz in Spain. These international examples serve as theoretical points of reference rather than as subjects of direct comparison with the Sicani context.

Additionally, the article reflects on the socio-cultural transformations occurring in rural areas and highly urbanised settings, particularly those linked to depopulation. Geolocalised quantitative data are employed to examine demographic trends in the study area, providing a contextual foundation for understanding how these challenges are represented in carnival narratives. The analysis subsequently focuses on the carnivals of the aforementioned municipalities, comparing traditional and contemporary expressions. This discussion is informed by a series of semi-struct-

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tured interviews conducted with various local actors involved in the present-day organisation of the carnival, including musicians, event organisers, representatives of local associations, and custodians of collective memory.³

1. Theoretical Definitions

In an attempt to interpret the carnival ritual, Buttitta (2010, p. 208) identifies four perspectives that are also relevant to the case study examined here: as a representation or dramatisation of cosmic chaos; as a representation or dramatisation of social chaos; as a temporary space of excess and enjoyment, not allowed in everyday life; and as a totemic event that engages the community, providing an image of cohesion and joy while contributing to the local economy by attracting external participants. These perspectives are present across different elements and manifestations of carnival, assuming varying degrees of emphasis in different historical periods. The multiplicity of elements and expressions emerging in local carnival traditions can be classified, according to Bausinger & Sordi (1982, p. 89), into three categories: 'signs', encompassing masks, emblems, and symbols; 'forms of interaction', which include processions, house-breaking, dances, and staged fights; and 'forms of communication', concerning language-based expressions such as satires, mock trials, songs, and proclamations. These elements—variably present across different local contexts—constitute the uncommon and exceptional nature of Carnival, manifesting in both public and private spaces.

Da Matta (1991) highlights the 'home' and the 'street' as the two central domains in which carnival unfolds in the Brazilian context. From a symbolic perspective, he examines the transition of elements between these two domains, from the domestic sphere to the public and vice versa. Public and impersonal values often infiltrate the private realm of the home, just as domestic elements extend into public space, to the point where 'the social world finds its centre in the personalised metaphor of the home' (Da Matta, 1991, p. 73). In some cases, these two spheres merge seamlessly. A different dynamic between the public and private spheres emerged in the revival of the Carnival of Cádiz, Spain, particularly following the return to democracy in 1979. From that period onwards, many spontaneous groups composed of family members found in the *peñas*⁴ not only a space to rehearse carnival songs but also a venue for intergenerational transmission and social gathering. These intimate and secure environments played a crucial role in reclaiming the street as a stage for freedom of expression, critique, satire, and humour—elements that define the contemporary festival, where costumes, parody, and songs serve as primary means of articulation (Mariscal, 2022, p. 206).

In the past, in the town of Corleone in Sicily, during the festivities, families and friends would gather in their homes to spend the evenings dancing, eating and singing 'i dubbi', riddles containing sexual references that, though prohibited by religious morality, provoked laughter among those present. Meanwhile, the streets were animated by masked figures, including the *riavulicchi*, who engaged in spontaneous group jumping and dancing, accompanied by the *cianciane tintinnanti*. On the final day, Mardi Gras (*Martedì Grasso*), the *Nannu* puppet was burned following the absurd reading of its will. This event, traditionally held in various neighbourhoods, represented a ritual sacrifice of a figure bearing the burdens of all evils, marking the birth of new forces (Cascio, 2022, p.108). With regard to the social and institutional dimensions of carnival, Matus & Aldana (2021) identify two key aspects in the Carnival of Barranquilla, Colombia, that shape audience participation: 'familiarity and spontaneity' and 'security and organisation'. The first aspect relates to the event's strong community foundations, its deep local roots, and its connection to historical memory. These elements foster social gatherings, the enjoyment of the festive moment, and improvisation. The second aspect concerns the in-

3 All interviews in the text were conducted by the author. A code is indicated to anonymise the testimonies.

4 In south Spain, "Peña" is a traditional bar where carnival groups usually practice their repertoire.

stitutional and managerial structures that regulate the event, ensuring its organisation and security while also highlighting the social contradictions that influence public participation and attendance.

The relationship between home and street, as well as between intimacy and impersonality and between familiarity and organisation, is particularly significant in the context of Sicily's small villages. Since the mid-twentieth century, a transformation in carnival events has been observed, shifting from celebrations held within homes to large-scale performances in the streets of the town. Another crucial aspect of the carnival phenomenon concerns its representative function as a ritual. One perspective in the study of rituals focuses on how elements of everyday social life are elaborated and dramatised within the festive moment—a concept that Buttitta (2010, p. 208) defines as the 'representation/dramatisation of social chaos'. This dimension, often overlooked in analyses of carnival, entails the transformation of real-world elements to create a 'new world'—a unique, highly significant, and politically charged moment. The dramatisation of everyday problems through ritual and myth offers an opportunity to reflect on the real world while also imagining an alternative one. Da Matta (1991, p. 25) explores how the ritual mirrors the social problems that triggers it, revealing «aspects that are normally submerged in daily routines, interests, indifferences, and other such complications».

In various traditional societies, dramatisation played a role in regenerating social cohesion and solidarity during times of crisis, counteracting processes of individualisation. In modern societies, by contrast, the ritual seeks to construct collective moments in which individuality is emphasised—whether represented by the local territory, an ethnic identity, or individual participants in the festive event. Within this framework, competitive and agonistic elements are integrated through the ritual to form 'omnicomprehensive totalities' (Da Matta, 1991, p. 18). However, different ritual combinations today accommodate both solidarity and individuality. Competition, which Cailliois (2017) defines as *agon*, is one of the fundamental categories of play and manifests as a rivalry focused on a specific quality or attribute—be it ingenuity, endurance, memory, or other skills defined by the rules of the game—within well-established limits. Competition is a recurring feature in various festive expressions, such as in *contrade*, which represent neighbourhoods during *palii* or historical games, and in the structural division of the city based on «complex symbolic markings», as observed by Fabio Dei (2017, p. 21) in historical re-enactments. As Di Pasquale (2017, p. 176) notes in his description of the *Ferie delle Messi* in San Gimignano, competition does not necessarily conform to specific cultural criteria, nor does it always produce discriminatory effects. Instead, it fosters an atmosphere of enthusiastic engagement among groups and stimulates participation.

Following Simeoni's (2016, p. 90) perspective, local events should be analysed by considering their particularities in the «vitally current» moment. While these events recur annually, they are unrepeatable in their combination of tradition and modernity. Such celebrations evoke memory while simultaneously drawing inspiration from global trends, incorporating elements of invention, imitation, and negotiation. Beyond pursuing economic interests and seeking media visibility, local festivals contribute to the production of social bonds, emotional connections, and a sense of communal belonging. In this postmodern urban context, carnival remains a popular festival, though not in a strictly traditional sense. Rather, it takes the form of 'a hybrid entity' (Matus and Aldana, 2021, p. 5), in which public and private institutions support traditional events in response to weakening community ties. Regarding the changes of carnival events in twentieth-century Italy, Mirizzi (2017) describes the consolidation of mass culture in the 1980s and 1990s, as well as the diffusion of transnational cultural models. When these global influences intersected with local traditions, the latter began to be perceived as remnants of a past world, associated with the elderly and often at odds with the expectations of younger generations. Today, this declining popular culture is being re-evaluated in response to a renewed interest in local identity and authenticity, often linked to tourism initiatives. In this context, Buttitta (2010, p. 234) describes contemporary 'popular' Carnivals, still alive in various inner areas and towns in Sicily, as disconnected from «traditional ceremonial systems», which have been excluded from

the calendrical festive cycle and desacralised. From this perspective, carnival has become an occasion for social gathering, entertainment, and collective reunion. In regions facing demographic decline, it serves as an opportunity for identity affirmation and local image promotion. Since the late twentieth century, the rediscovery of festive culture—both as an expression of belonging and as a driver of economic growth through tourism—has been critically interpreted as a process of «reification and instrumentalisation to the needs of the economy» (Rossi and Vanolo, 2010, p. 54). What was once a cultural dimension free from such impositions has now become a factor in capitalist development, repurposed to meet the demands of consumption and distributed on a global scale. At this point, a question arises regarding the meaning of carnival in contemporary society—a time in which, paraphrasing Bauman, liquidity has blurred the boundaries between culture and *loisir*, culture and entertainment, and authenticity and reinvention (Melotti, 2010, p. 61). While the rediscovery of traditional festivals is not only driven by commodification, it reflects a dual interest: the revival of an identity rooted in the past and the pursuit of authenticity within the framework of new media culture. The economic dimension of carnival as a «collective totemic event» is thus intertwined with its symbolic content. In this regard, Melotti (2010) describes how the process of glocalisation transcends borders and distances, bringing mass-consumed cultural elements from Brazil and the United States into various Italian carnivals. These new cultural elements may embody values that are different from those that originally characterised carnival celebrations. Nonetheless, new traditions can be invented that are recognised by the local inhabitants after a few decades. In this case, the notion of tradition is understood as a set of 'ritualised practices' that maintain an invariable character and reference a past that may be real or invented (Hobsbawm & Sanz, 2001).

Within Buttitta's (2010) framework of the «space-time of fun», some of the psychological and social functions of Sicily's 'traditional' carnival include its role in interrupting the continuity of daily life, fostering a temporary sense of community through participation, transgressing the dominant social value system, and satirising power. While these functions have not entirely disappeared, they now manifest in a range of urban entertainment forms, including media spectacles, stadium sports events, religious celebrations, festivals, and historical re-enactments. These are expressions of an ongoing 'carnivalisation' of society, in which entertainment is consumed as a commodity and serves to channel the tensions of life in a globalised world (Melotti, 2010, p. 64).

2. Sociodemographic Context of the Carnival in the Sicani Inner Area

Inner areas in Italy, small towns and villages less connected to metropolitan poles, are also affected by the cultural processes on a global scale mentioned above. However, in these territories, peculiarities linked to their rural condition and distance from urban centres can be observed, including depopulation. This demographic trend, together with phenomena such as unemployment, economic poverty, and territorial marginalisation, has contributed to the loss of cultural diversity and the vulnerability of tangible and intangible heritage in European rural areas. Local cultural and heritage resources, in turn, are fundamental in the development of these communities, representing opportunities for economic competitiveness and social cohesion in the mentioned territories (De Luca & Tondelli, 2022).

The depopulation and abandonment of inner areas, mainly concentrated in rural and mountainous regions of the country, is a long-standing historical-geographical process. This phenomenon is currently presented as a consolidated trend, organically linked with global dynamics, and is altering social, economic, and cultural conditions at the local level (Macchi Jánica & Palumbo, 2019). This demographic trend is observed in inner areas throughout the national territory, but with greater intensity in the South and in small municipalities (ISTAT, 2022).

According to Barca (2022), the marginalisation of inner territories arises not only from the loss of the crucial roles they once played in the overall territorial functions, which were supported by

usage, productive activities, and historically rooted social bases, but also from the urban imaginary that relegates them to a status of ‘remnants’ as opposed to metropolitan centers (De Rossi, 2018). Additionally, the ‘metrophilic culture,’ which exclusively associates modernity with large urban centers, views inner areas as places of refuge and seasonal leisure, or as ‘salvific’ spaces in the context of pandemics and climate change (Mussolino, 2023, p.145).

Moreover, the new model of urban-rural relations, characterized by high mobility of people and information, diverges from the previous static conception of Inner Areas. These regions now exhibit a cosmopolitan and hybrid character, facilitated by access to education, urban employment, and consumption (Querol & Ginés, 2021). From this perspective, one dimension of ‘rurbanity’ (Hoffmman et al., 2023) concerns the ‘lifestyle’ that leads a portion of the population to perceive themselves as «a little bit urban and a little bit rural» (Micheletti, Saravia, & Letelier, 2019, p.127). This dual belonging stems from the fact that, although they reside in cities, they maintain connections with rural areas due to their familial origins and the need to travel for certain activities. The carnivals analysed are located in the Sicani area, within the province of Agrigento in southern Sicily. This territory has been classified as an ‘inner area’ under the framework of the National Strategy for Inner Areas (SNAI), a national policy aimed at addressing the territorial marginality of municipalities defined as peripheral based on their distance from health, education, and rail services (De Toni et al., 2020). The SNAI identifies priority groups of municipalities that, through local partnerships, develop specific intervention strategies tailored to each territorial reality. In the case of the Sicani, the strategy was adopted to group 12 municipalities. To the northeast of this area, the three municipalities analysed—Alessandria della Rocca, Bivona, and Santo Stefano Quisquina—are situated in the hilly and mountainous region of the Sicani Mountains. The main towns of these three municipalities are approximately 15 kilometers apart.

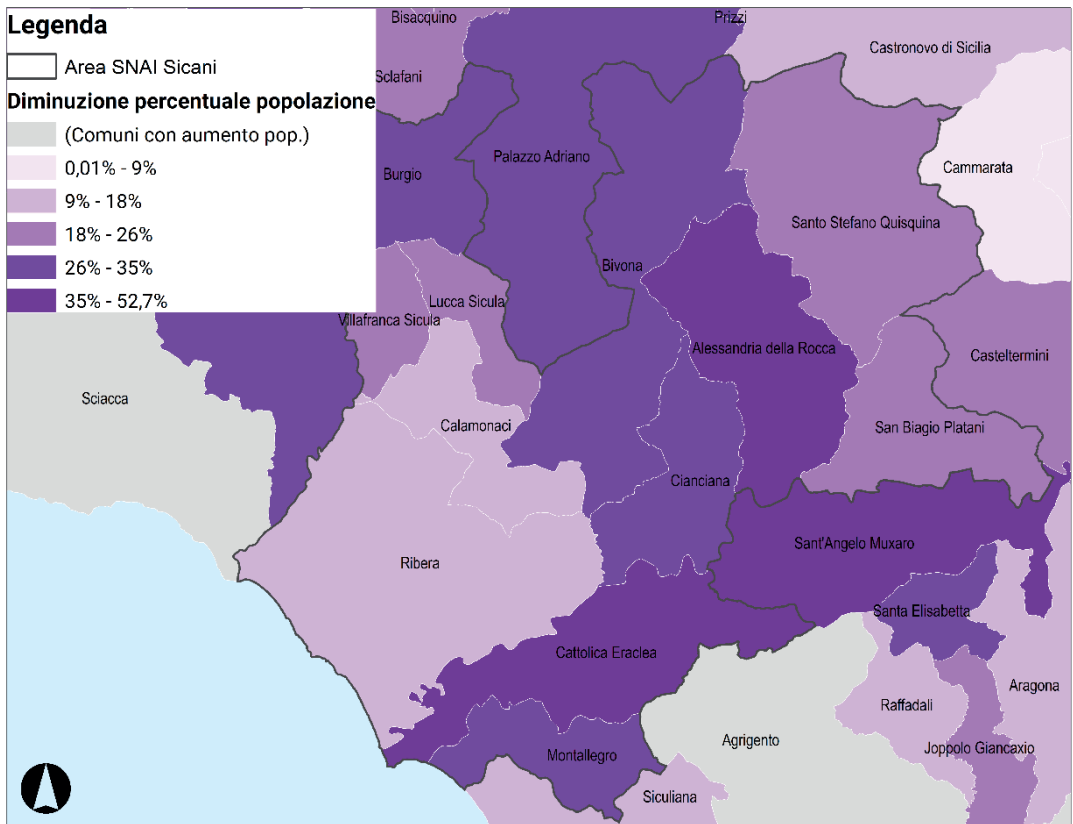


Fig. 1 - Percentage variation of municipalities in the Sicani inner area. ISTAT Census 1991-2018, SNAI intervention areas. Elaborated by the author.

