Strong Sustainability by Design

PRIORITIZING ECOSYSTEM AND HUMAN FLOURISHING WITH TECHNOLOGY-BASED SOLUTIONS

THE ARTS

Strong Sustainability by Design

This Compendium has been created by committees of the IEEE Planet Positive 2030 Initiative supported by the IEEE Standards Association (IEEE SA). The IEEE Planet Positive 2030 Initiative community is composed of several hundred participants from six continents, who are thought leaders from academia, industry, civil society, policy and government in the related technical and humanistic disciplines. At least one hundred seventy members of this community from about thirty countries have contributed directly to this Compendium and have worked to identify and find consensus on timely issues.

The Compendium's purpose is to identify specific issues and recommendations regarding sustainability and climate change challenges to achieve "Planet Positivity" by 2030, defined as the process of transforming society and infrastructure by 2030 to:

- Reduce Greenhouse Gas (GHG) emissions to 50% of 2005 GHG emissions by 2030.

- Significantly increase regeneration and resilience of the Earth's ecosystems.

- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050.

- Continue to widely deploy appropriate technology as well as design and implement new technological solutions in support of achieving technological solutions designed and deployed to achieve "Planet Positivity."

In identifying specific issues and pragmatic recommendations, the Compendium:

- Provides a scenario-based challenge (how to achieve "Planet Positivity by 2030") as a tool to inspire readers to get engaged.

- Advances a public discussion about how to build from a "Net Zero" mentality to a "Net or Planet Positive" ("do more good," that is, doing "more" than "don't harm") societal mandate for all technology and policy.

- Continues to build a diverse and inclusive community for the IEEE Planet Positive 2030 Initiative, prioritizing the voices of indigenous and marginalized members whose insights are acutely needed to help make technology and other solutions more valuable for all. Of keen interest is how to encourage more in-depth participatory design in these processes.

- Inspires the creation of technical solutions that can be developed into technical recommendations (for example IEEE SA recommended practice for addressing sustainability, environmental stewardship and climate change challenges in professional practice, IEEE P7800™) and associated certification programs.

- Facilitates the emergence of policies and recommendations that could potentially be intraoperative between different jurisdictions (e.g., countries).

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THE ARTS

Future Vision

It is 2030.

Art has provided humanity with a newfound focus on empathy supporting a broad change in the zeitgeist of policy, business, and technology in general.

Thanks to art, humans now have a space for systemic thinking that has helped people around the world to understand the complexity of overcoming planetary challenges through the interplay of many disciplines. In other words, in this process, art has played an integral role in combining the different pieces together and representing a fragmented world of various interpretations and truths. More than anything, art has shown stakeholders' different points of view, brought people together in a joint action to save the planet, and connected humans to a profound sense of meaningfulness. As a result, the much needed technological solutions and redesigns have taken place.

In 2030, the concept of art has reformed; it has its place empowering people in all their daily surroundings as one strong wire in the social fabric. When in earlier decades art's intrinsic value widened to social and participatory realms (as arts in health, as part of mental well-being, and other fragile groups), in 2030, art is now integrated into various powerful working contexts, with big impacts on the lives of many (political, corporate, and more). Art enables a creative approach breaking through limitations of norms, serving as a medium to reach new knowledge. Diversity and a cross-disciplinary approach are evidently important, and art can build bridges between people and enable exchange and co-creation.

In 2030, art has been accepted as a key enabler of human and planetary flourishing, harkening back to an era when millennia before the development of the scientific method, oral, spoken, and visual manifestations of cultural traditions formed the historical bases of art unified families, communities, tribes, and regions as peaceful modes of communication and unification.

The enormous change that occurred in the last seven years, beginning in 2023, was not linear. At that time, no single entity existed, and no clear events were available to lead people, companies, and countries into a completely different lifestyle. The change happened because many different movements and actors, across politics, business, and society at large, joined forces. Artists, with their ability to grasp glimpses of the future, led the way with their artworks. They guided people on the path of *deep listening and emotional connectivity*. With their art, they revealed what is really important and helped to ask: What is the legacy of humanity to the future generations, and what kind of world do people want to create? Artists contributed to the renewal of the systems and their norms, restrictions that define possibilities of development, pushed humanity's imagination to the next level, and enabled discoveries of new, unseen ways of being, doing, and existing in this world. This contribution paved the way to reducing greenhouse gas emissions dramatically, to stopping the extinctions of species, to regenerative new agricultural processes, and to healing Earth's ecosystems.

Introduction

As the effects of climate change become increasingly apparent, it is more important than ever that humans take action to protect the planet. While science and technology are crucial in addressing environmental issues, art plays a powerful role in raising awareness and inspiring change. The climate crisis is a crisis in the relationship of humanity with the planet. Art contributes to the change in this relationship, as well as to how humans interact with nature and the planet as whole.

Through various forms of expression such as visual art, music, literature, and film, artists convey the urgent need for change and the importance of sustainability. Art can be used as a means of communication and advocacy that can inspire the public to demand more from policymakers and industry leaders. The emotional impact of art can be particularly powerful in encouraging people to take action and become more invested in environmental causes.

Art can also serve as a means of promoting empathy and understanding, which is especially important when dealing with complex environmental issues. For example, a photograph of a polar bear struggling to find food in the melting Arctic can evoke a sense of empathy and urgency in a way that a data chart or scientific report may not. Through art, people can see the tangible effects of climate change and be moved to take action to protect the planet.

Art is a way to tap into tacit knowledge and connect to thoughts and ideas that cannot be expressed in any other way. This value is understood within the private and individual domain, but now it is topical for various organizations and systems in need of creative renewal for a sustainable change. It is essential to "build new bridges" of cross-disciplinary collaborations, to create access for art to support all kinds of communities.

In addition, many artists are now incorporating sustainable practices into their work. By using recycled materials, reducing waste, and minimizing their carbon footprint, artists are not only raising awareness about environmental issues but also serving as examples for others to follow.

The power of art in encouraging change should not be underestimated. It plays a vital role in supporting people in creating an emphatic relation to the environment. As we[1] work toward a more sustainable future, art should be supported and promoted to awaken environmental consciousness.

Art cannot save the planet on its own, but it can play an important role in raising awareness and inspiring change that is necessary for preserving the Earth for future generations. Art is a powerful medium that evokes emotions, creates empathy, and inspires people to take action.

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[1] "we" as in "humans"

Issue 1: The need to make people <u>feel</u> the urgency of climate change—emotions push people into action

Background

Besides the tangible and measurable aspects of climate change, the transformation of a personal environment also touches emotional dimensions on both a collective and an individual level. Art can be the space where emotions emerge, where difficult emotions can be handled in an appropriate way, and where emotional energy can become a driving force for positive change.

Emotions play a key role in fueling behaviors that generate action on all levels in society. David McLelland (McLelland et al., 1953), in his early research on behavioral issues in the 1950s, gave emotions the most fundamental causal dimension and showed how people who managed to gain extreme success in their careers were pushed by intrinsic motivation and good management of their emotions to excellence. Some decades later, Daniel Goleman[2] not only introduced this interpretation to a wider audience but also showed the direct connection between the role of emotions and the levels of individual and collective performance.

Climate change fuels a wide range of emotions from dark emotions like despair, grief, rage, fear, and anxiety to passion and love to act in front of a global challenge. If managed well, the emotions connected to climate change, even the difficult ones, can become a driving force for making necessary change. People can come to recognize the presence of the emotions in them and can learn how to channel the energy they create in a constructive way. Poorly managed emotions, however, can become destructive and cause the opposite effect of creating climate resistance and opposition toward positive climate actions or, for some people, the inability to act in front of the global challenge.

Art and artful methods can help elaborate the emotional dimension in relation to climate change in several ways. Artful practices can help develop emotional awareness and intelligence both on individual and collective levels, increasing human:

- Ability to *recognize*, both in them and in others, the emotions that often drive behavior (consciously or unconsciously)

- Ability to *give an appropriate name* to what is felt, in other words, to be emotionally literate

- Understanding of *how to welcome, control, manage, and direct* emotions to be constructive, rather than falling prey to them

- Understanding of *how to talk* about emotions connected to climate change

- Knowledge about *how to influence others* through emotions, that is, sensibilize them on the topic

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[2] Daniel Goleman, American psychologist, is one of the main theorists on the role of emotional intelligence in life and in people's actions. His ideas are a combination of interdisciplinary reasoning between neurology and behavioral sciences. His most popular work is *Emotional Intelligence* by Bantam Books (1995).

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Artworks can simplify and amplify at the same time. If on the one hand, they allow the transfer of complex concepts on an immediate descriptive level, then on the other hand, they bring out the emotional attributes in a more marked and distinctive manner. In this sense, they represent a privileged and direct access to the experiential world of people. While in contact with an artwork, the person is predisposed to a deeper exploration of their experience, of resistances, of pressures to move forward. Sometimes artworks that have a strong statement or express a clear provocation reach a person's sensibility in an immediate way. In the work of the Spanish artist Isaan Cordal (2011), *Politicians Discussing Global Warming*, for example, highly elegant men are drowning in a pond of water. This artwork can create *annoyance* and *irritation* in people. In the work of the Italian artist Sarah Ciracì (2021), *Sacrilegio*, the artist represents a bas relief of cows in an intensive farm. This piece makes many people feel *sad* and *angry* while thinking about how animals are treated in intensive farming and what are the consequences of this way of producing meat. Both art pieces spur strong emotions in people who see and reflect on their meaning.

But if artworks fire up human emotions, then they also provide the possibility to observe things from a distance. In fact, art can bring humanity closer to the meaning of lived experience, but at the same time, it can also allow people to take the right emotional distance to be able to observe, consider, evaluate, and reevaluate what is happening. By objectifying the interiority of thought, the people reflecting on climate change can physically detach themselves from it and look at it from new angles to create an action plan needed for the change.

Recommendations

1. **Encourage employing/using art to raise awareness and inspire change that is necessary for preserving the Earth's biosphere for future generations.**

2. **Actively involve people and communities in workshops that use art to reflect and manage the emotional side of climate change.**

3. **Invest in educational projects that use art as a means to stimulate emotional awareness in relation to climate change.**

4. **Give space (time and physical momentum) to elaborate on the emotional dimension in an adequate way.**

5. **Welcome all kinds of emotions to the co-reflection process, and use the artworks as a space to read and elaborate on the feelings connected to climate change.**

6. **Invite people to make an action plan and to use the emotional energy as a driver to fuel the change.**

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Issue 2: The need to enforce society's relational capital in the fight for climate change—how to increase opportunities to engage with art

Background

Global warming is the most complex collective challenge humankind as a species has ever faced. This challenge can only be coped with if the human species creates strong social bonds and collaboration. In fact, collaboration and cooperation are the key to tackling the environmental destruction that is currently happening. How to relate in a constructive way and become aware of the relationships that tie humans together (i.e., the interdependent nature of human existence) is the basis of collective survival.

