Visions
for Sustainability

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Vision without action is useless.
But action without vision
is directionless and feeble.
Vision is absolutely necessary
to guide and motivate.
(Donella Meadows)

Interactions between different logical levels
produce phenomena unseen at either level.
(Gregory Bateson)

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VISIONS FOR SUSTAINABILITY is an indexed scientific journal published in open access by the Interdisciplinary Research Institute on Sustainability (IRIS). The journal promotes a debate on how the concept of sustainability can be addressed and applied in existing and foreseeable societies worldwide. Particular emphasis is placed on facilitating communication between researchers of different disciplines, supporting educational projects and examining the role of contemporary science in dealing with issues related to sustainability. Papers are welcome from researchers and scholars of natural, political, social and other sciences as well as philosophical and humanistic disciplines, and in particular from anyone wishing to make a contribution which combines multiple viewpoints. The aim is to host as wide a range as possible of multidisciplinary, interdisciplinary and transdisciplinary perspectives on sustainability. Discussions or comments on articles which have previously appeared in the journal are also welcome. All submissions will be refereed before publication.

Psychology and Sustainability, *Homo Technicus* and Slow Tech

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Psychology and Sustainability, Homo Technicus and Slow Tech

In previous issues of *Visions for Sustainability* we have often published papers that consider the relationship between psychology and sustainability. On the one hand, researchers have examined various aspects of the incompatibility between how human societies and individuals behave in order to satisfy their needs and their desires and the natural processes that are essential for maintaining ecological balance and integrity, both for the people themselves and the environments they inhabit. Problems of sustainability are clearly related to human behaviours and therefore are a part of the psychological sphere. Studies have often focused on examining ways of promoting pro-environmental and reducing anti-environmental behaviours.

At the same time, other researchers have analysed ways in which developments in society have increasingly reduced the level of connectedness between people and nature and how this can lead to a condition of psychological distress and disease. Studies in this field are concerned with ways in which connection to nature can be promoted so as to both enhance people's wellbeing, thereby empowering them to realize to the full their potential in all spheres of life, and as a result also stimulate them to behave in ways that are respectful of and beneficial for the environment.

This issue contains two papers that deal with different aspects of these fields of research, together with a special section on "slow tech", which examines ways in which ICT in particular has radically changed the relationships between human beings and their relationship with the environment.

In "'From Ego to Eco': The contribution of Ecopsychology to the Current Environmental Crisis Management" Marcella Danon looks at how ecopsychology develops out of the meeting between ecology and psychology, starting from an analysis of the "ego dimension", one that is unable to grasp the connections with its surroundings, is deeply connected with an insensitive and merely utilitarian attitude towards the environment, its resources, and the biosphere. She then outlines a path of personal growth that leads to developing respect and empathy towards others and how this can facilitate a qualitative leap towards an "eco dimension". She argues that this can promote a change in the perception of oneself and towards the world by helping people to consolidate a

deeper awareness of themselves and interact in a dialogic way both with the human and non-human environment.

In "The impact of Biophilic Built Environment on Psychological Restoration within Student Hostels", Farhan Asim and Venu Shree focus on how university students living in hostels may be exposed to various aspects of stress and anxiety which burden them psychologically and cause mental fatigue. They look at ways to introduce students to natural environments which help replenish their mental resources and improve fatigued cognitive functions. They propose a link between Attention Restoration Theory (ART) and the Biophilia Hypothesis as a way of exploring Biophilic Design in order to research this aspect of human psychology and its relationship to nature.

Planetary, collective and individual limits

While the special section focuses attention on aspects of "slow tech" related to ICT, it is important to consider this in the broad context of how the path of human evolution has always been characterized by the ways in which *homo technicus* has developed new technologies at ever-increasing levels of scale, complexity and impact.

As Kaplan puts it:

> Technologies are best seen as systems that combine technique and activities with implements and artefacts, within a social context of organization in which the technologies are developed, employed, and administered. They alter patterns of human activity and institutions by making worlds that shape our culture and our environment. If technology consists of not only tools, implements, and artefacts, but also whole networks of social relations that structure, limit, and enable social life, then we can say that a circle exists between humanity and technology, each shaping and affecting the other. Technologies are fashioned to reflect and extend human interests, activities, and social arrangements, which are, in turn, conditioned, structured, and transformed by technological systems" (Kaplan, 2003, pp. 167-168).

The papers published in this issue deal with a range of questions related to the various narratives that accompany technological innovations, their reference paradigms, the dominant ideas and economic interests that drive them. In particular the focus is on the impact of digital technologies on our lives. The point of departure for each paper was a series of meetings held earlier this year at the Centro Studi Sereno

Regis in Turin, Italy, aimed at both teachers and members of society at large. The purpose of each meeting was to offer input and opportunities to debate issues concerning the need to develop technologies that are socially desirable, ethically acceptable and environmentally sustainable. The ideas proposed and debated, together with suggestions for reading, documents and images, were designed to provide teachers of all subjects with elements useful for developing transdisciplinary pathways with their students. The focus was on the relationship between human activities and behaviours and the limits they encounter, at the level of planetary limits (Meadows e al., 1972) and the collective and individual limits which are emerging linked to our capacity to absorb the growing bit tsunami. The digital revolution risks dramatically accelerating many processes without respecting not only the limits of natural resources and functions but also the limits of our minds, which require time, and at times silence, in order to be able to understand, reflect and choose. Awareness of these limits can facilitate, on the one hand, application of the ethics of error (the principle of caution, making reversible choices) and, on the other hand, the recovery of a correct relationship of dependency of humanity on natural systems, above all in this period of unforeseen, and ever more unforeseeable, global transformation of the planet.

Informed opinion on complex and controversial issues

From the initial development of instruments for communication and the transfer of information, the digital world has rapidly become the first line of interface between people and institutions through the accumulation and manipulation of Big Data. Digital technology has also become the tool through which we frame our knowledge and relationship with the natural systems. Drawing on an analysis proposed by the French philosopher Jacques Ellul over thirty years ago in *Humiliation of the Word* (1985), Foltz and Foltz (2002) speak of a new challenge that comes not from spoken or written words but from electronic media:

> … through the eruption of unlimited artificial images, we have reduced truth to the order of reality and banished the shy and fleeting expression of truth. Strangest of all, we are not dealing with the identification of truth with reality already found in science. Instead, this "reality" is really fiction – literally simulated, depicted (…). No longer are we surrounded by fields, woods, and rivers, but by signs signals, billboards, screens, labels, and trademarks: this is our universe. And when the screen shows us a living reality, such as people's faces or other countries, this is still a fiction: it is constructed and recombined reality . . . (p. 228)

Ellul's analysis anticipated what has become the experience of people today: from the proliferation of false truth and fake news to the preoccupation with personal image as mediated via social media; from the alarming rise in cyber-attacks and cyber frauds for which conventional security systems appear ill-equipped to the deployment of information technologies in complex military operations. In this scenario there are many questions which need to be asked from the perspective of scientists, citizens and politicians alike. Discussion of the risks or implications of advanced technology often tend to lead to a pronounced polarization of positions, at times expressed in terms of a juxtaposition between good and evil. Such a situation creates considerable problems for the building of a public opinion based on facts and rational argument. For example, recently the blog of the prestigious magazine Scientific American published two articles a few days apart from each other, focusing on the design and installation of communication networks using '5G' electromagnetic waves. The first one is written by Joel M. Moskowitz, PhD, director of the Center for Family and Community Health in the School of Public Health at the University of California, Berkeley. Since 2009 he has been translating and disseminating the research on wireless radiation health effects, and signed the *International EMF Scientist Appeal*, which calls for stronger exposure limits. Moskovitz appeals to the precautionary principle and asserts:

> As a society, should we invest hundreds of billions of dollars deploying 5G, a cellular technology that requires the installation of 800,000 or more new cell antenna sites in the U.S. close to where we live, work and play? Instead, we should support the recommendations of the 250 scientists and medical doctors who signed the 5G Appeal that calls for an immediate moratorium on the deployment of 5G and demand that our government fund the research needed to adopt biologically based exposure limits that protect our health and safety.

A few days later arrived the following reply from David Robert Grimes, a cancer researcher, physicist and science writer, based at Dublin City University and a visiting researcher at the University of Oxford:

> [Moskowitz]' piece has resonated with the

anti-5G movement, generating heated discussion online—but, alas, it is one that pivots on fringe views and fatally flawed conjecture, attempting to circumvent scientific consensus with scaremongering. […] While it's pragmatic and laudable to constantly monitor for any potential emergent effects, the overwhelming weight of the evidence to date does not support the hypothesis that our current cellular technology is carcinogenic.

The positions assumed by the two authors are typical of many situations involving scientific and technological innovations. A significant transition has occurred from traditional scientific practice – dealing with the measurement of a limited number of variables in controlled laboratory conditions – to contemporary issues involving experiments which literally take place 'in the real world'. The 'samples' used for testing are the very people who consume, purchase and receive the impacts of technological products and services and the large-scale experiments can often lead to unforeseen outcomes with far-ranging consequences at both spatial and temporal levels. Such conditions call for the development of greater awareness in civil society of both the nature and the limitations of the techno-scientific enterprise. The public is not in a position to develop an informed opinion about such complex and controversial issues. However, as members of the public, we are all involved in ongoing experiments which require that our experiences be articulated, voiced and shared. In this respect, the words of Isabelle Stengers are particularly significant when, in her book *A Manifesto for Slow Science* (2017), she calls for a pathway to an alternative science, arguing that researchers should refuse to allow their expertise to be used to silence or deviate the concerns of the public, or to spread the belief that scientific progress is inevitable and will resolve all of society's problems. Rather, science must engage openly and honestly with an intelligent public and be clear about the kind of knowledge it is capable of producing and the limits of that knowledge and the uses to which it can be put.

Slow Tech and intelligent choices
The papers which constitute this special section all address issues related to the essence of the oxymoron "Slow Tech". There is a widespread belief that technological innovation must necessarily be associated with increasing speed. Especially within the field of ICT, the speed of transmission of signals is increasingly identified with the speed of technological change and the durability of technological artefacts. Nevertheless,

a vital question that we should pose is whether technological change necessarily involves a process of speeding up and what are the consequences of such a race towards "newness" based on this idea of innovation, come what may. Indeed, the reality created by the digital revolution is one in which many other processes are also accelerated, without consideration of the planetary limits (resource use; environmental impacts, etc.) nor of our minds, which can only absorb and elaborate a limited quantity of stimuli. As we are now completely immersed in the infosphere, we need even more time to comprehend, reflect, and make intelligent choices, consider the potential and limitations of computational processes and applications of artificial intelligence, learn how to handle one's own digital identity and reflect on the ethical dimensions of digital technologies.
In "Slow Tech: Towards an ICT for the Anthropocene Age", Norberto Patrignani and Diane Whitehouse offer a broad overview of how ICT is shaping both our society and planet in terms of both increasing and unknown impacts. They argue that the entire ICT supply chain should move towards a more systemic view of the infosphere and elaborate on the concept of *Slow Tech* as what they call a *heuristic compass* for discovering new directions in the design of future complex socio-technical systems. What is necessary is the development of ICT that is *good, clean*, and *fair, socially desirable, environmentally sustainable*, and *ethically acceptable*.
In "Educational Unsustainability in Sub-Saharan Africa: In Search of Counter-Narratives to Policy Pressures and Exponential Tech Growth"**,** Michael Gallagher illustrates how the educational systems of sub-Saharan Africa have become increasingly in the hands of a network of global actors, with an explicit and inexorable link to technology and an implicit erosion of local educational autonomy as a result. He argues that there is an urgent need for rethinking autonomous space for participatory approaches, degrowth approaches, rights to repair and community technologies, in the face of policy pressures which are creating a largely unsustainable acceleration of educational technology.
In "Peer Education as a Means of Contrasting Cyberbullying and Online Violence. The Testimony of Young Protagonists", Ilaria Zomer shows how educational work concerning the issue of online violence takes place at the frontier between generations and between virtual and real. This is a methodological frontier whose complexity can only be understood through the testimony of those who are directly involved.

She offers examples of a range of testimonies gathered through letter writing during peer education activities.

In "Faraway, So Close: Bringing the Online on Stage", Luca Giacomini and Giorgio Bertolusso offer an example of how science and technology on the one hand and various forms of artistic expression on the other, can interact in complementary and mutually enriching ways. They propose ways in which experiences that involve both theatre and digital technology can build awareness of the complex nature of each of them and the roles they can play in the lives of each one of us. In "Mountains and Slow Tech. Evolutionary processes at the Interface with Natural and Virtual Ecosystems", Luca Giunti and Elena Camino offer us complementary perspectives on the increasing human alienation from nature and how facing the enormity of the spatial and temporal dimensions embodied by mountain ranges and relating them to the same dimensions within human technology can help us understand ways in which natural and virtual worlds meet and interact. Contemplating the multiple perspectives that mountains offer as an example of nature and considering the vast scale of the impact of digital technologies obliges us to ask vital questions that can no longer be avoided. In "The Evolution of ICT: Greater Benefits and Greater Challenges", Norberto Patrignani and Laura Colucci-Gray consider various aspects of the gap between the impact of ICT and the development of human awareness in this respect and reflect on the immense challenge of seeking to understand digital technologies and the ways in which they continue to influence and shape our ways of thinking and making decisions in our everyday lives. A theme touched on by Patrignani and Colucci-Gray, which is of great relevance but as yet very little debated in society, is that of the military applications of ICT. For example, the technology of swarming – drones deployed in squadrons, able to think independently and operate as a pack – is in its infancy, but armed forces around the world are investing millions of pounds in its development. In 2016, the US showed a video of more than 100 micro-drones over a lake in California manoeuvring, in the words of an air force scientist as "a

collective organism, sharing one distributed brain for decision-making and adapting to each other like swarms in nature"[1]. Once again, we are faced by the enormity of the ethical dimension that is opened up through the interaction between natural, human and artificial intelligences. Future issues of our journal will certainly explore this theme further, together with that of the environmental impacts of ICT which will place humanity face to face with the urgent necessity to reduce resource extraction and waste as well as energy consumption, which are pushing the Planet towards transitions which will potentially mark the end of humanity on the Earth, making room for new forms of life and and new evolutionary networks.

What is essential is understanding whether and how our technologies can impact in a positive way on these processes. Moreover, human relations are what "largely determine who uses [technologies] and for what purposes […] Technology, as such, makes nothing happen" (Marx, 2010, p.577). The human use of technology is the determining factor in terms of its impact.

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"From Ego to Eco": The Contribution of Ecopsychology to the Current Environmental Crisis Management

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Abstract
In this paper I explore some new directions to tackle contemporary environmental problems, and I discuss the benefits of adopting a psychological point of view. Indeed, I argue that an exclusive focus on the ego dimension, one that is unable to grasp the connections with its surroundings, is deeply connected with an insensitive and merely utilitarian attitude towards the environment, its resources, and the biosphere. I outline a path of personal growth that leads to developing respect and empathy towards others, and I show that such a path facilitates a qualitative leap towards the widest eco dimension. Embracing the eco dimension, in turn, promotes a revolution in the perception of oneself and towards the world, one that is comparable to the transition from adolescence to adulthood. Ecopsychology results from the encounter and collaboration between ecology and psychology and lays the foundation for an evolutionary challenge, by helping people consolidate a deeper awareness of themselves and to interact in a dialogic way both with the human and non-human environment. This discipline also contributes to develop an active and attentive attitude to one's own impact on the world, and to promote a process of personal growth (i.e., from ego to eco). Through this evolutionary leap toward a wider and more mature identity, we become aware of our role and responsibilities towards life and the world. In this paper I illustrate how this shift in perspective has been defended by many philosophers and thinkers through different notions and concepts – e.g., terrestrial identity, biospheric consciousness, ecological citizenship. I also show how embracing an ecopsychological perspective can make a difference in facing current problems with maturity, creativity and hope, as younger generations expect from us.

Key words: ecopsychology; ecology; psychology; environmental crisis; biophilia; personal growth; reconnection; mindfulness; ecological citizenship; terrestrial identity; sustainability; evolutionary challenge.

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Introduction

The growing complexity of the world requires an interdisciplinary vision in the service of contemporary needs. As a species, we are now active participants in designing the evolution of human society, its living community, and the planet itself. It is indeed not possible to face the current global challenges, as described in the United Nations' *2030 Agenda for Sustainable Development*, only from a technical point of view. The ongoing processes in our societies – which include economics, politics, environmental questions – follow rationales that are not necessarily rooted in the scientific sphere. While acting on climate, life under and above water, by preventing water pollution, air toxicity, forest destruction, and mass extinctions, it is also extremely urgent to act on more impalpable elements such as values, behaviours, attitudes and basic worldview. To maintain a human presence on Earth and allow it to flourish within terms today defined as 'sustainable', it is thus imperative to recruit knowledge and practices from the humanities, and especially from philosophical and psychological perspectives. This implies that environmental issues must be faced, first of all, as epistemological issues. "What we need, then, is a new 'paradigm' - a new vision of reality; a fundamental change in our thoughts, perceptions, and values" (Capra, 1990, p. 16) "to counterbalance our cultural orientation towards controlling and subduing nature rather than honoring that we are an intimate part of it" (Kabat-Zinn, p.15).

"Ego" as a stage in the personal growth process

Trapped in a narrow view of ourselves, it is increasingly difficult to feel the interconnection between one's own existence and that of others. This results in the so-called *skin encapsulated ego* (Watts, 1994, p. 76), focusing exclusively on the *I* dimension while otherness is seen only as an instrumental variable, functional to one's own well-being. Such state of consciousness is currently the most widespread among the members of our *Homo sapiens sapiens* species. As Metzner puts it: "We have forgotten something our ancestors once knew and practiced, respect for the mysterious, and humility in relationship to the infinite complexities of the natural world" (1995, p. 61). We have lost the perception of "being part of" – a family, a group, a society, the planet itself – as well as the sense of connection with the web of life. Once the *other* becomes only an object, no rules limit our actions, no ethical considerations constrain them, as we lack

attention to the implications and knock-on effects of what we do. Once we lose sight of the interdependency, our focus narrows down to the immediate effects, short-term policies, material advantages, for this is the only visible horizon at this level of maturity.

But what if we tried to see the current environmental crisis as an *existential crisis*? At the very beginning of his or her life, a child completely identifies with the mother, to the point that the concept of "I" has not yet developed. After a couple of years, the sense of self consolidates and sets itself apart from everything else. In this initial phase of discovery and consolidation of the *ego,* the child is predominantly selfish. In order to develop his own individuality and to start experiencing the world as a separate entity, he would tend to affirm himself as being separate from the rest, first of all from the mother. Such an evolutionary stage is, in fact, healthy and necessary, although it should be seen as a developmental stage which is instrumental to further growth. During adolescence, the sense of self consolidates and a deeper connection with the world must be regained, by integrating self-awareness with some awareness of the existence of others.

As Fabbrini and Melucci underline: "Adolescence is a catastrophic change, in the sense that is characterized by a discontinuity due to the leap in the perceptive plane, to the transformation of the look that the person is able to bring about his own existence" (1992, p. 34). As the outside world breaks into the life of the young human being, a feeling of shock caused by the new quality of "self-witnessing" forces the adolescent to rework his personal and social identity, while acquiring a broader point of view about himself and the world. Catani and Morgagni underscore the point effectively: "It is this phase of the life cycle in which the individual acquires the competencies and the requisites to assume the responsibilities of the adult; the period in which he faces tasks and duties for the first time, and in which for the first time significant choices are made, supporting the exclusive weight on his own shoulders" (2012, p. 17).

When the process is adequately supported by the external environment, a new need spontaneously emerges, namely to connect with "whoever is there" in addition to the self, on a level of equality rather than dependency. In this moment, parents are acknowledged – perhaps for the first time – beyond their role, as people, and the young human being may become a partner in the family management

process, as happens in traditional societies. Generally speaking, the psychological process of development outlined above is an optimal one as far as the individual and his or her relationship with society are concerned.

We can thus draw a parallel between such developmental process and our current historic moment. Indeed, we are in dire need of a transition from a rigid and limited sense of the *ego*, which appears still unable to grasp the connection with its surroundings, to a wider and more mature identity, in which we become aware of our role and our responsibilities towards life and the world. From this perspective, the environmental question takes on a new meaning and can be reformulated in psychological terms. In other words, how can we bridge the gap towards an adult stage of maturity in which, once the *I* dimension is honoured, we take a step towards the *We* dimension?

"Eco" as a broader horizon
Once we reach the stage described above, environmental commitment and psychology must proceed hand in hand. As Clinebell puts it: "It is crucial that those of us in the healing, teaching and helping professions, along with parents, understand the complex interrelationships of personal health and sickness with the wholeness and brokenness of the biosphere" (1996, p. 2). Yet, for such a connection between disciplines to work properly, psychology must also overcome an impasse and start focusing on the relationship between individual and environment, especially when it comes to natural resources. Indeed, Hillman has expressed the following worry about psychology: "I don't want it to be swallowed up in its caverns of interiority, lost in its own labyrinthine explorations and minutiae of memories, feelings and language – or the yet smaller interiority of biochemistry, genetics, and brain dissection." (1999, p. 52). In Ancient Greek, "eco" means "home" and it thus denotes our surroundings and our planet. This perspective could also be interpreted as a state of mind and a level of consciousness, where "eco" characterizes the awareness of the interdependency, connectedness, and belonging to the Earth. Roszak defines the *ecological ego* as this further step in the individual's growth process as well as in our species' evolutionary path: "The ecological ego matures towards a sense of ethical responsibility with the planet that is as vividly experienced as our ethical responsibility to other people. It seeks to weave that responsibility into the fabric of social relations and

political decisions" (1992, p. 321).

