

BIOGOV.NET PROJECT METHODOLOGY TO LINK ART AND BIOECONOMY EDUCATION

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Abstract

BioGov.net project is a three-year project funded by the Horizon Europe programme, composed of 10 experienced partners that will operationalise the project's activities in 8 EU countries: Estonia, Italy, the Netherlands, Greece, Slovakia, Czech Republic, Portugal and Germany. It aims at contributing to establishing innovative governance models in the bioeconomy education, with a special focus on vocational training and life-long learning.

One of the key characteristics of the project is the use of art in its different forms and applications to boost future bioeconomy education pathways.

In fact, there is a need for exploring new paths to govern the transition process, in particular by:

- making information and knowledge available and accessible
- assessing the regional needs and good practices to define targeted strategies towards fostering bioeconomy education and capacity building
- bringing the various stakeholders together to co-create guidelines for bioeconomy training and mentoring
- using arts in their different forms and applications to develop systemic thinking, encourage to pursue a career in the bioeconomy, facilitate inclusion and awareness.

To respond to these needs, BioGov.net seeks to explore innovative governance models for the bioeconomy education and co-create guidelines for bioeconomy training and mentoring, through a multistakeholder approach which will mobilise eight European Communities of Practice, while integrating humanities, art, design and culture to foster the transition to an innovative and inclusive bioeconomy. With this in mind, the project has defined a sound methodology for bridging knowledge, capacity-building, and good governance in the bioeconomy, while ensuring synergies, transparency of actions and inclusiveness of all actors, including socially vulnerable groups.

This paper will describe the methodological approach developed in the project to link art to bioeconomy education, based on different innovative formats and case studies stemming from the intersection between these two domains that could help to inspire, engage, encourage creative thinking, and facilitate inclusion.

Specifically, the following dimensions of the BioGov.net methodology will be tackled:

- Art to elicit new ways of thinking and develop skills needed in bioeconomy education
- Art to address different learning styles and facilitate inclusion of marginalized groups
- Art to communicate messages, inspire people and raise their interest and awareness
- Inject the bioeconomy in Cultural and Creative Industries professionals

Keywords: Art, circular bioeconomy, innovative educational formats, bioeconomy education, sustainability education.

1 INTRODUCTION

The European Green Deal (European Commission, 2019) was presented by the European Commission in December 2019 and it is an integral part of the Commission's strategy to implement the United Nations' 2030 Agenda and the Sustainable Development Goals – SDGs - (United Nations, 2015), the COP 21 Paris Climate Agreement (COP 21, 2015), and the other green priorities that were announced in Commission President von der Leyen's political guidelines (von der Leyen, 2019) and confirmed during the State of the Union Address on 13 September 2023, where the main priorities and flagship initiatives for the year to come were outlined, building on the European Union's successes and achievements of the past years (von der Leyen, 2023). Its main objective is to steer the transition to a

fair and prosperous society, with a modern, resource-efficient and competitive economy in Europe (European Commission, 2019). In this framework, the promotion of a new economic action plan was identified as a priority in order to modernize the EU's economy. Since 2010, the bioeconomy was pointed out as a key element for both smart and green growth in Europe (European Commission, 2010), playing a key role in tackling global challenges like climate change, land and ecosystem degradation.

In fact, according to the European Commission, the bioeconomy takes into account the constant growing of population and the need to embrace more sustainable ways of production, consumption and lifestyle to respect the ecological boundaries of our planet (European Commission, 2018). On top of that, if we consider that the whole bioeconomy sector already contributes almost 9% to the EU-27's labour force and 4,7% to the EU-27's GDP (Ronzon, T. et al., 2020), it is evident that it can help to meet a broad range of EU targets.

Nevertheless, raising overall awareness, informing and educating on the societal, economic and environmental impacts of bio-based products and processes is still of the utmost importance for the future development of a smart, sustainable and inclusive society, since bioeconomy has not yet entered the public consciousness as an exciting solution to address societal challenges. There is also a need for exploring new paths to govern the transition process, by making information and knowledge available and accessible, assessing the regional needs and good practices to define targeted strategies towards fostering bioeconomy education, promoting and developing systemic thinking.