The arts can work as a *boundary object* that connects people from diverse backgrounds and positions to each other to promote mutual understanding through discussion toward a common goal. The concept of boundary objects was proposed by Susan Leigh Star and James R. Griesemer in 1989. It originally began with the perspective of how professionals, amateurs, and others could collaborate across boundaries in the organization and operation of the museum context.

The arts especially help transcend traditional social barriers and norms, and social relational capital is a valuable by-product of artistic activity (Crossick & Kaszynska, 2016). For example, public art creates a sense of relationship and ownership in a city or region and enhances social connectedness. In addition, a 2016 art research project revealed that small-scale community art activities are more likely to benefit residents versus large-scale urban renewal projects (Crossick & Kaszynska, 2016). The creativity that social art projects cultivate may help collectivities to cocreate innovative solutions to environmental challenges locally. One example would be a work by the world-famous Argentinian artist Thomas Saraceno called "Museo Aerosolar." "Museo Aerosolar" had its birth in the Isola district in Milan, Italy, in 2007. For four months, the artist gathered with local cultural associations in Isola plastic bags to create an immense flying sculpture. The project represented an opportunity to transform what most would consider garbage into an object capable of bringing together the work of an entire community and embodied the vision of a future without pollution. The focus of the artwork is not as much on the result of the work than on the process of collective activation toward a common goal. Saraceno has since 2007 repeated "Museo Aerosolar" in 20 other sites around the world.

Therefore, art is a way to build relational capital in all kinds of spaces and communities, and it needs to be acknowledged as one relevant medium of transformation.

Recommendations

1. **Incorporate environmentally friendly art activities into lifestyles;** for example into hobbies that occupy a certain amount of time in human lives by replacing existing energy-consuming private activities. Traditional culture in harmony with nature is a reference (Japanese culture, for example, can incorporate various nature-infused artistic activities, such as tea ceremonies, flower arrangement, and poetry like haiku, inspired by intuitive penetration into nature and life).

2. **Build social relational capital through art activities in all kinds of communities and organizations.**

3. **Fund artist and art interventions that focus specifically on social and environmental aspects.**

Issue 3: The urgency to tackle the complexity of environmental change—expressing powerful contexts through art

Background

Art is a concept in constant flux. By default, art has its roots in communities and human expression, in the need for rituals and reflection. Art asks: What is humanity, and what are the stories of humankind? In modern times, the value of art is intrinsic. Art is used to manifest sophistication and human existence thriving, not only surviving.

What is happening in the environment and what kind of actions should be fostered is a so-called "wicked problem" (Rittel & Webber, 1973). There is no one simple solution to the changes and challenges happening globally right now. Art is one way to communicate the most complex challenges of all times, without the need to simplify them.

In the same manner that Renaissance art was the catalyst to grasping a new era, now, in this decade of environmental crises, art has a role to embody this shift, paving the way toward the future. Art is a tool to fill the imagination gap, to envision the future, to grasp that the world is not a disaster of business as usual but the one humans are working on, hope to create, and are truly wishing for.

Art is the tacit knowledge and language for all that which otherwise does not have a form, a way to be shared and experienced. In times of crises, art is not an addition or an ornament but the essential medium by which to explore unseen horizons together with people from various cultures, backgrounds, and disciplines.

Recommendations

1. **Test and pilot new forms of collaborations in which the arts and artistic expertise are integrated into decision-making, problem-solving, and future scenario work.**

2. **Support policies in which art is recognized as one key element for tackling "wicked problems."**

3. **Create the means, funding, and pilots for new cross-sectorial collaborations and actions that enable exchange between artists, stakeholders and experts from different fields.**

4. **Acknowledge artistic expertise as one essential skill and approach needed to resolve the most complex challenges and support the skill-building needed for new, to be established, cross-sectoral collaborations.**

Further resources

1. Kouzmine-Karavaïeff, Johanna, and Khawar Hameed. *Artists, Designers & Business in Cross-Sector Collaboration: A Report on the Untapped Potential for Systemic Change.* Artisans of Innovation, 2022.

2. Northern Dimension Partnership on Culture (NDPC). *Creative Industries' Future Session and Q&A with Futurist Roope Mokka: Imagination Gap*. YouTube video. 29 Sept. 2022.

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3. Salzburg Global Seminar 2021. *The Creative Power of the Arts: Reimagining Human and Planetary Flourishing.* Session 717, Apr.–Nov. 2021.

Issue 4: Need to sensibilize business leaders to act through art interventions

Background

Traditionally art has had a passive role in the business context, being for example a visual embellishment inside offices or adding value to company collections through smart art acquisitions. Participatory art and art interventions that bring business leaders to reflect on the consequences of their actions can radically change decision-making today.

Company value is no longer considered only through economic aspects. Companies that invest time and energy on the dimensions of environmental, social, and corporate governance (ESG) tend to become in the long run more sustainable, even from the business (economic) point of view. Companies sensitive toward environmental and social themes gain in reputation and brand equity—for example through bigger commitment and engagement from the people who work for the company—and tend to create more solid relationships with clients and other stakeholders.

Contemporary managers have the following challenges:

- Harnessing long-term vision while bringing in the results asked for by the market today
- Perceiving correctly the relationships of different actors in a complex business and societal ecosystem
- Understanding the consequences of decisions taken from both an environmental and a societal point of view

Art interventions can help with these issues by:

- Creating clearness through visual means and visual thinking
- Enabling a process of co-thinking in meetings
- Activating a creative process to invent new alternative solutions for making business
- Sensibilizing business leaders toward environmental issues
- Transferring artistic skills to business leaders: emotional intelligence, sensibility toward others, aesthetical intelligence, creativity, and cultivating curiosity

Examples of how companies can interact with artists to create more sustainable business and to communicate their stories are shown in the case studies below.

Creating specific shows/events/assets that connect company history, business challenges, and the concept of *greenshift* can be an efficient way to sensibilize stakeholders in society.

Recommendations

1. **Bring artists inside companies and let them actively stimulate people's thinking processes.**

2. **Use artworks as triggers to stimulate creative thinking and inventing the new.**

3. **Create interdisciplinary working groups where people from different professional backgrounds need to solve environmental company challenges together.**

4. **Visualize.** Use artful thinking, exhibition making, and curatorial techniques to sensibilize people in companies to the subject of *greenshift* and sustainable business.

Case Studies

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1. Partnership between Manufacturer and an Arts Foundation

   As a practical example of how companies can interact with artists to create more sustainable business, a global manufacturer of kitchen products has created a steady partnership with an associated arts foundation. The company has manufacturing plants in Italy, Poland, Mexico, Germany, India, and China.[3] The collaboration has created a steady residency of artists inside company locations to boost constant innovation, creativity, and a different way of thinking and has pioneered the investigation of the potential link between art and industry[4] to create a more sustainable company culture.

2. Partnership between a Construction Company and a Museum

   Another good example of this practice are the shows of a construction company in the spaces of the Triennale Museum in Milan, Italy (Webuild with Triennale Milano, 2023).[5] Three large shows were used to tell the world about the construction challenges of the company. In this case, exhibition making, large-scale installations, and good curatorial practice make evident the impact of the activities of the company in construction sites all around the world. Creating specific shows that connect company history, business challenges, and the concept of *greenshift* can be an efficient way to sensibilize people and leaders in companies to act in a more sustainable way.

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[3] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

[4] Fondazione Ermanno Casoli is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

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Issue 5: The need for artists and scientists to join forces toward achieving environmental sustainability— the power of STE(a)M

Background

Collaborations driven by art and science, sometimes referred to as *STEaM* [science, technology, engineering, and mathematics (STEM) plus arts and culture], can not only engage the public at multiple levels but also help solve problems in environmental sustainability. Artists and scientists observe and interpret the environment, including, and especially, humanity's place in it. Patterns and motifs abound in the natural world, animate and inanimate, which are studied by artists and scientists alike, albeit toward different disciplinary aims and employing different methods (University of Iowa Technology Institute, 2022). Such creative interdisciplinary efforts can be employed toward the goals of environmental sustainability.

The issue is not whether, but how, artists and scientists can work effectively to enable this type of STEaM-powered technical solution toward robust environmental sustainability. The languages, methods, and visualizations applied across STEaM disciplines are different, as is the target audience. Furthermore, funding challenges abound for truly interdisciplinary STEaM collaborations, especially efforts that connect STEaM creators across the world. Basic technological infrastructure is often missing, such as real-time reliable collaborative platforms, for artists and field scientists constantly on the move, often working from remote areas with limited connectivity. These technical issues, as well as disciplinary diversity, biases across art and STEM disciplines, and lack of interdisciplinary project training, can pose challenges for successful art and science collaborations that lead to actionable environmental sustainability. STEaM-powered technology, itself developed collaboratively by artists and scientists, can help in this regard by providing unified learning, collaborative, and communication platforms.

Role of art since the beginning of time

The connection between empirically acquired knowledge of sustainable living within the natural environment and artistic exposition of such knowledge is an ancient one. Millennia before the development of the scientific method and maybe even before artistic disciplines were formalized, ancient cultures across human history developed ecologically sensitive cultural practices based on artistic visualizations, practical observations, and knowledge-based understanding of the environment they lived in. For example, the Indus Valley civilization relics refer to the deity Pashupati, meaning "the lord of the animals" (Government of India, Pashupati Seal, 2500 BCE). This deity, which personified the human connection to the greater animal world, and later evolved into the prominent Hindu deity Shiva, embodies cultural practices aligned with ecologically sustainable living philosophies across ancient India. Some of these cultural practices are still in vogue, in the form of traditional religion, and often are artistically driven through musical chanting and traditional dance forms (Harrison, 1997; Khush Das, 2021).

Case study

In a video of a Pashupati seal from Indus Valley civilization, the artist uses traditional hand gestures and body movements from Bharatnatyam, a classical Indian dance form, to illustrate the water cycle as part of his interpretation of an ancient Sanskrit hymn (Shoklam, "Akasat Patitam Toyam"), stating, "As water from all resources reaches the sea so do all seekers to knowledge." It is a classic case study in how art creates a bridge between a scientifically verifiable phenomenon (i.e., the water cycle and ocean being the ultimate sink of falling water) and the theological journey of spiritual seekers toward divine knowledge and wisdom. The traditional idea of knowledge and spirituality explored here also inherently includes the idea of respecting water bodies like rivers as a sustainable natural resource. The Namami Gange effort by the government of India also uses the mythical and artistic visualization of the River Ganga (Ganges) as a mother to harness sustainability efforts (Namami Gange, Anthem, 2016; Namami Gange, Official Anthem of National Mission on Clean Ganga, 2020).

Similar ecologically sensitive cultural practices abound in most Indigenous cultures around the world, often observed to this day with rituals seeking blessings from the earth, river, air, and other natural elements. Such rituals, which acknowledge the profound importance of the natural ecosystem and humanity's place in it, also were built on ancestral knowledge of ecological sustainability, passed down among the generations. Such practical knowledge was often driven by practical "from-the-field" observations that were similar, albeit primitive, compared with modern-day empirical studies. This knowledge was also imbued with rich artistry of mythological storytelling, sculptures, paintings, dance traditions, and so on that informed and engaged the public with the need to uphold their stewardship of natural land they inherited from their ancestors.