All these authors see the exclusive focus on the *ego* dimension as limited. On the one hand, we are gregarious animals by nature, on the other hand we are spiritual beings who possess an ethical and value dimension that needs to be acknowledged and translated into action to generate an authentic sense of fulfilment.

To overcome the limitations of the *ego* dimension and to open ourselves to a further progression towards maturity, i.e., towards the *eco* dimension, we need to work on reconnection on three different levels. These levels of reconnection would help us gain a wider state of consciousness as well as a more mature attitude towards ourselves and the world:

1. Downward reconnection: recovering the awareness that all living beings are members of ecological communities linked to one another in a network of interdependent relationships (Capra, 1997).

2. Inward reconnection: opening up to the self- actualization process, getting in touch with "who I really am", beyond stereotyped images proposed or imposed from outside; building an inner dialogue, developing critical sense, the awareness of one's talents, needs and real desires, strengthening an active will (Assagioli, 1977).

3. Upward reconnection: discovering and training mindfulness, *our ability to be in the present moment* (Kabat-Zinn, p. 19) and opening up to the higher level of the psyche, the seat of the most advanced human potentialities (Wilber, 1985); acquiring a clearer and more effective perception of reality, greater availability to experience, increased unity of the person, spontaneity and expressiveness, firm personal identity, greater detachment and transcendence, objectivity with respect to self, ability to merge concreteness and abstractness, democratic structure of character, ability to love (Maslow, 1971, pp. 158-9).

By facilitating reconnection on each of these levels, a synergic process may be activated among them, and this in turn promotes the necessary step from a vision focused only on the *ego* dimension to an opening towards the wider *eco* dimension.

Such is precisely the challenge of Ecopsychology, a new discipline born from the encounter between ecology and psychology with the goal of providing practical tools for the peculiar and critical cultural moment we are experiencing.

Ecopsychology is born

The encounter between these two different and relatively young disciplines, ecology and psychology, took place a little over a century ago. Initially lacking any connection with one another, they were proceeding in parallel: the former focused on the environment's well- being and the latter on human well-being. Perhaps it was precisely their youth that made it easier to overcome the boundaries between them, and to venture into a new direction together. The official marriage between ecology and psychology took place in the late 1980s, thanks to a study group at the University of Berkeley focused on the relationship between human beings and nature and led by the students Alan Kanner and Mary Gomes.

This research group began to address the increasingly pressing need to connect environmental health with social and individual well-being. Elan Shapiro, also part of the same group, sought to involve Robert Greenway, who had been his psychology professor at Sonoma State University where he had been teaching psychoecology since 1968, exploring 'mind' and 'nature' interactions. The participation of Greenway in the group brings about the contribution of some of the main figures of the ongoing revolution within psychology. At the time he had already met Maslow, Skinner, Erikson, May, Rogers, Huxley, and he had studied enthusiastically the works of Jung, Buber, Watts, Shepard, and Bateson, along with the emerging field of transpersonal psychology. Greenway will end up participating in the group for one year, before returning to his homeland on the Olympic Peninsula.

Shortly thereafter, Theodore Roszak, historian of the counterculture and professor at Hayward (now California State University), will join the group. His addition to the group proves particularly fruitful as he brings together what emerges during the meetings with views he had already developed in previous publications, as well as with other synergistic lines of thinking emerging in those years (Greenway, 2000). This rich and dynamic set of ideas, attentive to the needs and problems of contemporary life, comes to be known as Ecopsychology and popularized through the book *The Voice of the Earth* (1992). The term "ecopsychology" well captures a trend that was very much alive in those years. Ralph Metzner, clinical psychologist and Professor Emeritus at the California Institute of Integral Studies characterizes *green psychology* as the quest to heal the relationship between humans and nature. The Australian

philosopher Warwick Fox calls *transpersonal ecology* the study of connections between environment and consciousness (Fox, 1995), while the pastoral counsellor Howard Clinebell uses the term *ecotherapy* to promote concrete practices aimed at cultivating the awakening of personal awareness and environmental ethics (Clinebell, 1996). The '90s are also the first time – historically speaking – that allows for the possibility of meeting and exchanging ideas online, and this greatly contributes to further expand the field of ecopsychology. As the International Community for Ecopsychology aptly summarizes: "Ecopsychology is situated at the intersection of a number of fields of inquiry, including psychology, ecology, spirituality, and environmental philosophy, but is not limited by any disciplinary boundaries. Put simply, Ecopsychology explores the synergistic relation between personal health and well-being and the health and well-being of our home, the Earth" (ICE, 1998).

Ecopsychology goes even further and rapidly broadens its field of interest and action range, to the point that it actually challenges three key assumptions of modernism: our exclusive identification with ego-centred subjects, our belief that world and self, or humans and nature are dualistically separated, and the anthropocentric belief that humans are the exclusive locus of meaning and value (Adams, 2005). Ecopsychology is thus a young science that "gets in the game to offer a concrete contribution in this particular historical juncture in which environmental emergency and psychological emergency are closely connected and the work on each of these fronts is functional to the resolution of what happens on the other" (Danon, 2006, p. xvii). In 1992, when The *United Nations Conference on Environment and Development* was held in Rio de Janeiro, Roszak perceived the relative absence of psychology in the debates on sustainability. Indeed, he saw the environmental crisis and the contemporary productive organization as *deep symptoms of unhealthiness that could be explained only by psychology or psychiatry* (Carvalho, 2013, p.11). The Jungian psychoanalyst and physicist Andrew Fellows has recently launched the following appeal: "We desperately need a wider alternative worldview that is plausible, intelligible and appropriate". This plea introduces ecopsychology as "an original approach to this metanoia that the current predicament of humankind and the planet demands" (Fellows, 2019, p. 6). This discipline thus appears today as a new vision: "By awakening an Earth awareness, we approach the environment in a

spontaneously respectful way, feeling ourselves an active part of ecosystems that are increasingly recognized to be wider and more complex. Furthermore, the reconnection with our deepest terrestrial identity promotes the ability to work in groups with creative and constructive synergies, indispensable for our future of sapiens" (IES, 2018).

The ecocentric vision

Ecosophy is one of ecopsychology's core philosophical tenets. The Norwegian philosopher Arne Naess, also founder of Deep Ecology, uses this term to overturn the anthropocentric paradigm that sees human beings at the top of a pyramid, and rather characterizes them as part of a cycle and a living community. In other words, he supports an *ecocentric vision.*

As Panikkar puts it, ecosophy is a new word to express an ancient wisdom. It expresses the very traditional awareness that the Earth is a living thing, both in its parts and in the whole (2015, p. 13). Similarly, science subscribes to this view of the human being as part of the evolutionary process on Earth, notably through the ideas expressed by the Gaia Theory. This theory developed through the work of the independent scientist James Lovelock and the biologist Lynn Margulis, and led to the definition of the Earth as a single living system, endowed with its own metabolism: *"*The living substance of the earth, the air, the oceans and the emerged surfaces form a complex system, which can be seen as a single organism with the capacity to maintain the right conditions for life on our planet*"* (Lovelock 1981, p. 8). The Gaia Theory also highlights the presence of feedback loops between life and environmental conditions: on the one hand life has the effect of stabilizing environmental conditions, while on the other hand, due to the constant process of evolutionary change, new life forms emerge together with novel effects on environmental conditions and thus new feedback loops. In the philosophical considerations which can be read between the lines of his scientific text, Lovelock suggests we see human beings as partners of the Earth, and even as parts of Gaia's nervous system. In this sense, metaphorically speaking, humans would be able to anticipate environmental changes and to prevent disasters in case of planetoids in collision orbit with the Earth (Lovelock, 1981). Gaian theory contributes to create a truly new vision of the relation between human beings and Nature, one in which humans are neither masters nor parasites but rather integral parts of the evolutionary process on

Earth. Similarly, the following Biblical passage portrays the human being as a custodian of the Earth: "The Lord God took the man and put him in the Garden of Eden to work it and take care of it" (Genesis, 2.15). Finally, we may start reading this passage as an invitation to creativity and responsibility towards the Earth, and no longer in a paternalistic and conservative sense. Many of the current environmental problems arise from exploiting resources in a way that is disconnected from the awareness of the consequences that actions have on the ecosystem. It is precisely here that psychology may become a strong ally of ecology.

The approach provided by ecopsychology consists in intervening from an unexpected direction, by curbing the process of current degradation through collectively healing both the social and the physical environment and through increasing awareness of individuals and groups. As Brown rightfully and concisely puts it: "We cannot restore our health, our sense of well-being, unless we restore the health of the plane*t*" (1995, p. xvi).

Ecopsychology can therefore be interpreted as a form of ecologically committed psychology, which takes into account a broad network of significant relationships including the family circle, friendships, society, and crucially the Earth itself. This approach has its roots in an epistemology that sees the human and social world as deeply continuous with the natural world. This is how Maturana and Varela, both biologists and philosophers, describe their approach: "There is no discontinuity between the social and the human and its biological roots. The phenomenon of knowledge is a single whole, and all fields have the same foundation" (1992, p. 47). Subscribing to these epistemological tenets opens us up to a new perspective: "If you will think of ourselves as coming out of the Earth, rather than having been thrown in here from somewhere else, you see that *we are the Earth, we are the consciousness of the Earth.* These are the eyes of the Earth. And this is the voice of the Earth" (Campbell, 1991, p. 40). Recently, the Canadian researcher and educator Mark Hathaway, and the Brazilian theologian Leonardo Boff coined the term *ecopsychosis* to describe the result of a dysfunctional lifestyle in contemporary societies. One of the issues connected to ecopsychosis concerns the perception that we somehow exist as isolated ego-selves who are utterly disconnected from others, and that we have no real ethical obligation to people, other living beings, or the Earth herself (Hathaway and Boff,

2009).

A possible antidote to this collective disconnection from the web of life would be a fine-grained work at the psychological level, one that would make us reconsider our identity in terms of being "part of the community" and thus responsible for the connection between different parts, as opposed to being isolated and disconnected.

Ecopsychology in practice

First and foremost, the mission of ecopsychology is a practical one, and it points to the development of personal growth, along with a sense of belonging and active citizenship. It does so through a work that encourages reconnecting with Nature and, at the same time, with our personal identity. By acquiring familiarity with the dynamic, changing and surprising natural world, we exercise vital skills in daily life among human societies – such as resilience, emotional intelligence, initiative, systemic thinking, synergistic action. When these skills are lacking, we are thus left with significant gaps to fill (see Danon, 2019, p. 19).

By bringing individuals and groups closer to wilderness and beautiful natural areas, as far as the operation is conducted appropriately, we activate a process of wellness. Indeed, empirical evidence shows that positive emotions, mental restoration and other benefits can occur after as little as 5-20 minutes of immersion in nature (Brown, 2013). Similarly, restorative environments can restore depleted attentional capacities as well as improve performance on an attention task (Berto, 2005). In these cases, ecology and psychology work together in a straightforward way: "Environmental restoration work can spontaneously engender deep and lasting changes in people, including a sense of dignity and belonging, a tolerance for diversity, and a sustainable ecological sensibility. This art and science of helping the web of life in a particular place heal and renew itself can serve as a mirror and an impetus for individual and community renewal" (Shapiro, 1995, p. 225). In other words, as Barbiero puts it: "Protecting Nature is an expression of our biophilia" (2017, p. 159).

By developing a greater sensitivity, presence and awareness, we allow ourselves to initiate a novel relationship with the natural environment and to live experiences that would not have been noticed and enjoyed had our connection been more shallow. This renewed openness and disposition to sensing and feeling, which becomes integral to thinking, has real implications for growth on a personal and relational level. Indeed, both intrapersonal and interpersonal relationships are facilitated when individuals and groups are invited to be gently in touch with themselves, when their attention is steered towards their inner dialogue, and when they are guided towards listening and sharing of feelings (see Danon, 2006). Methodologically speaking, the combination of outdoor, group and personal work proves to be particularly effective, powerful and enjoyable. The purpose of ecopsychology's exercises and activities is therefore to guide towards the development of empathy and dialogic skills, through the awakening of our innate Biophilia and our wider sense of identity and commitment toward life.

The term *ecotuning* describes the process of creating, designing, organizing, and conducting these activities. The term was coined by the *International Ecopsychology Society* in 2006 (then *European Ecopsychology Society*), precisely to define the activity of professionals who are trained in applied ecopsychology, although not necessarily psychologists themselves. The person in charge of ecotuning (known as *ecotuner*) acts as a facilitator in the process of regaining confidence with Nature, accompanying to resume direct contact with her. At the same time the ecotuner fosters and encourages high-quality relationships, (i.e. "ecological relationships"), with oneself, other people and the environment.

From a different perspective, Nature herself may be actively involved in a direct psychological work, by acting as a setting or a metaphor that facilitates the expression of one's sensing, feeling, thinking, or even healing. As some prominent ecopsychologists have put it: "It is when we know who we are, why we are, and where we belong, that the ever-present problems of living become easier to bear, and make more sense" (Sutton Chard, 1994, p.17); "The healing of the human-nature relationship must be included in the scope of the therapeutic practice" (Buzzel, 2009, p.20).

When ecopsychology's exercises and activities are conducted by therapists and psychologists, they are characterized as ecotherapy, or - in some contexts - as ecopsychotherapy. New branches of ecopsychology and new applications of its vision and practices are now emerging in different professional fields. Within education, ecopsychology has been used to facilitate communication between teachers and students and to emphasize the importance of experiences in contact with the natural environment also to enhance school performance. Similar practices have been applied to the organization of

nurseries so that they would include some significant experiences of Nature from an early age. Within leadership training and team building, ecopsychology works *as a basis for creating quality social ecosystems* (see also Danon, 2010, p. 376). Within coaching, it is used to supplement the practices aimed at facilitating the achievement of personal goals with a broader systemic and ecosystemic vision, so that one would learn to integrate one's own activity with the broader community. Within the practice of mindfulness, the natural setting enhances the efficacy and benefits of meditation and facilitates the achievement of a wider state of consciousness: "*While Mindfulness is a conscious presence to oneself, here we progress to Green Mindfulness which characterizes the Ecopsychological approach, that is the expansion of one's individual boundaries towards a broader sense of sharing with the world and, in particular, with the natural world to which we belong* (Danon, 2018, p. 56).

Facing an evolutionary challenge

Once activated, the process of personal growth leads to an increased awareness of one specific feature potentially exhibited by Homo *sapiens sapiens*, although not exclusively. Philosophically, this feature is known as free will: the possibility to oppose instinctual drives – i.e., the compulsion to repeat habitual patterns of behaviour – and develop functional new ideas, behaviours, realities, alongside a constantly changing context.

Free will can be first discovered, then strengthened; it must be appropriately cultivated and directed towards an ethical and responsible perspective, together with the ability to think and feel like one is as a "part of something".

Jeremy Rifkin characterizes this next evolutionary step as "The Age of Empathy". On his view, we are headed towards this goal and our awareness will emerge as beings who are part of the planet. He defines such process as the emergence of Biosphere Consciousness (see Rifkin, 2010). This is the core knowledge required today to lay the foundations for a sustainable future. Edgar Morin talks about this necessary leap in terms of "terrestrial identity" that is the awareness of our common destiny: "By the end of this century, we discovered Earth as system, as Gaia, as biosphere, a cosmic speck-Homeland Earth. Each one of us has a pedigree, a terrestrial identity card. We are from, in, and on the Earth. We belong to the Earth which belongs to us" (Morin, 1994, p. 187).

Leonardo Boff points the finger in the same direction by coining the term "Planetary Consciousness": "Now is the time to take care of things and the Earth. (...) We must all take responsibility for the life-system" (Boff, 2008). He suggests that science and religion work together to avoid tragedy and transform crisis into change towards another civilizing paradigm, one that is friendlier towards Nature and more respectful of the Earth. The same concepts clearly emerge from the following passage of the *Earth Charter*, first created after the Earth Summit in Rio de Janeiro (1992) and now adopted by thousands of international organizations: "We stand at a critical moment in Earth's history, a time when humanity must choose its future. As the world becomes increasingly interdependent and fragile, the future at once holds great peril and great promise. To move forward we must recognize that in the midst of a magnificent diversity of cultures and life forms we are one human family and one Earth community with a common destiny" (The Earth Charter, 2000, preamble). The ecologist and theologian Thomas Berry talks about an "Ecozoic Period" as the goal to achieve: such a society would be based on a relationship of care, respect and reverence towards the magnificent gift of the living Earth. As Swimme, a longtime collaborator of Berry, puts it: "The future of Earth's community rests in significant ways upon the decisions to be made by the humans who have inserted themselves so deeply into even the genetic codes of Earth's process. This future will be worked out in the tensions between those committed to the Technozoic, a future of increased exploitation of Earth as resource, all for the benefit of humans, and those committed to the Ecozoic, a new mode of human-Earth relations, one where the well-being of the entire Earth community is the primary concern" (Swimme and Berry, 1992, pp.14-15).

Recently even Pope Francis, in his encyclical *Laudato Sì*, has called for an "ecological citizenship", thus sending a message which stands in perfect harmony with the one defended by ecopsychology. Once again, ecological citizenship is seen as a necessary evolutionary leap, an urgent invitation to renew the dialogue on the ways in which we are building the future of the planet. Quoting Pope Francis: "First of all it is humanity that needs to change. The conscience of a common origin, of a mutual belonging and of a future shared by all is lacking. This basic awareness would allow the development of new beliefs, new attitudes and lifestyles. Thus a great cultural, spiritual and educational challenge

emerges which will involve long regeneration processes" (2015, p. 179). Psychology may therefore play a crucial role at the juncture of this evolutionary challenge, by expanding the "I" boundaries towards the "We" boundaries. In other words, leading the change from *ego* to *eco*, in which the *ego* is not lost but rather finds a wider meaning for its individuality.

New mindset, new feelings, new lifestyles

Besides theoretical and philosophical change, the qualitative leap defended above must also generate an actual change in daily attitudes and lifestyle. As Barbiero rightfully puts it: "Human health and prosperity depend on the health and prosperity of the entire biosphere" (2017, p. 186). This implies that sustainability should not simply be seen as an outer layer of respectability in terms of recycling and waste reduction. In fact, sustainability implies an ecocentric vision equipped with the awareness that our gestures and choices have profound implications on the system. Daniel Goleman dubs this process *ecological intelligence* and focuses on the impact that individual awareness may have on consumerist society. First, ecological intelligence encourages each citizen to promote conscious consumption and social commitment without forcing her to give up on her own agency and influence on the evolution of life: e.g., from the general trend of markets and social processes, to community meetings, to the management of a company (Goleman, 2010). Madonna has also recently described a similar process: "The awareness of the biological foundations of knowledge, or of what connects us with other living beings, helps us to be more tolerant and respectful of all life forms, because *when one recognizes his own affinity with the rest of the world, he inevitably treats it more similarly to how he treats himself, that is, in a more ethical way*" (2003, p. 208).

In summary, this is exactly the goal of ecopsychology, which responds to Hillman's call to "wake up psychology" by redefining the human being and trigger the inner change which will produce novel behaviours, actions and lifestyles. "In its broadest sense, Ecopsychology has become the art of awakening in people the awareness of being an active part in the evolutionary process of life on planet Earth" (Danon, 2012, p. 218).

Ecopsychology should thus be seen as a direction to take. We are free to choose if we want to participate in, ignore, or even oppose a qualitative leap of our Planet. As humankind, we will keep destroying the environment only until we think of it in terms of separation and we believe to be alone and isolated from it. We now have the option of choosing whether to remain grounded in the idea of a being only an "I" (*ego*), one that is separate from everything else, or we can aim at thinking and acting in a sharing and co-creating perspective, i.e., as a "We" (*eco*). Once we start grasping the meaning of our being alive on Earth in terms of belonging to it, it becomes apparent that caring for the environment and for others are intimately connected with taking care of ourselves. Acting in this direction would also be an answer to the demand of young people, one in which adults finally take responsibility for what is being done to today's Earth, which will also be tomorrow's Earth.

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The impact of Biophilic Built Environment on Psychological Restoration within student hostels

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Abstract.

The focus of this paper is on how students of technical educational streams may be exposed to various aspects of stress and anxiety which burden their psychological persona and put them in a state of mental fatigue. Although it is not entirely possible to eliminate the sources of stress and anxiety in the life of students, several attempts can be made to introduce students to certain natural environments which help recover their depleted mental resources and improve fatigued cognitive functions. Our proposal is to link Attention Restoration Theory (ART) and the Biophilia Hypothesis as a way of exploring Biophilic Design in order to research this aspect of human psychology and its relationship to Nature. Individual researches have presented some evidence in favour of these propositions and this paper examines the impact and the significance of a number of Biophilic Environment Variables as regards the Psychological Restoration of students within the built environment of hostels. In order to investigate this, student hostel rooms at two institutes (105 km apart) situated in the foothills of the Himalayas, both designated as of national importance in India, were surveyed using the following variables: *Nature in the Space*, *Natural Analogues* and *Human Nature Relationship*. These were correlated with the resident students' response to Plutchik's emotional stability wheel and some specific aspects of Perceived Restorativeness: *Being Away*, *Fascination*, *Extent* and *Compatibility*. The results indicate that the students in hostel rooms which have higher qualitative and quantitative scores in terms of biophilic environment variables (connection with nature) report greater Perceived Restorativeness and also possess better self-reported emotional stability.