The Sicani Inner Area is characterized by one of the highest percentage decreases in population over the 2011-2020 period (10.3%) (National Committee Inner Areas, 2022) and the highest proportion of peripheral and outermost municipalities (84.5%) compared to other SNAI Areas in Sicily⁵. Additionally, this area exhibits the highest percentage decrease in Utilised Agricultural Area (UAA) between 2000 and 2010, in relation to other Inner Sicilian Areas, with a reduction of -13.4%, falling well below the average of the Italian Inner Areas (-3.02%) (Census of Agriculture ISTAT, 2000; 2010). These data indicate a scenario of depopulation and peripherality, compounded by the decline in agricultural production and the traditional productive functions in these areas. As the Sicilian Region states (2021, p.3): «the homogeneity of the area is characterized by the economic fabric of the territory, predominantly agricultural with low income, lacking in the industrial sector and services, and with GDP per capita lower than the regional average».

In particular, the municipalities within the Sicani area show a significant decrease in population according to the ISTAT 1991 and 2021 censuses. Specifically, Alessandria della Rocca experienced a variation of -51.1%, Bivona -35.8%, and Santo Stefano Quisquina -26.1%. Despite the territory's demographic challenges, various institutional documents highlight positive conditions in other areas. For instance, the Sicilian Region (2021) notes the rich historical, cultural, archaeological, and natural heritage, and the consequent potential for the tourism sector. The first Local Development Plan (LDP) of the GAL Sicani (Local Action Group), anticipated in 2009, emphasized the historical and cultural values present in the area's villages, particularly events such as religious festivals and fairs linked to various local food productions, which have deep-rooted culinary traditions, handicrafts, and manual labour techniques.

Among the territory's priority needs, the LAP identifies: «enhancing the rural cultural heritage by recovering or strengthening the territories' identity, promoting culture in rural areas (literature, music, cinema, theatre, etc.), and recreational activities» (Sicilian Region, 2009, p.15). Moreover, the Sicilian Region (2021) explicitly indicates that the Sicani area stands out for its cultural and traditional events that enrich its annual calendar of activities, holding significant potential for tourism. However, it is emphasized that it is necessary to complement the actions of dissemination, protection, and promotion of material, archaeological, and natural heritage with the enhancement of its intangible dimensions, as noted by Gana (2022, p.132), by strengthening the existing cultural activities and events, as well as the actors and communities that manage them.

3. The Carnival in the “Sicani Area”

Various secular festive events and others linked to the religious calendar are active and socially rooted in the Sicani area. In almost all towns in this area, the ancient agrarian and religious symbolism of loaves of bread is represented on altars and tables, a tradition especially renowned in Chiusa Sclafani, Cianciana, and San Biagio Platani, where the 'Easter Arches' (Archi di Pasqua) festivity also takes place, attracting tourists from all over Sicily. The riggattiate, uniquely celebrated in Burgio during Holy Week and in Calamonaci for the feast of San Vincenzo Ferreri in August, is another event that remains strongly felt today (Cicala, 2015).

Carnival, while part of the religious calendar, has a secular character and still thrives in several towns in the area. For instance, in February 2023, it was celebrated in most municipalities of the area, including San Biagio Platani, Santo Stefano Quisquina, Bivona, Alessandria della Rocca, Montallegro, Cattolica Eraclea, Ribera, and Villafranca Sicula. In 2024, the event was revived by a municipal initiative in Burgio, Cianciana, and Lucca Sicula.

In the three analysed municipalities, Carnival is one of the most significant secular festivities in the annual calendar, with a local rootedness comparable to that of religious festivities, which sometimes attract more tourist interest. This rootedness also has historical foundations: in the

⁵ Data from the map of Internal Areas, with methodological support from NUVAP (Department for Cohesion Policies) and NUVEC (Agency for Territorial Cohesion).

past, Carnival involved the entire community, regardless of local peculiarities related to festive expressions. Today, Carnival celebrations are confined to small towns and the main streets. Each municipality provides limited resources to help build an allegorical float and support other expenses. Youth groups associated with the festivity and some associations coordinate fundraising among small local businesses for additional financial support to organize the event, design and build the float, and produce costumes and other necessary materials.

«Because of the economic situation, many young people are forced to emigrate to the north or even abroad for study or work reasons; consequently, these small communities remain somewhat uninhabited. Those of us who remain, whether we are in high school or fortunate enough to work in our hometown, manage to organize activities in our own small way [...] the municipality has funded part of these activities, but all the local businesses also contribute as sponsors» (Interview 01, Santo Stefano Quisquina, 18/02/2023).

Until the 1950s and 1960s, Carnival had a less spectacular, yet more community-based and sharing version among fellow citizens, as described in the various villages through the memories of those interviewed. It consisted of celebrations inside the village houses, opened specifically for the arrival of masqueraders, who, led by a non-masked character, the *bastoniere*, partied wherever there was music for dancing—also sharing simple, homemade food—while visiting different houses during the festive evenings. According to Bausinger & Sordi (1982, p.89), the carnival ‘forms of interaction’ at that time were housebreaking and dancing. This event was reportedly being revived by local associations in towns such as Palazzo Adriano, where masked youth dressed as shepherds, with large sticks in their hands, were already running and dancing «accompanied by carnivalesque shouts» in the main squares and streets at the end of the 19th century (Pitrè, 1889, p.23).

«They would come and ask: tenemo lo sonu? And there were all these people who dressed up in masks and wandered around these houses where the ‘sonu’ (sound or noise) was kept. There was a gentleman who would escort the masquerades, talk to the owner of the house and say: I have a group of masks. Since we all know each other here, it’s a small village, so he would give the consent to let the masks in» «On Saturdays and Sundays there was ‘sonu’. On Tuesdays there was carnival and then we traditionally had the ‘carnelevarune’, which meant that on the following Sunday we had the last carnelevarata, the last dance, the last evenings, and we were always hanging around [...] This type of carnival lasted until the late 1960s and early 1970s» (Interview 02, Alessandria della Rocca, 19/02/2023).

In the following decades, allegorical floats and outdoor festive activities, which included parades, processions, and masked dances around the floats, became the predominant events, replacing the tradition of lo sonu and house-to-house dances. One of the reasons for this shift can be traced back to the influence of the Matricola festivity from the 1960s onwards, which gained prominence as increasing numbers of younger people enrolled to the university (Green, 2023). Consequently, carnival expressions evolved towards celebrations that required more expensive and complex material production, both in the construction of the floats and the manufacture of costumes and the management of the event. Broccolini (2013, p.62), describing the Lenten carnival in Poggio Mirteto, defines this festive mode as a «typically urban carnival», in the Parisian style of the late 19th century, characterized by parades of floats, dances, and parties. From Buttitta’s (2010, p.241) perspective, contemporary Sicilian carnivals draw inspiration from spectacular carnival events of various origins, such as those in Venice, Viareggio, and Rio de Janeiro; an argument that aligns with Melotti’s (2010) observation on the influence received by Italian carnivals from abroad. These hegemonic models became established especially since the 1960s through media such as radio, press, and television, and can be observed in Sicilian rural communities.

In this process of transformation, the influence of major Sicilian carnivals such as those in Sciacca and Acireale, where the floats are the main attraction, has been significant. In addition to the changes in material elements, important symbolic elements were introduced during this period, such as the drafting of allegories with poetic and ironic connotations, referring to local and national actuality, as well as the representation of historical characters and worldwide stereotypes. In the three countries analysed, a decline in participation in Carnival and a decrease in the impact of this activity can be observed in recent years, a phenomenon resulting from various institutional, cultural, and demographic factors. For example, interviews confirm that the resources made available by the municipality for the production of Carnival have progressively decreased: «we feel that gradually this tradition is fading away because primarily the economic problem... that money is the main problem of realisation, then depopulation» (Interview 03, Santo Stefano Quisquina, 15/04/2023). These funds were used to finance the infrastructure of the event, i.e., the construction of the float, the dressmaking of the costumes, the logistical and technical production, as well as the cash prizes for the various competing categories. In previous decades, the funds allocated by the municipalities were larger and allowed for the construction of more floats. Additionally, these resources had a positive effect on the local economy, benefiting shops, tailor's shops, and encouraging the arrival of visitors. With the reduction of these resources, these positive impacts gradually diminished.

The agonistic dimension, enabled by the presence of several floats and masked groups in each village, is significant, as it is one of the symbolic motivations that drove various youth groups to put their best efforts into creating a creative proposal: «the carnival comes from there. The sprint, the desire to make the most beautiful float is born precisely because there is an active competition, a healthy competition because there are no quarrels [...] we know each other, we are friends, but when the Carnival period begins we are rivals» (Interview 03, Santo Stefano Quisquina, 15/04/2023). The agonistic motivation and group involvement that this non-exclusive competition entails are aspects previously noted by Callois (2017) and Di Pasquale (2017).

Prior to the 2020 pandemic closure, witnesses report that the formation of antagonistic groups was sometimes influenced by the presence of a specific memory bearer, who attracted their own circle of friends. However, in 2023, the reduction of resources offered by the municipalities led youth groups to unite in the construction of a single float for each village. This change has not resulted in a loss of the festive spirit, although motivation has suffered, especially in Alessandria della Rocca, where participation has greatly diminished and needs greater encouragement and guidance from the associations organizing the event.

4. Social Dynamics and Festive Traditions

From the interviewees' testimonies, it emerges that Carnival in this area was severely affected by the recent COVID-19 pandemic, during which, like many other cultural events, it was suspended. Its resurgence has not been easy, as the dynamics of interaction and familiarity, which were renewed each year for the organisation of the event, had dissipated. The motivation of the youth groups, which in each country drove the realisation of the carnival, has diminished to some extent due to migration processes, the scarcity of available resources, and the reduced time available for organisational management, also influenced by the late opening of calls for tenders by the municipalities. «For two years we had no carnival because of the pandemic, so the spirit had been lost a little. For example, sometimes they use the old structures, they transform them, instead, now they have been lost because for two years they abandoned them [...] if before they were seen more often now, they are seen less [...] So everything has become more complicated» (Interview 04, Santo Stefano Quisquina, 10/01/2023). «(The impact) could be even better, you could do more, (but we have) very low costs. How do you make structures, beautiful things? because you stimulate people like this, there is a prize, we pay for everything, let's try [...] Here we

arrive every year at Carnival the last days. How do you stimulate the children to do things, when such bureaucracy...? Besides, if you say it fifteen days before, it's complicated to solve» (Interview 05, Alessandria della Rocca, 19/02/2023).

Despite these difficulties, the festival still maintains an important gathering function and a 'sense of communion' (Simeoni, 2016), characteristic of contemporary 'popular' carnivals, as defined by Buttitta (2010). This function, particularly relevant for young participants, manifests itself in the preparation process preceding the activity, involving the collective creation of the allegorical float and choreography, inspired by concepts significant to the community. In these processes, unique moments of meeting and sharing occur throughout the year, which also motivate the return to the village of some young 'emigrants'.

«The best thing is not only the three evenings of Carnival, it's all the preparation that goes on beforehand. The guys rent a garage, a warehouse, and for more than a month, they build the float. Obviously, it's not really work, but it's an aggregative moment, so in the evening, you eat together, you put on music, you have company» (Interview 04, Santo Stefano Quisquina, 10/01/2023). «There were guys waiting to book the plane to come back for Carnival, which shows that there's still an attachment to this tradition» (Interview 06, Santo Stefano Quisquina, 10/01/2023).



Fig. 2 - 'Power, consumism, taboos are the laws of RAI TV', Alessandria della Rocca carnival 1983, and the 'Mamma RAI and Marco Polo' float. Source: photograph by Armando Cannata.

Regarding the ritual aspect, Carnival still retains some significant elements, albeit of recent origin. These elements are expressed in the dramatisation of the allegory embodied in the float itself, in the costumes, and in the composition of the hymn, which is learnt by the community during the period of preparation and reproduced during the parade. Specifically, one of the fundamental forms of Carnival communication in these countries is the allegory, defined by the interviewees as an easily understandable carnival idea with a social and topical theme, represented through the structure and characters of the float.

Individuals working on the creation of the allegory generally possess more experience and a greater personal commitment than the majority of young people involved in the construction of

the float. Filippo Mortellaro, a young student from Santo Stefano Quisquina involved in designing the allegory, inherited significant experience from his father, who built floats, and from his grandfather, Gaetano Ippolito, who acted as a *bastoniere* (Baton twirler) in the 1960s. However, the new generations experience some difficulties in fully understanding the importance of allegory:

«The allegories used here in Alessandria, as in all villages, are subjects that concern either the town or the nation [...] We'll base it on the local administration of this village and also generalize to Italy, because 'Toyland' (il paese dei balocchi) can also refer to Italy and Italian politics of the last 30 years. The problem is that I understand it. When I tell them -we have to see the allegory inside the cart- they ask: why? Because otherwise there is no point in making the float» (Interview 05, Alessandria della Rocca, 19/02/2023).

The idea of the allegory can be developed by an individual or a group, which chooses the basic theme from several proposed alternatives, related to local, national or international current events. Once the theme is decided, the allegory is represented in a sketch and, in some cases, written in a poetic text. An allegory with an international subject inspired the King Kong float of 1983, one of the most remembered in Bivona:

«King Kong was a structure, a giant, an animal that you see in the movies, but our reality was to show that at that moment in history, where there was the possibility of a third world war, to show Russia and the US confronting each other, and there was this big chimpanzee holding both the Russian leader and the US leader, and saying that if it's the third world war, I will be the one to rule, that is a return to prehistory, a return to being ruled by chimpanzees» (Interview 07, Bivona, 18/02/2023).

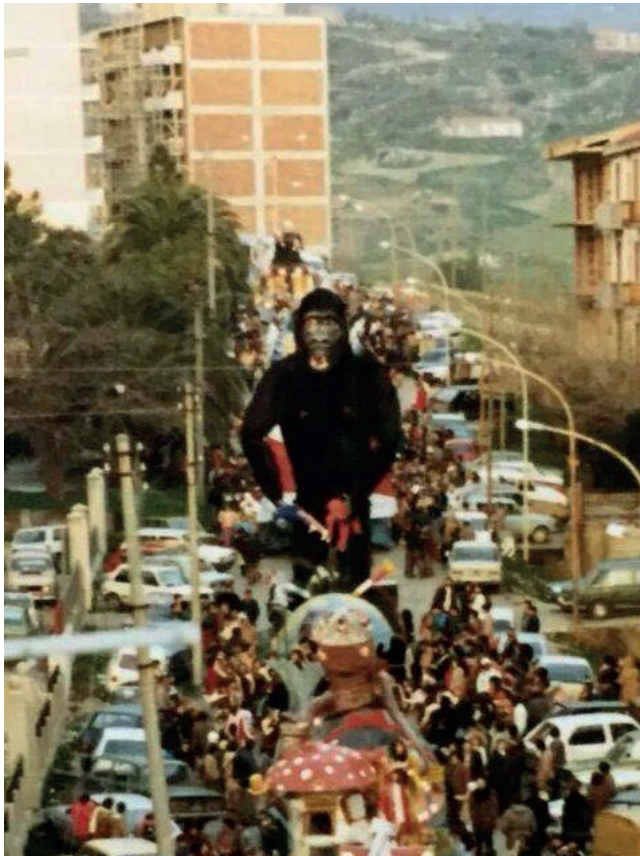


Fig. 3 - 'King Kong' allegorical wagon in the streets of Bivona, 1983.
Photograph sent in by Matteo Baio.

In 2023, the young *carristi* (float builders) of the Bello Lampo Group chose a subject for the allegory for the Santo Stefano Quisquina Carnival that is particularly relevant to the demographic problems in the small municipalities of the Sicilian inner areas. The allegorical float is entitled «A forza di ni nni iri lu carnevale va a finiri» (By dint of leaving, the carnival comes to an end). The allegory is dedicated to the local territory and underlines how the Carnival tradition is being lost due to economic problems, depopulation, and youth emigration. The return to the origins is represented by the traditional masks of Harlequin and Columbine, while the eagle, which takes a «flight of improvement», represents the passion for Carnival of a friend of the group of *carristi*, who passed away a few years ago and who had conceived the idea for this design (Interview 03, Santo Stefano Quisquina, 15/04/2023). The allegory reads as follows:

«Migration changes traditions that remain the heritage of all humanity. 'Escape' has changed the lives, the daily lives of the young people, but there is one thing we have learnt most of all: the desire to 'return to traditions'. In the float, Harlequin, Columbine, Punchinello, Pantalone and the eagle, an animal that masters in the foreground, symbolize the desire to return to the nest. The remaining figures emphasize a great desire to return to the past, that traditional past that made carnival rich and prosperous, to which each of us, with a lump in our throat, always remains anchored» (Frammento dell'allegoria. Gruppo Bello Lampo, 2023).