Today, however, with rapid degeneration of the natural environment due to large-scale deforestation, urban growth, and water/air pollution, these ancient practices designed for the ancestral environment may need to adapt to better connect the public psyche toward modern-era sustainability goals. Artists can still remind people us of these root practices through ancient art traditions, inspire growth beyond ritualistic habits to seek greater meaning, and engage the public to connect back with nature, just like in ancient times. The practical modern-era issue then is how environmental science and engineering (e.g., pollution studies) can inform art to encourage public opinion toward making this change. This fundamental issue ties deeply to the issues of cross-disciplinary training, dearth of sponsorship, and the technically reliable collaborative platforms mentioned above.

Sometimes the choice of a broad "popular" audience over a technical one for dissemination of new findings can be a mechanism for leveraging collective interest, understanding, and attitudes about issues deemed important by specialists whose communicative tools don't have much societal impact. This approach requires collaboration and conversations among the STEM population and the art and culture population to create bridges and mutual understanding of the details and the large patterns of technical material, as well as of the cultural contexts, currents, and media. One example of this is a book (Bennett, 2003) published for a general, nonacademic readership in Colombia that provides an accessible heuristic and cultural framework, as well as graphics that effectively convey the large patterns of the country's primate fauna, along with their beauty, ecosystem importance, and vulnerability.

A more theoretical yet profound example of successful STEaM collaboration would be the celebrated interactions between the Dutch artist MC Escher and scientists of his time (especially Sir Roger Penrose, see O'Leary, 2023). Such collaborations influenced both mathematics and art and, in its wake, architecture and human perceptions of reality (Overstreet, 2022). One wonders what Escher, with his seemingly endless

mathematical curiosity and inspiration from nature's motifs, would create today in this era of extreme environmental vulnerability. And yet, despite these successes, the issue of disengagement between artists and scientists remains a reality to this day if for no other reason than a simple lack of connection between the art and STEM disciplines.

The complementary pursuit of the measurable and the meaningful regarding environmental sustainability challenges can be harnessed using STEaM-powered projects. What needs to happen now, in the wake of climate change and related extreme events, is the harnessing of objective understanding of the environment with emotional cognition that enables responsible stewardship of the natural resources all people inherit from their ancestors.

The ancient Sanskrit saying *Satyam Shivam Sundaram* translates into English as "The truth leads to divinity, which leads to beauty." As creative thinkers, both artists and scientists seek the beauty inherent in nature as their intellectual reward, and harnessing this common interest toward sustainability can indeed restore the environment to its natural sanctity.

Recommendations

1. Combine the objective understanding of the environment with emotional cognition to enable responsible stewardship of the natural resources all people inherit from their ancestors.

2. **Look for beauty; look for patterns.** Geometry in nature and the beauty and dynamism of morphing shapes, patterns, and motifs, appeals to artists and scientists alike. This natural connection to beauty and patterns can be harnessed within successful STEaM collaborations, especially those that combine artificial intelligence (AI) and art. The key idea is for artists and scientists to come together and integrate how people observe nature.

3. **Use art to engage.** Art appeals to human emotional cognition, and therefore, science-informed art can respond to environmental sustainability challenges in a way that engages the public and policymakers. For example, artistic creativity is at the forefront of the Namami Gange initiative by the government of India (Primer Minister of India, "Namami Gange"; Namami Gange, Anthem, 2020).

4. **Connect sponsors and STEaM creators.:** Successful collaborations need cross-disciplinary funding, especially across international borders, as ecosystems in dire need of sustainability engagement may have the proper artistic resources but may not have the proper scientific resources, and vice versa.

5. **Create STEaM project platforms.** Create freely available STEaM-friendly platforms that allow asynchronous, easy-to-use tools for creators to share knowledge and expertise across different sustainability projects.[6] The key idea is to allow artists and field scientists who may operate via diverse time zones and potentially limited Internet connectivity to be able to share ideas and knowledge and work toward sustainability aims. While broad collaborative platforms that might generally solve these problems exist, these may be too generic, without easy-to-use features integrated for STEaM creation, and many STEaM creators lack the resources or training to steer these one-size-fits-all platforms toward successful project environments.

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[6] An activity underway is IEEE P7801[TM] Recommended Practice for Technical Knowledge Commons Initiatives and Platforms**.** Such a platform could also be used to share artistic knowledge, tools etc.

6. **Share ways of knowing; ask powerful questions.** Create public-domain knowledge dissemination and discussion forums where artists and scientists can identify key sustainability challenges and brainstorm important STEaM projects. Such forums must allow virtual, asynchronous, and hybrid participation given the inability of many artists and scientists to cross borders due to funding and visa issues.

7. **Connect traditional wisdom with short-term objectives that leverage and support long-term goals.** Build a common knowledge base of traditional/Indigenous art and cultural practices related to environmental sustainability aims that are measurable in the short term (e.g., how to fish sustainably). Such knowledge, which is usually documented in the long term across historic art, can be made freely available to scientists across the world to learn from practical and ancient wisdom. This knowledge sharing may lead to new scientific engagement regarding some old questions but in ways that are easily measurable and/or implementable in the short term (e.g., how much fishing is too much?). Such practical wisdom can be brought to light and examined through the lens of scientific rigor; then the distilled knowledge can be used for attaining sustainability goals across different spatiotemporal scales.

8. **Use art to communicate science.:** Enable knowledge sharing of scientifically investigated sustainability methodologies using art for effective public education and engagement (e.g., the visually illustrated book on Colombian monkeys and their ecosystems, see Bennet, 2003).

9. **Use science to make art more meaningful.** Artists invested in environmental sustainability can benefit from robust scientific knowledge and STEM collaborators to render their art more meaningful to the needs of modern-area sustainability challenges. For example, an artist knowledgeable on the water cycle and the connectedness of different water bodies (e.g., groundwater and river systems) can make a much more powerful statement on water pollution than can an artist who is not knowledgeable on these things.

10. **Disrupt perceptions that art and science are "too different."** Currently, public perception is that STEM and art are too "opposite" as disciplines to work together. A big part of this perception is how mathematics and science subjects are taught in schools and how children are ranked and separated based on their early ability to perform on time-sensitive tests. Gender-based biases also create artificial social barriers for successful STEaM fulfillment of young minds. While this is slowly changing, much remains to be done. Facilitate and model STEaM educational outreach and training at the elementary and high-school level where young minds can experience art and science through integrated STEaM projects.

Issue 6: Artificial intelligence needs art to confront the multifaceted challenges posed by AI systems' emergence
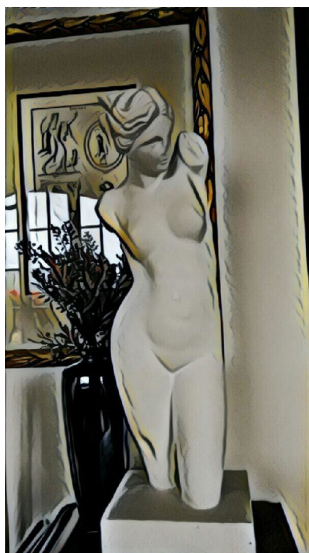
Image: John Favarro

Background

Most citizens have heard by now of *machine learning* and *deep neural networks*. This technology is the basis for the advances making the news in the worldwide press. Unfortunately, this technology is not only invisible (like all software) but also literally *impenetrable*. The reason is that this kind of software iterates in a way it appears to *learn*. Algorithms adapt as they iterate, so that what the software does after a certain point in time is no longer what it did when it was designed and implemented.

That may be acceptable for a program providing programmed recommendations on the nearest restaurant to visit, but this software is also being used in mission-critical systems like self-driving cars and medical diagnostics. In these contexts, it is important to understand what the software is doing. One major challenge now confronting engineers everywhere is how to understand how the software has evolved based on new data in conjunction with programming once in the field. The state of the art dealing with this so-called "explainability problem" is relatively young, with research not universally available via standardized governance or genuine content to end users.[7]

Notwithstanding the issues around explainability, the strides in machine learning are so impressive that the European Union has been concerned for many years about the effect it will have on society—for example, on the future of work. After establishing leadership recently in the protection of privacy with its General Data Protection Regulation, Europe has prepared various legislations concerning the *ethics* of artificial intelligence.

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[7] A key resource as an introduction to transparency, accountability, and personal data issues can be found in IEEE's *Ethically Aligned Design* document, as well as in the IEEE 7000 Standards Series that formally combines applied ethics to systems engineering.

In this regard an independent High-Level Expert Group (HLEG) set up by the European Commission issued a document (EC, updated 2022) in April 2019 titled "Ethics Guidelines for Trustworthy AI." The document immediately positions itself by evoking the concept of "human-centered AI,"[8] and one thread that tends to run throughout the exposition is the idea of *transparency*. As mentioned, machine learning technology produces programs and activities that could be dangerous to use in critical applications (like in self-driving vehicles on highways) because nobody understands what they do or, even more problematic, what they'll do *next*. That is, what will the AI programming instruct if a person suddenly appears in front of the car or, for example, turns off the road into a ditch and risks the safety of the passengers? This issue is not just a technical one but also an *ethical* one—a surprisingly old one, too. More than 50 years ago, the Trolley Problem (Wikipedia, "Trolley Problem") was posed and became essentially the genesis of current efforts to confront ethical problems of decision-making in the context of autonomous vehicles (not just automobiles).

Consider another example of the issue of transparency in AI. Some types of work that in the past could only be performed by humans—intellectual work, not just manual labor—could be carried out by devices equipped with AI, such as customer care robots, automated legal assistants, and robot investment advisors. But not many have considered another aspect: that the use of AI applications might cost somebody their job because it may well be a robot who is interviewing them for that job. Some recruiting tools (Ideal, "AI for Recruiting") handle tasks like reading job applications and deciding which ones deserve further study. It is already a serious matter that an AI application might decide not to give somebody a job because there is some evidence (Metz, 2019) that machine learning programs can absorb biases against underprivileged groups (by the training data they ingest). But it is even worse when the applicant does not even know that it was a robot who did not give them that chance.

This is where the "human-centered" guidelines of the European Commission's expert group become relevant. These guidelines state that humans have a right to know when they are being "processed" by an AI application rather than by a human being. That is, humans have a right to *transparency* (see IEEE SA, IEEE 7001-2021, for recommendations and support on these issues) in the matter of whether AI is involved in any decision-making process related to them. Furthermore, the guidelines admonish people/society to "pay particular attention to situations involving more vulnerable groups such as children, persons with disabilities and others that have historically been disadvantaged or are at risk of exclusion, and to situations which are characterized by asymmetries of power or information, such as between employers and workers."

The European Commission has done something necessary by expanding the scope of oversight beyond the previously narrow boundaries. And this is where art can step in to make a potential contribution: No discipline is more human-centered than art, combining influences from philosophy, ethics, psychology, literature, and other disciplines that are proving to be central to confronting the central challenges to a trustworthy and ethical approach to AI in today's society.