Key words. Biophilia; biophilic design; sustainability; sustainable architecture; psychological restoration; well-being; restorative environment.

Introduction

Academic stress and anxiety related to mental disorders are significant among school and college students throughout the world (Deb et al, 2015). According to a study conducted on college students of Indian medical, dental and engineering streams, stress was recorded in about 24.42% of them, out of which 19.7 % engineering stream students showed stress related symptoms (Waghachavare et al., 2013). The factors contributing to stress and anxiety are academic pressure, health consciousness, environmental disturbances and social imbalance. The extreme amalgamation of these factors often leads to depression and suicides, which is the 3rd leading cause of death among young age groups. The National Crime Records Bureau (NCRB) (2014) states that India has a suicide rate of 10.6 per lakh (100.000) of the population whereas Himachal Pradesh, which is a relatively small hilly state in the Western Himalayas, has 9.2 per lakh of the population with a 45% increase since 2012. In contrast to the NCRB report, the WHO (2016) states that India has suicide rate of 16.5 per lakh of the population, taking the annual count to 2.57 lakh Indians. This discrepancy could be due to the fact that the NCRB draws data from First Information Reports (FIR) which are often under-reported in Indi, whereas the WHO draws its data from sample registration surveys and medically certified causes of death which are mandatory in the country for legal claims and procedures. Out of the entire Indian population involved in this scenario 6.7% are students of age group 18 - 30 years, with 60% being male and 40% of them being female (NCRB, 2015). A study conducted exclusively for Himachal Pradesh by the Regional Forensic Science Laboratory of Dharamshala concluded that out of all the cases of suicide in Himachal Pradesh, 68.85% are males and 31.15% are females with 66.38% exposure on 21 – 40 years age group, out of which 13.11% are students and around 74.59% of the total population who committed suicide (all sub-groups covered in the forensic study for Dharamshala) preferred indoor closed locations (Pal et al, 2016).

An average human spends 90% of his time inside or around buildings (a membrane) and a plausible quantity of previous studies in this domain suggests that if these buildings are not designed in a balanced way with the human psychology then they can additionally burden the involuntary human attention and adversely affect behavioural and cognitive functions (Evans and McCoy, 1998; Takki et al. 2011; Seidman and Standring 2010; Pegas et al. 2011). Prolonged exposure to such negative environments can lead to development of several psychological ailments, which affect our mood and co-create mental disorders of severe intensities. Buildings affect mental health in direct and indirect ways. Physical contributors such as insufficient amount of ambient light, poor indoor air quality (IAQ), noise and uncomfortable thermal and ventilation conditions cause the direct effects on mental health (Chua et al., 2006; Fang et al., 2004; Kamaruzzaman and Sabrani, 2011; Seppanen, Fisk and Lei, 2006; Wargocki et al., 2006; Bakó-Biró et al., 2012). Indirect effects include the interferences in psychosocial processes like disturbing the sense of belongingness, wellbeing, self-efficacy, commitment, engagement, self-esteem, motivation and satisfaction (Evans, 2003; Carlson et al., 2012).
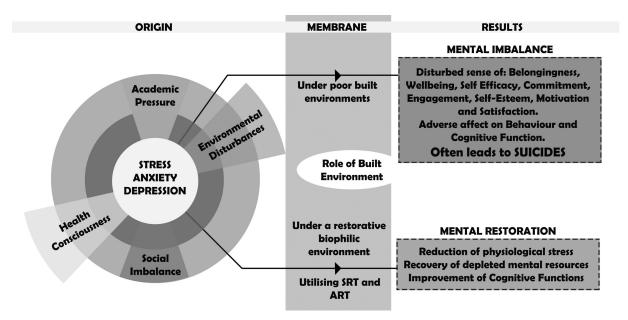

Figure 1. Role of built environment as a membrane in handling stress and anxiety.

Restorative Quality of Environment

In environmental psychology literature, the term 'restoration' has been used as a synonym for other terms such as stress recovery, mental fatigue restoration and improvement of cognitive functions and is associated with renewing or recovery of depleted mental resources through exposure to nature which diminish due to daily work or stressful situations (Ulrich et al., 1991; Kaplan and Kaplan, 1989; Hartig et al, 1996; Korpela et al., 2008). Restorative environments are certain nature rich environments (scenic views, dense and lush green vegetation, natural water bodies and imitations of nature like topiary and biomimicry) which promote and enhance the recovery process of human mental resources.

The term 'biophilia' was first introduced by Fromm (1973) as "the passionate love of life and of all that is alive" and later developed by Wilson (1984) in his 'Biophilia hypothesis', defined it as "the innate tendency to affiliate with other forms of life". Research on restorative environments has grown in quantity within the last three decades since Wilson presented his hypothesis. Since then, several theories suggesting mitigation strategies for psychological stress and anxiety were put forward by various environmental psychologists including Kaplan and Kaplan (1984, 1985 and 1989). The research within this domain developed within two distinctive theories: The Attention Restoration Theory (ART) by Kaplan and Kaplan (1989) and Stress Reduction Theory (SRT) by Ulrich (1991). Stress Reduction Theory (SRT) emphasizes how natural environments like greenery and landscapes can reduce physiological stress and negative emotions (Ulrich, 1983; Ulrich, 1991; Ulrich 1986). Attention Restoration Theory (ART) emphasizes how efficiently the natural environment can capture involuntary attention in an entirely effortless manner, thus easing the mind to recover from an exhausted directed attention system (Kaplan, 1984; Kaplan & Kaplan 1995; Kaplan, 1989).

Perceived Restorativeness: Being Away, Fascination, Extent and Compatibility

Extended and case specific researches on four theoretical restorative factors of ART - Being Away, Fascination, Scope or Extent or Coherence and Compatibility - resulted in the development of Perceived Restorativeness Scale (PRS), which is a tool developed by Hartig et al. (1997) to measure the restorative quality of the environment through evaluating the richness of these four restorative factors. Being Away represents the experience of the user to sense distance from the source of their mental stress or cognitive burden. Fascination is a facile action of attaining involuntary attention. Extent signifies the ability to interact with the environment without reaching any stage of boredom. Compatibility represents a stage of certain comfort and understanding where the user senses no need to use the intellectual or cognitive effort in order to understand the environment (Rai et. al., 2019). Kaplan & Kaplan (1989) explained that the PRS is not restricted to any one environment and it is more than capable of handling several environments. Thus, it became a valid tool for designers such as architects, landscape planners and urban planners to evaluate the impact of different existing and proposed settings on the human psyche through design (Ivarsson & Hagerhall, 2008).

Design influenced by Nature: Biophilic Design

Biophilic design uses the concept of Biophilia in developing design elements of built environment and surroundings in order to promote a greener and healthier approach (Kellert et al., 2011; Kellert and Wilson, 1995). Designers and researchers have attempted to enlist the elements or patterns of biophilic design to further understanding of how this concept can be developed and applied to design processes. McGee and Marshall-Baker (2015) tried to bridge the gap between architecture and biophilic design by introducing Biophilic Design Matrix (BDM) as a tool to strategically include features of Biophilia so that health and wellbeing can be optimized through design. Berto and Barbiero (2017) introduced the Biophilic Quality Index (BQI) which focused on restoration through an all building generalized tool created to measure the extent of the biophilic quality of the building. The available matrix, index and tools in this context provide a variety of variables for energy efficiency, aesthetic applications and generalized measures to evaluate a built environment. Our work is an endeavour to move further towards a design module which can classify each biophilic environment variable on the basis of its specific psychological impact in defined building typologies (as the users experience different degrees of stress and anxiety) when the variables are used in a design composition. This paper explores the psychological impact of a number of biophilic built environment variables (BEV) proposed by the Terrapin Bright Green framework - Nature in the Space, Natural Analogues and Human Nature Relationship - for the specific cases of student hostels within technical institutes. It also seeks to understand

the mediation offered by a person's emotional stability or mood in self-reporting the perceived restorativeness of his environment[1].

Methodology

Location and Participants

Two autonomous institutes regarded as 'Institute of National Importance' under the Indian higher education system were selected for this study. The institutes A and B are 105 km (65 miles) apart and situated in the foothills of the Himalayas called Shivalik Range in the hilly state of Himachal Pradesh with average elevation 901 meters above msl (mean sea level) and 1189 meters above msl respectively. Institute A is situated on the ridge line almost 200 meters above the town level with picturesque views of the Dhauladhar range of the Himalayas and experiences moderate summer and cold winters. Institute B is situated on the banks of the River Uhl (a tributary of the glacial River Beas) and has a relatively colder climate as compared to Institute A. Institute B has advantage in terms of visual and auditory comfort and the presence and movement of water over Institute A. Institute A has hostels which represents the static growth of the campus from 1980s to present, it includes buildings built completely in local dressed stone and timber to the recent trabeated concrete constructions. Institute B is a relatively new campus with its foundation stone laid after 2010 and thus most of the buildings belong to a significant planned and module-oriented masterplan. Both the institutes however maintain the same roof profile due to the heavy rainfall and cultural relevance.348 students (convenience sample) of the final year of graduate and post graduate technical courses who reside in single occupancy rooms, spread across six hostels from the two selected institutes, participated in the research study. The final year students were selected on the principal basis that they experience far greater levels of stress, anxiety and depression due to career concerns, placements and CGPI improvement peer pressure, in comparison to the students of other years (Waghachavare et al, 2013). The single occupancy rooms reduce the level of interaction within the built-environment and add layers of isolation to the mental persona of the student, thus magnifying the risks of stress, anxiety and depression (Holt et al, 2012). The hostels located on different orientations and locations are rich in natural-scape and have variations in their exposure to biophilic patterns (elements of natural representation). In this way, an adequate sample for

a reasonably significant analysis of the collected data was expected. Institute A has hostels which are part of this study in three separate clusters far from each other whereas the hostels of Institute B which are selected for this study are part of a single cluster which shares a common green area in the centre.

Procedure

Three sets of questionnaires (appendix) were adopted in part, developed and rigorously tested at Institute A before being used for this study: Perceived Restorativeness Scale (PRS), Biophilic Environment Variables (BEV) Investigation and Plutchik's emotion wheel. PRS's original version of 26 items, which was developed by Hartig et al. (1997), was used for evaluating perceived restorativeness of the built environment on a 7-point bipolar scale. Biophilic Environment Variables (BEV) Investigation is based on the original Biophilia Hypothesis and later developed postulates of Biophilic Design by Stephen Kellert and the 14 Patterns of Biophilic Design by Browning, Ryan and Clancy (2014). It evaluates the environment variables on a 3-point scale of the intensity and quality of their presence. There is a possibility that students who are emotionally stable may respond more positively to the PRS, so a modified graphical version of Plutchik's (2001) emotion wheel was used to identify and record the three most common emotions of the participants on a varying scale and given the weight of 60%, 30% and 10% respectively on the basis of their frequency of occurrence. The third questionnaire is used to mediate the results between BEVs and PRS so that an unbiased restorativeness review of the environment can be obtained.

The questionnaires were developed and tested through pilot studies carried out 3 months prior to the original study. The observations recorded during the pilot phases were utilized in the later development phases of the final version of the questionnaires. For example, Plutchik's Emotion Wheel Mean was modified for visual understanding as the students found it difficult to associate and communicate their exact emotion with the written words. For this reason, the pictographs were added to enhance the user-friendly design of the experiments.

The Terrapin Bright Green's broad classification-based framework was further broken down into 62 extended individual and detailed variables in order to minutely capture the individual impacts from field surveys and these were then grouped into the major classifications of 14 patterns of biophilic design after analysis in order to facilitate quantifying the results into already set parameters. Some variables were clubbed together and some redistributed if they appeared similar or associational or vice versa during pilot studies.

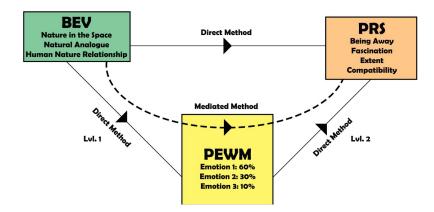[1] https://www.terrapinbrightgreen.com/

Figure 2. Tested Methods. **Note**: Biophilic Environment Variable (BEV), Perceived Restorativeness Scale (PRS) and Plutchik's Emotion Wheel Mean (PEWM).

Variable Type	Group ID	Grouped Variables	Recorded Variables
Independent Variables	**NIS**	Nature in the Space	1. Visual Connection with nature 2. Non-visual connection with nature 3. Connection with natural systems 4. Nature and Comfort 5. Light 6. Space
	NATLOG	Natural Analogues	7. Natural Shapes and Forms 8. Material Connection with nature 9. Complexity and order
	HNR	Human Nature Relationship	10. Preservation and Place-making 11. Prospect and refuge 12. Mystery & Risk / Peril
Dependent Variables	**PRS**	Perceived Restorativeness Scale	1. Being Away (BA) 2. Fascination (FA) 3. Extent (EX) 4. Compatibility (CP)
Mediation Variable	**PEWM**	Plutchik's Emotion Wheel Mean	1. Most Frequent Emotion – weight 60% 2. Second Most Frequent Emotion – weight 30% 3. Third Most Frequent Emotion – weight 10%

Table 1. Variables of research study

Four different methods are tested to analyze data acquired from the three different questionnaires used. As shown in Fig. 2, they were developed initially in order to orient the methodology towards the major questions associated with the nature of the research i.e., to ascertain the role of each variable in influencing the overall perceived restorativeness, as well as the mediation offered by the Emotional stability of the student. Firstly, three different regression models were created to address the research questions: a linear regression model between BEVs and PRS prospects (Direct Method), another between BEVs and PEWM (Lvl. 1) and the last between PEWM and PRS prospects (Lvl. 2). Secondly, Sobel mediation analysis was run to test the percentage effect and ratio of indirect to direct method of PEWM as a mediator on the Independent Variable (IV) BEV's impact on Dependent Variable (DV) PRS prospects against the null hypothesis of no effect.

Results

Descriptive Statistics

Across the two institutes, a total of 348 students (290, 83.3% from Institute A; 58, 16.7% from Institute B) responded to the questionnaires through paper medium. Institute and hostel wise population characteristics of the study sample are presented in Table 2. Descriptive statistics of mean and standard deviations of targeted age groups, PRS, BEV and PEWM are presented in Table 3. The respondents had average age of 21.92 years with overall PEWM mean of 1.20 (a positive value on a four axial 7-point bipolar scale indicates a positive emotional mean which refers to significant satisfaction deriving from the surrounding environment). There were some initial observations from the descriptive analysis which are graphically analyzed in Fig. 3. Students who responded highly positive on PRS variables Being Away (BA) and Fascination (FA) were more likely to reside in hostels which have significantly higher average score for Nature in the Space (NIS) on the BEV scale. The students who responded highly positively on the PRS variable Compatibility (CP) were more likely to reside in hostels which have significantly higher average score of Human-Nature Relationship (HNR) on the BEV scale. The highest positive Extent (EX) score was recorded from respondents who reside in hostels which have the lowest average score of NIS on the BEV scale. The hostel complex IITM of Institute B had higher qualitative and quantitative presence of BEVs as compared to the average BEVs of hostels of Institute A.

	Institute		Hostel						
	A	**B**	**DBH**	**HH**	**MMH**	**PGH**	**VBH**	**IITM**	**Total**
N	290	58	47	90	58	15	80	58	348
Percent	83.3	16.7	13.5	25.9	16.7	4.3	23	16.7	100
	Gender		**Educational Courses**						
	Male	**Female**	**B.Tech**		**B.Arch**	**M.Tech**	**M.Arch**	**M.Sc**	
N	333	15	267		7	56	4	14	348
Percent	95.7	4.3	76.7		2	16.1	1.1	4.0	100

Table 2. Descriptive statistics of frequency and percentage of surveyed sample from each hostel and institute.

Aspects	Min.	Max.	Mean	Std. Deviation
Age	20	31	21.92	1.695
Plutchik's Emotion Wheel Mean (PEWM)	-2	3	1.20	1.065
PRS Variables				
1. Being Away	-11	19	9.07	5.788
2. Fascination	-18	28	10.84	10.297
3. Extent	-15	9	-5.20	4.972
4. Compatibility	-8	31	11.98	7.767
Biophilic Environment Variables (BEV)				
1. Visual Connection with nature	0	18	11.04	5.953
2. Non-visual connection with nature	0	5	1.91	1.340
3. Connection with natural systems	0	4	2.36	1.478
4. Nature and Comfort	0	5	2.60	1.256
5. Light	1	14	8.95	3.287
6. Space	1	10	6.99	2.363
∑ (1-6): Nature in the Space (NIS)	2	56	33.85	15.677
7. Natural Shapes and Forms	0	12	7.24	4.081
8. Material Connection with nature	0	4	1.85	1.032
9. Complexity and order	0	6	3.73	1.950
∑ (7-9): Natural Analogues (NATLOG)	0	22	12.82	7.063
10. Preservation and Place-making	0	11	5.15	3.019
11. Prospect and refuge	0	9	4.76	2.479
12. Mystery & Risk / Peril	0	7	3.54	2.095
∑ (10-12): Human-Nature Relationship (HNR)	0	27	13.45	7.593

Table 3. Descriptive statistics of mean and standard deviations of surveyed sample from all hostels.
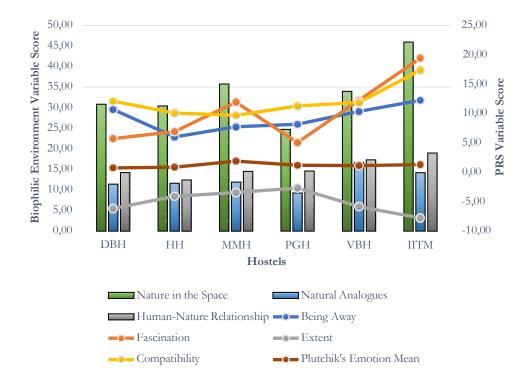

Figure 3. PRS and Biophilic Environment Variables: Comparison of Means for all surveyed hostels.

Regression Analysis

The regression analysis results were obtained from two different models: 1) Direct method between BEVs and PRS prospects and 2) Direct method Lvl. 1 between BEVs and PEWM are shown in Table 4. The standardized beta coefficient values (β) and adjusted R square for the whole regression model are highlighted if found significant. Out of the 48 tested cases of variable combinations in direct method regression between BEVs and PRS perspectives, 22 were found to be significantly associated. The significantly associated BEVs and PRS perspectives are Being Away (adjusted R square = .499, p < .01), Fascination (adjusted R square = .577, p < .01), Extent (adjusted R square = .170, p < .01) and Compatibility (adjusted R square = .631, p < .01). Although the direct method model shows significant associations between the grouped variables and PRS perspectives,

not all the BEVs established significant relationship. The most significant associations are shown by BEV Visual connection with nature which showed significant correlation with all four PRS perspectives followed by Non-visual connection with nature and Prospect & Refuge which showed significant correlation with at least three PRS perspectives. The BEVs Connection with natural systems, Natural shapes and forms, Material connection with nature and Complexity & Order showed significant correlation with at least two PRS perspectives whereas Nature & Comfort and Light significantly correlated with at least one PRS perspectives. Space is the only BEV which failed to establish any connection with the PRS perspectives. In Direct method Lvl. 1, which involves regression analysis between BEVs and PEWM, four out of the twelve variables were found to have significant correlations with the full model yielding significant association (adjusted R square = .452, p < .01).

Linear Regression Model		Direct Method				Direct Method
		DV under PRS				**Lvl. 1**
IV under Biophilic Environment		Being Away	Fascination	Extent	Compatibility	PEWM
Nature in Space	Visual Connection with nature	**.313****	**.212****	**.368****	**-.227****	**.323****
	Non-visual connection with nature	-.075	**.146****	**-.239****	**.224****	**.112***
	Connection with natural systems	.103	**.133****	**-.309****	.092	.027
	Nature & Comfort	-.022	**.1***	-.103	.08	.108
	Light	-.04	-.061	.058	**.164****	-.101
	Space	.048	.064	-.149	.076	.100
Natural Analogue	Natural Shapes & Forms	**.191****	**.364****	-.156	-.024	.108
	Material Connection with nature	.025	**-.129****	.094	**.235****	**-.121***
	Complexity & order	.099	.019	**.219****	**-.119***	**.240****
Human-Nature Relationship	Preservation and Place-making	.082	-.046	-.164	**.24****	-.053
	Prospect and refuge	**.149****	**.127****	.008	**.232****	-.069
	Mystery & Risk / Peril	-.024	-.009	-.022	**.125****	.029
Adjusted R square		**.499****	**.577****	**.170****	**.631****	**.452****

Note: ** p < 0.01; *p < 0.05; IV = Independent Variables, DV = Dependent Variables.

Table 4. Regression Results: The effect of Biophilic Environment Variables (BEV) on Perceived Restorativeness (PRS) and Plutchik's Emotion Wheel Mean (PEWM); Standardized beta coefficients.

Table 5 represents the regression model results of Direct method Lvl. 2 between PEWM and PRS prospects. PEWM is found to influence only Being Away (β = .546, adjusted R square = .296, p < .01) and Fascination (β = .408, adjusted R square = .382, p <

.01) out of the four PRS prospects. Extent (β = -.125, adjusted R square = .013, p < .05) and Compatibility (β = .266, adjusted R square = .068, p < .01) showed significant yet weak or negligible association with PEWM.

Linear Regression Model	Direct Method Lvl. 2: **DV under PRS**			
IV	Being Away	Fascination	Extent	Compatibility
PEWM	.546**	.408**	-.125*	.266**
Adjusted R square	.296**	.382**	.013*	.068**

Note: ** p < 0.01; *p < 0.05; IV = Independent Variables, DV = Dependent Variables.