Arts-based approaches and methods can help driving the change towards a more sustainable, just and inclusive transition, since they embrace more-than-cognitive aspects of knowledge, such as emotions, values, and intuition, that are often neglected or treated as marginal in conventional science. They also improve awareness and engagement with diverse audiences, such as policy-makers, practitioners, and the general public, by using creative forms of expression to stimulate the debate about alternative pathways and opportunities for sustainability.

For all these reasons, arts and humanities are at the core of many innovative initiatives funded by the European Commission to promote ecological awareness. For instance, the "Bioeconomy Creative Competition" was launched by the European Commission in 2022 to engage creative persons between the ages of 14 and 35 and promote the contribution of art to the sustainable and circular transition of Europe. The overall objective was to stimulate imagination and creativity of younger generations, to facilitate futures visioning and scenario building through artworks like short videos, images, paintings, drawings, gifs, poems, songs related to bioeconomy in everyday lives.

Also the New European Bauhaus, the EU creative and interdisciplinary initiative launched in 2020, connects the European Green Deal to our daily lives and living spaces, with the aim to bring citizens, experts, businesses, and institutions together to reimagine sustainable living in a creative, inclusive and transdisciplinary movement. In fact, arts can play a critical role in engaging young people and adults in sustainability topics, therefore raising their awareness also on bioeconomy and, in general, on the necessity to tackle pressing environmental issues caused by human's actions over the ecosystems.

In this respect, among the recently European projects funded under the Horizon Europe programme, BioGov.net seeks to explore innovative governance models for the bioeconomy education, with the aim of integrating art-based frameworks and the New European Bauhaus values, as well as embracing the STEAM approach to learning.

The project will co-create guidelines using art in its different forms and applications to boost future bioeconomy education pathways and in response to the above-mentioned needs. Specifically, this paper describes the methodological approach designed in the project to link art to bioeconomy education, to inspire, engage, encourage creative thinking and facilitate inclusion.

2 METHODOLOGY: FROM STEM TO STEAM

In 2012, the United States National Research Council proposed the acronym STEAM (Science, Technology, Engineering, Arts and Mathematics), as a new form of teaching seeking to promote curricular integration between science, technology, engineering, mathematics and the arts, therefore enlarging the pervious education approach based mainly on STEM (Science, Technology, Engineering and Mathematics). The STEAM perspective explores teaching and learning across different disciplines, hence facilitating interconnected, deeper, and meaningful learning processes, as well as collaborative and experiential learning (Videla, R. et al 2021). After all, art and science have long existed and developed collaboratively and this synergy was embodied in great thinkers like Leonardo Da Vinci. Moreover, arts-based methods and experiences became more and more central within sustainability science, as a means to stimulate societal and cultural transformations which affect groups and societies' cultural roots, including beliefs, behaviors, values and worldviews (Heras, M. et al., 2021).

As a matter of fact, art, expression and culture can provide powerful means to empower learners of all ages with the knowledge, skills, values and attitudes to address various challenges from climate change and environmental degradation to poverty and inequality (UNESCO, 2023).

The use of the arts to nurture education for *just sustainability* is central in many innovative educational, training, mentoring and research programs, to ignite critical and creative strengths in learners, while supporting an ethically-aware imaginative engagement (Hauk and Kippen, 2017). Arts-based education and research embrace transdisciplinary approaches to explore several key themes across fields. It can help surface the dynamics of arts as a source of connection and vibrance, creative resistance, resilience and regeneration. As stated by researchers Marna Hauk and A. Rachel Kippen, arts approaches to social and environmental issues strengthen capacities amongst learners, expand awareness and inspire regenerative action. Specifically, they articulated different dimensions of realising a just sustainability arts education, across context, contact, connection, content, process and practice, developing interactive research methods for visualising complexity networks, articulating the webbed connections between different key topics to improve just sustainability arts education design (Fig. 1). For example, they explored how environmental racism, ecofeminism and systems thinking approaches reveal underlying systems of domination; how the same kinds of approaches that invite creativity also support critical thinking and creative insight about ecojustice; how arts-based approaches support the kinds of social and place-and land-based engagements that fuel interest in, inspiration for and articulation of just sustainability topics and possibilities; and how these converge catalyses disruptive, transgressive and transformative social learning opportunities (Hauk and Kippen, 2017).