Are artists and engineers currently interacting with respect to AI and its primary challenges? There is good news and bad news in this regard: The bad news is that so far little has been reported in the arts *specifically* on helping machine learning specialists understand their software and to direct it toward ethical behavior (see Clancy & Tweed; for more information on Art and AI, see UNESCO's Recommendation on the Ethics of Artificial Intelligence, adopted by acclamation by 193 Member States at UNESCO's General Conference in November 2021). The good news, however, is that artists are very interested in applying machine learning *within their own profession*. The first step in any potential collaboration is awareness; therefore, this is an important first step.

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[8] Prioritizing human-centered or "human in the loop" control for AI is mirrored in multiple global principles on AI, including IEEE's *Ethically Aligned Design* document whose first principle is human rights with a focus on human well-being and environmental flourishing.

Currently, the artistic community is more interested in applying machine learning to its own creations, but once artists become fluent in the technology, they will be able to start pondering ways to confront the major issues arising around the introduction of AI into the world of today. As a specific example, consider the following two different definitions of *art*:

- Art is manifested in an artifact (a painting, sculpture, musical composition) that makes a deep emotional impression on a person.

- Art involves a person (the artist) attempting to communicate (emotions, ideas) to other people (the viewers, the listeners) through artifacts such as paintings, sculptures, and musical compositions.

Both definitions are in common use today. If the first definition is accepted, then it is valid to consider an artifact (painting, musical composition) generated by AI as art if it stimulates an emotion in the viewer or listener. But if the second definition is accepted, then art must be a human enterprise—it is *communication between humans*. Can there be such a thing as nonhuman art? The engineering community is not equipped to answer this question. The artistic community can help to resolve the question by engaging directly in AI technology. Can artists infuse machine learning programs with their artistic impulses in such a way that it becomes human-to-human communication? No one knows yet, but the artistic community can help find out, and it could have vast implications for creating a truly human-centered AI, expressing human values, which is the goal of the many social initiatives underway today, the so-called "complex adaptive coalitions, where business, government, social entrepreneurs, educators, competing superpowers and moral philosophers all come together to define how we get the best and cushion the worst of A.I."[9] Artificial intelligence needs art to be a part of these coalitions.

Recommendations

1. **Create the space and occasion for AI engineers to engage with the artistic community.** AI engineers should engage with the artistic community. The Artists and Machine Intelligence initiative provides an example: "By supporting this emerging form of artistic collaboration we open our research to new ways of thinking about and working with intelligent systems." In his essay "Art in the Age of Machine Intelligence," Blaise Aguera y Arca makes several interesting observations that are relevant to these ideas. First, he notes, "Art has always existed in a complex, symbiotic and continually evolving relationship with the technological capabilities of a culture." He then discusses the possibilities of neural-like systems to investigate topics as varied as culture, ideas, and "the working of our own minds." He further notes that this "requires that we apply ourselves rigorously and imaginatively across disciplines" and that there is "no shortage of engineers and scientists who are thoughtful and eager to engage with artists and other humanists."

2. **Help the artistic community to learn the fundamentals of AI technologies to be able to interact in a more efficient way with AI professionals.** The artistic community should go beyond mere usage of AI to learn the fundamentals of AI technologies. Much is currently being done to provide education in machine learning to artists. Machine learning software is notoriously difficult to create, but it is also notoriously difficult to use for non-experts. Therefore, there have been efforts to package the intricate algorithms and data structures into something more approachable for artists and musicians

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[9] Thomas Friedman, "Our Promethean Moment," *New York Times*, Opinion, 21 Mar. 2023.

(Wekinator website)[10], and free online classes for musicians and artists (Kadenze, "Machine Learning for Musicians and Artists"[11]). These efforts are especially important for the stated goals: For artists to be able to help people to visualize and externalize the intricacies of machine learning modules, they need to have a basic grasp of the fundamentals of machine learning. Artists should not shy away from machine learning technology, not only as a tool for their own endeavors but also as an object of their own attention, with a view toward assisting AI engineers.

3. **Give incentives to the artistic community to exploit AI technologies for its work.** The artistic community should utilize AI technologies for its work. Machine learning is being used to create many different types of art. The visual arts are well represented so far. Tom White is examining "the ability of neural networks to create abstract representations from collections of real-world objects." Some of the results of his "perception engine" implementations may be found here.[12] A particularly well-known example is stable diffusion, which is used to generate images based on text descriptions. The figure is a photo of a statue that has been enhanced by the Prisma app (Prisma Labs website)[13], which uses machine learning to transfer artistic styles to photos. Much is likewise happening concerning the relationship between machine learning and music, ranging from composition to performance.

[10] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

[11] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

[12] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

[13] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

Issue 7: The need to grow understanding of the effects of climate change in all factions of society—use of art and digital technologies to make these concepts more accessible

Background

"Climate Change is the defining issue of our time and we are at a defining moment," reads the issue page of the United Nations (UN, "Global Issues: Climate Change"). The article goes on to point out how human impacts have affected the climate. In short, "human influence" is warming the atmosphere, increasing weather and climate extremes, and putting natural ecosystems at risk. The problem is that this large-scale issue can be difficult for many people to grasp. It can be hard to imagine what a future impacted by climate change may look or feel like. Therefore, people may be less willing to engage with the issue when they have many other pressing demands on their daily lives. With this in mind, employing creative methods in the arts, including using digital means, can offer people a way to more readily experience the issue. Using digital art forms might allow for more people to engage with climate change in a way that can make it feel less amorphous and more real.

A variety of digital art forms may be used to invite people into conversations and experiences that shift understanding, perceptions, and feelings about climate change, ultimately propelling people to take positive actions as a result. This opportunity invests in digital forms of artistic expression as a means to help the public to better imagine how changes in the climate might affect humans, all life, the entire planetary biosphere.

For example, the arts may be used in virtual realities to experience the effects of climate change. As one example, climate researcher Juliano Calil (Rott, 2019) through his "Fleming Park Project" invited people to experiment with a future affected by climate change by taking part in a virtual reality (VR) experiment. The participants could experience their community as if it was "underwater" and as if the effects of climate change were real. As climate change "presents many challenges to coastal communities and to those trying to prepare for its impacts, How do you show people—and convince them—of a possible future?" (Rott, 2019) VR technology and the creation of a virtual reality that helps to perceive the consequences of climate change can help to do that.

Visualization in general is a powerful tool. The Icelandic artist Ruri has created maps on the change of sea level in coastal areas in collaboration with geographer Gunnlaugur M. Einarsson. In his work "Future Cartography X" (Rúrí, 2012), global warming is shown to result in progressive reduction of some of the Earth's coastlines, following the drastic rise of sea levels. The gradual decline of the topographical zero line is based on the observation of sea levels at the time of the initial mapping of the terrain.

New combinations of arts and technical possibilities may be explored to make climate change tangible. As one example, artists can use sound recordings to help articulate how the planet is changing. Consider the work of the researcher Grant Dean, which was recently featured in a New York Times article about the "music of ice" creating recordings of melting glacial ice. These recordings are used in installations, which serve both as an artistic experience but also help people to hear the effects of a warming climate. In this way, the use of technology and artistic expression invites a new way of accessing information about the changes happening in a particular area that might otherwise feel invisible to those who do not have access to visit or see these effects in person (Currin, 2023). The recordings are considered "beautiful, but there's a slow violence to the

sounds, too." Also: "The sounds are political statements that are not available to our ears unless they're recorded. They create space for empathy" (Currin, 2023).

Recommendations

1. **Promote and enable cooperation between scientists and digital artists.** Scientists should cooperate with digital artists to make scientific data more accessible to the public. One paper (Sommer & Klöckner, 2021) suggests that "climate change art is capable of changing people's opinions, as long as the message is hopeful, and gives people ideas for change" (Amsen, 2019)

2. **Use techniques of visualization and sound design to make evident and perceivable effects of climate change.**

Issue 8: Define "climate art" as a new language of aesthetics to create new ideas for articulating climate concerns to provoke action

Background

Contemporary art and classic art approach the theme of climate change and sustainability in different ways, reflecting the changing attitudes and concerns of society over time. One significant difference between modern and classic art is the focus on science and technology. Contemporary art tends to be more scientific and technologically oriented, reflecting advances in science and technology and their impact on the environment. Artists are using new materials, techniques, and technologies to create works that address climate change, such as pieces that incorporate digital media, electronic sensors, or living materials.

Many contemporary artworks are interactive, immersive, and experiential, inviting the viewer to participate and engage with the work. Some artworks even require the viewer's participation to be completed, such as works that rely on sensors or other forms of audience interaction. Classic art, on the other hand, was typically viewed as a static object to be admired and appreciated from a distance.

In contemporary art, climate change has become increasingly prominent with many artists using their work to explore and raise awareness about the environmental challenges societies and ecosystems face. In general, climate change is being addressed by a wide range of artists across many different disciplines. While there are too many to list, several well-known artists have devoted their work to the topic and continue to use their art as a means of raising awareness and inspiring action.

With the creation of awareness about the catastrophic development toward an end-time scenario, actionist art forms clearly gain priority over more static forms of representation. This priority is realized in the form of performances or media productions, such as film productions, which are the most popular form with the greatest reach for triggering actionism.

Recommendations

1. **Promote funding programs and large cross-border—possibly global—initiatives to enable art with relation to environmental issues and awareness raising.**

2. **Promote and enable art that explicitly addresses the issues of environmental disasters, climate damage, and the accumulation and use of waste products for art performances.**

3. **Promote visits to art exhibitions and artistic performances devoted to subjects of climate change and strong sustainability.**

4. **Adopt cinema films about climate catastrophe in public TV programs.**

5. **Organize visits to buildings made of new sustainable materials that serve as templates of advanced architecture.**

6. **Initiate cross-disciplinary and trans-disciplinary workshops between citizens, architects, construction enterprises, and artists.**

7. **Call for competitions in photographic documentation of using new sustainable materials in architecture and art (e.g., with sculptures)—materials causing no or minimal environmental impact.**

Further resources

1. Acute Art. "Marina Abramovic."

2. Chasing Ice (website).

3. Eating Our Way to Extinction (website).

4. Edward Burtynsky. "The Anthropocene Project."

5. Harvey, Fiona. "Margaret Atwood: Women Will Bear Brunt of Dystopian Climate Future." *The Guardian*, 31 May 2018.

6. Subhankar Banerjee (website).

7. Wikipedia, s. v. "2040 (film)." Last modified 28 Apr. 2023.

8. Wikipedia, s. v. "Before the Flood." Last updated 14 Mar. 2023.

9. Wikipedia, s. v. "Burning (2021 film)." Last modified 17 Feb. 2023.

10. Wikipedia, s. v. "David Attenborough: A Life on Our Planet." Last updated 24 Mar. 2023.

11. Wikipedia, s. v. "The Day the Earth Stood Still." Last modified 17 Apr. 2023.

12. Wikipedia, s. v. "Don't Look Up." Last modified 6 May 2023.

13. Wikipedia, s. v. "The Drowned World." Last modified 22 Oct. 2022.

14. Wikipedia, s. v. "The Great Derangement: Climate Change and the Unthinkable." Last modified 17 Apr. 2023.

15. Wikipedia, s. v. "An Inconvenient Truth." Last modified 3 May 2023.

16. Wikipedia, s. v. "Princess Mononoke." Last modified 4 May 2023.

Issue 9: The need for waste and waste management as a space for innovation and change of attitude toward waste

Background

Contemporary lifestyles generate a lot of waste. Therefore, how to turn today's living/societies into a more sustainable direction, that is, lifestyles that generate no or very little waste, is one of the big (environmental) issues of the current time.