Table 5. Regression Results: The effect of Plutchik's Emotion Wheel Mean (PEWM) on Perceived Restorativeness (PRS); Standardized beta coefficients.

Mediator: PEWM	DV - PRS											
	Being Away			Fascination			Extent			Compatibility		
IV - BEV	Sobel	% Effect	Ratio I/D	Sobel	% Effect	Ratio I/D	Sobel	% Effect	Ratio I/D	Sobel	% Effect	Ratio I/D
Visual Connection with nature	4.47**	24.06	0.316	5.98**	28.25	0.393	-1.32	51.56	1.06	-0.95	-7.6	-0.07
Non-visual connection with nature	6.54**	55.56	1.25	6.97**	43.05	0.756	-0.73	8.93	0.098	0.95	4.04	0.042
Connection with natural systems	6.15**	31.45	0.458	6.93**	33.85	0.511	0.215	-1.78	-0.01	0.91	4.07	0.042
Nature & Comfort	6.64**	47.38	0.9	7.30**	40.9	0.692	-0.88	15.65	0.18	1.3	8.44	0.092
Light	6.23**	41.85	0.719	6.79**	43.77	0.778	-1.58	34.42	0.52	1.86	9.34	0.103
Space	6.18**	32.94	0.491	7.23**	38.14	0.616	-0.24	3.1	0.03	0.008	0.042	0.000
Natural Shapes & Forms	5.63**	24.72	0.328	6.95**	29.05	0.409	-0.36	5.57	0.05	-0.242	-1.26	-0.012
Material Connection with nature	5.20**	32.28	0.476	5.48**	43.5	0.769	-1.65	24.36	0.32	2.07	5.75	0.061
Complexity & order	5.64**	30.71	0.443	7.29**	41.28	0.703	-1.86	94.71	17.91	0.087	0.626	0.006
Preservation & Place-making	5.77**	26.86	0.367	6.30**	35.23	0.543	-0.58	4.77	0.05	0.64	1.64	0.016
Prospect & Refuge	4.46**	25.48	0.341	4.60**	30.9	0.448	-1.39	10.2	0.113	2.34	4.75	0.049
Mystery & Risk / Peril	5.61**	31.8	0.466	6.00**	38.42	0.624	-0.93	8.11	0.088	1.25	3.22	0.033

Table 6. Sobel Mediation Analysis for Indirect and Direct methods. **Note:** The table summarises 48 different Sobel mediation analyses results highlighting significant indirect effects, ** p < 0.01; % Effect = Percentage of the total effect that is mediated; Ratio I/D = Ratio of the indirect to the direct effect; IV = Independent Variables, DV = Dependent Variables, PRS = Perceived Restorativeness Scale, PEWM = Plutchik's Emotion Wheel Mean.

Sobel mediation analyses was conducted to elaborate the relationship between BEVs and PRS perspectives when PEWM acts as a mediating variable. Table 6 summarizes results of 48 different mediation analyses as three different values to explain the effect: 1. Sobel values (s), 2. Percentage of the total effect that is mediated (% effect) and 3. The ratio of indirect to direct effect (Ratio I/D). The

Sobel mediation analyses results confirm and strengthen the conclusion of Lvl.2 regression results that PEWM influences only Being Away and Fascination out of the four PRS prospects. The BEVs which are majorly influenced (above 40%) by the PEWM mediation for PRS prospect Being Away are Non-visual connection with nature (s = 6.54, % = 55.56, Ratio I/D = 1.25, p < 0.01), Nature & Comfort

(s = 6.64, % = 47.38, Ratio I/D = 0.9, p < 0.01) & Light (s = 6.23, % = 41.85, Ratio I/D = 0.719, p < 0.01). The BEVs which are majorly influenced (above 40%) by the PEWM mediation for PRS perspectives Fascination are Non-visual connection with nature (s = 6.97, % = 43.05, Ratio I/D = 0.756, p < 0.01), Nature & Comfort (s = 7.30, % = 40.9, Ratio I/D = 0.692, p < 0.01), Light (s = 6.79, % = 43.77, Ratio I/D = 0.778, p < 0.01), Material Connection with Nature (s = 5.48, % = 43.5, Ratio I/D = 0.769, p < 0.01), Complexity and Order (s = 7.29, % = 41.28, Ratio I/D = 0.703, p < 0.01).

Discussion

The data collected suggests that students living in hostel rooms which had higher quantity and quality of BEVs were more likely to self-respond highly positively on PRS and this association was significantly mediated by PEWM of the students. The results lead us to the conclusion that the emotional stability represented by PEWM plays a significant role in the perception of hostel rooms as psychologically restorative environments when there is quantitative and qualitative presence of BEVs in them. The BEVs are strong proponents of creating restorative environments but their impact is significantly influenced by the emotional state of the resident students. The data further suggests that BEVs Visual connection with nature, Non-visual connection with nature, Material connection with nature and Prospect & Refuge have direct influence on the emotional stability of the students, their impact can be maximized through experimental design solutions and this in turn can increase the ability of the student to perceive their environments as restorative. Table 4 can be used to prepare a priority-wise hierarchy of proportionate use of BEVs so that a balanced environment can be created for user specific needs. Every space has a different use and it also differs in the degree of restoration they provide. However, the hostel rooms have limited space and scope for internal design interventions. The biophilic design of hostels could expand and seek more from its surrounding environment. It could thus be concluded that the design should not promote the idea of containment for students, rather it should just play a role of a membrane between them and the nature. The hostels should protect the students from the eventual hostilities of the natural environments (severe weather and climatic conditions) while making them aware of the surrounding environment in order to strengthen BEV Prospect and Refuge. They should also offer scope to interact with the natural environments so that the highly restorative BEVs

Visual connection with nature, Non-visual connection with nature, Material connection with nature, can be an active part of student life.

The hostels serve as the home to the students of technological branches for at least 4 to 5 years and play a significant role in influencing their emotional stability. If this is consolidated over time, then it may affect the development of their personality at the initial stages of their career when they experience severe levels of stress and anxiety. We believe that the results of our study point to how both emotional stability and the built environment play a role in the student's perception of their environment as restorative and can indicate a range of possible developments in this particular domain. If the BEVs are slowly affecting the restorative quality of the environment as well as the emotional stability of the student, then more research needs to be undertaken in order to understand their potential in creating a psychologically healthy society and restorative resident campuses for institutes. This study offers a partial conceptual framework for further investigating the modern daily life psychological health problems of the students around the world. We hope that it can provide a useful tool for environmental psychologists and designers in order to create and offer mentally sustainable built environments.

Conclusions

The study investigated possible triangular associations between Biophilic Environment Variables (BEVs), Emotional Stability (PEWM) and Perceived Restorativeness (PRS). It was limited in its approach to only final year students of technical courses who reside in single occupancy hostel rooms. The samples taken from each hostel were not of the same size but followed the same population to sample ratio. The two selected institutes had variations in the type of micro-climates with Institute A being a bit warmer than Institute B. The results are specific to the student hostel environments and should not be taken as generalizable for other similar studies. At the same time, we believe that the tools and questionnaires which were part of this study could be modified and reproduced within similar studies. Future research could attempt to enlarge the sample sizes with additional biophilic environment variables if available in any specific region or be created through redistribution of the existing tools. While our study targeted specific to the BEVs and psychological domains, other studies could include broader social and physiological health measures.

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Appendix – Survey Questionnaires - © Farhan Asim & Venu Shree

Biophilic Environment Variables (BEV) Investigation for Student Hostels

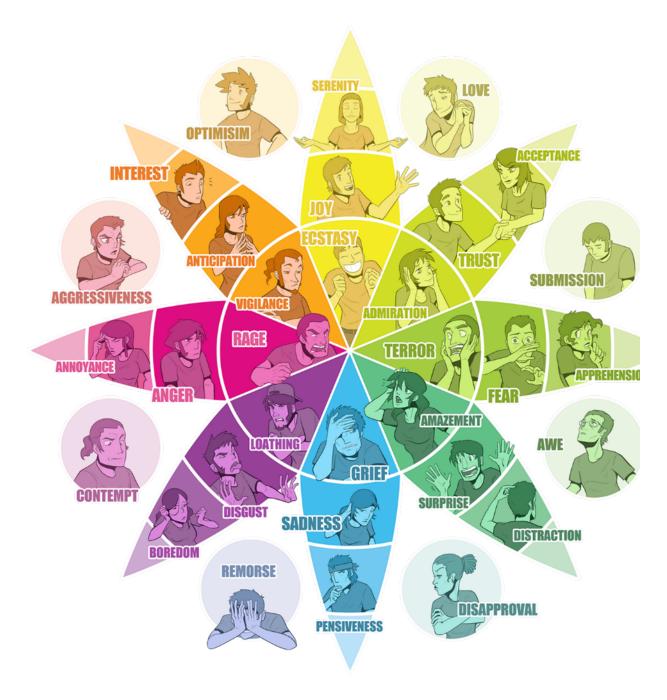| Likert Scale				NA	Apparent	Strong
NATURE IN THE SPACE	Environmental Processes	Visual Connection with Nature	Vibrant colours			
			Presence of water			
			Reflections*			
			Presence of Sunlight			
			Presence of plants			
			Presence of animals			
			Preferred views and vistas			
			View of Clouds*			
			Facade greening			
			Geology and landscape			
			Diversity in habitats and Ecosystems (Plants, Animals, Birds, etc.)			
		Non-Visual Connection with Nature	Auditory Variability (Natural Sounds)			
			Haptic Variability (Textures)			
			Olfactory Variability (Fragrance)			
			Gustatory Variability (Taste)			
	Natural Patterns & Processes	Connection with Natural Systems	Growth and change			
			Dynamic balance and tension			
		Nature and Comfort	Integration of parts to wholes			
			Ease of access to nature			
			Natural Ventilation**			
	Light & Space	Light	Natural Light			
			Filtered and diffused light			
			Light and shadow*			
			Reflected light			
			Light as shapes and form			
			Warm Light**			
		Space	Spaciousness			
			Spatial variability			
			Inside-outside spaces			
			Space as shape and form			
			Transitional spaces			
			Spatial Harmony			

*Elements of Non-Rhythmic Sensory Stimuli
**Elements of Thermal and Air Flow Variability

Legends: 2 - Strong, 1- Apparent, NA - Not Available				NA	Apparent	Strong
NATURAL ANALOGUES	Simulation of Natural Features	Natural Shapes & Forms	Botanical motifs			
			Tree and columnar supports			
			Animal motifs			
			Shells & Spirals			
			Egg, oval and tubular forms			
			Arches, vaults, domes			
			Shapes which resist straight lines and right angles			
			Biomorphy			
			Biomimicry			
			Geomorphology (Rocks, stones, pebbles)			
		Material Connection with Nature	Natural materiality			
			Natural texture			
		Complexity & Order	Information richness			
			Complementary contrasts			
			Hierarchically organized ratios and scales			
HUMAN-NATURE RELATIONSHIP	Place-Based Relationship	Preservation & Place-making	Indigenous materials			
			Landscape features that define building form			
			Integration of cultural and ecological values / elements			
			Sustainability			
			Spirit of place			
			Avoiding placeless-ness			
	Evolved Human-Nature Relationship	Prospect & Refuge	Unrestricted open and vast views			
			Security and protection			
			Mastery and control			
			Affection and attachment			
			Attraction and beauty			
		Mystery & Risk/Peril	Curiosity and enticement			
			Exploration and discovery			
			Fear and awe			
			Reverence and spirituality			

Perceived Restorativeness Scale (PRS) for Student Hostels
(Based on PRS – 26 by Hartig, Evans, Korpela & Garling, 1997 and ART by Kaplan & Kaplan, 1989)

This survey will collect information about your perception of the hostel environment. Please, indicate the extent to which the given statement describes your experience in this built environment on the below 7 points bipolar scale.

Factors		Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Being Away	Being here is an escape experience.							
	Spending time here gives me a break from my day-to-day routine.							
	It is a place to get away from it all.							
	Being here helps me to relax my focus on getting things done.							
	Coming here helps me to get relief from unwanted demands on my attention.							
Fascination	This place has fascinating qualities.							
	My attention is drawn to many interesting things.							
	I want to get to know this place better.							
	There is much to explore and discover here.							
	I want to spend more time looking at the surroundings.							
	This place is not at all boring.							
	The setting is fascinating.							
	There is a lot worth looking at here.							
Extent	There is too much going on.							
	It is a confusing place.							
	There is a great deal of distraction.							
	It is chaotic here.							
Compatibility	Being here suits my personality.							
	I can do things I like here.							
	I have a sense that I belong here.							
	I can find ways to enjoy myself here.							
	I have a sense of oneness with this setting.							
	There are landmarks to help me get around.							
	I could easily form a mental map of this place.							
	It is easy to find my way around here.							
	It is easy to see how things are organized.							

A modified version of Plutchik's psycho-evolutionary emotion wheel.

<u>List of emotions with their meanings:</u>

1. **Acceptance:** willingness to tolerate a difficult situation.
2. **Admiration:** respect and warm approval.
3. **Apprehension:** anxiety or fear that something bad or unpleasant will happen.
4. **Ecstasy:** an overwhelming feeling of great happiness or joyful excitement.
5. **Fear:** an unpleasant emotion caused by the threat of danger, pain, or harm.
6. **Joy:** a feeling of great pleasure and happiness.
7. **Love:** a strong feeling of affection.
8. **Serenity:** the state of being calm, peaceful, and untroubled.
9. **Submission:** the action of accepting or yielding to a superior force or to the will or authority of another person.
10. **Terror:** extreme fear.
11. **Trust:** firm belief in the reliability, truth, or ability of someone or something.
12. **Amazement:** a feeling of great surprise or wonder.
13. **Surprise:** a feeling of mild astonishment or shock caused by something unexpected.
14. **Distraction:** a diversion or recreation.
15. **Awe**: a feeling of reverential respect mixed with fear or wonder.
16. **Disapproval:** possession or expression of an unfavorable opinion.
17. **Pensiveness:** engaged in, involving, or reflecting deep or serious thought.
18. **Sadness:** the condition or quality of being sad.
19. **Grief:** an instance or cause of intense sorrow.
20. **Remorse:** deep regret or guilt for a wrong committed.
21. **Boredom**: the state of feeling bored
22. **Disgust:** a feeling of revulsion or strong disapproval aroused by something unpleasant or offensive.
23. **Loathing:** a feeling of intense dislike or disgust; hatred.
24. **Contempt:** the feeling that a person or a thing is worthless or beneath consideration.
25. **Annoyance:** the feeling or state of being annoyed; irritation.
26. **Anger:** a strong feeling of annoyance, displeasure, or hostility.
27. **Rage:** violent uncontrollable anger.
28. **Aggressiveness:** hostile or violent behavior.
29. **Interest:** the feeling of wanting to know or learn about something or someone.
30. **Anticipation:** the action of anticipating something; expectation or prediction.
31. **Vigilance:** the action or state of keeping careful watch for possible danger or difficulties.
32. **Optimism:** hopefulness and confidence about the future or the success of something.

SLOW

Special Section

TECH

Slow Tech: Towards an ICT for the Anthropocene Age

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Abstract
Information and Communication Technologies (ICT) are shaping our society and planet with unknown impacts and are definitely an integral part of the Anthropocene Era. The entire ICT supply chain should move towards a more systemic view of the infosphere. This paper proposes the concept of *Slow Tech* as a *heuristic compass* for finding new directions in the design of future complex socio-technical systems, by paying attention to ICT that are *good*, *clean*, and *fair, socially desirable*, *environmentally sustainable*, and *ethically acceptable*.

Key words: ICT, Slow Tech, Anthropocene

Competing Interests: The authors have declared that no competing interests exist.

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Introduction

The social and ethical aspects of ICT have been investigated ever since the beginning of the computer era and an increasing number of individuals have contributed insightfully to the foundations that underpin Slow Tech.

Starting in the 1930s, techno-determinism was already being investigated critically by certain researchers (Mumford, 1934; Ellul, 1954). Yet it was Norbert Wiener, a professor at MIT in the 1950s, who is considered to be the founder of the discipline of *computer ethics*. Wiener was the first person to open up the debate about the impact of computers on society and the risks of unemployment due to automation (Wiener, 1950). Another fundamental contribution came from Joseph Weizenbaum in the 1970s. Weizenbaum underlined the difference in the time dimension between computer and humans, and the risks of delegating certain human functions to machines: "... the question is not whether such a thing can be done, but whether it is appropriate to delegate this hitherto - human function to a machine" (Weizenbaum, 1976, p.207). In the 1980s, *computer ethics* became officially a discipline of study (Maner, 1980). In 1985, two leading researchers both proposed very different views of this new branch of investigation. James Moor proposed a *policy vacuum* approach, in which *computer ethics* was described as a way to fill the gap between technology and society (Moor, 1985). Deborah Johnson proposed a more proactive approach based on the concept of computers as *socio-technical systems*. For her, technology was not neutral, but rather both technology and society co-shape each other (Johnson, 2009). Since the turn of the century, many other scholars have contributed to this new field. Some focused on the daily work of computer professionals (Gotterbarn, 1991) or on the ethical dimension of ICT projects (Rogerson, 2009), and others concentrated on the more theoretical foundations of computer ethics (Bynum, 2000; Floridi, 2014).

This paper starts from the contribution of Deborah Johnson. It takes the view that technology is not neutral. It results from the many complex interactions human beings have with society and is a consequence of human choices - an artefact embedding values.

Slow Tech: a good, clean, and fair ICT

In the work of Johnson, ICT neutrality is deeply questioned. If computers are complex socio-technical systems and technology and society co-shape each other, then computer professionals have both the opportunity and responsibility to interrogate the premises of the design so that they can steer their use in appropriate directions. Yet which is the right direction? The Slow Tech approach starts to play an important role as a *heuristic compass* that can help guide computer scientists in their design activities.

We presented our first article about Slow Tech in ICT in 2013 at the *International Conference on the Social and Ethical Impact of ICT* in Kolding, Denmark (Patrignani and Whitehouse, 2013). The main concepts of the approach were explored in greater detail in our book *Slow Tech and ICT* (Patrignani and Whitehouse, 2018).

Slow Tech as an approach is explicitly inspired by the philosophy of *Slow Food*, the Italian - now worldwide - movement that introduces three basic principles that apply to the whole food value-chain: food must be *good* (based on good quality, healthy, and prepared according to time-honoured recipes), *clean* (by reducing its environmental impact to as low a level as possible), and *fair* (be respectful of the rights of farmers) (Petrini, 2007). Similarly, the *Slow Tech* approach starts by taking into account the limits of the planet and the limits of human beings. ICT have now reached such a rate of pervasive dissemination that they are shaping society and the planet in a scary way. Technology is now one of the main challenges of the Anthropocene era - the era where human beings and their artefacts have an immense impact on the planet and ecosystems, thereby underpinning climate change.

Slow Tech can thus be defined as a *heuristic compass*:"... a new starting point for systems design: ... based on a long-term view of the desirability and social importance of technologies, their environmental impact and sustainability, and the fairness and equity of the conditions of workers" (Patrignani and Whitehouse, 2014).

Good ICT

A *good* ICT is simply "*socially desirable*", that is, projects and applications are developed starting from human needs, and the technology is human-centred. According to Richard De George: "Computers and information technology should help and serve people and society. Where they do not, they should not be passively accepted" (De George, 2003). For example, inundating human beings with data and information and without the opportunity of turning it into knowledge by means of actual experience, stresses human attention capacity to the limits (Maffei, 2014).

There are several activities that can help to produce good ICT and there are a number of educational, design, safety, and economic aspects to achieving it. Since human beings can survive only by filtering this tsunami of bits, the task for

education systems is to provide the next generations of people with the skills and competences for *digital wisdom.* Another fundamental principle for a *good* ICT is that of *habeas data*: people have the right to know about their digital identity, how it is managed, and to have control of its storage and processing, including *the right to oblivion* (EU, 2019). Privacy-by-design should be the norm for any ICT project. *Design-for-all*, or the *Universal Design Principles* should also be the norm of a *good* ICT, which implies equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, size and space for approach and use (CFUD, 2019). A good ICT is designed in accordance with the Participatory Design approach in which users collaborate with designers in joint teams (Nygaard, 1996). *Good* ICT should also help human beings to use *less* ICT and find the right balance in time between online and offline (Fasoli, 2019). *Good* ICT must be safe, and this is particularly important for technologies where software (and its fragility) plays a central role (Rogerson and Gotterbarn, 1998; Gotterbarn, 1992). Finally, to maximize the innovation possibilities of ICT and its contribution to the economy, technologies should be open and thus based on *open software* (Stallmann, 1985), *open hardware* (OHWR, 2019), and *open data* (ODH, 2019).

Clean ICT

A *clean* ICT is simply *environmentally sustainable.* However, awareness of the *limits to growth* on a finite planet, which started with the groundbreaking report of the Club of Rome (Meadows et al., 1972), does not consider the ICT world. Yet ICT is no longer in the realm of clean innovation. As a consequence of the volume of its power consumption, its contribution to the greenhouse effect is now reaching 4% of CO_2 emissions. This is due to the more than four billion connected users and the cloud computing business models based on gigantic data centres (Belkhir and Elmeligi, 2018). Nevertheless, ICT could contribute to the ability to face the challenges of climate change through de-materialization. Improvements in the efficiency of many technical processes provide the opportunity of decreasing CO_2 global emissions by more than 10 Gton by 2030 (GeSI, 2019).