Figure 1. Diagram of informing literatures converging in just sustainability arts (Kippen and Hauk, 2016).

Among the European initiatives, the New European Bauhaus (NEB) fully integrates this multidimensional vision, bringing a cultural and creative dimension to the Green Deal to enhance sustainable innovation, technology and economy. Building on existing frameworks like the Davos Baukulture Quality System (Swiss Confederation, 2018), the initiative gives space for creation and experimentation, acknowledging that the transition is just as much a cultural and a social transition as a green one (European Commission, 2021), stressing the importance of supporting participatory and creative processes that empower communities to take decisions and self-govern, while promoting transdisciplinary activities. It is therefore considered as pivotal to take a collaborative and multi-level approach to knowledge creation between local, traditional and academic knowledge holders.

The NEB methodology creates bridges between different backgrounds, cutting across disciplines and building on participation at all levels, finally facilitating and steering the transformation of our societies. Specifically, it is structured along three inseparable values and working principles (Fig. 2):

- sustainability, from climate goals to circularity, zero pollution, and biodiversity
- aesthetics, quality of experience and style beyond functionality
- inclusion, from valuing diversity to securing accessibility and affordability.

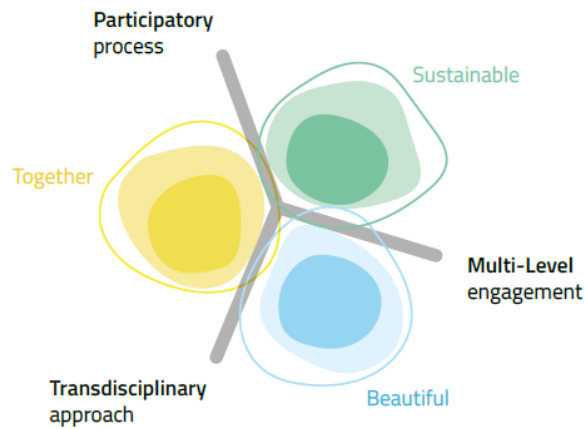


Figure 2. The NEB value and working principles (The NEB Compass, 2021).

The creative process represents the first core value of the NEB, as art and culture in all their diversity play a major role in making our lives beautiful and meaningful. Beauty is in fact recognised as a means through which it is possible to stimulate collective sensitivity, intelligence, and competences into creating a positive and enriching experience for people, beyond functionality.

According to the European GreenComp framework, «Sustainability means prioritising the needs of all life forms and of the planet by ensuring that human activity does not exceed planetary boundaries» (Bianchi, G. et al. 2022). In agreement with this definition, the NEB through its second core value aims to promote sustainability by incentivising the restoration of nature, raising the awareness on humans' impact on biodiversity and natural resources, as well as boosting a reconnection with nature.

The third core value of the NEB builds on the concept of inclusion and enriches it with the concepts of equality, accessibility and affordability. The final objective is to grant and secure equal access to opportunities and resources for all, encouraging exchanges across cultures, genders and ages.

Specific ambitions are also identified to foster the uptake of the above-mentioned core values (Fig. 3).