Fig. 4 - Sketch of the allegorical float 'A forza di ni nni iri lu carnevale va a finiri', Carnevale Quisquinense 2023. Drawing by Filippo Mortellaro.

The allegory underlies a second form of communication, namely, the Carnival anthem that serves as the soundtrack for the float. It is an original song, meant to be sung, characterized by cheerful carnival music with a tarantella beat and other traditional rhythmic elements, reinterpreted in a pop key. The hymn of the Carnival of Santo Stefano Quisquina 2023 was composed and produced by Salvatore Cacciatore, a local musician, who involved the *carristi* and some local personalities in the creative process, both in the composition of the song and in listening to what

was being created in the recording studio. Once completed, the song is distributed throughout the village so that it is known by everyone during the festivities.

«The anthem is a very important thing. So all the young people come to my studio to listen to what is being born, to see what it is because there is so much expectation. The anthem then is very catchy, it must immediately stick in the head. So already before Carnival, I give them the CD already prepared, the whole company knows it by heart and immediately there is a total diffusion of copies and everyone knows it. The evening of Carnival they all go out and by the time I put the hymn on everyone already knows it. [...] what makes the difference, however, is the theme, i.e., the allegory in the float, because if it's witty it's already an extra plus, and it also makes a difference the group of young people for that kind of float» (Interview 08, Santo Stefano Quisquina, 09/01/2023).

The Carnival anthem is now considered an established 'tradition' by interviewees. This expression arises from the passion for Carnival, and the desire for community involvement in the creation process. Although the hymn is a relatively recent tradition, it has taken root in these small villages in recent decades. In the 1980s, anthems did not yet exist; instead, amplified music was played on floats, often carnival and Brazilian music, but not specifically created for the occasion. Anthems, in the form we know today, emerged in the 1990s, as Pietro Lattuca recalls in reference to Bivona. Lattuca composed the music for several songs for the floats, some with lyrics written by local poet Giuseppe 'Beppe' Scili Bellomo. In Alessandria della Rocca, one of the musicians who has recently worked on composing carnival anthems is Daniele Guastella. These new carnival songs follow the rhythmic and sound pattern of the Sciacca Carnival anthems.



Fig. 5 - 'Ballets in front of the allegorical float'. Carnival of Santo Stefano Quisquina 2023.
Source: photograph by the author, 19 February 2023.

The social topics present in the allegory and their subsequent staging in creative elements such as the float, costumes, and anthem are concrete examples of the «representation/dramatisation of social chaos» through a contemporary carnival event. In today's Carnival, social cohesion and collective reaffirmation are manifested in public spaces, i.e., on the street. However, during the

periods of preparation and construction of the creative elements, the dimension of familiarity in intimate encounters and the weaving of social bonds in closed spaces are crucial. This process takes place in warehouses where the float is built, in bars, or sports centers where the choreography is prepared.

5. Final Reflections

Carnivals in small Sicilian villages have undergone significant changes in recent decades. Since the 1980s, celebrations have shifted from a logic of familiarity, spontaneity, and intimacy to one of impersonality, organization, and security (Matus & Aldana, 2021), moving from the house to the street (Da Matta, 1991). In this transformation, the incorporation of global cultural elements (Melotti, 2010) and the influence of other Sicilian carnivals, such as that of Sciacca, have conferred a greater character of spectacularity and competition (Caillois, 2017). In these rural contexts, a popular and contemporary carnival is configured (Buttitta, 2010) which, although it maintains ritualized practices that are locally recognized as traditions, is of recent origin and incorporates elements of invention: techniques and knowledge in the construction of floats, literary forms and satire in the allegory, musical and poetic forms in the anthem, 'forms of interaction' (Bausinger & Sordi, 1982) and entertainment in the carnival evenings.

In an attempt at identity affirmation, these practices are integrated into the dimension of cultural events that, in addition to contributing to social gathering, promote the local image in contexts of economic decline and depopulation. However, Carnival still maintains dynamics of dramatization of social chaos (Buttitta, 2010), especially through its creative elements: the float, costumes, dances, and 'forms of communication' such as allegories and anthems, which incorporate relevant community issues such as depopulation. Indeed, in spite of demographic trends, the artistic groups, associations, and communities of carvers that still remain in these villages continue to express their resilience through creative carnival work.

Carnival still represents an opportunity for meeting and social gathering, especially among young people, but there is also a gradual loss of motivation by these generations, due in part to the diminishing presence of people in the organizing collectives and spectators, key groups in events that, just a few years ago, involved an important part of the community. In the interviews, the issue of the predominant role played by technology and social networks for the younger generations emerges as a factor in the limited interest in 'traditions' and popular festivities. On the other hand, the motivation and commitment shown especially by the young girls of Alessandria della Rocca, in comparison to the boys, when carrying out cultural projects such as Carnival, is emphasized.

The demographic problems are highlighted in the discourses of the interviewees, especially in relation to the emigration of young people. External support and the few 'new energies' that fuel cultural activities in these villages are unable to counteract the effects of demographic decline. These trends also have an impact on the decline of people mastering the traditional trades and crafts behind Carnival production. This brings to a halt the process of passing on cultural knowledge to new generations, as with the technique of cartapesta (papier-mâché) and iron structures for the construction of the float, as well as with costume tailoring, which is now being replaced with clothes bought on the internet. These difficulties are not adequately addressed by administrations which, with a few exceptions, allocate decreasing resources to this activity every year.

A stronger institutional commitment to Carnival within the events calendar, including a certain amount of financial support, could initiate the revival of this moment of social and creative encounter, especially for young people. An example is the municipality of Cattolica Eraclea, where resources for Carnival have increased considerably in recent years, bringing good results (Interview 09, Cattolica Eraclea, 29/08/2023). In addition, the inclusion of Carnival in an intermunicipal logic, with social, cultural, and economic objectives, could have positive effects in these

depopulated territories, overcoming the fragmentary character of initiatives, which limits the effectiveness of cultural actions and increases the risk of banalization, in the logic of the spectacularization of art as decoration (Crobe, 2023).

Finally, a more accurate planning of the event could allow the connection with the Carnivals of the neighboring countries, the organization of common activities, the integration of associations and cultural stakeholders beyond the limits of each municipality and, as a possible positive impact, a greater presence of tourists, as well as local inhabitants returning to the village on the celebration days. This should be achieved without neglecting the pursuit of the aims of social cohesion of the most vulnerable groups, an aspect often not adequately addressed by the so-called 'cultural instrumentalism' initiatives (Rossi & Vanolo, 2010, p.68) for the promotion of culture in order to achieve development goals.

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Italo Calvino and the Invisible Cities: Between Literature and Urban Sociology²

1. Social sciences and rêveries

Urban sociology is a strange discipline, with an apparently clear, simple and well-defined object: the city. A concrete, visible and knowable reality that belongs to everyone's daily experience, including scholars'. Its widespread presence and historicity make it an essential part of the social and cultural imagination. Yet this object loses its consistency as soon as one approaches it and tries to conceptualize, narrate or represent it. In short, a reality that is visible to all but resists any interpretation. Of course, this is a problem for those who study it.

It is therefore understandable that, when faced with a book like *Invisible Cities* by Calvino—which seems to refer to every possible type of city and suggests the existence of a mechanism that can explain cities while representing them—the sociologists might react with curiosity, suspicion and even a hint of envy.

Among the numerous passages in the book that seem to propose an urban theory, one stands out. The Great Khan, for whom Marco Polo is illustrating the cities of his vast empire, tells him: «I have constructed in my mind a model city from which all possible cities can be deduced. It contains everything corresponding to the norm. Since the cities that exist diverge in varying degree from the norm, I need only foresee the exceptions to the norm and calculate the most probable combinations» (*IC*, p. 64)³.

The tone is that of a wise and powerful emperor. But in this crucial passage Calvino explains how he constructed his text, based on a logic that is almost scientific, deducing cases from a model. That sentence, in fact, synthesizes the work of the social scientist, whether an urban sociologist, a historian of the city or, in a more practical way, an architect or a urban planner, figures who often create variations from a model. Marco answers him that he, too, has a model of a city from which he deduces all the others: «a city made only of exceptions, incongruities, contradictions» (*ibidem*). In short, it is a strong interpretative model that, owing to its transformative character, encompasses realities with flawed and elusive elements.

Literature can afford to construct entire worlds without the anxieties of the social scientist, from whom the community expects credible demonstrations, made authoritative by increasingly refined methods. The writer creates worlds—fantastic, plausible, or seemingly so real as to be indistinguishable from our own—for which he is not accountable to anyone. The same happens with science fiction and movies, creating cities and urban systems often based on utopia, dystopia and even social theory, as in Fritz Lang's *Metropolis* (1927). Instead, the social scientist feels the need to demonstrate what he writes, and in doing so, especially when he is aware of the artificial and debatable nature of literature, he seeks to distance himself from it as much as possible, emphasizing the gap between his work and imagination. Of course, it hasn't always been so, and we know great social scientists who could elegantly play with words and images, just like writers, while also being able to describe and interpret the world.

In urban sociology, references to Calvino and his imaginary cities are frequent, although only few scholars have dared to explicitly mention his book in their writings.

One of them, Guido Martinotti, who also had a great passion for literature (and science fiction), during his lessons liked to refer to Calvino with a mix of admiring deference and sharp criticism. In a collection of lectures published posthumously, he seemed to have *Invisible Cities* in mind

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3 The quotations of *Invisible Cities* (*IC*) are taken from the translation by William Weaver. The page numbers refer to the 2023 digital edition by Vintage Classics.

when he explained the function of his discipline as follows: «Urban social sciences contribute to understanding phenomena that are not directly observable and thus allow us to grasp the characteristics of urban society that are hidden (or not immediately visible, or latent, as one might say)» (Martinotti, 2017, pos. 554).

The study of the city—an elusive and multifaceted reality, as he used to say—essentially moves from the visible to the invisible.⁴ But when the social scientist ventures beyond experiential reality, the gap between sociology and literature paradoxically fades. Certainly, the social scientist attempts to bring this invisible dimension into the realm of science, but in accepting it, he effectively renders all the invisible cities visible. In other words, he gives phenomenal concreteness to an immaterial dimension that easily slips into the realm of imagination and unreality.

Martinotti considered the city as a reality composed of both visible and invisible elements, where «the material and immaterial components of the urban phenomenon become equally important» (*idem*, pos. 322). However, his fear of opening the door too widely to literature led him to distance himself from Calvino: it was better, he said, to use «the somewhat clumsy term ‘non-observable’ instead of the more common ‘invisible,’ as this word had been used in many metaphorical ways» (*idem*, pos. 866). For him, metaphor was a disturbing element that could mislead scientific research. A little later, Martinotti recalls Calvino among those who have made metaphorical use of invisibility. The way in which he refers to him is significant: «the ‘poor Calvino’, whose extraordinary novel, in addition to rightly inspiring the imagination of millions of readers, has unfortunately also unleashed the imagination of conference and event organizers and other mid-cult people, who often speak of it having read only its title» (*ibidem*). The reference to Calvino, to criticize such figures, shows how important *Invisible Cities* was to him.

Martinotti confirms his complex relationship with the writer: «Calvino’s urban *rêveries* are [...] beautiful passages about cities imagined by a true poet, and they give us many extraordinary intellectual emotions». But, as *rêveries*, they can be misleading. Moreover, he continues, «unfortunately, they are poorly borrowed, mostly referring to the title of the story, even to support analytical discussions about cities [...]. The (bad) literarization of the discourse on the city is not limited to novelists or philosophers but is also practiced by social scientists, who should have a different language but, as is easy to discover, when they come to talking about cities, fall into the same common syndrome» (*idem*, pos. 2681).

Calvino, like an enchanting magician, would therefore create urban worlds that not only seem real but might lead (bad) sociologists to apply their interpretive categories to them and use them as metaphors for our own world. However, the invisible reality that the sociologists study must not be confused with the unreality that literature renders visible, despite the title of Calvino’s book. The sociologists should not play with metaphors. The divide between sociology and literature is reaffirmed with an insistence that reveals the difficulty of keeping them separate.

On the other hand, Calvino himself, through Marco Polo, explains that «the city must never be confused with the words that describes it», although he immediately adds that «between the one and the other there is a connection» (*IC*, p. 53).

Calvino’s urban *rêverie* is a parallel world, clearly unreal but so complex and variable as to seem possible. The absurd rules governing it and the fabric of memories and experiences populating it define a series of specificities that give rise to a strange and kaleidoscopic reality.

Calvino chose a narrative structure that harks back to the great travel accounts, which, from Herodotus to Marco Polo, occupy an ambiguous space between report and invention, contributing to the construction of the Western cultural imagination. These accounts have helped shape history, geography and anthropology, suggesting—between Orientalism and cultural relativism—the possibility of hybridizing styles and cultures. Calvino’s characters are not only

4 In urban studies, the theme of invisibility has become increasingly central, as shows the title—clearly inspired by Calvino—of an essay that explores the invisible aspects of the city, including new inequalities, the marginalization of vulnerable populations and digitalization: *La città invisibile. Quello che non vediamo sta cambiando le metropoli*, edited by A. Balducci, Milano, Feltrinelli, 2023.

backed by illustrious progenitors, like the two mentioned above, but also by centuries of literary tradition and scientific culture, spanning from the ancient world to the present day. Calvino's Khan and Marco Polo, therefore, move simultaneously within the historical and literary dimension of the great narratives of the past and within the context of contemporary times. It is in this closeness to the present that the emperor, the traveller and, let us not forget, Calvino himself seem to get close to the urban sociologists.

In their dialogue, the Khan and Marco Polo imagine a generative combinatorial model that, through «exceptions», «incongruities», «contradictions» and «reductions», can create and explain all cities. The city—or, rather, its idea—in this theory and in the stories that develop it, is at once abstract and concrete, always describable in the specific forms it takes from time to time, yet fundamentally unknowable, partly because it is subject to continuous change. In this parallel world, reality and fantasy, likelihood and falsehood are equivalent and coexist. Just as theory and practice seem to coexist: on one side, the reference model and the shape the city takes, and on the other, the set of rules, experiences, anecdotes, perceptions and memories that bring these spaces to life.

2. Dubai and Las Vegas: Invisible Cities

If, for Calvino's Khan and Marco Polo (and therefore for Calvino himself), all cities were «implicit», i.e. inscribed within a model and deducible from it, it could be said that they envisioned even today's cities, including those they could not have known or visited because they came into being or developed after their time.

I certainly don't want to fall into the «bad literarization» of urban analysis, as Martinotti called it. However, I believe that the development of urban civilization, especially in recent decades, has expressed a kaleidoscopic, and at times imaginative, reality that, while explainable through well-known sociocultural models and processes, seems to contain an episodic irrationality bringing it closer to the unreal world of *Invisible Cities*.

The urban space that most clearly, in the current historical and cultural phase, shows a curious closeness to the generative model of Khan and Marco Polo is perhaps Dubai: a real city in every respect, with over 3 million inhabitants and now visited annually by 18 million people. A city with a centuries-old history, but essentially reborn in the 1970s and, within a few decades, transformed into a true *global city*, with a significant role in geopolitical dynamics and an extraordinary economic and cultural appeal.⁵ Dubai has become a fashionable tourist destination and, in a midst of luxury and entertainment, has cemented itself in the collective imagination as a place worth moving to, even to seek good fortune.