Currently, a movement is emerging to revitalize communities through contemporary art that focuses the attention specifically on waste. Communities, citizens, artists, and various organizations are collaborating to create artworks and art interventions in the local environment by using waste as materials or by interacting with the waste management system. In fact, environmental art can be seen as a movement to enable art in local surroundings. Environmental artworks can include elements such as sound, light, color, and different kinds of everyday objects, and the audience's actions can be material for the artworks, as well as provide a space for innovative thinking.

For example, American artist John Sabraw combines art and science in his creative work. He works with scientists and environmentalists to extract toxic acid mine drainage from polluted rivers and then to process it into pigments to create beautiful paintings. Profits from his artwork also help to restore the environment of the river, making his work a recycling-oriented art form (Sabraw website; Sabraw, 2017).

Another example from Japanese art is the aim of creating new value through craftsmanship by using discarded or unused parts, tools, and scrap materials from manufacturing processes. For instance, an ultralight backpack is made by taking unused airbags from a decommissioned car body and reusing them as fabric (Pehrson, 2021).

The management of waste requires infrastructure and technological innovation. How to manage this in a sustainable way is also a challenge for all communities. Amager Bakke in Copenhagen, Denmark, is a combined heat and power waste-to-energy plant from the previous generation. It combines several interesting aspects: Besides being a power and waste incinerator, it is also a recreational facility for dry skiing, hiking, and wall climbing and an example of exceptional contemporary architecture. The plant[14] has received several design and architecture awards for the aesthetics of the building. The incinerator opened its doors in 2017, aiding the city of Copenhagen in its aim to become carbon neutral by 2025, and has since then become a strong symbol of the city and part of the local identity of the people.

Recommendations

1. **Visualize the waste materials in the city/community (e.g., material flow diagram).**
2. **Host an upcycle idea workshop with artists, craftsmen, engineers, citizens, experts on the circular economy, and more.**

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3. **Prototype some of the ideas from integrated upcycle workshops and promote them through websites or exhibitions.**

4. **Create an upcycle matching platform consisting of artists, waste materials, technologies, and companies.**

5. **Connect and combine different needs into one solution.** For example, reusing some parts from a device at the end of its current use and processing other parts for feedstock for different applications; the needs in this case would be handling of waste and the need for resources, such as parts for different devices and materials for new devices and/or processes, that could include materials for art.

Further resources

1. Kastner, Jeffrey, ed., and Brian Wallis, survey. *Land and Environmental Art*. London: Phaidon Press, 2005.

Issue 10: The need to invent new sustainable materials through artistic practices

Background

The authors of "The Jena Declaration" (TJD) proclaim that they:

> Call upon all relevant political and scientific institutions, including funding agencies, to use the UN "Decade of Action "as a time to ensure that the cultural dimension is at the core of sustainability programs. This also includes the need to "integrate the arts", as well as findings from the humanities and social sciences into the co-design of future, culturally and regionally diverse "ways of living sustainably." (The Club of Rome, 2021)

The speaker of TJD, Benno Werlen, claims that a "new aesthetics" in its materialization must be discovered and applied to express the concerns of strong sustainability. The question of what this new language in art is (i.e., what new forms of expression could be) can be answered in one dimension with regard to the material used for artistic expressions: Artists and designers are experimenting with a wide range of new and unconventional materials to create works that address aspects of climate change.

These materials include the following

- *Recycled materials*: Many artists are using materials that would otherwise end up in the landfill, such as recycled plastics, paper, and textiles.

- *Natural materials*: Some artists are using natural materials that are sustainable and renewable, such as bamboo, wood, clay, or natural stones.

- *Alternative plastics*: Several new types of plastics are made from renewable resources or are biodegradable, such as polylactic acid (PLA) and polyhydroxyalkanoates (PHAs).

- *Electronic waste*: Some artists are using electronic waste, such as discarded computer parts and circuit boards, to create new works.

- *Air pollution*: A few artists are using air pollution as a material for their art. For example, Anirudh Sharma has created a device that captures carbon soot from diesel generators and turns it into ink.

- *Living materials*: Some artists are experimenting with living materials, such as mycelium (the root-like structure of mushrooms) and algae, to create works that have a low impact on the environment. Examples of this choice for an artistic medium selection is argued in articles like that from Amanda Boetzkes (Boetzkes, 2021) on the aesthetics of plastic capitalism or in exhibition projects like "Reflecting Oil" from the Austrian artist Erich Logar (Expo 2020 Press release, 2021), which is a laboratory performance project using crude oil. These two examples are just a small sample of the hundreds more like them.

Architecture, as the artistic discipline in which the question of the materials to be used plays the most relevant role in translating design into concrete construction, is unquestionably of the greatest importance with regard to the selection of building materials.

In the effort to reduce the carbon footprint of architecture and make buildings more sustainable, architects and designers are increasingly turning to new materials and construction techniques that are more environmentally friendly. Here are some materials recommended for sustainable architecture, as well as some to avoid.

Recommended materials (Sample List)

- **Wood**: Wood is a renewable resource that can be used for construction, and it has a lower carbon footprint than many other building materials. It also has natural insulating properties, which can help reduce energy consumption.

- **Bamboo**: Like wood, bamboo is a renewable resource that can be grown and harvested quickly. It is also lightweight and durable with a high strength-to- weight ratio.

- **Rammed earth**: Rammed earth construction involves compressing soil and other natural materials to create sturdy, durable walls. It is a low-energy, low-carbon construction method that can also provide natural insulation.

- **Recycled materials**: Using recycled materials such as reclaimed wood, glass, and steel can help reduce the environmental impact of construction by reducing waste and minimizing the need for new resource extraction.

Materials to avoid (Sample List)

- **Concrete**: The production of concrete is a significant source of carbon emissions, and its manufacture and transportation require large amounts of energy. While it can be made more sustainable with the use of recycled materials and alternative cement mixtures, it should be used judiciously.

- **Steel:** Steel production is also a significant source of carbon emissions, and its high embodied energy means that it has a large environmental impact. Again, steel can be made more sustainable with the use of recycled materials and alternative production methods.

- **PVC**: PVC, or polyvinyl chloride, is a widely used plastic that has a large carbon footprint due to its production and disposal. Its use in construction should be minimized in favor of more environmentally friendly materials.

- **Foam insulation:** Many types of foam insulation, while effective at reducing energy consumption, can release harmful chemicals and have a high embodied energy. Alternative natural insulation materials like wool, cellulose, or straw bale should be considered instead.

In general, the use of locally sourced and renewable materials, along with alternative construction techniques and the reduction of waste and energy consumption, can help make architecture more sustainable and better adapted to climate conditions.

Recommendations

1. **Promote art exhibitions that explicitly address the issues of environmental disasters, climate damage, and the accumulation and use of waste products for art performances.**

2. **Call for art productions preferring new sustainable materials in art and in art-producing processes.**

3. **Request exhibitions with an explicit mission of expressions demonstrating and using sustainable materials.**

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4. **Create architectural competitions making prescriptions on the construction material to be used.**

5. **Fund programs for artists and art schools with a mission to address the climate catastrophe and search for and use renewable materials.**

6. **Offer art workshops in schools to teach children how to make "art" from waste materials.**

7. **Use locally sourced and renewable materials, along with alternative construction techniques emphasizing low impact, maintainability, longevity, and circularity of the "product."**

Further resources

1. ArchDaily Team. "Which Building Construction Materials Are Ecological?" *ArchDaily*, 14 June 2022.

2. Art in Context. "Recycled Art—Exploring Impressive Art Made from Recycled Materials."

3. Dücker, Maxime. "13 Incredible Artivists Using Recycled Materials in Their Art." *Causeartist*.

4. Friedman, Vitaly. "40 Terrific Works of Art Made from Common Trash." *JotForm* (blog), 25 Jan. 2023.

5. Shrink That Footprint Staff Writer. "7 Eco Friendly Art Supplies to Sustain the Environment."

Issue 11: Need to increase the dialogue between artists, policymakers, and the public to use art as a platform for environmental activism

Background

Artists, through their work, have the potential to act as powerful motivators for politicians to take up concerns on climate change. Art has the ability to reach people on an emotional level and therefore can contribute to raising awareness and to mobilizing action on climate issues.

Artists have various means and ways to use their influence. Throughout history, artistic activism has been used to raise public awareness and to apply pressure on politicians to take up the concerns expressed by artists. Artists can also facilitate forward discourse and through artistic practices provide a platform for dialogue to connect artists with the policymakers and the public in a meaningful setting. Artistic actions can, therefore, contribute in a significant way to the decision-making process.

The following examples demonstrate how artistic activist actions by artists could stimulate politicians to make decisions on climate change:

- The Climate Clock created by the artists Gan Golan and Andrew Boyd, a public art installation that displays a countdown of the time remaining before the world reaches a critical tipping point (Climate Clock website.

- The Divestment Movement (Rapier, 2022), which calls on institutions such as universities, religious organizations, and pension funds to divest from fossil fuels, has been driven in part by creative activism. For example, in 2015, a group of artists and activists staged a "die-in" at the Louvre Museum in Paris to protest the museum's ties to the oil and gas industry. Since then, the movement has grown significantly, with institutions representing trillions of dollars in assets divesting from fossil fuels.

- Danish-Icelandic artist Olafur Eliasson's large-scale installations that explore issues related to climate change, such as "Ice Watch" in Paris, which featured 12 large ice blocks taken from the Greenland ice sheet arranged in a clock formation to symbolize the urgency of addressing climate change.

- The Artivist Collective (The Artivist Foundation website), a group of artists and activists using art as a tool for social and environmental justice. Their work includes public installations, murals, and performance art pieces that highlight issues related to climate change and environmental degradation.

- The Yes Men, a group of artists and activists using satire and performance art to draw attention to social and environmental issues also on climate change. They have created high-profile pranks and hoaxes, including posing as representatives of the US Chamber of Commerce and ExxonMobil to highlight their opposition to climate action.

- American artist Mel Chin creates works that address climate change. His most well-known project, "Revival Field," involves using plants to remove heavy metals from polluted soil, demonstrating the potential of how natural systems can address environmental problems.