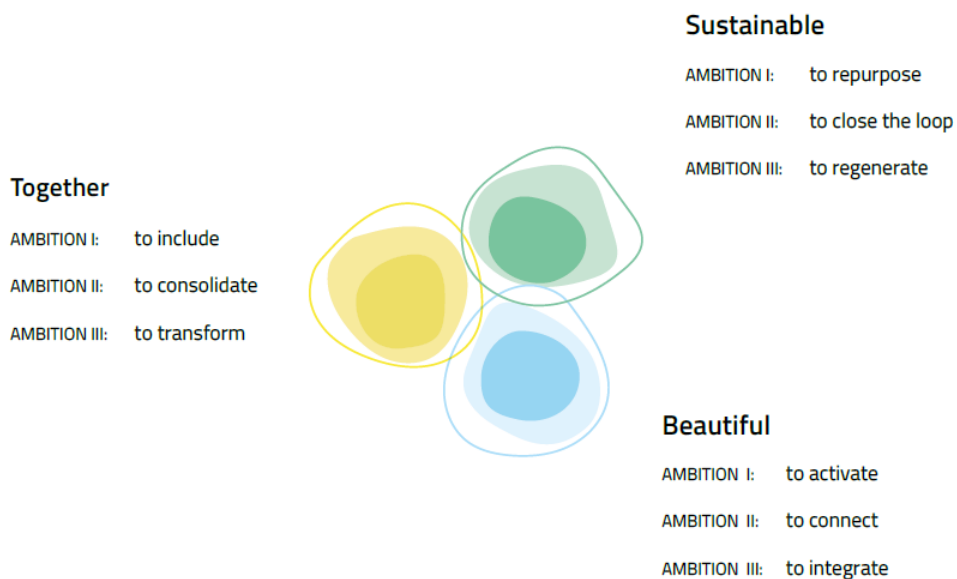


Figure 3. The specific ambitions associated to the three NEB's core values (The NEB Compass, 2021).

All these approaches can grapple with power dynamics and ethical issues that arise in transdisciplinary and participatory research, by creating spaces for dialogue, reflexivity, and empowerment. By invoking sensory, aesthetic, and affective experiences of the natural world, they shift relationships to nature and foster environmental awareness and stewardship.

Embedding all these aspects and values and integrating art-based frameworks and the STEAM approach to learning, BioGov.net project, funded under the Horizon Europe programme, contributes to establishing innovative governance models in the bioeconomy education, with a special focus on vocational training and life-long learning. Through a multistakeholder approach, the project will mobilise eight European Communities of Practice in specific target Regions, while integrating humanities, art, design and culture to foster the transition to an innovative and inclusive bioeconomy. The following paragraph describes in detail the project's methodology to link art and bioeconomy with the aim of bridging knowledge, capacity-building and good governance in the bioeconomy, while ensuring synergies, transparency of actions and inclusiveness of all actors, including socially vulnerable groups.

3 RESULTS: LINKING ART AND BIOECONOMY EDUCATION

BioGov.net project will operationalise its activities in eight EU countries, building multistakeholders European Communities of Practice in Estonia, Italy, the Netherlands, Greece, Slovakia, Czech Republic, Portugal and Germany.

Art in its different forms and applications represent the key aspect identified by the project to boost future bioeconomy education pathways and explore new paths to govern the transition process, in particular by:

- assessing the regional needs and good practices to define targeted strategies towards fostering bioeconomy education and capacity building
- bringing the various stakeholders together to co-create guidelines for bioeconomy training and mentoring
- developing systemic thinking through art-based teaching and learning, therefore encouraging to pursue a career in the bioeconomy, facilitate inclusion and awareness.
- making these outputs available and accessible for replication in form of data, knowledge, methodologies and governance recommendations
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In order to do so, BioGov.net designed a sound methodology that links art to bioeconomy education along 4 different dimensions:

- Art to elicit new ways of thinking and develop skills needed in bioeconomy education
- Art to address different learning styles and facilitate inclusion of marginalized groups
- Art to communicate messages, inspire people and raise their interest and awareness
- Inject the bioeconomy in Cultural and Creative Industries professionals.

Per each dimension, various innovative formats and case studies are presented.

3.1 Art to elicit new ways of thinking and develop skills needed in bioeconomy education

The circular bio-based economy encompasses various systems and sectors, including land and marine ecosystems, green infrastructures, primary production sectors (agriculture, forestry, fisheries, aquaculture, and aquaponics), and more. The transition from a linear fossil-based economy to a circular bio-based economy requires the adoption of new approaches to identify the interdependencies between these systems and sectors and develop strategies to promote sustainable growth.

Several EU funded projects like BIOVOICES, Transition2Bio, BIObec and BioGov.net promoted multistakeholder discussions to identify what are the necessary skills and knowledge needed to address the challenges and opportunities associated with this transition. According to the stakeholders participating, there is a strong need of educational programmes which stimulate systemic thinking, circular and sustainable mindset, structural change (biotransition), transversal competencies and skills and divergent thinking.