Dubai is undoubtedly a city Calvino could not have known. When he wrote his *Invisible Cities*, it didn't yet exist in the form we see today, with its skyline of astonishing skyscrapers, including the Burj Khalifa, 829-metre-high, which since 2010 has stood as the world's tallest building. As in a tale of Calvino's novel, it guarantees Dubai a unique identity and a record-breaking distinction. Among the many symbols of its urban landscape there is the Dubai Frame, inaugurated in 2018 and immediately hailed as one of its "must-see" attractions. This 150-metre-high frame-like structure allows visitors to admire the city from its observatory. But it is something more. It is a monument designed to be a strong architectural element enriching the urban space and reinforcing Dubai's image as a city of excess and hyper-contemporaneity. It is a monument meant to be looked at, photographed and reproduced, but also a device built to direct the gaze toward the city: not only that of tourists, but also that of those who consume it from afar, in promotional brochures or social media. It is a giant frame that celebrates Dubai as a masterpiece. Yet, this operation also marks a dystopia: the inhabited space is transformed into a stage that, in some way, excludes its inhabitants.

5 On the relationships between urban policies and tourism in Dubai, see Melotti (2014).

The city becomes intelligible through the materialization of a theoretical framework that allows us to observe it. The city itself suggests its interpretation. The Dubai Frame is a material element (thus visible) that directs and regulates our gaze, showing us what it deems useful to be seen, while (invisibly) suggesting an interpretation that extols the uniqueness of what we are seeing. We see an image that gives us the illusion of understanding the city, which, however, remains unknowable.

If we pass through the Frame and approach the city, we find a cluster of skyscrapers, iconic buildings, artificial islands, luxury hotels and enormous shopping malls. Among its most intriguing features—not less eccentric than those of Calvino's *Invisible Cities*—is the ski station inside the Mall of the Emirates. Complete with five slopes, a ski lift and a chairlift, it offers snow in a city where temperatures often exceed 40° C. Beyond its recreational and sporting dimensions, the indoor snowfields serve as a dystopian marker aimed at defining an idea of the city and asserting its status as a global city.

This world, in some ways, is anticipated and narrated by Calvino: the city with a thousand variations, where everything is possible, has become reality. A dystopia in every respect, but also a real space where one can move, have fun, consume and live.

One of the most Calvino-like spaces in Dubai is undoubtedly the Ibn Battuta Mall, a shopping centre named after the famous 14th-century traveller (a sort of Arab Marco Polo), which recreates the atmosphere of the countries he visited: Andalusia, Tunisia, Egypt, Persia, India and China. Inside, some architectural elements evoke «the charm of the centuries-old African souks», «the majestic monuments and immense wealth» of Mughal India, «the world of storms, shipwrecks, and pirates» of exploration-era China, «the covered streets of Baghdad», and, of course, the lotus-shaped columns and hieroglyphics of ancient Egypt.⁶ Themed installations complete this immersive experience: a Chinese ship, the Lion Fountain from the Alhambra and a grand mechanical clock, a marvel of Indian engineering. Similarly, another shopping centre, the Dubai Outlet Village, features an interior designed to resemble San Gimignano, with its stone façades and arches. Themed spaces, especially those created for commercial purposes and the culturalization of consumption, are recurring features in the contemporary urban landscape.⁷ In places like these, urban dystopia takes on a historical and geographical dimension: a journey through time and space that could well have been imagined by a poet, writer or storyteller, such as the Marco Polo of *Invisible Cities*. The difference, however, lies in the fact that these are “real” places within highly visible cities.

Among the many contemporary places that exhibit a Calvino-like dystopia is Tianducheng, a Chinese city in Zhejiang Province. This daring urban experiment, initiated in the early 2000s, reflects a concept of city-building (quite different from European traditions), emphasizing artificiality. Tianducheng is a vast urban complex entirely themed after Paris, complete with a scaled-down replica of the Eiffel Tower.⁸ While its outward appearance resembles a Disney-style theme park, Tianducheng is a real city, designed with residential purposes and integrated into broader territorial development and real estate speculation projects.

The city has a profoundly liquid and postmodern character, where the playful and touristic dimensions are indistinguishable from other elements of urban space. Tianducheng is a city, but it is also a dystopian space where identity merges with otherness: a place historically and spatially unconnected with its surroundings, yet deeply embedded in powerful contemporary dynamics, such as globalization and cultural interconnection. Its allure, for both residents and tourists, lies precisely in this otherness, which becomes its defining identity. Tianducheng, as a «variation» and dystopic replica of a real city, could easily fit into Khan's catalogue, where cities can sprout, replicate and resemble one another while remaining fundamentally distinct. Tianducheng is a

6 See <https://www.ibnbattutamall.com/en>.

7 On theming, see Bryman (1999, pp. 29-33).

8 For the use of theming in China, see Bosker (2013) and Melotti (2018), and, for Tianducheng's Paris, the beautiful photographic volume by Prost (2020).

new city, which, in a different space and time, reproduces a city with centuries of history—similar yet different, and unquestionably real.

Among places that help us understand contemporary dynamics and capture the interest of philosophers, urban planners, architects and sociologists, we must not forget Las Vegas. It is perhaps one of the few “fantastic” contemporary urban spaces that Calvino might have been aware of. With its themed hotels, casinos and restaurants, Las Vegas is a special urban space, which pioneered a new type of city, devoted, at least initially, to gambling, sex and entertainment. It is a city built for a transient population: gamblers, tourists, newlyweds and convention attendees. Its residential function, though significant, is conceptually residual: workers who keep the hotels and casinos running live in a sort of parallel ghost city. Time and space in Las Vegas are molded to delight its consumers, with architecture inspired by ancient Rome, Pharaonic Egypt and Venice.⁹ For these peculiarities, Las Vegas could easily belong to Calvino’s invisible cities.

In some respects, Dubai can be considered a new Las Vegas and, in a consumer-driven society always in search of novelty, has actually surpassed it. However, in 2023, Las Vegas inaugurated an attraction, the Sphere, which, thanks to its strong iconic power, has entailed its return to the global imagination. It is an enormous sphere, over three hundred metres tall, entirely covered in LEDs, capable of creating a potentially infinite number of images. Among those that have most caught attention, there is the large eyeball, which seems to gaze at those who look at it. Las Vegas is the city of gambling and entertainment par excellence, but, in a changing sociocultural context, this gives way to unsettling elements. The great eye of Las Vegas is designed to be consumed by the tourist gaze, but it presents itself as a space dominated by something that looks, observes, controls and even judges. The Sphere is an element that characterizes the urban reality and in some way regenerates it. Owing to its uniqueness, it would not look out of place in one of Calvino’s invisible cities, whose communities seem to be at the mercy of the elements they helped create, but which escape their control and make them prisoners.

In our world, in fact, many variants can coexist and, above all, reality and artifice often end up hybridizing, accompanying the “liquidity” between past and present and between living, productive, consumptive and recreational dimensions, heightened in the postmodern context that was forming when Calvino was writing his *Invisible Cities*. At that moment, Calvino was probably observing the ongoing change with a critical eye, though not yet clearly defined.¹⁰

The Caesars Palace, the large Roman-themed casino hotel in Las Vegas (a precursor to postmodern theming and one of the symbols of postmodernity), was inaugurated in 1966, just six years before the publication of *Invisible Cities*. Urban planners and architects began reflecting on the new urban realities that, like Las Vegas, were then emerging. Robert Venturi’s famous essay on Las Vegas (1972) was published in the same year as *Invisible Cities*. The work of his group on this city proposed an interpretation of the meaning of spaces that (as he himself explained when accepting the Pritzker Prize) show the vitality of urban sprawl and allow us to recognize the importance of mass culture for architecture, the «genius of the everyday» and the significance of the commercial dimension of our culture (Venturi, 1991). In those same years, Umberto Eco (1976) discovered Disneyland, «a world of fantasy more real than the real world», and published an essay on hyperreality, which would have a remarkable influence, not only in Italy.

3. Between narrative and reality: urban theories and (in)visible cities

If Disneyland, Las Vegas and Dubai express, in some respects, the hyperreality conceived by Umberto Eco (1976) and analysed by Jean Baudrillard (1981), the Calvino’s cities—although hyperreal and vaguely inspired by reality, of which they can be considered fantastic variants—live only

9 On the postmodern character of Las Vegas resorts, see Melotti (2011).

10 For the relationship between Calvino and postmodern culture, with particular reference to *Invisible Cities*, see M. Meschini (2018), who states that Calvino “perfectly thematizes the postmodern principle of cognitive uncertainty” (p. 48).

in the non-real dimension of the narrative. This is the invisibility the author refers to, playing on the power of literature, which can make even the non-existent visible. However, when Calvino imagines a city, he acts as an architect or an urban planner, and when he analyzes it, he acts as a sociologist. Of course, urban sociology works with the real world, even when studying its invisible aspects. However, even the sociologists imagine cities, when, in order to interpret them, they build models.

The affinities are even closer. Calvino's city, despite its fantastic forms, fundamentally responds to the European tradition.¹¹ The reflection on the city is truly vast and dates back quite a long time, especially if, stepping outside modern thought, we include works such as Plato's *Republic* or Aristotle's *Politics*, which in the real or imagined *poleis* identify a key element of the social and "political" life. The city is a social fact and a human creation tied to specific contexts and needs. Alongside this aspect, however, there is an ideal one, which transcends the forms it takes at any time.

Even in urban planning and sociology studies, despite the differences in individual and cultural orientations, the idea remains that the city is a "thing", to quote Durkheim: a describable phenomenon, which, despite its complexity and myriads of variations, refers to an abstract idea of the city, modelable and subject to rules and exceptions. This can be seen in important studies from the decade preceding the publication of *Invisible Cities* and, as evidence of a period of intense reflection on the phenomenon, in the immediately subsequent years. Notably, *The City in History* by Lewis Mumford (1961), *The Idea of the City* by Joseph Rykwert (1963) and *History of the City* by Leonardo Benevolo (1975) show how scientific reflection on the city is based on the assumption of its thinkability as an "idea". In this regard, the title of the book by Rykwert, whom Calvino personally knew, is particularly significant. The city is thinkable in itself, because, regardless of its form, it has a symbolic structure that can be traced and decoded.

Similarly, the monumental contributions of Mumford and Benevolo imply an abstract idea of the city, which takes concrete form, with historical, geographical, social and cultural variants: the ancient, medieval, modern city; the European, Asian, American city, etc. I remark that the final paragraph of Mumford's book (ch. 17, par. 11) was just entitled "The invisible city".

In the same perspective, we can read the sophisticated cities imagined by recent sociology: the smart city, the green city, the blue-green city, the hospitable city, the inclusive city, the sustainable city, etc.¹² Calvino did not necessarily make use of the theoretical models conceived by utopian thinkers, urban planners and sociologists, which he partly was acquainted with, but, as a good European, he was formed in a context with a tradition of reflection on the city. This was the basis on which he created his fantastic cities as variants of real cities and, at the same time, possible cities, deducible from an abstract and pervasive idea of the city.

In this curious correspondence between fantastical elaboration and scientific thought, we can recall some urban theories that appeared after the publication of his book or even after his death. On the one hand, these theories provide tools for interpreting the worlds he imagined and, on the other, describe realities that would not be out of place in his work. If read as one of his stories, these descriptions, while depicting real cities, give life to a deeply dystopian world of possible cities.

Alan Bryman (1995, 1999) recognized in Disney parks a system that influences society as a whole, and John Hannigan (1998) showed how Disneyfication has particularly impacted urban culture, where a fantasy city based on consumption and entertainment has emerged. These analyses

11 According to Barengi (2002), the origin of *Invisible Cities* is closely intertwined with the studies of Charles Fourier, a prominent figure in early 19th-century utopian socialism. Furthermore, as show the four pages from Calvino's archive studied by Barengi, «evocative urban images are directly drawn from the writings of other authors», including John Ruskin, Victor Considérant, Étienne Cabet, Friedrich Engels and Joseph Rykwert, as featured in F. Choay's anthology (1965). For further insights into the sources of *Invisible Cities*, see Belpoliti (2005).

12 On the *smart city*, see the special issue of *Fuori Luogo*, edited by M. Bernardi and L. Bottini (2023). For an intriguing critique of the *smart city* as an expression of the «temporality of financial capitalism», see Beauregard (2015). On the *blue-green city*, see Bernardi and Marra (2024).

concern real processes related to tangible cities, such as Las Vegas or Dubai. At the same time, they propose models that seem to create new types of cities, which can be added to the “normal” ones, as their variants. The fantasy city, in short, could be Dubai, but it could also be one of the invisible cities of Calvino or one of those implicitly present in the generative structure of his text. In the same way, we can also interpret the famous (and debated) theory of “non-places” (*non lieux*) by Marc Augé (1992).¹³ Cities, which we are accustomed to thinking of as a collection of places, also contain non-places. Augé referred to those spaces (shopping malls, supermarkets, service stations, airports, etc.) that are present almost identically everywhere, with functions that tend to erase identity and specificity. Non-places, unlike traditional places such as squares, markets or cathedrals, are also incapable of generating identity in those who frequent them. Clearly, Augé aimed at highlighting and deploring the cultural and existential homogenization produced by globalization.

Augé’s theory, also due to the striking expression that summarizes it, quickly became popular: the non-place is now a category evoked, often inappropriately, to describe some unsettling, dystopian or incomprehensible aspects of our cities. Non-places have thus become narrative elements capable of creating parallel cities, dotted with black holes that swallow their users.

The back cover of the French edition of his book is, in this sense, a small masterpiece, comparable to Calvino’s descriptions of invisible cities—places characterized by strange architectural elements, unusual events and odd behaviour: «Le *non-lieu* est donc tout le contraire d’une demeure, d’une résidence, d’un lieu au sens commun du terme. Seul, mais semblable aux autres, l’utilisateur du *non-lieu* entretient avec celui-ci une relation contractuelle symbolisée par le billet de train ou d’avion, la carte présentée au péage ou même au chariot poussé dans les travées d’une grande surface. Dans ces *non-lieux*, on ne conquiert son anonymat qu’en fournissant la preuve de son identité, passeport, carte de crédit, chèque ou tout autre permis qui en autorise l’accès».

It is clear, however, that these places most fully express the nature of the postmodern condition. Not only do they have their own identity, as signs of the integration of urban space into a given sociocultural system, but they are also powerful means of assigning identity, as they affirm the inclusion of their users into the society of flows and consumption and create new spaces of socialization. Thus, the same *non-places* can be interpreted as *hyper-places* or *super-places*: new categories that both enrich and fragment urban space.¹⁴

Theories, in other words, are “narratives” which, as such, can coexist. The world of urban studies is a great book, where, like in *Invisible Cities*, different worlds come to life and coexist. However, unlike in Calvino’s work, where differences prevail and new cities constantly appear, in the book of studies the urban space can be the same, even though it appears differently depending on the theory used.

The same applies, of course, to more recent theories, such as *the fifteen-minute city* by Carlos Moreno and the then-mayor of Paris Anne Hidalgo, which envisioned a city where people can reach everything they need—work, school, stores, cinema, gym, etc.— within fifteen minutes (Moreno, 2024). In this city, one can walk or bike to work, perhaps in co-working spaces, or even work from home thanks to smart-working. Daily life seems like a fairy tale, and its description could fit among those of “invisible cities”. The narrative form of the theoretical discourse, after all, brings it closer to a literary *rêverie*. This city, designed to reorganize the urban life more functionally, can also be considered a desirable model for the future city. Yet, in our cities, it is often already possible to access most services within a quarter of an hour, as in that utopian city. The fifteen-minute city thus does not exist and exists: it can be realized with specific interventions, but it can also be present without them.¹⁵

13 According to Martinotti (2007, pos. 2782), Augé is a fortunate «commodifier of words», who allegedly drew from a text by M.M. Webber (1964), without citing it. His urban anthropology, lacking scientific rigor, falls within the realm of *rêverie*—the term he also used for Calvino’s *Invisible Cities*.