As for institutions, art and culture are connected to environmental policies on several levels. Since international policies play a significant role in the shared issue of the climate crisis, the role of cultural relations and diplomacy cannot be underestimated. Many governments use cultural diplomacy to promote their environmental policies and to build relations between civil society and cultural actors. For example, the German Federal Foreign Office has a program called *Kultur und Klima* ("Culture and Climate") that promotes cultural exchange and collaboration on environmental issues (Blumenreich, 2022).

One prominent political personality who has promoted interventions from the art community to inform about their environmental policies is Alexandria Ocasio-Cortez[15]. The US representative has collaborated with artists and designers to create graphics, posters, and social media campaigns to promote her "Green New Deal" proposal. She has also highlighted the role of art in advancing climate justice, stating, "[A]rt has a critical role to play in shaping our political and social realities." Another politician is Elizabeth May, the former leader of Canada's Green Party, who is known for her advocacy of the arts in environmental policy-making. She has worked with artists and cultural organizations to promote environmental issues and has emphasized the importance of using creative methods to communicate complex environmental problems to the public.

The potential between arts and policymakers is not only on the level of advocacy but also in the creation of new forms of dialogues and how to integrate art into the decision-making process as one resource and tool to create new knowledge. As one example, the Committee for the Future in the Finnish Parliament has been working together with artists to reach new visions related to the future of Finnish society (Riksdage, 2022). In these processes, the Committee for the Future combined working groups of scientists, experts, and artists to enable a multidisciplinary approach for a deeper level of understanding of the use of art for the members of the Parliament. New cross-disciplinary methodologies on the highest levels of decision-making should be explored to support decision makers' abilities to tackle issues of a complex nature, such as the climate crisis (Ståhle, 2007).

Recommendations

1. **Launch and support platforms for dialogue between artists, policymakers, and the public.**

2. **Fund and support joint art projects between artists and citizens with intentions to engage the policy-making level.**

3. **Integrate art and artistic expertise into all levels of policy- and decision-making.**

4. **Motivate policymakers to include art and art action to stimulate ideas for their lawmaking and regulation making processes.**

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[15] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. This example is provided to demonstrate how any politician or policy member can utilize art and does not represent an explicit or implicit political endorsement from IEEE.

Issue 12: The need to connect arts to the SDGs—use arts to generate the narrative

Background

Artists are always asking questions of themselves and others, connecting themselves to the world, interacting with it, and expressing themselves to encourage people to have a positive view of themselves.

Art activities are defined as a series of activities from the birth of an idea to its expression and delivery to people. Such activities have a sense of "surprise," "playfulness," and "excitement" that open people's hearts and minds, and they create opportunities to melt away divisions and differences with others, transform values, and become a force for the regeneration of loose connections.

In contrast to the objective and analytical approach of science, the subjective and integrative approach of art is capable of moving people's hearts and creating behavioral change.

Artists, who have the power to find what is buried or unnoticed in the world, can also bring value and potential to the surface of society and can create opportunities to discover and solve social issues. For example, UNESCO asks, "How can culture help fill implementation gaps in the achievement of the 17 SDGs?" Some approaches for the IEEE Planet Positive 2030 Initiative could be implemented by considering the value of art to the SDG agendas.

- For SDG 3 "Good Health and Well-Being," art's value is in building a community through arts-based activities, arts festivals, and so on. One possible approach is to form a foundation for community behavioral change for climate action by strengthening social relational capital. For example, The Setouchi Triennale (Japan) is a grand regional revitalization project under the theme of "Restoration of the Sea." With the help of contemporary art, the Triennale uses islands that have been forgotten amid modernization as its stage, with the hope that the island's older persons will smile, and that the Inland Sea can become the "Sea of Hope" for all regions on Earth.

- For SDG 4 "Quality Education," art's value is to foster emotion and sensitivity through arts appreciation education, arts communication, and so on. Therefore, one possible approach is to nurture a sense of awe of nature and empathy for the Earth. For example, many picture books and videos for children clearly illustrate how humans are blessed by the bounty of nature. Museums also play important roles to support and provide learning opportunities in support of the SDGs.

- For SDG 8 "Decent Work and Economic Growth," art's value is to improve productivity through well-being and creative workspaces. Therefore, one possible approach is to reduce energy consumption by economic activities. For example, today's innovation centers and other facilities are designed to enhance creativity and productivity, with art, background music, sophisticated employee cafeterias, and other devices to appeal to and possibly improve the five senses.

- For SDG 9 "Industry, Innovation, and Infrastructure," art's value is to combine different elements through inclusive and holistic thinking. Therefore, one possible approach is to apply science and technology to the green industry by supporting artistic creativity and expertise. For example, an off-grid hotel is independent of existing electricity, gas, water, and other infrastructure and is self-sufficient in energy and water through the power of nature. Energy generated by solar panels is stored in storage batteries, and water is filtered and sterilized from rainwater collected from the roof for domestic use.

- For SDG 11 "Sustainable Cities and Communities," art's value is to preserve nature and culture through preserving cultural heritage. Therefore, one possible approach is that preserving cultural heritage will help protect nature and make the city more sustainable. For example, once registered as a World Heritage site, it is necessary to pass on to the future not only the heritage sites themselves but also the rich natural environment and the livelihoods and beliefs of the people who live there.

- For SDG 12 "Responsible Consumption and Production," art's value is to foster craftsmanship through local traditional arts and culture. Therefore, one possible approach is to manufacture and reuse/recycle with biodegradable materials and non-artificial components. Culture, particularly traditional knowledge systems and environmental management practices of Indigenous and local peoples, provides insights that enable better management of ecological challenges, preventing biodiversity loss, reducing land degradation, and mitigating the effects of climate change. For example, waste food materials such as food peels and cores are formed into tableware using proprietary technology. After use, the tableware is collected, crushed, and dried at the plant before being processed into feed, fertilizer, and so on.

- For SDG 13 "Climate Action," SDG 14 "Life Below Water," and SDG 15 "Life on Land," art's value is to raise questions through socially engaged arts practices, art and science collaborations, and so on. Therefore, one possible approach is to provide an opportunity to think about what each person can do as a personal matter. For example, at the botanical park, after viewing vegetation from around the world, a large screen shows images of Earth if climate change cannot be improved at this rate, and questions are posted on the pathway leading to the exit.

- For SDG 17 "Partnerships," art's value is to draw a desirable vision through vision design, communication design, and so on. Therefore, one possible approach is to create and communicate a vision that people can sympathize with. For example, a research institute draws a picture of lifestyles in the bio economy era and tries to promote changes in social systems.

SDGs	Arts' value	Example of arts' activities	Approaches
Goal 3: Good Health and Well-Being	Building a community	Arts club activities, Arts festival, clowns working in hospitals, art in mental health therapies, etc.	Formation of a foundation for community behavioral change for climate action by strengthening social relational capital
Goal 4: Quality Education	Fostering emotion and sensitivity	Arts appreciation education, Arts communication, etc.	Nurture a sense of awe of nature and empathy for Earth
Goal 8: Decent Work and Economic Growth	Improving productivity	Well-being and creative workspaces, etc.	High productivity can reduce energy consumption from economic activities
Goal 9: Industry, Innovation, and Infrastructure	Combining different elements	Inclusive and holistic thinking, artistic expertise included in industries and development of innovations, etc.	Apply science and technology to green industry by creativity
Goal 11: Sustainable Cities and Communities	Preserving nature and culture	Preserving cultural heritage, etc.	Preserving cultural heritage will help protect nature and make the city more sustainable
Goal 12: Responsible Consumption and Production	Fostering craftsmanship	Local traditional arts and culture in circular economy developments, etc.	Manufacture and reuse/recycle with biodegradable materials and non-artificial components
Goal 13: Climate Action	Asking questions	Social art, museum pedagogy, and artworks of climate change for raising awareness, etc.	Provide an opportunity to think about what each person can do as a personal matter
Goal 17: Partnerships for the Goals	Drawing a desirable vision	Vision design, communication design, new cross-disciplinary collaborations with artists and other sectors, etc.	Create and communicate a vision that people can sympathize with

Table 1. SDGs and Art.
(*Credit: Hironobu Mirata*)

Recommendations

1. **Dedicate time to reflect on how art interventions can be integrated into the various areas of SDGs.**

2. **Promote, invest, and enable projects that interact with art to achieve the SDGs.**

3. **Calculate social return on art investment such as carbon reduction effects of art activities.**

4. **Organize conferences, workshops, and competitions focused on best achieving as many of the SDGs as possible.**

5. **Build contacts with finance investors using the SDG criteria for their investments (e.g., UNGSII).**

Further resources

1. Art Setouchi (website).

2. Gardens by the Bay. "Cloud Forest."

3. Manninen, Jussi, Riitta Nieminen-Sundell, and Kaisa Belloni, eds. *People in the Bioeconomy 204*4. VTT Visions 4. Finland: VTT, 2014.

4. Northern Dimension. "NDI Policy Brief 18: Culture Must Be Recognized As a Driver of Sustainable Development."

5. UNESCO World Heritage Convention (website).

Issue 13: The need to choose a problem solving approach to reach sustainability—the Bauhaus design and policy approach to reach sustainability

Background

Art as a form of self-expression uses various media, such as paintings, sculpture, photography, performances, and new media, to communicate ideas, emotions, and experiences. The primary focus of art is to create something aesthetically challenging, emotionally resonant, and thought provoking. Art is often not necessarily bound by any functional or commercial considerations.

Design, in contrast, is the process of creating functional and aesthetically pleasing objects, systems, and environments. Design often involves problem-solving and creating solutions that meet specific needs and requirements. The primary focus of design is to create something useful that meets specific needs, while being visually pleasing. Design can contribute to achieving climate goals by creating sustainable products, buildings, systems, and solutions that reduce greenhouse gasses. Art and design are related but distinct fields that have different goals and applications.

Art is a form of self-expression focused on creating aesthetically challenging and emotionally resonant works, while design is a problem-solving process focused on creating functional and aesthetically pleasing objects, systems, and environments that meet specific needs.

The concept of seeing the contribution arts play in the interplay of a Gesamtkunstwerk ("Holistic Artwork") is an approach that was successfully realized in art and design production in the West during the World War I era through the Bauhaus (Dezeen Magazine) philosophy, which has been revived by the European Union (EU) to inform its current cultural framework strategy. The *New European Bauhaus* (NEB) initiative summarizes the concepts of the so-called "European Green Deal" in an overall aesthetic image (EU, "New European Bauhaus").

Photo credit: Günter Koch

Global influence through a reform art movement in Germany in reaction to World War I

The Bauhaus was an art school founded in 1919 in Germany that is still relevant today in many ways, particularly in terms of its approach to the relationship between art, design, and society. The school's focus on combining form and function and its emphasis on practical design solutions for everyday life has had a lasting impact on modern art and design.

In relation to climate change, the Bauhaus approach of using design to address social and environmental issues has inspired many contemporary artists and designers to find sustainable solutions to the world's problems. The school's focus on using new materials and technologies to create functional, sustainable designs has influenced the use of eco-friendly materials and innovative design solutions in contemporary art.