Systemic thinking in circular bioeconomy is a way of understanding and designing the interactions between biological resources and human activities in a holistic and sustainable manner. It involves applying the principles of circular economy to the production, consumption and valorisation of renewable

biological materials to maximise the value and utility of biological resources, while minimising the environmental impacts and waste generation. It also seeks to foster innovation by inspiring people and raising their interest and awareness about sustainability, promoting the debate and collaboration among different stakeholders, enhancing social inclusion and participation in these issues.

In this context, art-based approaches offer unique opportunities to explore sustainability issues from different angles and encourage systemic thinking, but also divergent thinking and the development of transversal competencies and skills. By combining artistic expression with scientific knowledge, bioeconomy education can foster a more holistic understanding of the complex challenges we face and inspire positive change.

In bioeconomy education, techniques and formats like design thinking and visual thinking can be used to develop systemic thinking and transversal skills, foster creativity, critical thinking, and a deeper understanding of sustainability issues.

Transition2BIO project, in collaboration with the Startupper School Academy, an initiative promoted by Lazio Innova to foster sustainable innovation and entrepreneurial skills in high school students, successfully implemented capacity building activities using Design Thinking techniques. The students have been challenged to create new solutions and ideas using biomaterials, while considering the entire Life Cycle, including End-of-Life of the products designed.

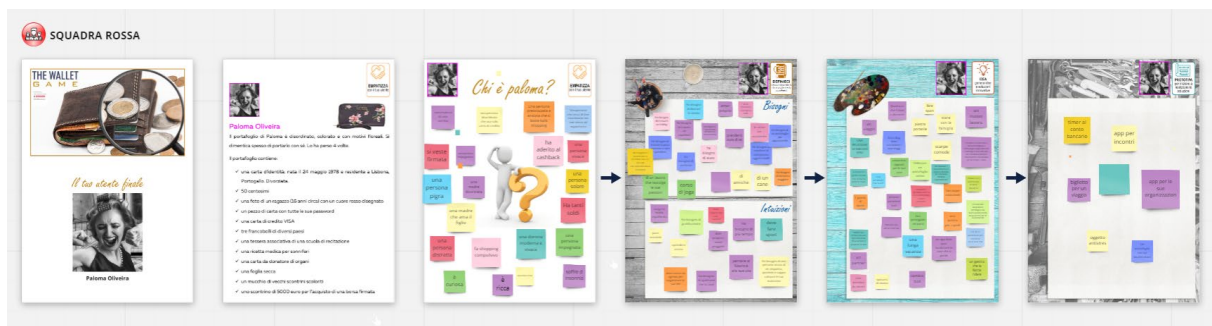


Figure 4. Design thinking to elicit transversal skills in high school students

Finally, art-based methodologies might also be used to foster mutual understanding, trust, and ownership by involving stakeholders in co-creation processes or participatory art projects, to promote ethical and responsible practices and address the potential impacts, risks, and benefits. By raising critical questions or provoking emotional responses, art-based approaches can also stimulate critical thinking, challenge assumptions, values, and norms that underlie sustainability issues and can foster innovative methods and pathways in bioeconomy education.

3.2 Art to address different learning styles and facilitate the inclusion of marginalised groups

Promoting inclusiveness in bioeconomy education is crucial for achieving sustainable and equitable growth, by creating an environment that values diversity, fosters collaboration, and ensures equal access to educational opportunities. It involves equipping marginalized groups with knowledge and skills related to the bioeconomy, empowering them to contribute to sustainable practices and innovation.

During the activities within the BioGov.net Communities of Practice, several case studies have been presented to understand how to facilitate the access to bioeconomy-related opportunities for marginalized groups. Marginalisation can derive by difficulties in accessing education. Specifically, in the regions targeted by the project, there is a huge need to design inclusive education pathways for people with learning difficulties (e.g. Dyslexia, Dysgraphia, Dyscalculia, Visual Perceptual/Visual Motor Deficit, Attention Deficit Hyperactivity Disorder (ADHD) Language Processing Disorder, Non-verbal Learning Disabilities), non-native speakers (e.g. migrants) and to motivate/stimulate people not easy to engage (e.g. NEETS, unemployed, etc.).