14 For *hyper-lieux*, see Lussault (2017), and for a reflection on those categories, Castigliano (2021).

15 For a critique of Moreno’s model, see Balbo (2020).

In a similar way, we can consider the idea of the *global city*, developed by Saskia Sassen (1991), which exerted a considerable influence on social studies. The global city can be seen as a Calvian city, because its processes are largely "invisible", reflecting the flows and mechanisms of post-industrial society. Its «cross-border dynamics», «strategic transnational networks» and «spatial organization of finance» refer to a real and unreal world that would not be out of place in Calvino's *Invisible Cities*. Consider one of the characteristics that define global cities: although they are distant and represent different histories, cultures and traditions, they resemble each other much more than they resemble their nearby cities. The scientific observation takes on almost fairy-tale contours, generating a type of city with the magical virtue of resembling each other and not resembling any others.

4. Calvino's City without Utopia: Between History and Mythopoiesis

Calvino's city remains an elusive space: its kaleidoscopic nature eventually builds an extremely dynamic and complex urban system. In the fable-like dimension of the story, the city almost seems to self-generate: «the catalogue of forms is endless: until every shape has found its city, new cities will continue to be born» (*IC*, p. 126). It is, in short, a world made of forms in perpetual transformation, but also in constant search of balance. In this urban universe, humans seem like an alien element, subject to the form of the city, generated by the unfolding of possibilities. They do not seem to be their creators but their victim. This is a surprising stance for an author who was well-versed in both the European classical tradition and the scientific debate about the city and its history. Moreover, the form seems to prevail over substance, including social structure, determining the relationships, experiences, dreams and frustrations of the inhabitants.

Pier Paolo Pasolini (1999) recognized the cultural and political implications of this conception: Calvino's urban universe is deeply idealistic and Platonic in its constant (though dynamic) dichotomy between reality and the world of ideas and seems to leave little space for Marxism, which «the book, while encompassing, denies (but does not abjure)». Pasolini also points out that in Calvino there is little room for the idea of a Better City: perfection, if ever, can only be achieved outside of history.

In a famous lecture in New York, Calvino (1983, p. 40) defined his work as a «last love poem for the city». But this love is truly strange: Calvino's city does not conceal its harshness and does not seem like a place for living. Joy, happiness and love mostly appear in the form of memory or desire, in a deeply experiential perspective, often in a time placed elsewhere.

However, the kaleidoscopic nature of his urban universe should not lead one to think that he lacks a clearly defined idea of the city. On the contrary, it is precisely its possible infinite variations that shape a powerful and almost all-encompassing idea of it. This can be due partly to Calvino's cultural background and his readings and partly to his life, which led him to quite different cities in terms of size, structure and culture, such as Sanremo, Turin, Rome, Paris and New York.¹⁶ In the aforementioned lecture (pp. 37-38), Calvino confirmed the importance of this experiential element in the construction of his work: «everything ended up being transformed into images of cities», including the garbage that is thrown into the streets every day.¹⁷

The setting of the story in the time of Marco Polo is obviously metaphorical, because he tells of timeless cities, placeable in any era, including our own. As the story progresses, the contemporary dimension becomes increasingly evident, to be explicitly revealed in the series of «continuous cities»: timeless, certainly, but immersed in processes of growth and distortion responding to phenomena characteristic of the context in which Calvino lived.

¹⁶ On the relationship between Calvino and the cities he encountered, see Barengi (2023).

¹⁷ In *Invisible Cities*, trash is the element upon which the identity of the city of Leonia is constructed, as «you can measure Leonia's opulence, but rather by the things that each day are thrown out to make room for the new» (*IC*, p. 102).

In the final part of the work, the kaleidoscopic effect becomes even more intense: the literary dimension seems to recede in the face of history, which becomes an indispensable element. Reality and fantasy intertwine, now hybridizing, now remaining clearly distinct, in a flow in and out of history. Marco Polo imagines and describes invisible cities unknown to the Khan. However, the latter possesses an «atlas» that shapes the urban universe, placing it on a map that encompasses everything. This universe is therefore knowable: it can not only be narrated, as Marco does, but also placed on a map. This is a significant shift, which, from Anaximander onward, marks the possibility of deciphering the world and analysing it scientifically.

That atlas «preserves the differences intact» (*IC*, p. 125), maintaining the distinctions that define identities in a world of constantly changing forms. This clarification highlights an important conceptual issue regarding the complex relationship between theory and practice, as well as between fantasy and reality: the map describes with precision a world that is simultaneously fantastical (because it belongs to a literary creation) and real (because it exists within the reality of that fiction and takes shape through tools of scientific thought). On the other hand, Marco Polo himself (the interlocutor of the Khan) was a “real” traveller, who visited “real” cities and lived in them, becoming a mythical figure of an explorer and adventurer, and a valuable source for the study of past peoples and cultures. He is, in fact, remembered as the author of an important diary (*The Travels of Marco Polo*, in Italian *Il Milione*), which he did not write himself, having “told” it to those who wrote it, probably with additions and embellishments. It is this dual nature of Marco Polo, between history and mythopoiesis, that Calvino captures and amplifies, making him the narrator of *Invisible Cities*.

The Khan’s atlas, which contains everything, also expresses this duality. In the final section of the text, through this atlas, other cities are described—cities different from those recalled by Marco Polo, since they relate to the extra-literary reality, which brings the story back into the dimension of myth and history. Thus, cities from mythical, philosophical and utopian thought are evoked (such as New Atlantis, Utopia and the City of the Sun), along with great historical cities (such as Ur, Jerusalem and Granada), sometimes transfigured by myth, literature and collective imagination (like Troy, Samarkand and Constantinople), together with modern realities, such as San Francisco, Amsterdam, New York and Osaka (*IC*, p. 147; pp. 124-126). It is precisely in these references to stunning contemporary urban realities that mythopoiesis reappears: San Francisco seems to arise from a union of Troy and Constantinople, while Amsterdam and York are almost magically connected with New Amsterdam and New York. The play of forms that gives rise to the cities somehow make them real, passing from literary fiction to history and geography.

The method of the Khan and Marco Polo for understanding and generating cities proves to be a powerful hermeneutic tool: it suggests the existence of a model from which all cities can be deduced, using exceptions and combinations. Inconsistencies and contradictions, as Marco emphasizes, do not undermine the model but, on the contrary, are constitutive elements, forming the solid liquidity (or, if you prefer, the liquid solidity) of the urban world.

Calvino, in his lecture, explained that «the idea of the city» conveyed in his narrative «is not outside time» and that, above all, in his book one can find, both implicitly and explicitly, «a discussion on the city in general» (1983, p. 40). *Invisible Cities* remains within a fable-like and literary dimension, but, with that statement, the author asserts an intent that brings him closer to the world of urban theories (which are themselves narratives, if not a specific form of narrative). Furthermore, within the work, he proposes an interpretive model of deductive nature that presupposes an idea of the city.

In that lecture, Calvino also questioned the meaning of the city and proposed a (much-quoted) reading key for his book: «What is the city today, for us? I believe that I have written something like a last love poem addressed to the city». The city is a plural phenomenon that concerns «us», but its interpretation can only be subjective. *Invisible Cities* is thus a celebration of urban civilization, personal like every declaration of love. The idea of the city, from theory, returns to the intimate and individual fact of experience.

5. Urban Crisis between Unhappiness and the Loss of Boundaries

In the same lecture, Calvino asserts that his reflection on cities takes place «at a time when it is becoming increasingly difficult to live there» and adds that «it looks, indeed, as if we are approaching a period of crisis in urban life». The “crisis of the city”, together with the “flight from the city”, is a recurring theme in cultural imagination and public debate. Calvino himself is aware of this, and towards the conclusion of *Invisible Cities*, one of his characters says that «until every shape has found its city, new cities will continue to be born» (*IC*, p. 126). The city cannot die.

Calvino’s doubts probably stemmed from the condition of decay and conflict (of also social kind) in the capitalist cities, like the working-class Turin, which he knew very well and depicted in some of his writings.¹⁸ The post-industrial city was just beginning to make a timid appearance, and Calvino, like others, anticipated a criticism of it. However, a postmodern city, conceived as a reality to flee from, did not yet exist. His criticism was focused on a specific aspect of the city: its continuous growth, erasing identity and differences, which, in *Invisible Cities*, form the identifying features of urban civilization. In this regard, he explicitly stated: «The image of ‘megalopolis’—the ending, undifferentiated city, which is steadily covering the surface of the earth—dominates my book, too» (Calvino, 1983, p. 41). The existential and experiential dimension remains at the forefront: «*Invisible Cities* is like a dream born out of the heart of the unlivable cities we know» (*idem*, p. 40).

This unlivability is associated by him with the environmental degradation and alienation caused by growth: an attention that reflects a significant aspect of the 1970s counterculture. This makes his position highly modern, anticipating the recent environmentalism, which has reintroduced themes such as the crisis of urban development models and the flight from the city.

The pages in which some elements of the contemporary cities appear together with a critique of their development model are those dedicated to the «continuous cities».

Procopia is the city that grows by devouring the nature around it and creates an osmotic and suffocating urban landscape made up of increasingly numerous «faces», replacing ditches, trees, thickets and even the sky (*IC*, p. 131-132). This urban sprawl swallows rural areas, but also turns the city into slums, overcrowded in a disorderly manner. Growth is a process of destruction and alienation, in which there are no people, but only faces piled up on top of each other.

Cecilia, on the other hand, is the space that interrupts pastures. It is also alienating and destructive, and to the shepherd who speaks of it, it appears so senseless that, in his opinion, it does not even deserve a name: «Cities have no name for me: they are places without leaves, separating one pasture from another» (*IC*, p. 137). For those who do not participate in urban life, the city makes no sense. As for Marco Polo, he recognizes only cities and cannot identify the meaning of uninhabited places, where everything blends together. In other words, there emerges a conflict between populations, perspectives and lifestyles. However, there is no relativism: even those who live in a city, like Marco, can lose themselves in it, failing to distinguish anything in places that seem all the same. The great traveller also confesses not knowing when and how he ended up in that city. «The places have mingled» (*IC*, p. 138), the shepherd wisely notes. Cecilia is a metaphor for the boundless, globalized city, identical to all the others of the same type, but it is also a denunciation of the senselessness of an urban condition erasing all differences.

Penthesilea presents this process in an even more paroxysmal way. As one moves through it, there is no way of understanding whether one is in its centre or in its outskirts. Centre and periphery lose their meaning, to the point of raising the doubt that it is «only the outskirts of itself» and that it «has its centre everywhere» (*IC*, p. 146). In the literary transfiguration as in reality, the city continues to subvert the spatial organization, concentric and hierarchical, of Western culture.

Trude, a prototype of postmodern seriality and standardization, seems an anticipation of Augé’s non-places: it is the city made of places identical to those of many others, and thus similar to

¹⁸ See, for example, the story *La nuvola di smog* (1958), the “cloud of smog”, set in a city identifiable as Turin, where pollution becomes a metaphor for the psychological and existential difficulties of urban life.

them «detail by detail». In Calvino's reading of urban space, based on experience, Trude is an entity that, owing to indistinguishability of its places, creates disorientation: the airport where you arrive seems like the one you have departed from, and the hotel where you check in for the first time makes you feel as though you had already been there (*IC*, p. 116). It is, in short, the homogenized, standardized and serialized world of Sheratons and McDonald's, described a few years later by urban sociologists.

The Calvino city is a space that tends to be unhappy. In the previously cited lecture, Calvino states that his book includes both happy and unhappy cities, opening and closing with happy ones. However, the happiness of the first, Diomira, is based on the sense of envy it evokes in the traveller. The happiness of the last, Berenice, is even more doubtful: there is an «unjust» Berenice, which has a hidden twin sister, the «city of the just», but even in this «a malignant seed is hidden» (*IC*, pp. 145-146). It is an image marked by disenchanting realism, revealing everything but happiness. Even the reference to the «future Berenice», which recalls the utopian element in the work, does not hint at a bright future. Its presentation concludes with a truly interesting reflection that seems to suggest a Vichian recurrence of history: «the real Berenice is a temporal succession of different cities, alternately just and unjust». However, there is never a synthesis (Hegelian or Marxian) to crown a path of growth and improvement. Injustice is inevitable, and in this urban universe where form prevails over structure, justice, the only element governed by humans, seems destined to fail. The slight utopian element is immediately erased: «all the future Berenices are already present in this instant» (*ibidem*). In short, the Gramscian "future city" does not exist, not even in a tale.

6. Memory and Postcards: Identity and Crystallization

In the aforementioned New York conference, Calvino also provided a striking definition of the city and urban culture: «A city is a combination of many things: memory, desires, signs of a language; it is a place of exchange, as any textbook of economic history will tell you – only, these exchanges are not just trade in goods, they also involve words, desires, and memories» (1983, p. 41). Here, the kaleidoscopic nature of Calvino's urban system from plurality becomes complexity. The urban space is a dense place, where, beyond formal elements, difference depends on experiences and emotions.

Thus, the city is conceived as an extremely dynamic and highly subjective system, where the individual perspective alters its meaning. The anthropocentric totalism replaces the an-anthropocentric formalism, which, in its fragmentation, proposes an arduous and unsatisfactory idea of urban life. Calvino, in illustrating the structure of *Invisible Cities*, highlights the importance of two elements, «memory» and «desire», which also serve as interpretative categories that allow for the deep understanding of many cities. However, these are ambiguous and elusive categories, because of their experiential and individual dimension: memory takes the form of regret, nostalgia and the search for a past—lived or not lived—that cannot be repeated or changed, while desire is a feeling that swallows the future without ever possessing it.

Memory can become a destructive tool, as happens in the city of Zora, «forced to remain motionless and always the same in order to be more easily remembered» (*IC*, p. 13). But, staying motionless, it languishes and disappears until it is forgotten. The city is a dynamic reality that cannot crystallize. This is almost a self-evident observation, which adheres to a strongly realistic and organicistic view of the city. However, it also contains a critique of those («the world's most learned men») who study and interpret urban space only to crystallize it into formulas and theories. It is not surprising, therefore, that an urban sociologist like Martinotti felt the need to distance himself from Calvino, emphasizing the dreamlike dimension of *Invisible Cities*.

However, Calvino's observation can be used to explain the identity death of those cities that, in order to be better remembered, in response to the *tourist gaze* crystallize and transform into theme parks or places entirely similar to others, losing their specificity and ending up forgotten. I don't think Calvino was thinking about tourism, but Zora seems to be the prototype of a village that transforms into a museum with «the quality of remaining in your memory point by point», perhaps with a list of famous men who lived there, famous works exhibited or important events that occurred there, but, without change, exits from time and nullifies itself. However, reality is increasingly complex: tourism, even when it crystallizes certain aspects (e.g., "ancient" inns, "typical" products, "traditional" festivals, etc.), transforms the territory (e.g., homes becoming B&Bs, shops turning into souvenir stores, etc.). Zora, in short, would not die from not being changed, but from being changed too much, in a self-consuming process where change leads to crystallization.

In Maurilia, the relationship with tourism is explicit: «the traveller is invited to visit the city» (*IC*, p. 26). Its tourist dimension seems intrinsic. The city, however, can only be understood through the «postcards» of its past, and the local community invites visitors to observe it through «old postcards that show it as it used to be». The present seems to disappear. This is a very particular form of tourist self-crystallization, different from that seen in medieval villages and art cities. The past is not recreated and staged with forms of *staged authenticity*; it is the present that folds upon the past: the traveller «must praise the postcard city and prefer it to the present one». The community has renounced its present (and therefore its future) and offers only an image of its past, even though it is conveyed by postcards and not by reconstructions or stagings. This is a process that, even in this form, fits into the mechanisms of the *tourist gaze*, which leads the community to offer visitors an image of itself (in Italy usually tied to the past) that is deemed to meet their expectations.¹⁹

The process can also be read from the perspective of the traveller. On the one hand, they find themselves in the present-day Maurilia, observing and exploring it, but they are invited to read it only through its past, which prevents them from establishing an authentic and deep relationship with its community. On the other hand, they carry out a standardized operation, consuming the tourist space by consuming its images. Maurilia, the postcard city, seems to be a metaphor for contemporary tourism.