The Bauhaus approach to collaboration and interdisciplinary work is relevant in today's art perception on climate change. The school brought together artists, designers, architects, and engineers to work collaboratively on projects, and this interdisciplinary approach has inspired many other contemporary artists and designers to work across disciplines to address environmental issues.

Finally, the Bauhaus approach to education, which emphasized learning through experimentation and practical experience, has inspired a generation of contemporary artists and designers to find innovative ways to address climate change.

The school's focus on problem-solving, creativity, and innovation has had a lasting impact on art education and continues to inspire artists and designers to find sustainable solutions to the world's problems. The ability to bring together many artists across many cultures is converging these days into an international cultural program of the EU. The NEB adds a cultural and creative dimension to the European Green Deal to

show how sustainable innovations can provide tangible and positive experiences to be implemented in everyday lives.
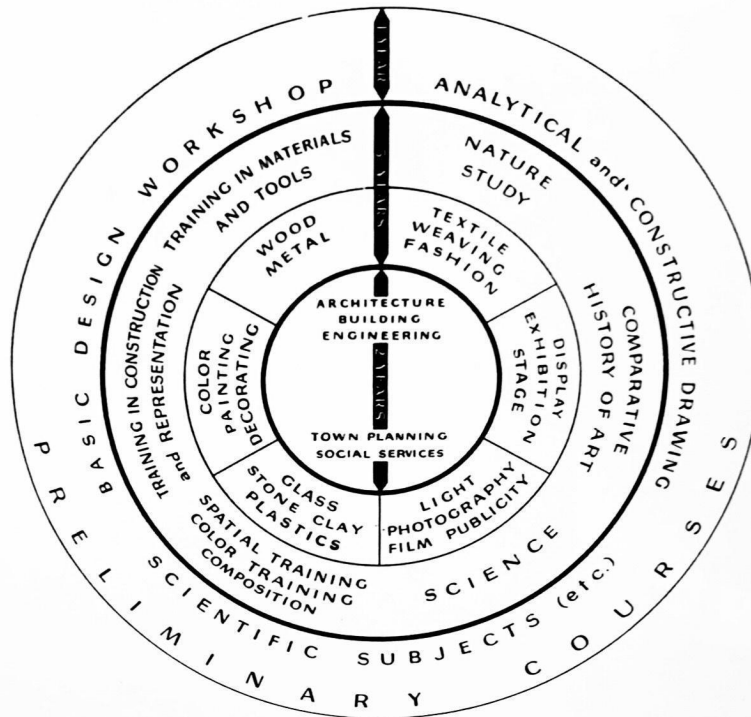
Bauhaus School

The NEB combines the grand vision of the European Green Deal with concrete changes on the ground—changes that will improve people's daily lives, changes they can experience in a tangible way in buildings, in public spaces, and in the form of fashion or furniture. The NEB aims to create a new lifestyle that balances sustainability with good design, uses less carbon, and is inclusive and affordable for all.

The NEB started in the early 2020s and has been and will be included in many existing EU programs to support the achievement of the SDGs as a contextual element or priority without a dedicated budget.

The funds to be made available for implementation are provided by various EU programs. In addition, the European Commission encourages EU member states to apply the core values of the NEB in their national territorial and socioeconomic development strategies and to use the relevant parts of their building and resilience plans and cohesion policy programs to build a better future while achieving strong sustainability goals for all.

The framework concept of the NEB provides a key motivational movement to mobilize civil society (while still being a political project) to take up art and design as instrumental to achieving the climate goals in the form of collaborative projects.

Recommendations

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1. **Foster research and identify funding opportunities within the New European (NEB) program and its successor on European, national, and global levels, where global applications of NEB would be implemented via cultural sensibilities and adaptations to non-European regions.**

2. **Participate in public art projects oriented by an objective of the European sustainability strategy framed by the European Green Deal, many of them installed in decentralized places, especially in European countries.**

3. **Communicate stories about Bauhaus's influence beyond Germany and Europe (e.g., in East Asia).**

4. **Organize visiting tours to the "consecration sites" of Bauhaus in Weimar, Dessau, and Berlin (Gropius Center).**

Further resources

1. Dezeen Magazine.

2. European Union. "New European Bauhaus." Beautiful, Sustainable, Together.

3. Wikipedia, s. v. "Bauhaus." Last modified 30 Apr. 2023.

Issue 14: The need to create empathy toward the environment—artistic listening exercises

Background

Among the issues involved in developing empathy for the environment, foremost is that of developing sensitivity toward the world, natural or not. One way to develop this sensitivity in a sensory way is to address the sounds heard on a soundwalk.

In 1969, the composer Murray Schafer (Schafer, 1969) proposed the practice of walking around a city and paying attention to the sounds nearby: both those produced by cars or human beings in general and those produced by the atmosphere, such as by the wind or by birds and other nonhuman beings.

His purpose was to draw attention to noise pollution (i.e., the physical and psychological effects produced by continuous exposure to sounds and noises beyond a certain tolerance threshold).

Schafer called this sound world in which humanity is immersed "soundscape." Thus, through the World Soundscape Project at the Simon Fraser University in Vancouver (Canada), he initiated both the analytical study of soundscapes and the possibility of specifically creating new soundscapes and, therefore, the formation of the so-called musical genre of soundscape music.

Many years have passed since the proposal of these concepts, but the practice of developing a sensitivity toward the soundscape by choosing a specific path and then crossing it on foot in silence, to which the musician Hildegard Westerkamp has given the name of "soundwalk" (Westerkamp, 2006) has not been developed and disseminated adequately. For this reason, new life should be given to this practice to increase public interest in environmental issues.

Recommendations

1. **Develop the criteria for building a soundwalk as an art form to create better understanding of the environment**

2. **Maintain the didactic aspect of sensitivity training, practicing soundwalks in schools of all levels.**

3. **Underline the ecosystem nature of the soundscape, even in the contrast: human and nonhuman.**

4. **Extend the idea of soundscape also to sound environments that are prevented by the mere presence of humans (birds or insects that stop producing sound if a human being is present) or that are not normally perceptible due to the limits of their hearing system.**

5. **Bring the soundwalk also to formats linked to digital (podcast, streaming) or analog (radio) distribution.**

Case study

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For the use of the soundwalk as a tool for developing environmental awareness in city design in different places such as Berlin, London, and other cities, see Radicchi, A. and others, 2021, "Sound and the healthy city" in *Cities & Health* 5, no.1-2: 1-13.

Further resources

1. Schafer, R. Murray. *The Soundscape: Our Sonic Environment and the Tuning of the World*. Rochester, VT: Destiny Books, 1993.

2. Truax, Barry. *Acoustic Communication*. New York: Ablex Publishing, 1984.

Issue 15: Reconnecting with nature is essential for humans to devise integrated strategies to meet climate change challenges—tapping into inner knowing and guidance

Background

The climate crisis poses unprecedented challenges, and humans can neither solely rely on past experiences nor on science-based knowledge and technology to solve it. Saving the planet requires adaptation of lifestyles and behaviors, as well as training human capabilities, such as empathy and awareness, so that humanity can tap into its inner knowing and guidance, which will help people to respect nature and maintain their human dignity.

Especially in Western societies, many people hardly use their senses and "antennas" anymore as they rely increasingly on technology to provide data and information. People have lost touch with nature and have disconnected from their spiritual selves (Schuring, 2019). Many do not know their purpose in this world, which is connected to living a meaningful and joyful life. While technology, for example, AI, offers us many escapes, it may also make people lazy when it comes to human capability cultivation (Merl, 2022). From an ethical point of view, it seems like human dignity could be soon lost.

Most human beings are convinced that technologies can further improve life in many ways. Accordingly, a strong focus has been placed on technological advancements, which has resulted in tech-focused policies, funding programs, educational curricula, and mindsets. And so, while the world has become a global village and while humans have started to outsource production processes, monitoring, and decision-making processes to algorithms, people have often forgotten about the benefits and wisdom of local, place-based, Indigenous knowledge—inner knowing and guidance that has helped to cultivate human life throughout history while respecting natural forces and the rights of nature (GARN, "What are the Rights of Nature?").

Indigenous knowledge, local or place-based knowledge, can help humanity reconnect with human capabilities and develop the power of inner knowing and guidance while re-learning how to work with the energies and other life forms in the world. The cultivation of inner knowing and guidance can lead to a much-needed change in mindset and ultimately to a change of behavior and lifestyle. However, it takes the willpower, the insight, and most importantly, the daily practice to make these changes. Institutionalizing awareness-building and future skills training based on Indigenous knowledge can help here.

Indigenous Cultures and Mindset: According to many Indigenous cultures, thinking is reflected in speech, and words are reflected in actions: Humans think, talk, and act. Thus, according to these Indigenous approaches, the thinking does not only come from the mind but also is a cooperation between the heart and the mind. Indigenous knowledge is also often referred to as "inner knowing" or "inner guidance": the ability to look at and within oneself with awareness, and to relate this inner view to the outer world. Life is a cyclic process where everything is connected with each other; reciprocity is an important aspect as "you harvest what you sow."

The Western approach, on the contrary, is seen by many as being driven by capitalism and consumption and puts emphasis on the here and now, following a straight linear timeline with a certain goal to be reached. Indigenous cultures respect their ancestors and the generations that follow and see themselves as part of the eternal circle of life. Human beings are part of the bigger picture; they are part of nature and not superior to

nature. Indigenous peoples know that they can always rely on Mother Earth, and so they treat nature with respect. Treating nature with respect includes not exploiting nature. To save the planet, humans need to stop seeing aspects of nature as natural resources but as fellow beings. In this line of thinking, it is not about short-term self-optimization but about connecting with the self and perceiving ourselves as part of nature in the long run.

Recommendations

1. **Institutionalize human capability cultivation with nature and art-inspired coaching methodologies.**
    a. Provide more funding and research programs that focus on embodiment and art-inspired coaching.
    b. Include embodiment and meditation practices in educational curricula and organizational training.

2. **Push behavioral change by means of embodiment practices, such as meditation, qigong, yoga, and poetry reading.** These practices will help develop human senses regarding nature and individual spirit.

3. **Stop making use of meditation, qigong, or yoga solely for the purpose of self-optimization, but bring this into the perception of the whole picture.** Kindness to ourselves will lead to kindness toward others, not only toward human beings but toward all beings.

4. **Design and institutionalize culturally grounded and socially relevant rituals or ceremonies. They** are Indigenous ways to go with the cycles of life, to bring matter and spirit together in a communicative way. Educational programs can help form an intent in humanity's heart and mind that is of service to the self and the surrounding world.

Further resources

1. Schuring, Hermine. *A Life in Service: Stories & Teachings from Mala Spotted Eagle*. BookBaby, 2019.

    The book *A Life in Service* contains the wisdom and Indigenous knowledge passed on by Mala Spotted Eagle to Hermine Schuring. Mala shared the knowledge of Indigenous elders and his life experiences with Hermine, putting the focus on the importance to walk in balance on Mother Earth. Pollution in our minds creates pollution everywhere else, as all life on this planet is connected.