To address these needs, that are very specific and vary case by case, BioGov.net is exploring how the VARK model (designed by Neil Fleming) can be used in combination with artistic approaches, to educate for the bioeconomy. VARK model suggests that everybody receives, processes and retains information differently (e.g. visual, auditory, written, kinesthetic and multimodal). This approach allows individuals with diverse learning preferences to engage with the material in ways that suit their needs and strengths.

Although the VARK model can be applied transversally to all education programmes, BioGov.net is discussing how bioeconomy education can benefit from this conceptual model to improve bioeconomy education, taking particularly into consideration the needs of marginalized groups.

In this context art can provide a creative and engaging approach, responding to different learning preferences, as well as involving in education those people that are not engaged with the formal education system (e.g. migrants, primary sector, NEETS, etc.). By using methodologies and artistic communication it is possible to create a more inclusive and effective learning environment, integrating the use of creativity in various ways to better engage and empower diverse target audiences, including marginalised and disadvantaged groups.

3.3 Art to communicate messages, inspire people and raise their interest and awareness

The use of inspirational case studies and artistic formats to educate in the bioeconomy has been recognised as relevant to integrate the opportunities created by the human-centric principles, offered by art, culture and (eco)-design, with respect to the bio-based feedstocks, including traditional and novel biological materials. By leveraging the link of Art and Bioeconomy, it is possible to attract the larger public, convey messages, and inspire and raise awareness towards the bioeconomy.

Art can in fact help in communicating complex messages and topics such as climate change and pressing environmental issues, contributing to inspire people and raise their interest and awareness about sustainability.

The “Bioeconomy Village” and the BioArt Gallery are two examples of formats designed by BLOWAYS and BIOVOICES projects and then successfully exploited in the context of Transition2BIO and GenB projects. They represent an effective and engaging way of displaying the bio-based products in everyday situations, enabling the visitors to touch and feel what bio-based economy is, during large-scale events and exhibitions. The Bioeconomy Village (Fig. 5) concept was developed initially in the context of the BLOWAYS, promoting the showcase of bio-based products. It aims to raise awareness, improve knowledge on products of renewable origin and promote the applications and benefits of the circular bioeconomy and sustainability, fostering dialogue, confrontation and sharing between the general public, researchers and companies.



Figure 5. The Bioeconomy Village, in the context of the high-level round table about the role of bioeconomy for the Green Transitions, organised in by Transition2BIO project and held at the Italian Chamber of Deputies, 2022.

Through the display of products, examples and practical demonstrations, visitors are shown, in a clear and engaging way, how the bioeconomy is increasingly part of our daily lives and how conscious consumer choices can have a positive impact on environment, society and economy. The exhibition is

continuously enriched with new products, it is currently composed of more than 350 different bio-based products and it is often coupled with the BioArt Gallery (Fig. 6).

The latter, is a powerful tool to attract interest, raise awareness, inspire, and stimulate curiosity and discussion on the different sectors in which the bioeconomy has a positive impact: agriculture, cosmetics and nutraceuticals; construction and restoration, cleaning and hygiene; design and clothing; toys and sporting goods. The BioArt gallery consists of several types of visual materials that can be selected according to the type of event and context (maxi pictures, standalone cardboard panels or roll ups), which have high visual impact, presenting promising feedstock and its related bioeconomy applications, as well as examples of bio-based products already available in the market.



Figure 6. The BioArt Gallery in different formats.

By using visual, auditory, or performative means it is therefore possible to convey complex and abstract concepts, leveraging the “wow” effect connected to artistic language and contents, to attract the larger public and stimulate their curiosity and engagement.

3.4 Inject the bioeconomy into Cultural and Creative Industries professionals

Finally, BioGov.net methodology targets professionals involved in Cultural and Creative Industries to inform and educate them on the opportunities offered by the bioeconomy. The aim is to stimulate the integration of bio-based materials in art, design and architecture, therefore improving the sustainability of these applications. The building sector is responsible for almost the 40% of global CO₂ emissions, producing an incredible amount of waste material which has a permanent character and compromises the biosphere equilibrium. Therefore, there is a need to explore new perspectives in design culture and architectural experimentation, to raise awareness on the environmental impact of this sector, while reaching better ecological performances and supporting a long-term positive interaction with the ecosystems, even during the end-of-life stage of buildings.