More research is needed in order to understand the complexity of the global impact of ICT. For example, it is only recently that investigation has begun into the materials (minerals, such as rare-earths) needed for manufacturing electronic devices, the electricity required for powering the gigantic cloud computing data centres, and the growing mountain of e-waste sent to Africa (Patrignani et al., 2011; Bernhardt and Gysi, 2013). At the current growth rate in cloud computing data centres and with the Internet of Things, when billions of ICT devices will be connected, the ICT industry will, by 2020, have surpassed both the aviation and shipping industries with regards to CO_2 emissions. By 2025, this industry will absorb 20% of the world's electricity (data centres, with one-fifth of the Earth's power consumption and will become the largest global energy user). By 2040, ICT will be responsible for 14% of total emissions (Marques Lima, 2017; Vidal, 2017).

A *clean* ICT should therefore address these challenges by minimizing the extraction of new materials (e.g. by recycling and repairing devices), by reducing considerably the power consumption of ICT, ensuring the use of renewable energies, and stopping the export of e-waste to Africa and south-east Asia. Each of these measures need the collaboration of a wide range of stakeholders: of users (by improving their purchasing selective criteria), designers (by innovating the ICT supply chain incorporating the repairability-by-design rule), and policy makers (by introducing strict norms for the release of new products onto the market, if they are not recyclable, repairable, and not accompanied by a strict Life-Cycle-Assessment) (Andresen et al., 2014).

The ICT of the Anthropocene era should immediately seek to enlist a *circular economy* approach. Many researchers are now focusing on these aspects for reducing the impact of ICT and facing the climate change challenge (ICT4S, 2013). Indeed, the concept of *limits* as recently been introduced into the ICT domain for investigating the impact and the environmental, material, energy, and social limits of ICT. The area of "computing within limits" is now becoming critical for the future of ICT itself (LIMITS, 2019).

Fair ICT

A *fair* ICT is simply one that is *socially acceptable.* The ethical issues underpinning *fair* ICT focus on the working conditions of people who produce these electronic devices. Indeed, among the many vulnerable stakeholders of the ICT world, these members of the workforce are often forgotten. Nowadays mostly located in the south-east Asia, every day these workers produce the devices used by the rest of the world. A *fair* ICT should pay attention of their working conditions, their human rights, dignity, and lives. In many countries - for example, in the mines in Africa where they are extracting the minerals essential for the ICT industry, child labour is the norm (OECD, 2004). It

is only recently that the working conditions of the personnel that produce with their own hands the billions of smartphones on the international market have been described (CLW, 2018; Condiffe, 2018). When launching a new generation of electronic gadgets on the market, the ICT industry, users, and policy makers should all seriously consider the *fair* side of ICT.

Conclusions

The ICT industry is now playing a fundamental role in the Anthropocene era and is now the *platform* for the many dimensions of people's lives. ICT is having a huge impact both on humanity and on the environment.

It is therefore the responsibility of users, ICT providers, and policy makers to steer the entire *infosphere* towards a more systemic view. At all stages and phases of the entire supply chain of data, information, and knowledge, people and players should be more aware of the complexity of the background societal, economic, and ecological context, including both human society and the planet (Carayannis et al., 2010). Data should not be taken out of context just for processing. Rather, it should be seen as *an imperfect representation of reality*, an attempt at *understanding the patterns and processes of interdependency in complexity*. As Nora Bateson suggests, it should be seen as "warm data" (Bateson, 2019).

As part of this trend, *computer ethics* should evolve towards an even more *proactive* ethics, a more *close-to-the-world* discipline, capable of *making a difference*. Ethics in itself should develop away from being an abstract set of rules to a reflection capability for everyday living in-the-world, it should become an *ethics of praxis.* As suggested by Varela, it should be a *project of being* rather than a *system of judgement*, a goal of expertise and wisdom (rather than a matter of rules that are universally applicable (Varela, 1999).

In the Anthropocene era, *Slow Tech* could become the *heuristic compass* that indicates promising directions for future ICT, by presenting us with just three simple questions: is the technology g*ood*, is it *clean*, and is it *fair*?

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Educational Unsustainability in Sub-Saharan Africa: In Search of Counter-Narratives to Policy Pressures and Exponential Tech Growth

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Abstract

The educational systems of sub-Saharan Africa have become increasingly entangled in a network of global actors: supranational and national policy, non-government organisations (NGOs), funders, and commercial organizations wanting to capitalize on perceived gaps in local capacity. Education is being renegotiated through an explicit, inexorable link to technology, an explicit call to rapidly construct technological markets for education throughout sub-Saharan Africa, and an implicit erosion of local educational autonomy as a result. This research interrogates commercialised edtech policy in sub-Saharan Africa and explores its effects on how educational infrastructure is being built and imagined in higher education. This obscures local context and educational practice with a global, marketized and standardised new 'normal' which carries with it considerable ecological implications. There is an explicit need for a rethinking of local educational autonomy in face of policy pressures which are stimulating a largely unsustainable acceleration of educational technology.

This paper seeks to interrogate what methods exist for adaptation of policy targets and the creation of autonomous spaces for deliberation and adaptation consistent with horizontalism, including participatory approaches, degrowth approaches, rights to repair, and community-owned technologies. Without this, the acceleration of edtech, e-waste, and the global imaginaries of digital education are likely to continue.

Key words: Horizontalism, edtech, Sustainable Development Goals, Policy, Sub-Saharan Africa

Competing Interests: The author has declared that no competing interests exist.

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Introduction

In much of sub-Saharan Africa (SSA), growth-based models of international development are increasingly at odds with sustainability and sustainable education. There is a need to revisit 'agency of non-human matter and the need to revisit questions of human subjectivity in light of ecological crisis, contemporary geopolitics and technological shift' (Bayne 2018). As discussed in Gallagher (2019 In Review), this is partly due to the increasing entanglements of supranational policy pressure (Grek 2009, p.24), the ambitious educational targets of the Sustainable Development Goals (SDGs), the work of civil society organizations, non-government organizations (NGOs), and the increasing presence and autonomy of commercial actors in shaping local educational agendas.

Increasingly, and particularly in the Global South, national educational policy is tasked with a massive scaling of educational provision and increasingly proscriptive calls for more technology to satisfy that scaling in keeping with SDG 4[2] which calls on member states to "ensure inclusive and equitable quality education and promote lifelong opportunities for all" by the year 2030 (UN 2016). Several targets within this goal and the indicators associated with these targets are powerfully proscriptive for how digital education is realised in the Global South.

These educational contexts are becoming increasingly bound in a network of actors-policy, NGOs, INGOs, global educational actors like the Programme for International Student Assessment (PISA and PISA-D), and commercial organizations wanting to capitalize on these gaps in local capacity. Being bound in these global networks carries with it a 'massive defuturing effect, which negates places, regions, and countries the possibility of multiple futures' (Escobar 2019, p. 1). In becoming increasingly adherent to the 'global' educational economy, the 'local' of the Global South is becoming normalised and its multiple futures muted. Its emphasis shifts from local educational practice and ecologies to global compliance.

What is fueled in this negation of the local beyond an erosion of local educational practice and autonomy (Gallagher 2019 In Review) is an unsustainable and ultimately ecologically damaging educational context. The educational targets of SDG 4 accelerate a massive influx of technology and a redesigning of local pedagogy towards global indicators like PISA and other supranational policy pressures. The scale of

technology influx is mirrored to some degree in local patterns of technological consumption, particularly in sub-Saharan Africa. The number of new subscribers to mobile services (largely the gateway for access to social services, including education) is expected to be 165 million by 2025; smartphone adoption is expected to rise from 36% in 2018 to 66% in that same span (GSMA 2019). Data is being consumed at dramatically increased rates throughout sub-Saharan Africa (SSA) increasing from 1.1 GB of data per subscriber per month in 2018 to an expected 8.5 in 2024.

This technological expansion has significant material implications. The material of digital education is becoming increasingly concentrated in SSA in e-waste sites like the infamous Agbogbloshie in Ghana (detailed, among other African e-waste sites in Asante et al 2019), with clear ecological and health concerns (Daum et al 2017). Paradoxically, the address of e-waste is an explicit focus of SDG Goal 3 (Good health and Well-being), Goal 6 (Clean water and Sanitation), Goal 8 (Decent Work and Economic Growth), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), and Goal 14 (Life Below Water) (ITU 2017). The waste of technological expansion makes fulfilling these goals difficult.

Rather than scaling up, technological alternatives exist for education in local contexts if development is decoupled from growth-based models. These alternatives are predicated on local educational autonomy, participatory processes, and value-based technological design, which this paper will present as a possible antidote to the accelerating ecological crisis emerging globally, and particularly in sub-Saharan Africa.

The work of education needs to focus on the impact 'of specific practices and assemblages of the human and non-human' (Edwards, 2010, p. 9) on shaping these educational contexts, how these can be redesigned to address the ecological unsustainability of technological consumption, and to present new narratives of sustainable technology use in education. This is especially critical in imagining the 'new' local that this paper purports to explore.

Ceding Local Educational Autonomy

It is important to note that this paper acknowledges that the SDGs, and their predecessors the Millennium Development Goals (MDGs), are inexorably entangled in an increasingly sophisticated landscape of educational policy, supranational policy pressures and increasingly influential global models of

educational governance like PISA and PISA-D. While the SDGs deserve scrutiny, and indeed this research attempts to add to a growing body of critique around them, they have merit. Although largely in its infancy (ratified in 2015), the SDGs have significantly contributed to widening participation in formal education across traditionally disadvantaged groups at primary, secondary, and tertiary levels. Their significant value, despite the critiques presented in this and further research, remains.

However, many of the targets and associated indicators of Sustainable Development Goal 4 are largely focused on mass efforts of education and serve to erode the local contexts of education through their execution. First though, we must look at the language itself. SDG 4 is designed to "ensure inclusive and equitable quality education and promote lifelong opportunities for all" by the year 2030 (UN 2016). Several targets within SDG 4 and the indicators associated with these targets are proscriptive for how education is envisioned, and how technology is increasingly positioned as a means of achieving that vision.

Massification is explicit in many of these targets ("access for all", "all learners", "substantially expand", "substantially increase" "mainstreamed" and so forth), suggesting again the need for at scale educational provisions consistent with the prior widening participation discussion. All require significant structural reconfiguration to ensure success: 4.3 requires a significant and gender equitable increase in participation; 4.7 suggests a significant curricular redesign and expansion; and 4.c suggests a significant increase in enrolments in teacher training programmes. Taken together, they represent a massification effort, and serve to contribute to the overwhelming drive to provide 'technical fixes' to the challenges of widening access to higher education (Selwyn 2016, p.37). Education becomes increasingly a digital education to satisfy these scaled efforts.

Additional non-educational actors include international policy instruments which carry with them technological targets that contribute to the tendency towards 'technical fixes' for scaled approaches to education. It is important to note that while most of these instruments have discrete (i.e. context-specific) value they further entangle local educational actors in an increasingly supranational policy system. Further examples include the Sendai Framework for Disaster Risk Reduction, whose targets include the promotion of 'real time access to reliable data, make use of space and in situ information, including geographic information systems (GIS), and use information and communications technology innovations to enhance measurement tools and the collection, analysis and dissemination of data' (UNDRR 2015, p.15). The New Urban Framework in its call for 'encouraging urban-rural interactions and connectivity by strengthening sustainable transport and mobility, and technology and communications networks and infrastructure' (Habitat III 2017, p.15), and UNESCO even more explicitly forwarding 'the role that such technology can play to accelerate progress' towards the SDG 4 (UNESCO 2019).

Codified in the Qingdao Declaration, the links between the educational targets in SDG 4 and the role technology plays in servicing them are explicit: 'To achieve the goal of inclusive and equitable quality education and lifelong learning by 2030, ICT–including mobile learning – must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more efficient service provision' (UNESCO 2015, p.3. The UN itself is explicit as well: "Given the diverse, multidimensional, ambitious and absolute nature of the Sustainable Development Goals, it will be practically impossible to achieve all of them by 2030 without the development and appropriate application of science, technology and innovation" (UNCTAD 2019, p.2). Education and technology have become inexorably linked in broader policy contexts.

Education quality: a measure of economic prosperity?
The scaled targets and related international policy entanglements are linked to an accreditation and compliance global network with significant capacity for reshaping local educational agendas, curricula, and practice. There are global (largely Global North) bodies of accreditation and compliance that further cede local educational autonomy largely in the interests of international curricular and performance comparison: the Programme for International Student Assessment (PISA), the International Association for the Evaluation of Educational Achievement (IEA), the Trends in International Mathematics and Science Study (TIMSS), and the Programme for the International Assessment of Adult Competencies are but a few, although PISA's influence as 'as the main engine in the global accountability juggernaut' (Meyer and Benavot 2013, p.9). Despite critique around the cultural interoperability of PISA metrics (Unterhalter 2017), its explicit endorsement by the Organization for Economic Co-operation and Development (OECD) as the world's 'premier yardstick of education quality' and championing by

the World Bank (Auld et al 2019) as a means of achieving some measure of economic prosperity have further reinforced the scaled educational efforts of SDG 4.

Predictably more public private partnerships are sought to achieve educational scale, particularly commercial actors: digital education platforms, mobile telecoms, internet service providers, hardware and software manufacturers, and more all are bound in an entanglement which has direct impact on the for-profit educational organizations creating and occupying the new markets created by these public private partnerships. Perhaps this is best typified by Bridge International Academies, a for-profit education company designing low-cost schooling largely in developing nations with an array of technologies and proscriptive teaching, including geolocated devices that map low-income communities, smartphones that automate administrative functions, and computer devices that perform the duties of a teacher (Riep 2017). Teachers employed through these low-cost schools such as Bridge are generally less educated and less compensated than state teachers of the respective national systems.

Beyond the significant critique received from Teachers' Unions and some civil society actors in Kenya, Liberia, and Uganda (The Economist 2018), Bridge International Academies typifies the entanglements that SDG 4 and other supranational policy pressures, accreditation and compliance regimes, and technology are rendering where 'structural power and neoliberal ideologies are glossed over in the SDGs and are being promoted in controversial ways already in developing countries' (Sultana 2018, p.189). Beyond merely shifting the configuration of education towards more 'open' (and therefore more commercially susceptible) systems, the SDGs attempt "to 'liberate' the user from social structure and hierarchy, boosting individual freedoms and reducing centralized controls over what can and what cannot be done" (Selwyn 2016, p.157). Broadly, such Public-Private Partnerships have been called into question, leading to demands for them to be accompanied by a governance framework within which private sector partnerships can be held accountable and transparent, yet technological expansion continues unabated.

Bridge International Academies stands at the intersection of policy, practice, and capital financed as it is by a group including Bill Gates, Mark Zuckerberg, and the World Bank/International Finance Corporation (IFC). The agency of local educational institutions in these technological partnerships is muted with their limited capacities to mediate supranational policy pressures associated with ambitious educational targets and the new markets being created to service them. What is critical here is that this structural power in education is being renegotiated through an explicit, inexorable link to technology, an explicit call to rapidly construct technological markets for education throughout sub-Saharan Africa (Riep 2017), and an implicit erosion of local educational autonomy as a result. Educationally this is highly problematic but ecologically much more so as the next section will attempt to evidence.

Shifts in positions of teaching

This drive linking technology to education in response to SDGs is well underway. There are quite explicit calls for greater links between technology and the SDG goals, that when listed as in the following suggests a break from local educational contexts and the technological providers that are increasingly structuring this new educational context: 'big data; the Internet of things; machine learning; artificial intelligence; robotics; blockchain; three-dimensional printing; biotechnology; nanotechnology; virtual and augmented reality; renewable energy technologies; and satellite and drone technologies' (UNCTAD 2019, p.2). Such a list is emblematic of the sociotechnical imaginaries of Silicon Valley (Weller 2015), rather than an educational approach with fidelity to the particulars of local educational practice.

The break generated here is couched, predictably, in language pointing to compliance with the targets of the SDGs; it is not difficult to trace a path directly from this rhetoric to the types of educational economy envisioned by Bridge International Academies: 'New digital platforms, including massive open online courses, provide online courses that allow for open access and unlimited participation through the Internet...lower-cost replication of high-quality teaching, content and methods; self-paced learning; and data analytics for optimizing learning on the platform' (UNCTAD, 2019, p. 24). In this position, we see a redefinition of teaching towards a position of 'replication' and 'self-paced learning', a trend to what Biesta refers to as 'learnification', or a reduction of education to matters of learning (Biesta, 2010). It is also a position of education that makes initiatives like Bridge International Academies possible with their use of scripted teaching activities and non-certified teachers. We see many of the same instrumental positions of education that generates data which is then circulated through the global 'digital data

economy, available for use by a variety of actors and agencies in ways that are often unknown to the people about whom this information relates' (Lupton and Williamson 2017, p.782).

Education in the Global South is being increasingly redrawn as a minor actor in a larger data economy, propelling further commercial interventions and claims of 'optimizing learning' and acting purportedly as 'a transparent instrument for educational export, keeping curricula, pedagogy, and educational values intact whilst they are broadcast to a global population assumed to be in deficit' (Gallagher and Knox 2019, p.226).

The increasing ecological impact of education

Beyond these scaled positions of education is a general disassociation of the technology being used in this digital education and its ecological impact. This is an education increasingly driven by technology, suggesting a massive increase of technology to satisfy the massed educational targets of the SDGs. Such an increase generates considerable amounts of waste. Electronic waste (e-waste) or waste electronic and electrical equipment (WEEE) refers to used and end-of-life electronic and electrical products; it is an issue that disproportionately impacts the Global South. It draws further attention to the broader global entanglements of digital education in SSA.

E-waste has two core issues: the volume of computers and related e-waste improperly disposed of in landfills and the toxicity of the components themselves (Hawari and Hassan 2008) which have significant health consequences: Asante et al's (2012) investigation on e-waste recycling workers from perhaps the most notorious e-waste site in Agbogbloshie in Ghana found high levels of arsenic; lead and mercury cause severe contamination in landfills which can spread to ground water resources (Hawari and Hassan 2008). E-waste pollutants are generally not disposed of properly, or they are taken care of by an informal sector and recycled without properly protecting the workers, while emitting the toxins contained in e-waste (Balde et al 2017).

E-waste is complicated by global entanglements of policy and practice. The uptake and shorter replacement cycles of technology are contributing to the global growth of e-waste. Around 50 million tons of e-waste, is being discarded yearly, a figure that is expected to double by 2050; only 20% of e-waste is thought to be recycled (World Economic Forum 2019).

However, the increase of e-waste in SSA is largely not an indigenous issue; it is circulated through the same global entanglements of policy and practice as discussed before. For example, in 2015/2016, EU member states were the origin of around 77% of Used Electric and Electronic Equipment (UEEE) imported into Nigeria (Balde et al 2017). Africa itself produces very little; the lowest amount of e-waste per inhabitant was generated in Africa; this is a number that is set to rapidly accelerate particularly as more technology is incorporated into education, amongst other sectors.

Just as policy serves to accelerate this technological consumption in service of the educational targets of SDG 4, policy also fails to track its outputs of e-waste. A lack of available data makes surfacing these ecological impacts muted. Only 41 countries have official e-waste statistics and 80% of e-waste is largely untracked (Balde et al 2017). This remains, largely, an issue of visibility: narratives of rapidly increasing technological consumption are divorced from accompanying and complementary narratives of ecological impact wrought as a result.

These trends are increasingly prevalent in the technologies currently being advanced by INGOs and the commercial sector in response to educational challenges. For example, UNESCO (2019) has lauded blockchain technology as having the potential to *transform* and *innovate,* including education. The UN has incorporated blockchain into giving access for refugees to social services and education (Kshetri and Voas 2018). Yet the global mining system that blockchain technologies depend on requires a vast consumption of electricity, equivalent to that of Austria's, and establishes a significant carbon footprint, equivalent to that of Denmark in its entirety (Truby 2018). The educational potential of such technology use is held in stark contrast to the ecological impact of its materiality.

Yet within this technological consumption are faint signs of promise for a new local that defies the imaginaries of global edtech and policy pressures, particularly in SSA and in emerging economies. The carbon footprint of technology, defined as the full life cycle carbon equivalent emissions and effects from a particular product (Malmodin and Lundén 2018), is shifting away from older hardware and bespoke solutions to centralised app-based platforms and more energy efficient mobile technologies. As such, the carbon footprint of ICT itself (including hardware, telecommunications centres, data centres, enterprise centres, and more) peaked at 2010 globally and has been decreasing since then, despite increased data consumption consistent with steaming services (2018).

ICT growth overall is constrained largely as a result of a 'persistent energy crisis' in SSA where energy consumption is considerably lower than the global average (Akinyemi et al 2015). Yet this energy crisis has contributed to the growth of mobile technology adoption through SSA and sustainable technological approaches to development. This includes solar power grid installations (Mekonnen and Sarway 2017), particularly for supplying mobile technologies (Max and Berman 2018). M-Kopa Solar and other 'pay-as-you-go providers of solar home systems, catering to low-income, off-grid' (Rastogi 2018, p.93) communities are emerging across SSA. The significant penetration of mobile technologies, the natural constraints of limited energy assets, and the increasingly sustainable ingenuity around ICT as a result of these constraints has generated the potential for a new local, or a counter-narrative to exponential tech-growth.