However, Calvino, more than focusing on tourism (which, when he wrote *Invisible Cities*, was in a very different phase from the present), was thinking of another phenomenon: the transition, which occurred in many places, from provincial cities to metropolises. He interpreted this not as a historical fact but as an experiential one: the citizens struggle to recognize themselves in the city around them and long for the city of the past, transfigured by nostalgia, which they probably would not have appreciated in its reality. Calvino here, as in other passages, invites reflection on the difficulty of understanding the present, a result of rapid and uncontrolled growth.

The Subjective City Between History and Memory

Calvino devotes considerable space to the city's immaterial and subjective aspect, where memory expands and completes the experiential element: the city is lived and reshaped by recollection. The remembered city is no less real than the actual one, but it is different. In the imaginative dimension of the narrative, however, memory can also be a dream and can merge with it. This happens in Isidora, where the traveller, now at an advanced age, visits the city he dreamed of when he was young, finds «the wall where the old men sit and watch the young go by», sits among them and realizes that everything has passed. The city seems to devour those who live in it: it gives the illusion of fulfilling dreams, but in reality, it consumes lives in an endless waiting: «Desires are already memories» (*IC*, p. 7).

In Zaira, the reflection on the importance of the immaterial dimension is even more explicit: the description and quantification of the material elements that make up a city are meaningless

¹⁹ For the *Staged authenticity*, see MacCannell (1973); for the *tourist gaze*, see Urry (1990) and Urry and Larsen (2011).

because «the city does not consist of this, but of relationships between the measurements of its space and the events of its past» (*IC*, p. 9). The city is a system of relationships (as many sociologists would agree), but in this case, these do not coincide with the “non-observable” aspects that Martinotti referred to. In Zaira, it is the event-related dimension, made of occurrences and experiences that turn into memories, that shapes the space and gives meaning to places. The city, with another not-so-positive image, is presented as a «sponge» that absorbs memories. The relationship with the past holds special importance in a cultural system strongly rooted in historicism, like ours and even more so that in which Calvino was trained. But this relationship is always problematic: «The city does not tell its past, but contains it like the lines of a hand» (*ibidem*); a past «written» in the myriad of material elements (corners, handrails, flagpoles, antennas, etc.) that forms its space, but only make sense in relation to the events connected to them (experiences, memories, etc.). In Calvino’s city, the architectural and monumental components seem secondary: history is based on the stories, even those made up of trivialities and neglected memories.

Calvino seems not to believe in History with a capital H, as a structuring element of cultural thought. This lack of solidity, although an outcome of the literary fiction and the constructive mechanism of the work, paves the way for a liquidity that is already postmodern. The world of *Invisible Cities* is fragmented and difficult. The past changes as the journey progresses, and every decision modifies it (*IC*, p. 24). This statement, obvious even if uttered in a wise tone, allows for a complete deconstruction of our relationship with time and space. Every choice precludes others, and the world, instead of expanding, seems to shrink around the individuals, suffocating them in urban spaces that, at every place and at every moment, show what could have been and was not. Calvino’s postmodernity (or at least that of his Marco Polo) is not joyful. On the other hand, the individual seems to acquire great power. His “gaze” constructs space: «elsewhere is a negative mirror», which, through the gaze, allows one to recognize «the little that is his, discovering the much he has not had and will never have» (*IC*, p. 25). This concept can be identified as an anticipation of the *tourist gaze*: an active gaze, capable of transforming space, causing the local community to conform to the stereotypes that shape it.

In Calvino, the gaze ends up influencing the city and thus also its history, understood as the visible result of a diachronic process. The past, tied to the individuals and their gaze, prevents a monumental view of urban space, which is deprived of history and, to use a term not present in *Invisible Cities*, cultural heritage.

7. Hermeneutics and Urban Fragmentation

An interesting aspect of Calvino’s work is his ability to deconstruct the city in a game that reveals its fragilities. In this universe based on «form», the city can grow exponentially and find itself split and reflected, or, as happens in Armilla, it can lose those material and architectural elements (walls, ceilings, floors) that, in European urban thought, distinguish the city as a collection of dwellings. Armilla «has nothing that makes it seem a city, except the water pipes that rise vertically where the houses should be and spread out horizontally where the floors should be» (*IC*, p. 42). However, it is not a cold, metallic city from a science-fiction future: the pipes resemble a «forest» with sinks and bathtubs standing out like «late fruits still hanging from boughs» and with young women «luxuriating in the bathtubs» suspended in the void. Thus, Armilla is a dreamlike city, almost Fellinian in its exuberance of joyful female nudity. The fragile verticality and lightness of its structure seem to give narrative form to the sculptures of Fausto Melotti, which Calvino knew and admired.²⁰ The charm of Armilla lies in this sculptural and po-

²⁰ Calvino himself acknowledged the influence of Fausto Melotti on his vision of the city: «There was a time when, after meeting the sculptor Fausto Melotti [...] I was inspired to write about cities as thin as his sculptures: cities on stilts, cities like spider webs» (Sfogliando l’atlante [interview], *L’Espresso*, 18, 45, November 5, 1972, p. 11). The intellectual

etic essence, which intertwines the material and the immaterial: the city, stripped of its external elements, lets emerge those invisible, which constitute its real structure and determine its shape. Armilla is a diagram of flows, which allows one to see and conceptualize structural elements and systems of relationships that are usually not visible. In this perspective, Armilla is pure urban theory: it gives shape to that society of flows and networks, both material and immaterial, visible and invisible, which is one of the endpoints of the current analysis of the urban space. However, the deconstruction goes further: on the one hand, it brings the city back to its zero degree as a system of infrastructure; on the other, as if to reaffirm the symbolic essence of urban life, it dissolves the mechanical brutality of the infrastructural level in a timeless mythical lightness. The city, we discover, is in fact populated by nymphs, who, after ascending subterranean veins that seem to come from a pre-urban past, enter the piping system, which are for them a «new aquatic realm». The city, despite of its most mechanical and anti-poetic aspect of a set of pipes, succumbs to the atemporal beauty of myth. Thus, the history of the city becomes evanescent and confused, transforming into mythopoetic memory: the invasion of the nymphs «may» have driven out the human beings; Armilla «may» have been built by humans as a «votive offering», to make amends for having contaminated the waters with a brutal development. A powerful yet unsettling image, which sets up a post-apocalyptic scenario. These nymphs, bathing in the city abandoned by its builders, seem to have erased humanity and regained control of an ecosystem altered by men. But Calvino, adopting the fluidity of mythical thinking, also proposes another scenario: the city is a gift from men to the nymphs, which re-consecrates the territory. One can, in fact, find a balance between nature and culture, and it is possible to rediscover the “soul of places”, even though, sadly, this implies a withdrawal of human beings and their abandonment of the city.

In Marco Polo’s narrative, the fragmentation of urban space becomes a cognitive tool: deconstruction allows for the focus on minimal and seemingly insignificant elements, from which experiential micro-narratives emerge. The city of Zaira is the emblem of this hermeneutic path: the city, the narrator recalls, is made of «relationships between the measurements of its space and the events of its past» (*IC*, p. 9). Architectural elements become significant if interpreted in a relational logic, transforming space into narrative, memory and experience, linking it to the community that inhabits it (as, for example, the gutter on which a cat walks, destroyed by a cannon shot, as recall the old men who mend the fishing nets at the dock). Street corners, window grilles, staircase handrails, flagpoles and lightning rods become structural elements, rich in experiential meaning, giving sense to form.

It is not only the city that fragments, but the gaze itself that breaks and multiplies, altering our idea of the city. In *Zemrude*, those who look upward see window sills and curtains; those who look downward see gutters, manholes, fish scales and waste paper. However one aspect is not truer than the other (*IC*, p. 58). The fragmented city seems incomprehensible, but it actually gains meaning precisely from the plurality and complexity of this fragmented gaze, which surpasses the idealistic and aulic character of the pre-postmodern city-*polis*, the highest expression of civilization. A new urban gaze in which one can glimpse a literary and fairy-tale form of micro-history.²¹

Calvino’s deconstruction of the city can be related at least in part to a postmodern gaze, but, even more, to an awareness, even of political nature, of the transformation of the social and economic context. The theme, therefore, is not the much-feared death of the city, but the implosion of an urban model that, as Calvino wrote elsewhere, exposes its «disintegrated or cancerous

relationship between Calvino and the sculptor has been extensively explored in essays (see, among others, L. Modena, 2004) and exhibitions (such as *Fausto Melotti. In leggerezza. Un omaggio a Italo Calvino*, Santa Maria della Scala, Siena, December 7, 2023 - April 7, 2024).

21 The micro-history was taking shape in those years precisely within a context linked to the Einaudi publishing house, which, from 1981 to 1991, would entrust Giovanni Levi and Carlo Ginzburg with the direction of a specific collection, “Microstorie”.

parts». On the other hand, exposing the unpleasant elements of this fragmentation, can be the starting point for working out the «city of tomorrow» (1975, p. 349). With all due respect to Pasolini, an element of utopia, a legacy of a progressive cultural and political formation, in Calvino exists, even though in him form prevails over structure. The expression he uses, «the material from which the city of tomorrow will take shape», does not necessarily imply a social or political action (though it does not exclude it) and seems to leave the future of the city to an ananthropic process of recombinations of forms from which «new cities will continue to be born» (*IC*, p. 126). Calvino's gaze on the city is neither naive nor uninformed. The fairy-tale dimension of *Invisible Cities* should not make us forget other reflections, rooted in reality and attentive to social complexity. Beyond a good knowledge of urban studies, his daily experience as an urban intellectual (and perhaps as a *flâneur*) gave him a clear idea of the processes underway, which he expressed with sociological lucidity: It is with new eyes that we today look at the city and before our eyes appears a different city, of which social composition, population density per square metre of built space, dialects, public and family morals, entertainments, market stratifications, ways of inventing solutions to service deficiencies, of dying or surviving in hospitals, of learning in schools or on the street, are elements that compose an intricate and fluid map, difficult to reduce to the essentiality of a scheme» (1975, p. 349). Calvino thus raises the issue of interpreting contemporary urban civilization and realizes the need to identify an interpretive scheme, even if he perceives its impossibility, if not its futility. And here the path of the literary figure diverges from that of the sociologist.

Among the sociologists who have used *Invisible Cities* to build a reflection both on urban theories and dynamics we have to recall Paolo Perulli. His book *Visioni di città* (2009) begins «right where Calvino's atlas of invisible cities ends» (p. 3). According to him, cities are mainly forms, and the Calvinian approach to urban civilization, based on a caleidoscopic generative system, is able to catch the deep nature of the urban experience. In this view, centuries of urban theories, urban planning and urban realities constitute a kind of Calvinian variation that accompanies social history. Calvino is something "good to think with": the history of urban civilization as well as the contemporary city become an a-temporal system, where the central-city, the compact-city, the archipelago-city, the mobile-city, the laboratory-city, the body-city, and so on, coexist, mix, bud and follow one another. Perulli dwells on the urban transformations due to the process of globalization and criticizes the long-standing tendency to design urban entities «without a centre»: amorphous realities «devoid of orientation and structure» (p. 35). A sentence that seems to recall one of Calvino's cities even literally.

Perulli also focuses on cities that represent a «frame», that is, a cognitive framework for some a-territorial flows of delocalized, dispersed and fragmented actors, as Simmel and Goffman said when discussing social life in early metropolises. The same, in his opinion, could be repeated as concerns certain contemporary cities, such as the global city-regions, which have developed under the influence of powerful multinational and transnational corporations (p. 38).

On the other hand, the new cities, due to the intersection of material and immaterial flows, present boundaries that are increasingly less physically traced, like the «invisible city» that Mumford (1961) referred to in the final part of his book. This definition probably inspired the title of Calvino's novel, which, implicitly but clearly, describes the «commodification» of the human beings entailed by some present urban realities.

The decades that separate us from *Invisible Cities* seem to have partly bridged this distance: the fragmentation to which Calvino submits some of his cities recalls that carried out in recent years by some sociologists. The *flâneur* of Giampaolo Nuvolati (2013), perhaps the most Calvinian Italian sociologist, moves slowly and without preconceived schemes to discover urban space, and, like Calvino's Marco Polo, recounts the cities he encounters starting from seemingly disconnected and insignificant details. The city changes according to the gaze of those who live in it and observe it. The scholar who adopts an emotional and experiential hermeneutics can connect with the soul of the places and better understand the city. The atrium of a station, the

entrance to a hospital, the churchyard become crossroads of meanings. Space is deconstructed into narratives and, in this way, acquires meaning. In this way, the scholar acts as a «metropolitan poet», entering into a narrative dimension that, despite the different context, is not far from that of Calvino, repeatedly recalled.

In a subsequent work, Nuvolati (2019) decomposed urban space into small and humble elements, true «interstices» loaded with social density, in which one can trace the same emotional and experiential components that were foundational to Calvino's urban culture: memory, desire, nostalgia. The dimension of the everyday and lived experience creates the urban fabric, gives meaning to the places and builds communities.

In this hermeneutic process of conceptual fragmentation of the city, we must remember the work by Robert Beauregard (2015), whose almost dreamlike-fabulistic contributions would not be out of place in *Invisible Cities*. The smart city is presented by him as the «evil twin of the slow city»: an image that recalls the duality of Calvino's Berenice. The city, moreover, is rethought by him as a «heterogeneous» reality, meaning a complex system, constituted and populated by «non-human» elements, both animate and inanimate, such as animals, rivers, sewage systems, tram lines, cables and sensors, which, together with humans, create urban space (pp. 11-13). Beauregard's thought evidently expresses a new post-human and animal-rights cultural sensitivity, which, like in a Calvino story, makes «visible» what is invisible. What he describes seems a futuristic and science-fictional world, but is our world, just like the urban universe of *Invisible Cities*.

We find a more pragmatic approach in Mark Purcell (2022). He explains that, in an age ominously marked by the return to fascism, we have to find a new «strength»: the city is the space where we have to build (and stage) an intellectual and practical resistance. He catches an interesting relation between Calvino's *Invisible cities* and a work published two years before: Henri Lebevre's *La révolution urbaine* (1970). The «capitalist city» of Lebevre—where people are trained to become consumers rather than citizens and are made politically passive by isolation—is viewed as a kind of Calvinian dystopia that reflects the real world. Exactly as Calvino's novel, it gives us «an intellectual and emotional orientation» to take action.

The most important lesson we can learn from *Invisible Cities* is precisely this. Cities, for better or worse, are our world: we can design them, invent them and dream of them but, above all, we must live them. Literature and social sciences are nothing but bridges between these different dimensions.

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Pandemic, culture and well-being.

A community study on the impacts of Covid-19 with respect to individual psychological well-being²

Introduction

The role that well-being plays is of fundamental importance when put in relation with ‘functioning’, both in individual and collectivity terms, encompassing one’s physical and psychological health, which is the outcome of subjective perceptions relating to one’s health placed within the context in which one individual lives and acts, and the relations and connections with other community entities. The impact of external agents, such as disruptive factors causing a sudden change of the aforementioned dimensions, can trigger a stressed state of being in both the individual and the local social system, with deep alterations to their efficiency and functioning skills. Analyzing their results is therefore necessary in order to build up strategies and actions aimed at relieving the pressure, leading to the additional step of restoring the potential well-being conditions for the subject and the collectivity.

The pandemic that struck the globe from 2020 contributed to the alteration of the socio-economic fabric of the territory, affecting the well-being sphere of people. The containment measures against the spread of Covid-19 led to a limitation of people and social actors’ freedom, majorly impacting personal and communal lifestyles. Community life, and social and cultural activities and initiatives connected to it, has been deeply affected by such limitations. Community life is the amalgam of a multitude of factors, among which we can name the relational dimension and affectivity (Di Nicola, 2013), and space and time elements (Nuvolati, 2003).

The coming of the pandemic and the activation of mitigation actions, such as interpersonal distancing, restriction of movement, cancellation of gatherings and the lockdown of social and recreational spaces, has therefore potentially caused a profound effect on the very social fabric of communities, with a predictable impact on the individual psychological well-being³.