Issue 16: Effective "narratives" about climate change are urgently needed for people to get engaged—use the work of Indigenous artists to educate and inform wider audiences about the impact of climate change to create possible solutions stemming from Indigenous wisdom?

Background

Indigenous epistemologies view the world as relational and are based on the idea of kinship, where every animate and inanimate object has a relationship with each other (Abdilla et al., 2021). Historically, Indigenous art has been created with total respect to the environment. Materials used are natural with no overconsumption of resources. The Emberá of Panama, for example, weave palm leaves dyed with natural pigments to create brightly colored masks used for traditional ceremonies. It unifies the concept that art and nature are inseparable. In a changing world, Indigenous artists seek ways to share their narrative about the impact of climate change on their homelands using various technologies.

The case studies below demonstrate where Indigenous artists have woven together traditional techniques and wisdom with technology to illustrate the impact of climate change on their culture and lands. They express their values and knowledge for future generations through their art. Note that no singular Indigenous perspective exists, however, and this issue seeks to provide general guidance while respecting the diversity of views among all Indigenous peoples.

Recommendations

1. **Use virtual reality/augmented reality experiences to bring viewers awareness and create a sense of empathy, as well as of urgency.** This approach also helps provide a voice for Indigenous peoples as the story can be told through their own words and artwork without having viewers walk through Indigenous lands.

2. **Embrace country-centered design from Australian Indigenous peoples' systems where humans and technology are agents of the same system and can't be observers outside the system.** Use agent-based modeling techniques.

3. **Provide opportunities for Indigenous artists to preserve their stories and histories through technology.** Give them sovereignty over the work produced.

Case studies

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1. Yuméweuš

   Steve Yazzie is a Navajo artist whose work "Yuméweuš" consists of hydroponic towers that explore the interconnectedness of "you," "me," "we," and "us" and the relationships that exist between these words. The towers are the intersectionality of Indigenous customs and science. The sand paintings feature the chemical structure for amaranth, which grows in the hydroponic towers instead of healing Indigenous designs (Yazzie, 2022).

2. Gold King & Associates

   A secondary work by Yazzie consists of a real estate advertising sign for Gold King & Associates placed outside a property that asks people to call a number (720.281.9199), where they hear a message that could be a story or poem about colonization of Indigenous lands, the impact of climate change and environmental destruction, or the idea of kinship. Callers then have the option of leaving their own message.

3. Rise: From One Island to Another

   'Poetry, as with other art forms, can speak to us" on "various"…levels. I feel that in the art space, you leave room for mistakes, for conversation. For humanity. I am not an expert on a scientific level, but I am an expert on being a human being. And we definitely need our humanity in this situation."
   (Aka Niviâna at the 2019 Global Landscapes Forum)

   Rise is a visual collaborative project between two young climate activists and poets, Aka Niviâna from Greenland and Kathy Jetnil-Kijiner from the Marshall Islands. Through poetry and imagery, they take the viewer on a journey of two island homelands impacted by climate change: the rising sea levels affecting the Marshall Islands and the melting glaciers of Greenland. The film places both poets on top of a melting glacier in Greenland where their collaborative effort tells the story of their ancestors, humanity's interconnectedness, the damage inflicted to the land, and their resilience in the face of monumental environmental loss. The result is a visually stunning film that highlights human interdependence and is a call to action.

4. Unceded Territories

   Artist Lawrence Paul Yuxweluptun from the [Musqueam, Squamish, and Tsleil-Waututh](#) First Nations (currently known as "British Columbia") collaborated with filmmaker Paisley Smith to create an immersive virtual reality experience where viewers throw oil paint in the environment that is Yuxweluptun's artwork. Once the viewer has finished throwing the paint, they are shown that the oil paint has destroyed the painting beyond reversal. Unbeknownst to the viewer, they are the colonizers, and by exercising their will on the environment, they are leaving a trail of destruction and devastation in their wake. The intent is to bring awareness to non-Indigenous populations as to how they are participants of habitat destruction and pollution through consumption and how hundreds of years of consumption in the name of progress has directly impacted Indigenous communities who have lost their lands and livelihoods (Guo, 2020).

5. Ngapulara Ngarngarnyi Wirra (Our Family Tree)

   Australian football player Adam Goodes has performance data recorded via a biometric device. Adam is Adnyamathanha, where the peoples belong to two blood groups and their kinship ascribes to either the North or South winds. The sounds of the North and South wind were recorded as they moved around a sacred tree (wirra) on Adnyamathanha land. Inside the tree, an elder is recorded speaking in the Adnyamathanha language. A machine learning model combines the spoken Adnyamathanha language with the sounds of the North and South winds. In the culmination of the piece, Adam's biometric is used to create a point cloud around a 3D model of the tree (wirra) where

the North and South winds combined with spoken language move through the point cloud. By combining ancestral ways and artificial intelligence, it demonstrates a way to illustrate kinship between humans and algorithms, as well as a way to preserve ancestral ways and customs respectfully (Abdilla, 2020).

Further resources

1. Lewis, Jason Edward. *Indigenous Protocol and Artificial Intelligence Position Paper.* Honolulu, Hawaiʻi: The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR), 2020.

Issue 17: Effective narratives about climate change are urgently needed for people to get engaged—using polyphonic[16] storytelling and poetry as methodologies

Background

From a human perspective, saving the planet is about finding humanity's purpose and identity on this planet, the ability to respect all humans, and the willingness to live humbly. Cross-cultural, cross-hierarchical, cross-generational, transdisciplinary, and transgender conversations (Merl, 2023) in communities of practice (Wenger-Trayner & Wenger-Trayner, 2020) that are inspired by polyphonic storytelling and poetry can play a crucial role in this. They can help humans harness the power of imagination and move constructive climate narratives forward (Böhringer, 2023).

The prevailing climate narrative, which is often nourished and spread by mass media and social networks, may paralyze individuals and systems rather than to drive behavioral change. This is why the recommendations provided under this Issue are based on a series of pilot workshops that were conducted on the theme of climate change that support the idea that building more poetry and polyphonic storytelling into existing curricula and educational programs can help humanity develop the skills needed to create impactful climate narratives that can drive behavioral change and lead to concrete action steps in the real world.

"Six conversation-based workshops on environmental themes were conducted with an arts based, multimethod approach (McNiff, 2017) between November 2022 and February 2023. Participants were between 21 and 63 years of age and comprised engineers, IT experts, social workers, office workers, legal experts, journalists, public officials, company managers, researchers, creative designers, and part-time students from Austria, Germany; the Netherlands; Italy; and Bosnia. Group size varied between 6 and 30. Five groups met online via a video-conferencing tool as members were geographically dispersed; one group met in person in Vienna.

Participants were taken on a poetic journey where they had to deal with a variety of mostly environment-related ancient and contemporary poems, Indigenous poetry and classic literature, poetic video inputs, sketches, and images (see below). The experiment was split into two parts. Part 1 aimed at defining the prevailing climate narrative as perceived and told by participants, referred to as 'Narrative 1.' Part 2 aimed at coming up with an alternative climate narrative, referred to as 'Narrative 2.' Qualitative text analysis (Miles, Huberman, & Saldana, 2019) revealed that Narrative 1 is clearly overshadowed by negative feelings and emotions, such as sadness, guilt, anger, frustration, fear, fury, and a feeling of helplessness, while Narrative 2 is built on optimism, gratitude, love of life, respect for the other, the willingness to take risks, and the courage to fail in the effort to create a good situation for humankind. Both narratives are built on four climate-related pillars or value systems that were identified during Part 1 of the thought experiment: 1) comfort and convenience; 2) health and safety; 3) expectations and social pressure; and 4) commercial interests. Overall, this pilot study (Merl, 2023) demonstrates how poetry

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[16] Polyphonic = producing many sounds simultaneously; many-voiced.

can inspire a constructive polyphonic climate narrative" (adapted excerpts from Merl, 2023).

Many more such pilot studies need to be carried out in different contexts with multiple stakeholders to move an impactful collective climate narrative forward.

Please note that the poems and sketches used in the polyphonic storytelling pilot workshops are quoted below.

Recommendations

Qualitative, text-based analysis has provided the following recommendations aimed at "educators" (teachers, lecturers, curriculum developers, learning and development (L&D) professionals, organizational trainers, educational authorities, policy and decision makers):

1. **Build more poetry into existing curricula and thereby support the development of future skills or 21st-century skills that will help learners find their purpose and identity on this planet.**

2. **Provide effective train-the-trainer programs so that educators can adopt a teaching approach that allows them to effectively teach future skills and enable their learners to harness the power of imagination.**

3. **Establish multiple transdisciplinary, cross-cultural, cross-hierarchical, transgender, and transgenerational spaces.** That is where humans can re-learn with the help of artists how people see and listen to each other and how they can connect with each other to nourish a constructive climate narrative.

4. **Use poetry (artistic impulses) to deconstruct the prevailing climate narrative and spread constructive, collective (alternative) stories through (social) networks to reach as many stakeholders as possible.**

5. **Engage people in deep reflection and collective storytelling experiences so that they can move beyond their current fixation on tech as the solution to environmental problems.**
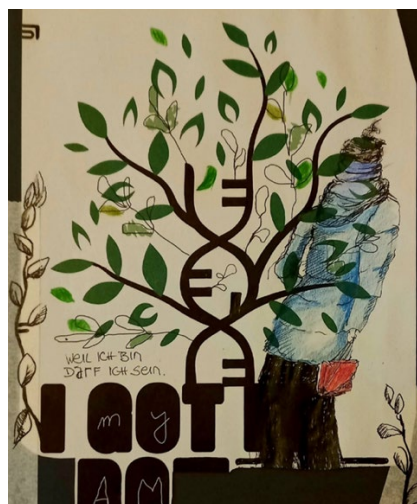
Klaus Kramer for Poetry in Business, Gesprudel, Sketch, Mixed Media Collage and Poem (2022)

Poems and sketches used in the polyphonic storytelling pilot workshops:

1. Gesprudel, by Klaus Kramer, 2022

    Herbstlichfließend in die Weite und den Raum
    Treibt ein gefallender Baum,
    in den Wassersprudel saugen sich Luft und Traum,
    im dichten Geäst verfangen der Schaum.
    Das Gestern schwimmt weiter im Morgen noch kaum,
    Zaghaft im Winterlicht den Frühling erlaubm;
    den Sommer nicht ahnen, mal schaun.

2. Excerpt from Ulysses, by Alfred Lord Tennyson

    […] Come, my friends,
    'T is not too late to seek a newer world.
    …
    For my purpose holds
    To sail beyond the sunset, and the baths
    Of all the western stars, until I die.
    It may be that the gulfs will wash us down:
    It may be we shall touch the Happy Isles,
    And see the great Achilles, whom we knew.

3. A Light Exists in Spring, by Emily Dickinson

    Not present on the Year
    At any other period –
    When March is scarcely here
    A Color stands abroad
    On Solitary Fields
    That Science cannot overtake
    But Human Nature feels…

Klaus Kramer for Poetry in Business, Ka Fee, Oil on Canvas (2022)

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