Alternative Digital Futures: Horizontalism

Technological alternatives exist for a 'new' local but only if the local is decoupled from growth-based models of development and allowed to "radiate out" horizontalism, rather than scaling-up" (Escobar 2019). These alternatives, as this section will attempt to illustrate, are predicated on local educational autonomy, participatory processes, and value-based technological design. They are nominally bound in degrowth models of educational development, or education that services 'an equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level' (Schneider et al, 2010, p.511).

As such, we are presented with two objectives to envision alternative (digital) educational futures. First, a resistance to normalization that the use of the term horizontalism suggests in this context. Second a degrowth-based model for use of digital in education. Horizontalism refers to positions of society that emphasize networks rather than hierarchical societal structures. Emerging from the sociotechnical developments of the 1960s, it involved a view of society as a series of networks, where both 'networked power' and 'networked resistance' (Davies 2012) can co-exist. More recent manifestations include grassroots mobilization efforts in Argentina where 'thousands of middle class and recently declassed urban dwellers […] have organized themselves into neighborhood assemblies' (Sitrin 2007) as well as many of the Occupy movements (see Ancelovici 2016). Horizontalism is increasingly and predictably coalesced around the digital in both networked power and networked resistance arrangements

(Chadwick and Dennis 2017). It is not without considerable critique. Wood (2010) notes that diffusion in horizontalism - the acceptance of some specific item, over time, by individuals, groups, communities - requires time and autonomy for deliberation and adaptation. Markus (2012) notes that horizontalism will struggle to establish spaces of autonomous deliberation if it cannot, paradoxically, 'formulate a larger vision for a society', suggesting tension between the local and the 'global.'

Horizontalism as positioned here suggests a series of diverse and dynamic spaces networked, but not necessarily normalizing. That is, the local educational networks of Lagos needn't normalize with the educational practices of Kampala and neither should necessarily normalize with the 'global' indicators of PISA. Deliberation and adaptation, rather, become the hallmarks of radiating an educational horizontalism. Such approaches explicitly foreground participatory approaches, explicitly foreground diversity in evaluating educational systems, and explicitly foreground resistance to 'standardized definitions of worthwhile skills and knowledge that are measurable and common for developing countries' that PISA-D purports to advance as '"benchmarks" and objective measures of quality by both donors and national authorities' (Sjøberg 2015, p.124). Without this autonomy to diversify, deliberate, adapt, and ultimately resist, many of the participatory processes described in the following sections are immediately compromised.

Alternative Digital Futures: Degrowth

The second objective to envision alternative educational futures is a degrowth-based adoption and adaptation approach of the digital for education. Some have argued that degrowth requires limits to technologies (Samerski 2018) while other degrowth communities define themselves around particular technologies (Kerschner et al 2018): the Fairphone (Haucke 2018), makerspaces and fab labs (Kostakis et al 2018) and even the recycling and reuse communities emerging around the e-waste discussed prior (Vallauri 2009). What a degrowth position provides here is an alternative to the growth-based targets of the SDGs and the entanglements of global actors positioning themselves to meet these targets.

Technologically, it is instructive in that it allows for scrutiny and selectivity by local educational systems in regards their technological acquisition; selectivity and scrutiny that is largely absent from the directives of policy and strategy documents

and their assertions that 'information and communication technologies (ICTs) *must* be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective service provision' (UNESCO 2015, p.8). 'Must' becomes 'might' in a degrowth model dedicated to a 'voluntary societal shrinking of production and consumption aimed at social and ecological sustainability' (Demaria et al 2013, p.192). Again, without autonomy, the possibility of digital educational degrowth is severely compromised.

Radiating out Horizontalism: Local practices
Controls on technological acquisition alone is not enough for a degrowth model; 'agencies' take shape in the social and that is largely where I draw your attention in this paper.
[…] agency is always contained within practices, and that being so, agencies take shape, and are shaped by, social practices. It is important to note here that change to a degrowth society must also reside in social practices rather than merely in the structures or values of agents. What counts is the change in practice (Heikkurinen 2018, p.1657).
I would argue, however, that the agencies taking shape in the current educational systems outlined in this paper are largely structural (from SDGs to national educational policy to INGO reports to commercial technological intrusion) and largely disadvantageous to the agencies of the local educational environment. Without a decoupling from the constraints of these supranational policy pressures, the agency of the local will remain impoverished. Yet, Heikkurinen's position remains true; that there is a parallel need to change (educational) practice, to build in time and space for deliberation and adaptation that suggest the increasing importance of participatory models of technological and educational design.
Despite the advantages of participatory technological and educational approaches in realising this horizontalism, their use in technological design is not unproblematic; 'participatory researchers are perhaps traumatized by the constant battle to confront technological deterministic views... and may choose to deemphasize the role of ICT' (Bentley et al 2019, p. 491). The commercial and policy imaginaries of technology use in education often travel far ahead of the collective and participatory imagination rooted in local application. How technology is used in education in Dar es Salaam or Dhaka is at least partially framed in Washington, D.C.; London, Paris, Silicon Valley, and increasingly Beijing. For many, this will lend itself, as Bentley et al suggest,

to de-emphasize technology in their design processes.
Yet diverse participatory practices remain, and they are at the heart of what is being proposed as an alternative to ceding of local educational autonomy to supranational actors. Okon (2014) in research on rural Nigerian communities and their use of technology suggests a context-driven approach to enable communities to define the parameters of use and meaning of ICT themselves. Yoon (2003 and 2006) interrogates the processes of deliberation and adaptation in South Korea as technology is 're-traditionalized' in ways that often defies the global attempts to 'liberate' the user from social structure and hierarchy' (Selwyn 2016, p. 157). As Yoon suggests in the South Korean context, quite the opposite is true; the technology is remade and imbued with local practices.
Tenhunen (2018, p.155) explores mobile phone use in rural India, drawing particular attention to the diversity of practices between rural and urban communities; this diversity is instruction for horizontalism as well in establishing how the 'local' might represent a composite of networks. Tenhunen also notes that 'purchasing digital technology has become a significant symbolic act through which people can seek to improve their position and challenge hierarchies', particularly for disadvantaged caste groups. The act of acquiring the technology becomes a social practice itself.
King et al (2019, p.286) explore the specific ICT practices of Timor and how they intersect (and are partly produced by) the influences of infrastructure, family, literacies and the colonial legacy to denote 'individual's engagement within the particular forms of constraint and opportunity that exemplify life for many in countries of the Global South.' Technological agency and horizontalism exists, however constrained, defying and disrupting the normalizing rhetoric of global digital education discourse.
Might this agency and horizontalism be fostered through the creation of autonomous spaces of deliberation, adaptation, and design? Might technology be "reoriented towards convivial societies through deglobalizing and re-futuring co-design transition strategies" (Escobar 2019, p.3) consistent with the degrowth approaches suggested in this paper, ones countering the technological acceleration that policy pressures stimulate? The answer to these questions is a qualified yes. Escobar's *re-futuring* in this context is dependent on some measure of *release* from policy pressure along with participatory models of deliberation and adaptation.

Participatory Design Models

Participatory design models are critical to this process for a variety of reasons. First, they are explicit about the autonomy of the locales participating to define challenges and enact responses. These models provide capacity to deliberate and adapt in locally appropriate ways without normalizing to a globalized imaginary. Typifying this participatory technological space are Dearden and Haider Rizvi (2015) exploring participatory design in the ICT4D context; Sultana et al (2018) for designing technology for women in Bangladesh; and Arevian et al (2018) exploration of participatory design models for co-creating mobile health applications. Nemer (2015), and Bentley et al.'s (2017) use of photography to stimulate participatory exploration of the technological practices of favela residents in Brazil is instructive here in providing capacity to surface both existing technological practices of the favela residents and the technological installations themselves (mesh networks, for example). Such participatory methods surface technologies and contextually specific practices which begin to define the local in response to the global.

Participatory design models are not free from critique, suffering as they do from promoting 'functional or instrumental values' and failing to directly address values of 'moral import, such as privacy or autonomy' (Manders-Huits and van den Hoven 2009, p.55), yet they are values-based, because of their commitment to a collective shaping of a particular future (Van der Velden and Mortberg 2015, p.1).

Moreover, participatory design models through this collective shaping of a particular future are advancing counter-narratives to global largely homogenized edtech imaginaries. They provide a design narrative capturing accounts of 'the history and evolution of a design over time, including the research context, the tools and activities designed and the results of users' interactions with these' as well as 'the path leading to educational innovation, not just its final form' (Mor et al 2012, p.164). The collective memory is sustained in the design narrative. Beyond merely employing participatory models in both education and technology towards functional objectives or responses to challenges of local importance, this research suggests that participatory design models provide the narratives that locally responsive models of digital education are sustained, both rhetorically (resisting global edtech discourse and calls for increasingly scaled targets), and ecologically (providing space to deliberate and adapt in locally meaningful ways).

Okon (2014) call for a context-driven approach to allow communities to define the parameters of use and meaning of ICTs for themselves through some approximation of participatory design is instructive here. We should note how this approach stands in contrast to the deliberate narratives around Open Educational Resources (OER) (Ferreira and Lemgruber 2019) and Massive Online Open Courses (MOOCs) (Adams 2019) and their capacity to end a worldwide 'crisis' in education by broadcasting to a 'global population assumed to be in deficit' (Gallagher and Knox 2019). Indeed, as Wolfenden and Adinolfi (2019) suggest, the local educational agency that might exist in OER use sits in their deliberation and adaptation by local educational actors. In the horizontalist positions advanced in this paper, communities define their own digital education parameters through participatory design.

The right to repair

The right to repair is critical to both participatory design, adaptation, and deliberation. Repair in this context refers to 'the creative, resourceful, and improvisational work of getting technological systems and artifacts working and keeping them going long beyond their initial points of adoption' (Houston and Jackson 2017, p.200). Research has shown how repair cultures contribute to the building of appropriate and resilient infrastructures particularly important in resource-constrained and ecologically fragile contexts (Ahmed et al 2015 exploring Bangladeshi repair workers and Jackson et al 2012 work on Namibian repair workers are representative here). Broadly, repair studies draw attention to larger processes of valuation, breakdown, and e-waste.

It also surfaces practices of care and repair that sit comfortably within these new locals of digital education. 'Care as an object of study draws our focus beyond the functional, toward a range of affective connections, attachments, and commitments that may shape and give meaning to the work of providing for, protecting, and maintaining sociomaterial worlds' (Houston and Jackson 2017, p.201). The participatory design models presented earlier surface these connections of care and repair and foreground their importance to creating localized responses to the accelerating import of 'global' technologies. The general lack of rights to repair merely protects 'the power and prestige of (distant) global manufacturers over the interests of (local) users, extending proprietary privilege and control well beyond the point of sale' (Houston and Jackson 2017, p.210). The right to deliberation and adaptation are bound in these rights to repair, as

are the implications for transitions into 'green technologies' (Suh et al 2017) and their promotion of circular economy models that seek to mitigate the effects of e-waste: recycling and reuse of technology are core to these movements (Balde et al 2017).

Trans-national arrays and grass-root driven transitions

Ultimately, participatory models; rights to and cultures of repair; providing autonomous spaces for deliberation and adaptation; and the surfacing of local educational and technological practices on which to rest new imaginaries of digital education provide a framework on which to explore horizontalism. Yet they are constrained by the same supranational policy pressures and subsequent global edtech acceleration explored in this paper, suggesting an additional need for a *release* from or *reinterpretation* of global educational policy targets through deliberation and adaptation. Yet this *release* is unlikely in the current geopolitical climate; global policy pressures leading to an acceleration of 'global' edtech acquisition (and subsequent e-waste) continues unabated fueled in part by the imaginaries of scaled education and edtech's role in servicing that scale.

Yet horizontalism offers an alternative to that imaginary. 'If the world is a web of radical interdependence, it follows that all local, place-based, and communal struggles are already interconnected, even if they might not know it. There is no "scaling up" to be achieved because there is no "up" to be found. We need to imagine a different politics consistent with this deeply relational vantage point' (Escobar 2019, p.00). We need to do this in ways 'framed not only within oppositional pairings such as 'global' versus 'local', but which elucidate how binaries themselves are constituted through far-flung trans-national arrays of sociomaterial practice' (Henry et al 2019). These 'trans-national arrays', and new spatial constructs like glocalism (the centering of global civic engagement in the local community, see Hartman 2017) are helpful for imagining 'grassroots-driven local and regional transitions' (Escobar 2019, p.3), particularly for digital education. Indeed, technology is critical to reimagining these new locales and the horizontalism that connects them: 'many technologies can be reoriented towards convivial societies through deglobalizing and re-futuring co-design' (Escobar 2019, p.1). Deliberation, reorientation, adaptation, and re-futuring become the hallmarks of these approaches.

There are further technological implementations that can be reoriented to support this horizontalism, including community-owned internet networks (CN) in sub-Saharan Africa like the Kondoa Community Network in Tanzania, which has connected four rural educational institutions (Matogoro 2018); the Zaria Community Network and Culture Hub in Nigeria, which has provided Internet access for students and researchers and to locally hosted teaching and learning resources via wireless hotspots on campuses and in public locations (Metri 2019); and BOSCO Uganda, which has developed solar-powered community networks in rural Uganda and provides entrepreneurial education on opportunities provided by these community networks (APC 2019). Locally owned and local facing, these networks and the communities and cohorts they stimulate are critical in creating autonomous educational space to deliberate, adapt, design through participatory models and to 'radiate out horizontalism.' There is an explicit need here for further research that critiques how policy pressures are stimulating a largely unsustainable acceleration of edtech acquisition, and what methods exist for adaptation or a release from policy pressure coupled with autonomous spaces for deliberation and adaptation consistent with horizontalism. Without this, the acceleration of edtech (and e-waste) and the global imaginaries of digital education is likely to continue apace.

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Peer Education as a Means of Contrasting Cyberbullying and Online Violence. The Testimony of Young Protagonists.

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Abstract
Educational work concerning the issue of online violence takes place at the frontier between generations and between virtual and real, a methodological frontier whose complexity we can only attempt to understand through the testimony of those involved. This paper proposes examples of a range of testimonies gathered through letter writing during peer education activities.

Key words: Online Violence, Cyberbullying, Peer Education, Testimony

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Nonviolent education projects

Since 1982 the voluntary association Centro Studi Sereno Regis (CSSR) has been working to promote the culture of peace and nonviolence. The Centre's activities involve research, education and nonviolent action, each of which is an integral part of the pursuit of its mission. The research is intended as an intellectual space for deepening understanding of a holistic approach to peace, both in terms of the areas of human life that can involve nonviolence and of the attempt to deal with the phenomena of violence in their direct, cultural and structural forms. Education is the field of action for the endeavour to disseminate, create awareness and educate for a culture of peace and nonviolence, with approaches and methodologies that are in line with that aim. Schools are the principal environments in which this work is carried out. Nonviolent action is taking up a position, participating in processes of change, creating a space in which people can act to do something about the various forms of violence that surround us.

As with all our activities, the following educational projects involve an initial period of study and analysis, the educational activities proposed and a space in which the teenage girls and boys involved can act non-violently in order to bring about change.

Cyberbullying

As of 2013 our Centre has been studying the question of online violence online and in particular the emergence of cyberbullying. This is a form of abuse which is voluntary and repeated so as to create a power relationship between perpetrator and victim in which the latter is unable to employ effective strategies in order to respond. It is different from more traditional forms of fully in that the medium used eliminates any possibility of activating an empathetic process and has no spatial or temporal boundaries. The contents can become viral and destroy the reputation of the person under attack both in distant places and times. In contrast to a to a direct gesture of bullying, cyberbullying appears even more de-responsabilizing for the perpetrator. It's only a shared video!

From our point of view, cyberbullying represents a group disfunction and cannot be resolved only by acting on bully and victim in the case of a particular episode of online violence. The phenomenon can only de understood in terms of its social dimension, building reciprocal roles that adolescents construct during their development phase. Thus our educational work is always conducted at group level. New forms of cyberbullying evolve together with the emergence of new social media platforms that are ever more concerned with building self-image and thus increasingly prone to public ridicule.

Online hate

In 2015 the phenomenon of hate speech began to emerge and attract our attention in terms of theory and educational praxis. The spread of intolerant discourse, the normalizing of denigrating and dehumanizing expressions - above all concerning minority groups, but also in general in terms of the other who has different opinions from mine – might seem a phenomenon that principally involves the adult world. In fact, however, this kind of language constitutes a social and cultural environment in which teenage girls and boys are immersed on a daily basis in a polarization of public discourse and opinions, a challenging of the concepts of truth and authority. This becomes a kind of background noise that impedes study in depth and assimilation of information that is not emotionally skewed so as to be in line with one's pre-existing ideas.

At the same, although this paper focuses on the violence that both characterizes and is specific to the virtual world, it cannot be denied that the new media involved offer enormous expressive opportunities, provide a much enhanced potential for building knowledge and communicating with vast areas of the world, facilitate many aspects of the lives of everyone and extend the range of activities possible within learning environments. Moreover, social media are an intrinsic part of the lives of young people and this is a process that cannot be turned back.

Peer education

Analysis of the phenomenon of hate speech and of the best practices that have been promoted to combat it led us to develop an educational approach to intervening based principally on offline action and which aims to promote the building of groups characterized by positive relationships and the acquisition of "antibody" values such as respect and acknowledgement of the other, drawing on the methodology of peer education.

Peer education has long been introduced and widely applied in Italy, above all in the area of prevention of risk behaviour and drug abuse, emphasizing the importance of the communicative dimension and the role of those who benefit from the experience. Young people can best understand the risks of abuse if these are explained by

someone of their own age in a language that they feel is theirs, without the kind of self-censorship that would be spontaneous if talking to an adult.

No one can be considered too young to be a peer educator and become responsible for one's own education and that of others. Those who choose voluntarily to become involved have initial training of between 12 and 18 hours and then work in small groups to plan projects. Our work involves classes at lower and upper secondary level, generally in vocational schools in areas that are geographically and culturally on the outskirts, where there is a prevalence of male students and a lack of attention to developing personal and social competence.

The role of peer educators

The focus of our work has gradually moved from the young people who are direct beneficiaries of projects to those who work as peer educators. We believe that any kind of abuse, be it online or offline, is the result of malfunctioning in group dynamics, rather than a single defect in the bully or a mere inability to find adequate self-protection strategies on the part of the victim. Thus the priority has to be working at the level of group dynamics and peer educators are trained to intervene in this way in order to promote a healthy school environment. This involves intervening in a way that is continuative and sustainable in time and acting in such a way as to bring about change in that direction.

Towards participatory evaluation

What follows is a description of a process based on "letters written to ourselves" by peer educators who have participated in projects for peace education, texts which they might re-read at a distance of months or years in time in order to see what has changed in themselves during these educational experiences. The objective is also that analysing our work as a centre through the eyes of those who are active in our projects.

The extracts that follow come from a group of peer educators working in a third class in an upper secondary school, each of which attended a 4-day residential course in 2016. The residential nature of the experience proved to be highly significant for the participants.

Two elements concerning the writing of letters to ourselves are particularly important in terms of our objectives and involve the Theory of Change and the reflexive approach. The Theory of Change (Brest, 2010) is an approach within the field of social work in terms of planning and evaluating projects which promote social change through the participation and direct involvement of those who are the beneficiaries and focuses the attention on their perception of the situation in which they are. This methodology means that the data to be analysed is not pre-defined, but rather emerges from the participants' reflections on their experience. This is coherent with a positive vision of the young people themselves, based on promoting participation and empowerment. Educational initiatives, particularly with respect to the prevention of violence between young people, often risk identifying certain teenagers as victims to be protected and cared for and others as violent and deviant with a consequent need for security and repression. In other cases, there are social platforms who look at young people as a new pool of consumers. We prefer to consider them as subjects in processes of change that can take place here and now in the reality that surrounds them, thereby placing them at the centre of evaluation procedures and subject planning of hoe to proceed.

The task proposed was to *write to your future self about what has changed in you and for you after this experience*. The Theory of Change permits us to gather elements about online life that only teenagers can identify and narrate and is therefore an essential part of the process of analysis and project building.

The reflexive component

A number of elements that emerged from the peer educators were unexpected, causing me some surprise and offering me opportunities for further analysis.

Social networks impose a kind of fictitious instantaneity, that is fictitious because nothing obliges the user to react instinctively and immediately to whatever stimulus appears on the screen, while at the same time almost everyone reacts as if instantaneity were necessary. Reflexiveness counters this attitude because it requires time to remain within the lived experience, interpret the changes brought about in oneself and the surrounding environment. Becoming reflexive means looking both back toward the past and forwards in the direction of the future, since it requires reflecting before replying, publishing, posting, or twitting on the potential consequences of our actions. In 2015 a 15-year-old girl, Trisha Prabhu, developed a simple app called "ReThink", through which a pop up emerged whenever someone was about to post an offensive content, saying "What you are writing could be offensive for someone. Are you sure you want to publish it?". The concept of the reversibility of one's actions is a recurrent theme within this approach to peace education. Our

experience leads us to conclude that digital devices create a form of detachment from the consequences one's own actions or inactions can have for oneself or for others, de-responsabilizing, de-materializing, distancing outcomes in space and time, setting off chains for which we cannot know the final link. In this respect, it can be very productive to ask young people questions like "In twenty years from now, will you be happy about or embarrassed by the image you are now posting on Instagram?".

Letter to myself
What is sharing?

Life in common was wonderful. I had never experienced it.