This paper focuses on verifying two hypotheses:

- If the psychological well-being is the outcome of the aforementioned community life conditions, what effect was triggered by their pandemic-induced interruption?
- What is the role of the social and cultural dimension in the definition of the individual psychological well-being?

This exploratory study aims to verify how psychological well-being, a dependent variable, has been affected by the decrease and/or cancellation of the opportunities linked to communal life, such as the participation to social and cultural events, which are independent variables.

This study is inspired by a February 2020 survey, which was also repeated the following year, in February 2021, on a sample of the population of a municipality in the metropolitan area of Milan, Branzate. The research falls within the scope of community studies, and by adopting a multi-disciplinary approach aims to highlight the possible alterations triggered by the pandemic, com-

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3 It is important to highlight the ongoing debate regarding the scope of policies implemented by public decision-makers in relation to the configuration of pandemic mitigation actions. For example, this includes the effects of a lack of informational pluralism (Lello & Bertuzzi, 2022), leading to a limitation in the dialogue among social actors, as well as the hegemony of mathematical and predictive tools over elements such as human reasoning and social practices (Campo et al., 2021). The purpose of this contribution is not to delve into this perspective, but simply to point out its presence.

pared to the main determinants composing the individual psychological well-being. The comparison between the two samples, pre and post pandemic, shows how some individual features trend toward a change on their impact on well-being. Additionally, the study underlines people's perceptions in relation to the loss of recreational and socio-cultural opportunities. When their actualization and participation is limited, they take on a preeminent role within the spectrum of elements that constitute individual well-being, clarifying the potential connection with the interpretative theoretical model related to individual psychological well-being and community life.

1. Well-being and community.

The dimension of individual well-being is an important scientific interest area, even in sociological studies, and has engaged several disciplines through a perspective that has aimed to provide a possible representation of the phenomenology in a theoretical-interpretative key. An exhaustive review of every and single sector goes beyond the scope of this study, but a summary of its main approaches could prove useful to comprehend the perimeter in which individual well-being is analyzed, and to identify the basic elements influencing its trend.

Economic sciences have long promoted observations related to the well-being levels of individuals, see Faik (Faik, 2015). The common data in the parameterization model is identifiable in the economic growth framework, the mean through which the betterment of people's standard of living is possible, thus promoting more well-being. The most commonly used tool for the measurement of economic variable and well-being is GDP or generated income. Originally, this index's goal was to verify the economic status of a territory and the ensuing access individuals have to goods and services, all elements contributing to the improvement of people's lives. As time went by, GDP functions broadened, and today it is an element used to define the well-being of a community. Many researches, such as Canoy and Lerais (Canoy & Lerais, 2007), provide a demonstration of the asymmetry between the concepts of utility and well-being, highlighting an analytically structured critique between a well-being generated by an individual's earning capacity, related to the access level to goods and services of the market through which one can satisfy one's needs and wishes, and a well-being model related to an holistic personal development (Hirschauer *et al.*, 2015). As underlined by Stiglitz, Sen and Fitoussi (Stiglitz *et al.*, 2009), while the well-being perimeter is surely built around material living conditions, which are a consequence of an individual's economic skill, other elements can participate in its definition, such as health, education, environment, social links and personal activities. Sociological disciplines have examined well-being through various lens, considering both territorial and non-territorial variables. The theoretical-interpretative model of this study utilizes as its foundation territorial-based variables, where the location features turn into the space aimed at defining the social ecosystem – relational and communal – whose value is reflected upon the perception of individual psychological well-being.

Starting from the set of elements implemented in planning physical space, it is highlighted how said process profoundly impacts individual well-being (Bellaviti, 2008). Other studies have highlighted the impact of, for example, the availability of natural areas (Burns, 2005), urban density (Guite, 2006), living quality (Albouy, 2008), the difference between urban and rural areas (Requena, 2016). An in-depth analysis of the living quality concept, in its anthropized environment sense, led to a general consensus: urban areas are more likely to provide a higher level of individual well-being compared to rural areas (Vigano *et al.*, 2018). This result is due to the proximity of individuals to services, production areas, employment and income, welfare-related opportunities and educational system; therefore, anthropized areas possess more local efficiency, both in an economic and social sense, compared to rural ones. Several scholars (for a general overview see Hudson 2008) also highlight the conspicuous negative externalities present in ur-

ban areas which influence individual well-being, generated, for example, by bad environmental quality, which impacts one's physical and psychological health (Bellaviti, 2008). Furthermore, Bergamaschi (Bergamaschi, 2016) points out how urban areas have been subjected to a steady impoverishment of social dimension elements, with repercussions on the well-being of people. In these territorial frameworks, the action of factors such as privatization and the worsening of public space quality affects the quality of the urban social fabric, which is ultimately less stable, restricting the individual development not only in the tangible areas but also intangible ones, as is the case of psychological well-being.

Sociological analysis has been focusing its gaze on social fabric and relational contexts, the immaterial dimension of territory, on the matter of individual and well-being development. Research strived to understand how social value within a community is created, and its effects on individual and collective well-being. As highlighted by Bergamaschi & Castrignanò (2017), the well-being of a community is influenced both by its own material development conditions, such as the environmental quality of the location and the economic development level of the territory and its people, and by the presence of intangible elements which contribute to constitute its 'self', the place's very own identity. The identity of the space in which an individual lives and acts is a fundamental factor in building social well-being, and it is the result of the relationships among the individuals belonging to a specific territory, behaviors and habits that promote the creation of groups and community with social subsidiarity as their own foundational principle (Monteduro, 2017).

Sociology also showed an interest in territorial governance ways, and how they affect the conditions of individual well-being. As outlined by Mazzette (2017), the possible approaches, top-down or bottom-up, create several effects on the way the location is experienced and social practices. The author postulates how a governance that involves citizens in knowledge-related processes and needs, which are involved in decision-making, has beneficial outcomes for strengthening relationships, especially in neighborhoods.

Community studies have long sought to understand the elements that can drive socio-economical development. The focus has been on verifying the role of communities and local systems as parameters for generating social capital, the foundation for building elements such as solidarity, trust, relations, culture, which can support development. In this sense, the concept of community has been the subject of analysis that, through time, came to a definition of its main features. The first analysis level focused on the socio-cultural sense. Mela (2016) postulated the possible key principles. Said elements pertain to the presence of a homogeneous social group and the presence of organic features: distinctive socio-cultural peculiarities, accepted among their members, which can promote a bond permeated by solidarity, belonging, trust and identification.

A second analysis level takes on a different path than the socio-territorial one. According to this interpretation, a community is considered as the relation between a group of individuals and the territory, and its fundamental traits are determined by its spatial features and the quality of the social bond (Castrignanò, 2009).

A third analysis pinpoints the relation between time and space as the *deus ex machina*. This approach underlines how the nature of a community is the result of relationships, which are not solely the result of functional relations, but are linked to time and space wherever they are created. In this sense, time and space are the building blocks of the interactions between the actors, and they take on a specific role in the structuring of the core elements of a community, such as, for example, trust and commonality, with potential positive outcomes on individual well-being (Nuvolati, 2019).

All the approaches indicated share one element: the ways with which the concept of community is represented. They pertain to the possibility that individuals, through relations and/or thanks to the physical spaces, are able to build up a system of relations and connections which, as indicated by Donati (Donati, 2020), promote the creation of 'relational goods'. These assets, intan-

gible in nature, are the result of the sharing of places, experiences, and various opportunities conducted in the absence of excludability, rivalry and positioning elements. As such, relations become the foundation for the creation of a wide range of elements, such as trust and cooperative norms, which, if properly implemented and nurtured, can trigger a virtuous cycle of new relational goods. This dynamic can turn into a platform for positive outcomes on the growth of local social capital and the constitution of community life, influencing both individual and collective well-being. The study of Cardamone and Zorzetto (Cardamone & Zorzetto, 2000) underlines how territorial culture, i.e., the context of community, social practices and individual relationships, is one of the key elements for individual well-being, since it can nourish the feeling of identity and social cohesion. Tavano Blessi and Padua (Tavano Blessi & Padua, 2016) also highlight how spaces with a socio-cultural vocation are the ideal drivers for community development. The presence of places dedicated to events of social and cultural nature can become an agent for creating gatherings, relationships, intangible elements correlated to social capital, which act as drivers for individual and community well-being.

As summarized by Colleoni (Colleoni, 2019), mobility and interconnection are turning into the fundamental traits for social participation and the constitution of individual and collective well-being. During the most acute stage of the pandemic, and for a very long time afterwards, said elements were restricted. While the territorial mobility of individuals has been precluded for 71 days between February and May 2020, it is also true that almost every single gathering activity, including those of social, recreational and cultural nature, has been severely limited, if not erased, up until the spring of 2021, resulting in the conditions for promoting a deprivation of social and relational chances in individuals. In this perspective Jacobs (Jacobs, 2012) indicates that if said deprivation status is replicated throughout time, it can potentially generate negative externalities on a social and well-being scale. Restraining the activities and opportunities aforementioned can then trigger a progressive impoverishment of the socio-relational fabric present in the space, threatening both the generative pillars of a community and the foundational traits related to physical and relational proximity in a place, affecting the perceived well-being of individuals.

The goal of this study is aimed at verifying how the coming of the pandemic and the containment policies implemented and repeated through time have affected community lifestyles and, consequently, individual psychological well-being. Subsequently, the impact of the social and cultural dimension on the composition of psychological well-being will be examined, as well as how the variation in opportunities and interactions caused by the applied restrictions has affected said elements.

2. Methods and case study.

A computer-assisted personal interview (CAPI) survey was conducted in the community of Baranzate, a town located 7 km from Milan, which presents a population of 11,700 inhabitants (ISTAT 2021). The questionnaire was administered by Doxa, the Italian pollster company, on individuals aged between 18 and 34 years old (universe of 2297 persons as for the 2021 Baranzate municipality census bureau) and >64 years old (universe of 2155 persons as for the 2021 Baranzate municipality census bureau) at two different times: in January 2020 and then February 2021. If the second survey was conducted to assess the effects of the pandemic on the population of the municipality, the first one was carried out just before the onset of the pandemic period and was originally conceived in 2019 as a preliminary exploration for the development of a strategy and community development actions in Baranzate through investments in socio-cultural spaces and initiatives.

The municipality experiences socio-economic and cultural marginalization compared to other centers in the province of Milan, as exemplified by a high percentage of immigrant population

(Baranzate: 34%, Milan province: 12.4%, 2021 data) and a low economic level (individual income in Baranzate: 19,232; Milan province: 27,396, 2019 data). Moreover, there is a limited presence of cultural and community-oriented places and events, as well as fewer socialization opportunities. While the described socio-economic traits could introduce potential biases in the research, they actually provide an opportunity for further investigation. This study aims to explore the impact of a sudden and disruptive event, such as the pandemic, on a disadvantaged area. Given the exploratory nature of the study and the comparative methodology between two samples from the same area - thus sharing similar characteristics - it is possible to assume that the previously described territorial profile does not influence the study's results in relation to its objectives.

A potential factor that could introduce bias into the results is that the initial data collection took place in early February 2020, perhaps being affected by an additional bias linked to the presence of individuals infected with COVID-19 in the region. However, this possibility is considered remote. While the first confirmed cases reported by the media date back to January 30, 2020 - two foreign tourists in Rome - the first officially diagnosed case involving Italian citizens was recorded on February 21, 2020, several weeks after the sampling was conducted. Therefore, this factor can also be excluded as a determining influence on the study's conclusions.

Individual well-being status has been assumed as the dependent variable, and was registered thanks to the PGWBI. This instrument allows us to measure the state of possible subjective well-being or distress, in other words to measure elements related to what we could call the potential perception of individual well-being. The PGWBI has been adopted since the 1990s (Dupuy 2002) and psychometric / sociometric properties have been evidenced and validated for clinical and research aims. The PGWB is based on 22 self-administered queries distributed in six HRQoL domains: vitality, state of depression, anxiety, self-control, positive well-being, and general health. Each item is rated on a 6-point scale (from 0 to 5) and the subject is asked to report his emotional, physical and health conditions in relation to their life over the previous eight weeks. For this study we have adopted a short version of the PGWBI in all 6 questions, which explains more than 92% of the variability of the full version, already validated in previous clinical and research projects (Grossi et al 2006), showing a Cronbach's Alpha from 0.80 to 0.92 in respect to 0.90 / 0.94 as recorded in previous studies.

The administered questionnaire included two additional areas of investigation:

- a. Questions aimed at defining the socio-demographic profile of each respondent, including gender, age, educational background, and profession;
- b. Questions regarding the participation in social and cultural facilities and activities, which could potentially foster a sense of community in the Baranzate area.

The rationale behind collecting data on the latter aspect is linked to the hypothesis regarding the correlation between socio-relational activities, their role in building a community dimension within a territory, and their potential impact on both individual and collective well-being.

The methodology involved gathering information about participation levels in four specific dimensions and related activities, following the approach outlined by Tavano Blessi (Tavano Blessi, 2014). These factors pertain to:

Cultural dimension: Participation in cultural activities and events, such as attending a concert, going to the theater, or visiting an exhibition.

Social dimension: Engagement in social activities, volunteer work, community service, and social services.

Leisure events dimension: Activities such as going to a nightclub, taking a walk, or spending time with friends.

Sports activities dimension: Practicing a sport, going to the gym, or attending a sports event.⁴

4 The activities mentioned are derived from a study conducted on 110 participants at the 2008 ESA – European Sociological Association Conference. This study examined the potential selection and role of a set of socio-cultural activities in relation to their degree of social orientation. For the complete methodology, please refer to: Tavano Blessi, G., Grossi, E., Sacco, P. L., Pieretti, G., & Ferilli, G. (2014). *Cultural participation, relational goods and individual subjective well-being: some empirical evidence*. Review of Economics & Finance, 4(3), 33-46.

The intensity of individual participation has been measured on a quantitative scale through a composite sum of frequencies, expressing in this way the number of days in a year of at least one activity, making up a specific index called Cultural Index, which has been correlated to the PGWBI in order to assess possible effects.

The individual psychological well-being (PGWBI) may range from 0, the maximum distress level, to 110, where the total score <60, displays severe distress; from 60 to 70, moderate distress; between 71-90, no distress; >90 to 110, well-being.

As previously underlined, the study has an exploratory profile, and in light of the general objective, the analysis techniques adopted were limited to a descriptive level. No intersectional analysis was conducted to detect, for example, differences in perceived well-being among women based on job position or educational level. For the analysis of the relationship between the Cultural Index and PGWBI, Pearson's linear correlation was used. This technique is admissible since the variables involved are continuous rather than ordinal.

<i>Dimensions investigated</i>	<i>Index</i>
Well-being	PGWBI
Cultural-Social Participation	IC Cultural Index

Table 1. Dimensions investigated and related index

The sample characteristics are shown in Table 2. These present some differences, which can be attributed to the sample composition method as previously illustrated. Since they are of modest or minimal significance and affect only certain subcategories of the analyzed variables, in light of the exploratory nature, such differences do not influence the possible final result.

VARIABLES	2020 %	2021%
GENDER		
Male	60,8	60,4
Female	39,2	39,6
AGE		
. 18-24	9,7	14,9
. 25-34	16,2	16,9
. 35-44	18,2	14,1
. 45-54	14,5	12,4
. 55-64	16,7	14,4
. 65-74	13,5	13,7
. > 74	11,2	13,6
EDUCATION		
Primary School	11,1	9,2
Secondary School	32,9	40,8
High School	52,8	42,6
University degree	5,2	7,4
EMPLOYMENT		
Retired	25,2	26,2
Housewife	11,2	8,7
Unemployed	12,2	7,5
Workman / Blue collar	12,2	11,2
Manager / Professional	7,2	4,0
Tradesman / Artisan	7,7	5,5
Teachers, Clerk / White collar	22,2	21,7
Student	6,7	10,5

Table 2. Samples characteristics (n=401)

3. Results

The results of the study are shown starting from the well-being dimension, and table 3 highlights the positioning of the Baranzate population in the two surveys. The data reflect how, in 2020, the PGWBI was 65.8, a value which, in the following twelve months (2021) reached 63.12. The discrepancy is of minor entity, highlighting a modest impact during the pandemic period, which didn't affect in any substantial way the condition of individual psychological well-being. It should be noted how the psychological well-being recorded in Baranzate in 2020, before the pandemic hit, is lower than the national average of 77.14 (Grossi, 2019), and this difference is potentially attributable to the socio-economic and cultural conditions of the territory described beforehand.

	2020	2021	P value
average		65,76 63,12	0.03
delta	2.64		

Table 3. PGWBI level 2020 - 2021 samples (n = 401)

As for the main individual variables, the ratio between age and psychological well-being shows some interesting data. The youngest bracket – 18 to 34 years old – shows a higher well-being in 2021 compared to 2020. The subjects between 35 and 64 years of age show a stability in the perceived well-being level, while the group of people of a more advanced age (>64) manifests a decline in the values. Data, therefore, show a progressive decrease of the psychological well-being as age increases, so that the behavior of the subjects over 35 is in line with other studies. For the subjects between 18 and 34 years of age the results are partially unaligned with research carried out during the pandemic period (Kauhanen, 2023), recording a growth in perceived well-being. The motives which might be at the basis of this discrepancy were not a part of the scope of this study, although a counter-intuitive element was registered: the forced condition of permanence within one's home and the limitation of external activities allowed for an improvement of the perceived well-being conditions in young people.

	2020	2021	P value
18- 24	70,29	82,96	0.0025
25- 34	66,44	71,96	0.0765
35 – 44	63,62	64,14	0.0878
45 - 54	65,18	64,19	0.7823
55 - 64	57,74	58,30	0.7824
65 – 74	61,94	57,82	0.0989
> 74	58,07	56,16	0.4101

Table 4. Correlation between age and PGWBI 2020 – 2021 samples (n = 401).

The evaluation of the professional status in relation to psychological well-being presents several analogies with what came to light for the previous variable. Table 5 illustrates how certain categories benefitted from the forced limitation of spaces of individual freedom, and the subsequent impossibility of going to one's workplace or education site. For students, teachers, public servants and retailers, perceived well-being improved, while for the other professions it remained stable or it worsened slightly. The dynamic shown has some similarities to what other research revealed about the impacts of the pandemic in relation to employment type (Lovreglio, 2022),

wherever there is a linear correlation between working condition and psychological well-being. The impact of the pandemic and the restrictive policies employed seemed to influence students and unemployed people the most, but even in this case providing a clear interpretation is not possible, since the study did not gather data related to the motivations. What was revealed for these two categories is in line with the results of other research (Sousa-Uva, 2021), and shows the hypothesis that the possibility of remote work, for example from one's own home, increased the well-being of both students and white collar workers, such as public servants, teachers. This dynamic is reflected even on professions with higher responsibilities, such as managers and entrepreneurs, while the well-being level decreased in those who could not perform their jobs remotely, like construction workers, retailers, retired people and homemakers.

	2020	2021	P value
Student	70,76	77,29	0.1858
Unemployed	58,56	73,57	0.0009
Teachers, Clerk / White collar	65,82	69,7	0.1394
Tradesman / Artisan	69,25	65,71	0.3026
Manager / Professional	68,24	64,27	0.7084
Workman / Blue collar	65,9	63,96	0.5840
Housewife	61,21	59,18	0.5800
Retired	60,71	57,44	0.0732

Table 5. Correlation between employment and PGWBI 2020 – 2021samples (n = 401).

Table 6 contains gender-related data. The findings show how the male gender reacted more positively to the pandemic compared to the female gender. While men's well-being increased, it decreased for the women. On a general level, the results match the findings of literature which reported how, overall, the female gender registers a lower psychological well-being when compared to the male one. There are multiple reasons for this, which can be traced back to, for example, the biological difference between women and men, as the former is more affected by distress phenomena (Waldron, 1998), and the social role of women, which changed during the last decades. As highlighted by several studies (see, for example, Matud, 2019), the female gender takes on different and tendentially increasing tasks (for example work, family care, free time and more), which might have caused a lower psychological well-being level. It is therefore plausible that the worsening condition registered in this research for the female gender could be in accordance with the increase in the number of household activities, due to the combination of factors such as pandemic restrictions and the forced presence of other members of the family. Another element that could explain the gender gap can be found in the increase of domestic abuse during the lockdown. A revision of the literature based on the analysis of 32 studies carried out from 2021 to 2023 by Kourti (Kourti *et al.*, 2023) highlights how, especially during the first lockdown, domestic abuse episodes increased, and the victims were mostly women. This could also be factored in when explaining the results of table 6.

Concluding the in-depth analysis of the well-being trend for the female gender, and supporting the hypothesis previously described, we have the job market analysis for the Baranzate residents. It shows how the employment rate is higher for men than it is for women, and how this category is mainly employed in homemaking activities (such as housewife or maid). This is further evidence supporting what has been reported insofar, and a possible reason for the lower psychological well-being level registered in the study.

	2020	2021	P value
Female	62,98	61,35	0.8174
Male	63,33	69,43	0.0328

Table 6. Correlation between gender and PGWBI campioni 2020 – 2021 samples (n = 401).

The pandemic triggered different events in relation to one's level of education (table 7). The data revealed that those with a higher academic credentials, such as a university degree, reported an increase in the individual well-being perception, while those with a low level of education saw a decrease. Said modification could be due to two conditions. The first one is related to the dynamics listed beforehand for the various professions, specifically the low-effort conversion toward remote work for white collar workers, such as teachers, public servants, managers, compared to the other categories, which usually have achieved more advanced education titles compared to the so-called blue collars. The second condition draws from what emerged in other studies about the weight of one's level of education on one's individual psychological well-being (Liu, 2023), which highlights how those possessing a high educational level have a higher propensity to keep, or even improve, their well-being level during adversities, compared to people with lower educational levels. A possible explanation of this dynamic, which is not supported by the information emerged by this survey, but can be helpful to understand the casual relation mentioned before, is provided by Antoci (Antoci *et al.*, 2007). The author presents a behavioral and cognitive model which highlights how, as the educational level of an individual increases, the same happens for adaptability, along with reading and interpreting environmental reality and its possible mutations. In other words, the more extensive the body of information an individual has developed and assimilated in terms of knowledge and experiences, the more sophisticated their mental models will potentially be, meaning their cognitive relational skills with the surrounding reality and therefore the adaptability to a new situation. Those who possess these skills are bound to have a high predisposition and propension to modify their perceptive and behavioral patterns, acting in a way more befitting to the constitution of a new subjective well-being status. The data gleaned from the survey highlight what has been described especially for people with a university degree, but, compared to other research (Liu, 2023) there is no linear growing trend of well-being in relation to one's title. Due to the sample size, any further insights – the concurrence of the job position, for example – do not lead to significant results.

	2020	2021	P value
Primary School	56,64	54,40	0.4126
Secondary School	60,36	61,31	0.0132
High School	65,76	65,98	0.9069
University degree	65,67	80,88	0.0012

Table 7. Correlation between education and PGWBI 2020 – 2021 samples (n = 401).

The last analysis layer concerns the Cultural Index and the individual psychological well-being (PGWBI). As shown beforehand, the research is inspired by the hypothesis which postulates that the socio-cultural offer level of a territory and participation are the fundamental layers for generating well-being. By participating to these kinds of events, in fact, individuals can strengthen exchanges and interactions, building up social fabric and community spirit, which themselves are drivers for individual well-being.

The research examined, therefore, the weight of social, leisure, sport and cultural activities, following the model provided in section 2 of this study. Table 8 shows the results of the correlation between PGWBI and the Cultural Index. In order to further underline the importance of the latter

dimension within the basket of elements considered in this study, we present the ranking of the first six variables according to the positive and negative correlation degree in relation to the individual psychological well-being before and after the pandemic (table 9).

	2020		2021	
	Average	PGWBI (r)	Average	PGWBI (r)
Cultural Index - CI	60,39	0.186	36,43	0.235

Table 8: Variation in intensity Cultural Index and correlation with the PGWBI, 2020 – 2021 samples (n = 401).
P-value < 0.00001

2020		2021	
r	Variabile	r	Variabile
0.202	HIGH SCHOOL	0.375	AGE 18-24
0.186	CULTURAL INDEX	0.235	CULTURAL INDEX
0.145	AGE 18-24	0.224	UNIVERSITY DEGREE
0.127	STUDENT	0.205	STUDENT
0.090	AGE 25-34	0.154	MALE
0.072	TEACHERS, CLERK	0.146	AGE 25-34
-0.076	UNEMPLOYED	-0.154	FEMALE
-0.084	RETIRED	-0.159	AGE 55-64
-0.106	SECONDARY SCHOOL	-0.165	AGE 65-74
-0.111	AGE >74	-0.188	PRIMARY SCHOOL
-0.137	PRIMARY SCHOOL	-0.199	AGE >74
-0.149	AGE 55-64	-0.258	RETIRED

Table 9: Ranking of variables according to the correlation index with the PGWBI, 2020 – 2021 samples (n = 401).

The two tables indicate the ranking of the social and cultural dimension within the perimeter of the factors derived from this research, and the results allow us to underline two key elements. The first concerns the incidence of the socio-cultural dimension on the PGWBI. Although the values present a statistically weak or modest relation, in both samples the social and cultural dimension always ranked second among the elements which affect individual well-being. Even though – because of the pandemic – social gatherings were severely reduced, the correlation with well-being has increased. The beginning of the pandemic, then, created the chance to verify how the incidence of said initiatives and the ensuing presence of spaces to hold them is important for people’s psychological well-being, becoming even more impactful whenever the chance to experience them is reduced or lacking, as it happened during 2021. The data provides an explanation of the weight of the social and cultural dimension for the individual psychological well-being. As highlighted by Brown (2015), the benefits for the individual during social and cultural activities do not stem from the intensity of the participation but from two elements, apparently separated, but significantly intertwined. From the one hand, almost every socio-cultural initiative is structured as collective activities which can stimulate relationship opportunities and the definition of a shared experience. The possibility of sharing an experience with other people triggers within the subject a connection formula with a social group, which can generate acknowledgement and belonging of the individual toward collectivity, with important effects on

well-being, as shown in section 2 of this study. On the other hand, when social and cultural activities become scarce, they create an increased value in terms of psychological well-being, showing a scenario where the correlation between the intensity of participation and individual benefits is reversed. The elements shown highlight how said actions play a fundamental part in relieving an individual from the lack of social and relational activities, which the pandemic triggered, due to their nature as drivers for sharing events and participation. While the research carried out insofar allow us to verify that the connection among social, cultural activities and psychological well-being is always a positive one, no matter the participation intensity, the following study confirms what was proposed in the theoretical model by Brown: should these activities be quantitatively limited, they promote a higher well-being level per attended unit compared to systems where the offer is richer.

The second element is related to Baranzate's context, but it can be applied also to territorial environments with different features than the case study examined herein. The studies on the matter measure how social and cultural activities are the most relevant opportunities to achieve individual well-being. Their contribution is even higher in contexts where such initiatives and infrastructures for them are scarce, such as Baranzate's case. If social and economic issues are present, these initiatives can promote beneficial effects that can go further beyond the mere entertainment aspect. By drawing from their ability to trigger relationships and sharing through participation, in fact, they can improve the well-being of individuals, becoming potential tools at the disposal of the social and community network of a territory. In territories with social issues, said activities play a structural function for an individual's functioning, nourishing the need for relationships and communication, along with the knowledge and exposition to new experiences, outlining a possible solution to what Antoci (Antoci, 2002) describes as the social and cognitive impoverishment risk in advanced societies, which can deteriorate an individual's well-being.

Conclusions: Community well-being, well-being community.

As claimed by Nuvolati (2010), the well-being of an individual is not the result of the hoarding process of resources and/or goods, nor the simplistic correlation to material lifestyle conditions. Well-being is born from what we are, our being, and from what we do and know how to do, our skills, rather than what we own, our possessions. As the author points out, the paradigm shift related to the well-being concept in post-industrial societies sets a new perspective where the key role is not played by resources but by actions, the activities carried out by an individual.

It is in this direction that Donati (2013) shows how relations are a structural element in constituting an individual, and how it is through interactions among individuals that a person can build their own identity. The model defines how the social relation is only partly born from the context within which it configures itself – place and chance – but it is majorly influenced by how individuals interact with each other – their relationships – and this is the element at the heart of a person's identity. Relational activities, like social and cultural ones, are therefore potentially at the base of that individual well-being, because it is through those very elements that the fundamental structure of an individual configures itself, along with their position within the local social fabric.

Given these premises, therefore, it is capital to verify the circumstances that lead a subject to the definition of their well-being; chances related to the opportunities that territory and society, in their various structuring dimensions, are able to provide.

In this exploratory article, the authors' focus was on understanding the effects of the pandemic on the individual psychological well-being of the citizens of the municipality of Baranzate (MI), setting up the analysis on a theoretical-interpretative model related to the community lifestyle dimension, specifically in its function as a social and cultural opportunity driver for the consti-

tution of individual psychological well-being. As shown in section 2, the participation to said occasions can create the composition platform for relational goods, and through them, it can promote the conditions for meetings and relationships between individuals, in a non-exclusive, non-utilitarian context; an inclusive context, which can generate a community fabric and well-being among the individuals who are part of it, as put in the thorough empirical analysis by Becchetti (Becchetti *et al.*, 2008). As such, the study promoted an analysis of the incidence of social and cultural initiatives, which are potentially part of the community social fabric, on psychological well-being, and the disruptive event of the pandemic set forth the stage for experimental research.

While, for data collection, almost every comparative study in the literature aimed at evaluating the effects of the pandemic opted for the web method (CAWI), this study chose the CAPI method. As verified by Agans (2024) the web methodology (CAWI), widely employed in social sciences, has a high percentage of fake participations, meaning subjects not pertaining to the sample on which the research is aimed to, which can impact the reliability of the results, an absent or very weak adulteration for random statistic samples. Additionally, the reliability and soundness of the survey is reflected in the Cronbach alpha value, which amounts to 0.91 in 2020 and 0.89 in 2021.

To summarize, the results of the survey provide the following possible interpretations:

- a. in a municipality such as Baranzate, already affected by severe socio-economic and cultural issues, the pandemic has apparently not caused a decline in the perception of the well-being of citizens;
- b. for some subject categories – young people, white-collar workers, highly educated people and men – the pandemic has even represented an opportunity for improving the conditions of the perceived well-being;
- c. the activities and the presence of socio-cultural spaces deeply affect well-being and, although limited, as in during the pandemic timeframe, while on a general level the consequences in terms of a decline of well-being are more pronounced, on a punctual level the value of these activities increased, highlighting how these opportunities are structurally linked to the well-being status of individuals.

In conclusion, social and cultural occasions in the territory are a constitutive dimension for personal well-being, due to their nature as relational experiences that can induce growth processes within individual identity. Nonetheless, these activities become important tools for community development, both for their fruition/participation and the places where these are carried out. In the first case, fruition/participation, the findings of the survey highlight how, for the whole sample, the social and cultural dimension plays a fundamental role in well-being perception, and, by connecting this element to what has been presented by Brown (2015), they become occasions for building up local socio-cultural peculiarities, which can promote the concept of community as postulated by Mela (2016). Even the places where the fruition/participation happens – the dedicated areas – are potential tools for the configuration of individual well-being and, parallelly, for community building. As shown in section 1 of this contribution, these areas are containers acting as platforms for structuring occasions for meetings and relations among the participants to the initiatives they promote, core elements for the social capital of a territory. It is through these lens that these spaces contribute to shaping community life and thus become a means for generating both individual and communal well-being, precisely due to their own temporal and spatial vocation, as underlined by Nuvolati (2019). Planning development actions through a social and cultural leverage can play a relevant role in the composition of the local communal fabric, especially in areas with socio-economic issues. The investment is within the community and for the community, a community which, if given the chance and with people's participation, can create collective and individual well-being, by promoting occasions aimed at compensating exceptional events such as the pandemic, as illustrated in the present study.

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