This affirmation was surprising, yet recurrent, in the letters, containing elements of appreciation, of difficulty, and in any case of growth. It would seem contradictory to hear how girls and boys who continuously share parts of their private lives, at times their most intimate aspects, in a changing context in which borders are ever shifting and constantly mediated, move in social communities that are in fact non true communities at all. In sharing online, everyone chooses what to share, a part of oneself that is selected, partial, modified, filtered so as to please, provoke, scandalize, be sure of existing. Yet life in common is not part-time, where you enter holding your breath, like going to school, it is sharing everything, natural, where helping each other is expected, collaborating, where hiding cannot go on indefinitely, and where everyone is imperfect in some way. The worst insult between teenagers seems to be "You've had it!", a fiction that all share through social networks but which no one admits and, on the contrary, everyone continues to repeat unfiltered. One of the most painful dimensions of cyberbullying is that the attack is not so much directed at people as such but rather the way in which they have chosen to show or present themselves to others, in what they consider to be the best possible light, exposing themselves to the gaze of others.

Our aim is to offer schools immersive community experiences where people share their bodily selves, in which they mediate their own needs with those of others, a situation which young people of 16 or 17 often experience for the first time and which they much appreciate.

Accepting yourself

Acceptance is not only something to seek in others, but rather in young people should be a process regarding oneself:

Through this experience you've succeeded in accepting a part of yourself that you knew about but that you always kept hidden. You're afraid of

believing that others can become fond of you. Perhaps this has always been your big problem in class. Your classmates perceive this and so it becomes a self-fulfilling prophecy. You're afraid of etting yourself and trusting others…. If you feel you're more accepted, then slowly you can begin to put down roots.

Seeking equivalence

In the end, what is most interesting but also most difficult to achieve is equivalence within a conflict. Perhaps also the fact of dealing with questions so profound, like conflict, your own personality, active listening. I found myself in difficulty, really involved in the first person, and I wasn't ready for it.

During our activities, Patfoort's equivalence (1987), Galtung's triangles of conflict and violence (1996) and Rosenberg's nonviolent communication (2015) are all models on which to base understanding and acting in situations characterized by interpersonal conflict and violent dynamics with which peer educators become progressively familiar. The conflicts both concern relationships where the peers have to decide how to act and involve that dimension in which we are all involved. In this way, the training they undergo so as to be able to work with others also prepares them to work on themselves. What is most important is to deconstruct a model of conflict as a zero-sum game, challenge the idea of violence as the only way of relating in a situation of conflict, show how nonviolence is not passiveness or inaction but rather assertiveness and constructive reaction, create awareness of the presuppositions that have given rise to conflict and the effects that their development will have on all parties. Young people are used to living learning processes as something immediate and almost external to them. A learning process that directly involves them can often find them unprepared and put them on the defensive. In this respect the peer educator works as a facilitator who accepts different points of view and encourages a calm discussion of different points of view within a condition of equivalence.

Courage

At first, I wouldn't have bet anything on this project. Before starting out I asked myself if it was too late to call everything off. I asked myself why I'd even accepted to do it. I could have stayed at home or gone out with my friends. I wasn't interested in being with people who for me were only classmates. People who you see for five hours a day and after school that's it. I really didn't want

to do it, but I couldn't have been more wrong. We took part in games, experiments, reflection sessions and during all these things something took place that in three years I had never experienced. In the group we were listening to each other, we were talking, we were opening ourselves up to each other.

It takes courage to participate in a peer education project, abandon your comfort zone and open yourself up to others. Initially collaboration with the teachers and the school as a whole is fundamental. The effort the young people make in jumping into the unknown has to be supported, encouraged and acknowledged. The theme of courage is recurrent in our activities, Civil Courage, courage to speak out, to denounce, to intervene in a situation of oppression and violence. Courage requires training and many experiments show how strong is the bystander effect which stops people intervening because there are others who could do it. Online space multiplies this effect and breaking the wall of silence, even if extremely difficult, often leads to reactions that are positive and supportive for people who have not had the courage to intervene before. Online action needs to be trained, planned and enacted in a coordinated fashion.

Love and value difference
There are thirty-two of us and we have all suffered or are all suffering, each one of us reacting in their own way to the pain. Now I know that we are all equal, with the same fears and worries. It's just that some of us hide them better than others. I've learnt to appreciate all the differences between us that annoyed me before. I've learnt to recognize the real value of the people around me.

Online space often gives young people the illusory impression of being able to accede to any kind of information via the freedom that internet affords everyone, and that what they find is necessarily the truth and the same for everyone. If put in a situation where each one of them looks for information about the same thing simultaneously, they are stupefied to find that what is displayed on the smartphone of their friend is different from that on their own. How is it possible that a device that permits a (presumed) unlimited freedom to search – and therefore discover the truth – can show different results for each one of us?

Each one of us looks at the world from a particular point of view and we are continually challenged, called into question, oppressed, disappointed or convinced by others' points of view or ideas of the world, each of which is in turn influenced by innumerable personal, interior, cognitive and social aspects, at both micro- (such as the family

we grow up in) and macro- (such as the country we were born in) levels. Through complex and secret algorithms social networks filter the contents to which we accede and feeding our sense of wellbeing online. Nothing does this more than finding a group of like-minded people. This filter bubble effect[3] (Pariser, 2011), together with that of a natural homophilia (Bessi et al., 2015) is facilitated by the ease of finding even the most minority groups and positions. Moreover, there is the dimension of the silence spiral, through which if people feel that theirs is a minority position in a given situation they tend not to intervene. All these elements mean that the internet environment that each one of us encounters ends up being entirely in line with our beliefs. We continually reflect on it in an online world that continues to reflect us, within echo chambers (Del Vicario et al. 2016) in which information, ideas or beliefs are amplified and reinforced by the communication and the repetition inside the closed system we inhabit.

What effects do these processes have on young people? In the first place there is an increasing difficulty in relating constructively to diversity, whatever form it takes, to come into contact, even casually, with something truly different from personal experience and convictions. The same difficulty involves expressing one's own position, since this is not necessary if everyone thinks like me, and entering someone else's bubble is only a question of provoking or enjoying myself. The adolescent is constantly searching for positions which are clear and well-defined, compromises and nuances are difficult to accept, the quest for belonging and identity is fundamental, and all this risks leading young people to extremes.

An approach based on peer education can gradually lead to exploring individual differences as a resource for oneself and for the feedback to give to others who are younger. Diversity is re-discovered in the unity and the uniqueness of emotional experiences, in acknowledging others' emotions that reflect one's own.

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[3] Pariser argues that users are subjected to fewer conflicting points of view and are intellectually isolated in their own information bubble

Being with others

Now I've learnt that being with others is more enjoyable and that discovering and being discovered is really a wonderful experience.

Social networks have not necessarily increased the feeling of solitude but have rather led to new forms of solitude or difficulty in opening up to others and showing one's own complex features to others. Peer education activities can provide a space for meeting and building protected relationships in which the fundamental rules and attitudes involve suspending judgement, reciprocal listening and empathy.

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Faraway, So Close: Bringing the Online on Stage

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Until relatively recently, science and technology on the one hand and various forms of artistic expression on the other were generally considered to be separate manifestations of human cultural production. Today, however, more and more examples of how they can interact in complementary and mutually enriching ways. In the words of Charlotte Hale, science communicator, choreographer and dancer with the Flux Dance company: "You'll probably leave a performance with an opinion. You'll talk about it afterwards and it's that conversation that is the key to science communication and engagement". Or, as Alexander Kelly, co-artistic director of Third Angel company puts it: "Theatre and science collaborations can help anticipate the future and help … understand what's coming … pose some big questions about who we are as human beings … the massive impacts on our lives".
Here Luca Giacomini and Giorgio Bertolusso propose ways in which experiences that involve both theatre and digital technology can build awareness of the complex nature of each of them and the roles they can play in the lives of each one of us.

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Why acting or, better still, why acting in 2019? Why do we feel like meeting unknown people to watch and listen to what the actors (they also unknown) want to tell us? All the world seems to go in the opposite direction. Technology, Science and Economy are leading to an airier and more aseptic society, where social interactions between humans are falling apart.

Narrowing down the question, why are we acting in 2019, anyway?

The question is not quite precise. The right question should be: why am I going on acting, even though I started without any artistic flair (just to forget my old girlfriend, to find a new one or to understand that I am not looking for a girlfriend at all)? I laid open to unknown critical looks and to ridicule many times, I did not find a new girlfriend and of course I realized that I will not get rich on stage, so why am I going on acting? I could attend a foreign language course instead, or a master's degree which might increase my career opportunities or the dear old course of Latin American dance…

The answer is easy: like all drugs, acting is highly addictive. You cannot do it without those unknown looks, you need them, you look for them, a thread runs between you and those looks, you investigate them, play with them, you thrill them and are thrilled by them.

And so, again, the direction is opposite to that of the world. Because we are not talking about scripts able to make you cry at minute 37, musical scales in minor keys to make your heart leap or algorithms to improve your mood. We mean a dialogue which keeps among people a good amount of improvisation and emotional appeal, different every night.

Communication becomes deeper and touches the soul, contents pass in a more effective way. Some studies confirm this. Staging plays on emotional channels, that makes contents more understandable.

Our challenge was to imagine a conference-play which could tell in a different way what we knew from our job and personal interests: digital technology. Exactly what seems opposite to the ICT world, the insubstantial versus the presence. A performance on stage can't do without an audience. Actors and audience need to feel and

smell each other, mistakes and fear must be shown, the actor must show their faults. There are no reductions, actors are scared if they feel the audience is inattentive, they are scared to lose their attention, and are willing to fight for it.

We were sure, like more influential others, that thinking about the digital revolution is important, so we tried. It was not easy. At the beginning we started with a real conference about the least known aspects of the fourth digital revolution, but since then we were so bored that we found it impossible. Then our acting experience helped us, so we started to plan something more similar to a play. All we had read, learnt and discussed was emerging, giving us the frame on which to build short scenes and monologues. Real stories were created, they were ridiculous, dramatic, surreal. So a plot was born, with a structure and different scenes, each of them about diverse aspects of digital technology. We had to make choices, since the topic was so wide that it was impossible to include all the subjects: social media, cyberbullying, the internet of things, self-driving cars, digital ethics, cyber-wars…

We were also aware of the quick changes the single aspects are undergoing. The risk of obsolescence is real. Our structure divided in scenes helped us, each of them is a single module which can be enriched or deleted. We can also add new modules if we find new subjects that we are interested in.

First, the beneficiaries of this work should have been adults, people who had not grown up with these new technologies and that probably did not know their real possibilities. Maybe they had a computer at work or at home, but they looked at it suspiciously or a little scared. Ours was also a pedagogical aim, a contribute against the risks and mistakes of surfing the web. We thought that young people, born with digital technology, may have found our contents trivial, too didactic or even useless. We see them surrounded by electronic devices and continuously online. We believed they are immersed in the digital world with abilities we could not even imagine at their age. We see young people living so much in this augmented reality that we thought they did not need our words or our help, but we were wrong.

The most effective image that struck us was that of an ostrich, since they are immersed in the new technologies with their head, but their body is left out, they do not even know they have a body, keeping their head under the digital sand. They have a very shallow knowledge of their devices, but above all, they have no awareness.

Digital awareness is the project's title. Our motivation was that many young people live and use technology and devices without being aware of the consequences of the underlying processes. Privacy about data, their persistence, induced social effects, the relationship between digital technology, politics and wars. Another main theme is the future of work in our world, which young people are bound to and that new technologies are dramatically changing.

Our first test was at the Scientific High School "Gobetti" in Turin, with a group of students from different classes. It was a day of self-management and they voluntarily decided to attend the play and the following debate. They liked the performance very much and the discussion was very passionate with a lot of questions. We were really surprised: the students, even the youngest, were greatly interested in the risks of the new technologies, in the relationship between technology and wars. It was clear they had thought on those issues and they considered them relevant.

We then performed our show in other scientific high schools in Turin, in Italy. Each time a hundred, a hundred and fifty students were paying attention to our show (which is difficult to believe since such groups of young people can develop astonishing levels of noise), they wanted to tell and listen to stories about that digital planet. We were talking about their world. Some were really odd episodes related to the social media, like the one of a guy who had a namesake of the same age but living in a different region, who had died in a car accident. Some friends of the unlucky boy had looked for his profile but had found that of his namesake who received hundreds of messages, even though he tried to explain the mistake.

But it was not always like this. Moving away from the city and reaching schools in the province of Turin, we met students who were elsewhere, taken by that same world we would have liked to discuss. Perhaps we spoke different languages, maybe they didn't know the language of theatre enough. In those occasion the presence was not sufficient to set a connection.

"Reality is often more boring", Luca Giunti, Park Keeper, says. "It takes six hours to hide and five seconds to take that beautiful picture of the eagle. But we are beneficiaries of the shots only and often we observe them for less than five seconds. Of the other six hours no memory is left."

As actors, it was painful to lose that contact we look for with so much effort. But we reflected that those are the right places to take our work. Those are the guys who need a higher reflection, (also suggested by their teachers) on the digital world of which they are unaware consumers.

We would like to realize a "suburb tour", as we call

it, since there is where a show like ours is more needed. We would like to win the challenge and find the solutions, modifying the language, maybe with the help of a team of teachers, psychologists and sociologists, introducing new topics and thus breaking through blue screens and bent heads. Distance is the word we began with. This word sounds in a special way to actors. A "faraway" show is the one which gives no emotions. A "faraway" actor is somebody who does not care about the audience. A performance on stage does not make sense on screens, since a dimension is missing: the relationship between actors and audience. Theatre is physical and emotional presence. Theatre is "closeness". If theatre is here and now, the relationship between humans filtered by a device and then by a software is faraway, devoid of many aspects. Living without these aspects is convenient, especially for a teenager. As we actors say, it is a world with limited sensitivity, where we risk less but we also live less.

Distance is what divides those young people and us. They do not understand the technological evolution processes that we started and we do not realize what they are doing with it and how they are experiencing it.

(Translation by Marinella Depperu)

Mountains and Slow Tech. Evolutionary Processes at the Interface with Natural and Virtual Ecosystems.

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There they are, you will have to go a long way round
if you want to avoid them.
It takes some getting used to. There are the Alps,
fools! Sit down and wait for them to crumble![4]

These lines by the poet Basil Bunting capture a sense of the human as an infinitesimally small biotic part of a web of abiotic and biotic immensity, relating the enormity of the spatial and temporal dimensions embodied by mountain ranges like those of the Alps to the multiplicity of human reactions to them: a sense of frenzy or of calm, acting to reduce or eliminate obstacles, ignoring or contemplating, denying or accepting. In the following personal reflections, Luca Giunti and Elena Camino explore many aspects of such dimensions and reactions as they consider ways in which natural and virtual worlds meet and interact, while the photos taken by Luca Giunti capture their essence.

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[4] Basil Bunting (2000), *Complete Poems*, New York: New Directions

The smaller we come to feel ourselves compared to the mountain, the nearer we come to participating in its greatness. I do not know why this is so. […] Every living being is connected intimately, and from this intimacy follows the capacity of identification and as its natural consequences, practice of non-violence. Now is the time to share with all life on our maltreated earth through the deepening identification with life forms and the greater units, the ecosystems, and Gaia, the fabulous, old planet of ours (Arne Naess, Oslo, 1912-2009).[5]

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[5] Naess, A. (1989*) Ecology, Community and Lifestyle*. Cambridge: Cambridge University Press

Mountains and vital questions we cannot escape
Luca Giunti

All mountains are constantly subject to a process of crumbling and levelling out. Geologically, incessant erosion creates new rocks that fall due to the force of gravity. Climatically, rising temperatures cause glaciers to shrink, lowering mountain peaks and melting the permafrost that for thousands of years has held together layers of rocks, thereby permitting them to fall. The constant pressure exerted by the continental plates and the lifting of the continents that is ongoing since the end of the last glaciation are in themselves too slow to counter these phenomena and the speed of the decomposition they bring about.

Above all, a process of levelling out of our mountains has taken place in our minds and in our behaviours. Our contemporary world does everything possible to eliminate them, physically and culturally. Rail and road tunnels constantly penetrate them at the base in order to permit us to go straight ahead. Ski lifts and helicopters climb them using fossil fuel energy instead of that of humans and animals. Electricity and computer networks eliminate gradients and instantaneously connect places that up to twenty years ago were isolated.

Why has this happened? Because mountains present us with features that we do not want to see, or rather that we no longer want to see. In the first place, mountains, by definition, rise. Trivial as it may seem, it is essential to recognize this. Indeed, if we exclude all the various types of lifts or motor vehicles, mountains are places to go walking in. Something that today many young people and adults never do. Not strolling along a road but walking on tracks for hours and with a full rucksack. If, like me, you often accompany people along mountain pathways - even if they are easy, wide and well signposted – you find it worrying to see how many of them continuously stumble, are unable to maintain a rhythm and a quickly out of breath, after half an hour of walking declare themselves dead tired, and after two hours have huge blisters on their feet.

The reason is well-known. We are largely sedentary and lazy. While young people practise many kinds of sport, these are all highly structured and on surfaces that are absolutely perfect. They are used to having everything immediately and without effort and have no sense of appreciation of the healthy dimension of making an effort and feeling fatigue.

At the same time, at school they learn that the most important conquest by the human species was an erect posture. They study the exploits of the great explorers and the campaigns of the ancient armies, all rigorously on foot. All the adventures of the Anabasis of Xenophon, Cyrus the Great, Hannibal of Carthage, Genghis Khan, Attila the Hun, the Crusaders, Marco Polo, Hernán Cortés, the pioneers of the Far West, may have involved some ships and horses, but primarily they were based on walking and the best-known event in the Olympic Games was based on running an immense distance to stretch the limits of physical endurance. And they may find out that their own grandparents covered distances now considered impossible on foot, perhaps even to attend their same school.

Little over half a century ago life in the mountains was very different. Many resident or seasonal communities lived there, growing crops and breeding cattle. There were fewer woods, more pastures and more irrigation channels. The paths used today by excursionists linked the villages, the fields, the grazing lands and the valleys. They were wide, open and well-tended because of their daily use, whereas today tourists complain that they are badly signposted and overrun by shrubbery. The dry-stone walls that still withstand gravity bear witness to the toil and fatigue of our ancestors. We can frequently come across the ruins of stone settlements covered by vegetation ("Stones once houses covered with wild roses"[6]). Stopping and trying to imagine the inhabitants' daily life without electricity and running water (still a reality in many parts of the world less fortunate than others) is a highly beneficial mental exercise.

Mountains also make us face something rare in cities - silence. Continuous noise is a cause of significant disorders and is something to which we become habituated. Often several hours of detoxification are necessary to be able to do without headphones or smartphones or to stop shouting continually, so as to appreciate once again a sense of quiet. Even though this is never absolute, since it always full of rustling, whispering, popping, animal noises and voices, sound that are always different and never-ending, but all natural.

Then there is the question of space, another dimension that contemporary life has made us lose. Medical research shows a correlation between visual disturbances in young people and the lack of things to observe in the distance since we are hemmed in between walls and buildings.

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[6] Lyrics from a song by Lucio Battisti "Il mio canto libero" (1972)

Mountains make us look up as we climb, widening our gaze as we reach their peaks. In this way we realize how small we are and how little we know of our world. And this is disturbing, leading us to level them and level ourselves.

Mountains can also be places of darkness. Astronomers and stargazers increasingly decry how our artificial lighting is spreading and worsening. Many people can no longer see galaxies like the Milky Way. Pollution in the mountains is still at a relatively low level and the air is thinner, and this enables us to enjoy a starry sky with all its fascinating mixture of emotion, curiosity and mystery. And this is not just a question of … scientific perspective or idle romantic imagination. From the origins of human conscious – perhaps some 100,000 years ago – we have always been able to simply look up and see the sky, the stars and the planets. This black dome has accompanied human evolution and been a source of inspiration for thinkers and artists alike. The great voyages of exploration, from the Phoenicians to Columbus, have used it as an instrument for spatial orientation, the Christian tradition has seen in it the sign of the birth of Christ, Galileo, Kepler and Copernicus used it to lay the bases of modern science, Kant found in it a principle of reason and universal judgement, poets and lovers have searched it for answers to the fundamental question of life. Its daily spectacle was free and brought together all humankind: kings and peasants, navigators and shepherds, monks and brigands, industrialists and office workers, drivers and labourers, miners and furnace workers. While returning home in the evening, everyone could freely cast a glance – and so formulate a thought – on the infinite. Only within the last fifty years – no more than the blink of an eyelid in terms of human history – have we almost entirely lost this ability. Mountains are still dark, but today this terrifies us. We rather light them up (skiing by night, beacons, lamps, cameras) or avoid them – and so inhibit our gaze and thought.

Being in the mountains means reflecting continuously, even if unconsciously, about what is necessary and what is essential. If initially we carry on our shoulders all that we consider indispensable, after two or three trips we drastically reduce the weight and the volume. We discover how much energy our electronic devices consume and how they cannot be plugged in to a fir tree to be recharged. And we might just be shocked to find out that we could perhaps learn to live without them.

The first basic lesson that every novice climber receives is that if you are in difficulty, if the weather changes or if your companion does not feel well, then turn back! No matter if you are only a few metres from your goal, turn back! Even if you have spent months and money on organizing the climb, turn back! Wise and disinterested advice. Simple advice that can save lives, costs and hydrogeological instability. Advice that avoids television or newspaper headlines – which deal with wasted rescue expenses or landslides and never with money saved or floods avoided. The essence of this mountain warning is "be reversible", because what is irreversible is never a good outcome. Today we tend to consider what is irrevocable as something positive and this is another reason why we do not like mountains and try to level them out. They put us face to face with our limits, while we would like to be omnipotent and unlimited.

Mountains teach us to face the unforeseeable and be adaptable. These are perhaps the most important specific characteristics that have favoured our evolution. Today we risk forgetting them. If I have planned a trip on a given day and with a given itinerary, nothing can make me change my mind. If I have planned it to last for two hours, no meeting or obstacle can slow down my progress. Better still if I arrive ten minutes early! A thunderstorm, a herd of cows, a group of trekkers, a park keeper, will never be seen as potentially enriching occasions to wait, look around me, discover new features, but rather only as impediments to my performance – naturally, to be shared as such on social media as soon as possible. We want safety at any cost and in any circumstance, but mountains remind us that this is an illusion. Lose our path, slip, fall, are all accidents we would like to avoid but which can happen. They will be less likely the more we are prepared inside ourselves (mental before physical training) rather than externally, because there will be times in which GPS and smartphone cannot help us. Every year alpine rescue units tell of highly equipped and costly expeditions to help someone wearing flip-flops in difficulty on snow slopes. Contemporary life tries to convince us that experience can be substituted by information. Mountains show us that this is not true and so we have to try to cancel them.

Finally, mountains offer refuge for those in need. It is no accident that for centuries it has been impossible for invaders to subjugate the afghan population because they always hide in the mountain peaks that they know better than their enemies, despite possessing inferior technology. For the same reason, in Italy the members of the resistance against the fascist regime took to the mountains. Likewise, mountain passes allow the movement of migrants, smugglers, victims of

persecution and clandestine travelers, all of whom need to escape the watchful eye of the established authorities in a given place and time.

Fatigue, Silence, Vast Spaces, Darkness, Essentialness, Limits, Inborn Rebellion. Mountains offer all these and many other dimensions. As with many other vital questions related to the development of human technology, we cannot escape asking ourselves for how much longer this will be so.

The dimension of time in the mountains. Catching the moment after waiting and watching for hours.

Mountains and evolutionary timescales.
Elena Camino

A rapid separation from nature
At first sight the relationship between mountains and ICT may not seem evident. Yet for Luca Giunti mountains clearly demonstrate how experience cannot be substituted by information. He speaks of mountains that with the passage of time are subject to a process of levelling out, both literally and metaphorically. Mountains that require effort, with few inhabitants, that are vast, silent and dark. At the same time, mountains teach us about what is essential (lightening the contents of our backpacks), about reversibility recognizing limits, turning back), about adaptability (in the face of the unforeseen, the new, the mysterious).

Working for many years as a Park Keeper he has built a deep knowledge both about mountains and about the numerous people (excursionists, children and adolescents) he has accompanied along their pathways. Over the years he has observed the increasing difficulty they have in walking, the rapid onset of fatigue in climbing, the perceptual dystonia that makes difficult the recognition of the relationship of proportion between animals, the difficulty in maintaining concentration for even a short length of time, of listening or watching in silence to pick up the sounds or shapes of nature and take in the wide-reaching panorama.

He has learnt how to deal with the youngsters' dismay as they lose contact with their virtual reality in the absence of a wi-fi signal in valleys and on peaks and the lack (as yet?) of electric sockets in trees to recharge devices.

While the reflections from the Park Keeper's perspective are gentle and ironic, they also highlight a dramatic change that in less than a century for over half of humankind has led to the loss of direct experience of nature – what has both accompanied and forged our entire evolutionary history in terms of the development of our species and of our societies.

The common ancestor of humans, chimpanzees and bonobos that evolved into being 6 million to 8 million years ago gave rise to a succession of ancestors of hominids (and hence of modern humans, or Homo sapiens) known as hominins. Hominids first began forming their own tools about 2.6 million years ago, made purposeful use

of fire starting about 800,000 years ago and experienced an accelerated increase in brain size between roughly 800,000 and 200,000 years ago. Most modern human characteristics have evolved in the last 200,000 years, with a shift to farming and agricultural methods from hunting and gathering beginning about 12,000 years ago.[7]

In terms of evolutionary timescales, the sudden loss of full immersion in nature has been analyzed from various perspectives, in the attempt to understand its implications and act consciously and rationally in the light of this abrupt change. Each analysis inevitably starts from specific and often implicit views on human nature, on how individual human beings function, on the meanings and modes that characterize the relationships between humans and other living beings. Thus, the range of different interpretations of this rapid and radical separation lead to many diverse and often conflicting conclusions.

A dynamic interplay between body, mind, emotion and nature

Although viewed historically as separate functions, in recent years complex motricity and cognition are increasingly being considered as functionally connected. Along a timescale of millions of years, the human body and mind would have been gradually molded, in a slow evolutionary process at the interface with natural ecosystems. According to the view proposed of *embodied cognition*, "the nature of a living entity's cognition is shaped by the form of its physical manifestation in the world … […] embodied cognition emphasizes how the particulars of human bodies acting in complex physical, social, and cultural environments determine perceptual and cognitive structures, processes, and operations. In contrast to traditional views of cognition, an embodied approach suggests that humans should be considered first and foremost as active agents rather than as disembodied symbol processors" (Antle, 2009, p. 27). More recently, Leisman et al. (2016, p.2) have pointed out that "all views of embodiment share the understanding that cognition is a complex set of internal activities, bound to each other and to the world through perception and action in real time with no static and isolated representation of anything, that is, that cognition is just a complex dynamic system".

According to Glenberg (2015), an embodied approach to cognition asserts that all cognitive processes are based on sensory, motor and emotional processes, which are themselves grounded in body morphology and physiology. Within this framework, the goal of cognition is effective action in the service of survival and reproduction.

The role of nature in personal self-realization in terms of evolutionary biology has given rise to the concept of *Biophilia*, a term which expresses the meaning of "love of life or living systems." It was first used by Erich Fromm to describe a psychological orientation of being attracted to all that is alive and vital. E. O. Wilson used the term in the same sense when he suggested that biophilia describes "the connections that human beings subconsciously seek with the rest of life" thereby proposing the idea that *"the deep affiliations humans have with other life forms and nature as a whole are rooted in our biology"* (Kellert & Wilson, 1993, p.416).

Such a natural orientation towards other members of the web of life might be connected with a quality defined as a kind of *intelligence*. Over time, intelligence has been defined in many ways: the capacity for logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem solving. More generally, it can be described as the ability to perceive or infer information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context[8]. According to Gardner an intelligence is "a biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture" (1999, p. 33-34). To an original list of seven kinds of intelligence, he subsequently added naturalistic intelligence, defined as nurturing and relating information to one's natural surroundings. As underlined by Morris (2004, p. 159) "this sort of ecological receptiveness is deeply rooted in a 'sensitive, ethical, and holistic understanding' of the world and its complexities – including the role of humanity within the greater ecosphere".

Nature as educational subject: from biophilia to stewardship

Human bodies acting in complex physical, social, and cultural environments determine perceptual and cognitive structures, processes, and operations. Even processes that seem abstract, such as language comprehension and goal

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[7] https://sciencing.com/human-evolution-timeline-stages-theories-evidence-13719186.html

[8] https://en.wikipedia.org/wiki/Intelligence

understanding, are embodied. Growing evidence of the interdependence between mind, body and environment has led to many experiments within the field of education, even in terms of learning abstract notions in Mathematics or Physics and how motor activity is central to concept building (Yee et al., 2013; Weisberg et al., 2017). Moreover, as cognition is formatted in terms of sensorimotor experience, and sensorimotor systems make those thoughts dynamic, even language comprehension and goal understanding are embodied (Glenberg, 2015). An increasing collection of reports indicates shifts in perseverance, problem solving, critical thinking, leadership, teamwork, and resilience (Kuo et al., 2019). On the contrary, there is increasing evidence that "reduced postural activity in childhood harms natural exploration of the surrounding, thereby reducing the ability to learn from experiences, and leading to developmental delays" (Leisman et al., 2016, p. 2).

Since 1950, the world's urban population has risen almost six-fold, from 751 million to 4.2 billion in 2018[9]. In 2009 the urban population surpassed the portion of people living in the rural areas. Over the next few decades, the rural population is expected to level out and eventually decline, while urban growth will continue to shoot up to six billion people and beyond. In this way, there is inevitably an increasing gap between the possession of abstract knowledge about the environment and real, concrete experience in nature. Meanwhile, hundreds of studies have recently been investigating the role that experience in nature – from wilderness backpacking to plants in a preschool to a wetland lesson on frogs— may have in promoting learning, and converging evidence strongly suggests that experience of nature boosts not only academic learning and personal development, but also environmental stewardship (Kuo et al., 2019).

Spending time in nature fosters an emotional connection to nature and, in turn, conservation attitudes and behavior. Awareness is increasing of how direct contact with nature may be the most effective way to nurture the growth of environmental stewards (Lekies et al., 2015). An emotional connection to nature, which may be more difficult to acquire in a classroom, is a

powerful predictor of children's conservation behavior, so that a nature-based environmental education, which combines the acquisition of environmental knowledge with the promotion of an intrinsic driver, namely connectedness to nature, is proposed as a holistic approach to increase ecological behavior (Siegman & Pensini, 2017, abstract). In this respect, Gould affirms that "we cannot win this battle to save species and environments without forging an emotional bond between ourselves and Nature as well-for we will not fight to save what we do not love" (Gould, 1993, p.40). Biophilia is precisely that emotional bond with Nature and being innate in children it can be the most solid starting point to develop naturalist intelligence. At the same time, an extensive literature, together with much shared direct experience, demonstrates the efficacy of being exposed to natural environments in order to develop or regain a sense of wellbeing or serenity, or to improve or restore the capacity for attention or concentration. This is particularly significant as regards children, where research into their perception of restorativeness and the potential restorative effects of natural environments for this population suggests that children living in a place with more Nature are likely to benefit with respect to their cognitive functioning or attentional capacity (Berto et al, 2015).

According to Berto & Barbieri (2017, p.4), Biophilia, as the evolutionary legacy, and naturalist intelligence, as the potential goal of education, can be considered the two poles of an environmental education journey where perceived restorativeness and connection to Nature play a significant role".

To summarize, we can say that various experimental approaches come together in indicating that direct, intense and prolonged experience in natural environments leads to advantages both in terms of cognitive development and wellbeing together with the promotion of attitudes and behaviors involving care and protection of nature.

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[9]

https://www.weforum.org/agenda/2019/09/mapped-the-dramatic-global-rise-of-urbanization-1950-2020/

Natural environments promote wellbeing and serenity, care and protection

Virtual nature and elusive spaces

In recent years an increasing quantity of research and publications have been dedicated to "technological" solutions to the increasing deprivation of experience in nature, in order to re-establish a harmonious relationship between body, mins and nature. According to Truong et al. (2015), technology has today begun to change human's long-standing experiences with nature. Through videos and documentaries, we travel, discover magnificent windows opened onto wildernesses, landscapes, places and species we would not be able to reach and see otherwise. Virtual Reality (VR) aims to elicit sensory responses to simulated environments. Exponential increases in computing power, along with other innovations in display system hardware and software, have enabled dramatic improvements in the quality of simulation. Newer systems are capable of more modes of sensory stimulus (such as vision, hearing, and touch) with greater detail at higher frame rates. More physical phenomena can be computed in real time (rather than precomputed and "baked in"), allowing for higher fidelity inter-action (Hall et al. 2012).

Embodied cognition literature has led some researchers – in particular those linked to commercial applications of VR for entertainment purposes – to explore ways in which virtual reality may be a surrogate for real-life natural environments. Truong et al. (2015) have focused on how players relate to Nature in the world's number one online role-playing game, the World of Warcraft (WoW, millions of players throughout the world), and they suggest that gamers in these worlds actually prefer to gather and role-play in natural-looking areas with a predominance of greenery, even when not actively exploring. Indeed, in modern society, artificial constructs and electronic technology now dominate most peoples' interests (technophilia). Buettel & Brook (2016) argue that gaming technology can excite people about nature, unlock their inherent biophilia, and highlight the value of ecological restoration in their everyday lives. According to Shin (2018, p. 71) with the rise of VR technologies and services, *"the user's role has changed from passive consumer of technologically provided immersion to active creator of immersion. The VR user creates, adapts, and modifies immersion, depending on his or her day-to-day activities and context"*.

This computational approach to the relationship between people and nature is in rapid expansion, in a parallel fashion both to that of the exponential growth of calculation capacity and Big Data as well as market pressures that see in VR commerce vast developmental opportunities. Nevertheless, there are some areas of human experience that do not lend themselves to quantative study, areas like childhood memories, insights, certain deep emotions, spiritual experiences, magical encounters, spaces which elude a computational and thingifying approach. In the words of Raimon Panikkar (2005) reality has a cosmic dimension of

matter and energy, of space-time, that cannot be ignored. Human beings are neither merely products nor masters of nature and the world is their extended bodies, with which they share life and destiny. The logos accompanies all our lives, but not everything can be related to or by the logos. The human, the infinite or divine and the material are not three separate realities but rather three aspects of one unique, same reality, the awareness of which reveals the ambiguities and limits of all strictly scientific or cultural discourse.

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The "Evolution" of ICT: Greater Benefits and Greater Challenges.

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Norberto Patrignani is a Lecturer in Computer Ethics at the Polytechnic University of Turin, Italy, and has a longstanding interest in Information and Communication Technologies having seen its development over the last 45 years. Laura Colucci-Gray is a Lecturer in Science Education at the University of Edinburgh, United Kingdom and member of the Editorial board of *Visions for Sustainability*. For a long time, she has been interested in controversies arising at the interface between scientific and technological developments, the environment and society.

While Information and Communication Technologies (ICT) has been around for some time, citizens' interest and awareness of its applications, consequences and impacts on all sectors of civic society is relatively recent, and even more so in education.

In the following dialogue, Laura and Norberto exchange their thoughts on the immense challenge of seeking to understand digital technologies which continue to influence and shape our ways of thinking and making decisions in our everyday lives.

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Laura: Starting from the very beginning: when did you first become interested in ICT?

Norberto: I was hired by Olivetti[10] at the Research Department in Ivrea in 1974. With a diploma in Electronics and a first degree in Computer Science from University of Turin, I have seen the last 45 years of history of ICT, from Personal Computers to Cloud Computing.

In 1985 I started to investigate the social and ethical implications of ICT, thanks to the international organization named Computer Professionals for Social Responsibility (CPSR), based in Palo Alto (where Olivetti had a Research Lab). In 1993, I introduced the first course "Computer Ethics" in Italy. Since 2008 I am teaching "Computer Ethics" at the Polytechnic University of Turin.

Laura: The change from personal computers to cloud computers is of interest to *Visions.* It seems that we started from a product which was largely deployed for tracking people and resources for military and commercial purposes. Now we have reached the point when every single person with access to a computer can be 'wired' into a large data system. Such transition has occurred quite fast but also quite subtly, as many of us still retain images of personal computers as little 'black boxes' in the living room, for playing videogames. It is interesting to see how young people appear to be the 'key brokers' in the relationship between business, the military sector and civic society. From an educational point of view, this raises questions about the opportunities that exist for young people in schools to monitor and critique the world of technological objects populating their lives. But before moving on to that aspect, can we clarify what we normally understand by Information and Communication Technology: its applications and uses?

Norberto: Normally people consider technology (and ICT in particular) as "neutral", often ignoring that technology and society co-shape each other.

So, people accept all new technology passively, they do not see the opportunity for designers of computer systems to drive in some directions their development.

Every new generation of devices is accepted as an "evolution": they are faster, with more features, etc. but very few people ask about the social, environmental and ethical impact of these new "gadgets".

Laura: Evolution, involution, devolution… the key is in the language! In an article I had co-written with my colleagues Anna Perazzone, Elena Camino and Martin Dodman in 2013, we reflected on the use of metaphorical language in science. We have become so accustomed to using particular words that are derived from everyday contexts that we no longer pay attention to the social context surrounding the origins and uses of those words, and the values they carry. In that article, we asked students to draw their understanding of evolution in Biology: their visual descriptions indicated largely a process of linear transformation leading to 'improvement', either by acquisition of new features or enlargement of existing capacities. The surrounding environmental context - or the relationship with other species or other non-living things - was largely ignored. It is an idea of 'evolution' which appears to have been seamlessly extended also to the 'evolution' of information and communication technologies: a view which assumes all changes to be positive and desirable, largely ignoring the context and the purposes for which products have been devised.

To this point, why do you think we do not hear so much about military applications of ICT?

Norberto: Society in general is not involved in military discussions, for example, in Italy very few people are aware that in our territory we have many atomic weapons installed. The same applies for ICT applications in a war scenario.

The very first ICT researcher that raised this issue was in 1947 (!), when the founder of computing and cybernetics, prof. Norbert Wiener ("A Scientist Rebels", *Atlantic Monthly*, January, 1947) publicly refused to collaborate with the military: *"I do not expect to publish any future work of mine which may do damage in the hands of irresponsible militarists"* (p.46).

The second historic example was in 1985, when the founder of Object-Oriented Software Programming, prof. David Parnas resigned from the United States Government Scientific Committee of the project SDI (Strategic Defence Initiative). His experiences are recounted in this article: Parnas L.D. "Why the SDI software system

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[10] Olivetti was founded as a typewriter manufacturer in 1908 in Ivrea, near Turin, by Camillo Olivetti. The company is known internationally for the manufacturing of electric calculators, first launched in 1948 and the production of Italy's firslectronic computer.

While the company sold its electronics division to the American company General Electric in 1964, it continued to develop computing products on its own; one of these was Programma 101, one of the first commercially produced personal computers.

will be untrustworthy", American Scientist, 73:5, Sept-Oct 1985, 432-440.

The last example is the debate inside Google where many software designers refused to collaborate with a Pentagon Project https://globalnews.ca/news/4124514/google-project-maven-open-letter-pentagon/ Let's keep the discussion open and diffuse!

Laura: I find this information very interesting. For example, I have come to learn that the field of science education in the United Kingdom is relatively recent. I believe it started when funding was allocated to Technical Institutes (later Universities) after the Second World War to promote scientific literacy aimed at developing a 'specialist scientific workforce' to be deployed both in the commercial and military sectors. The history of the field is bound-up with the economic and technological changes which have followed the 'petroleum era' as recounted by Rodger Bybee in an article published in 1975! Currently, the rebranding of science education as 'STEM' (Science, Technology, Engineering and Mathematics) appears to be aligned with forms of economic imperialism. Another area that is also emerging within this is 'data education', teaching young people to 'code' arguably to develop logical thinking and practical skills, while detracting attention from critical, evaluative and ethical reflection that is required to deal with the complexity of our changing environment. In a recent article "Neoliberalism and STEM Education", published in 2016 in the Journal for Activist Science and Technology (JASTE), Prof. Lyn Carter is particularly critical of this view. There are important responsibilities for the educational sector, at all levels in education.

As a scientist, what do you think are the most pressing and concerning issues in this sector?

Norberto: I think the "autonomous weapons" is the most pressing and concerning issue https://www.stopkillerrobots.org/. Such weapons would be able to identify, select and attack without further human intervention, thus effectively further distancing 'attackers' from 'those who are being attacked', and circumventing moral responsibilities for those who make the decisions.

Laura: Who are the stakeholders involved? And who drives these developments?

Norberto: The main stakeholder is the Weapon Industry that in many countries has a strong impact on the government.

https://www.nytimes.com/2017/09/22/business/economy/military-industrial-complex.html Of course, the key is to have the support from society (the risk of losing jobs, etc ...) particularly in those countries/areas which have largely devolved primary production activities (farming; manufacturing etc) to other countries. So, the key actors involved are the military industrial complex; governments; society (e.g. the Union of workers! they should say a word about the involvement of workers in these applications); Peace advocacy organizations (e.g. https://www.icrac.net/) and of course, Computer professionals' organizations (ACM, IEEE; IFIP, etc.).

Laura: I would add also research centres in the Universities, and the critical role played by private-public partnerships which are taking centre stage particularly in the global South. There seems to be a need for gaining a much broader, systemic view and concerted action on the matter. In what way can you incorporate this knowledge into your role at the European Union (EU)?

Norberto: I am a member of several panels of Ethics Reviewers for EU projects (Horizon2020, etc.) but military projects are following a different track: there is not a peer-review process on the ethical aspects of such projects provided by external and independent subjects.

Laura: Are there national or international institutions which should demand transparency over the financial support given to the military?

Norberto: It is a complex issue due the lack of independent ethical procedures I described in the previous point. Of course, the entire society should have a word about how to spend public money. I think that organizations like the United Nations Institute for Disarmament Research (UNIDIR) should demand transparency, but also computer professionals' organizations should.

In fact, returning to the subject of STEM education, I would agree that we need to prepare next generations to deal with digital technologies, 'coding' is necessary, but not enough. They also need tools for reflecting about the co-shaping between technologies and society, they need to use ICT with 'wisdom', we can call it 'digital wisdom', which is taking care also of the social and environmental impact of computing. For example, very few people know about the CO_2 contribution of ICT: about 4%, so addressing the climate change is also connected with our electronic devices' consumption. Another example: very few people know the conditions of

workers in manufacturing plants for the electronic industry in the South East of Asia. Can we still accept to buy e-things that comes from working conditions very close to slavery? So 'digital literacy' need also a 'digital wisdom'.

Laura: it looks like there is plenty more research and action to be taken with regards to Information and Communication Technologies. Computer Ethics should be incorporated in education at all levels, from early years onwards. We deal with a field which grows faster than our ability to understand it; however, we are also grappling with very fundamental questions and problems concerning the impact of wars on the livelihoods of many people. As citizens, we should all be asking the key questions of where do our computing resources come from; who benefits? And to what end?

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