In this context, biomaterials, as an alternative to traditional building materials, can play a key role in promoting the integration of biological matter and living organisms in “bio-informed architectural spaces” (Marinelli, 2023).

Specifically, in the wider domain of sustainable architecture and design, bio-architecture and bio-design are part of an emerging movement, whose aim is to incorporate the use of living materials, or “moist media”, such as fungi, algae, yeast, bacteria, and cultivated tissue. Bio-architects and bio-designers essentially cross traditional art-design-science boundaries to create new solutions and technologies whose properties are enhanced as a result of the implementation of biomaterials.

A practical case study is represented by biofabrication, which is based on the do-it-yourself creation of biomaterials. The purpose is to promote material activism (Ribul, 2013) and encourage the development of innovative models to replace conventional industrial ones, as well as to envision the potential application of bio-based materials and living organisms in the built environment. This method of self-production is closely aligned with movements such as DIY, maker culture, and the free and open-source approach, which are part of the fablab (fabrication laboratory) concept. In fact, biofabrication shares with these movements the philosophy as well as the technologies of digital fabrication, such as 3D printing, but it gives more prominence to the implementation of sustainable materials such as bio-based filaments to 3D print objects or molds to cast the biomaterials produced. Therefore, through a

bottom-up approach based on open-source recipes for creating biomaterials and innovative tools, biofabrication enables designers to enter into the logics of materials development, strengthening their activist role in promoting a systemic change while enhancing their creativity (Fig. 7).



Figure 7. Samples of biomaterials self-produced through hands-on experimentations. Selenia Marinelli, 2023.

Moreover, this hands-on practice stimulates a deeper reflection on the entire life cycle stage of the materials produced, raising awareness on the importance of using renewable biological resources and residues, and therefore also on the environmental impact of the materials that inform our spaces and mediate our experiences.

Besides this more experiential approach, similar applications from established design firms have shown that the integration of biomaterials is already possible. The Hy-Fi Tower built by The Living in 2014 or the Growing Pavilion designed by Pascal Leboucq and Krown Design for the Dutch Design Week in 2019 (Fig. 8), are practical examples on the use of mycelium-based bricks (that are inherently compostable and therefore produce near zero emissions). In these two applications, mycelium is deployed to create environments which are intrinsically adaptable and open to transformation, rather than being just static containers. The ultimate aim is to meet the demands of deep ecology, which requires the embodiment of a biocentric point of view on the project, while triggering new scenarios on more environmentally conscious design and architecture.



Figure 8. To the left: *Hy-Fi Tower, The Living*, 2014. To the right: *The Growing Pavilion*, Pascal Leboucq + Crown Design, 2019

4 CONCLUSIONS

Art can be a powerful way to boost participation in sustainability issues, by using various forms and applications to engage with diverse audiences, address their needs and interests, and empower them to take action for a more sustainable and ethical future.

As proved throughout this paper, art can in fact elicit new ways of thinking to develop skills needed in sustainability education; inspire people, and raise their interest and awareness about sustainability; enhance social inclusion and participation in these issues, by creating opportunities for dialogue, collaboration, and empowerment among diverse actors and communities. For example, art can foster mutual understanding, trust, and ownership by involving stakeholders in co-creation processes or participatory art projects, to finally support ethical and responsible practices and addressing the potential impacts, risks, and benefits of actions on the environment, society, and culture.

By raising critical questions or provoking emotional responses, art-based approaches can also challenge assumptions, values, and norms that underlie sustainability issues and can foster innovative methods and pathways in bioeconomy education.

European funded initiatives and projects, such as the New European Bauhaus and BioGov.net, seek to increase the visibility and accessibility of art-based approaches, recognising their value towards a more sustainable, just and inclusive transition. Several examples in other European programmes also demonstrate the interest of investing in this cross-cultural domain, especially targeting young generations:

- “ArtS: Skills for the Creative Economy” was a project aimed at developing the skills and competences of young people in the creative and cultural sectors, by providing them with training, mentoring, and networking opportunities. The project also promoted the use of art as a tool for social inclusion, intercultural dialogue, and environmental awareness;
- The “Green Art Lab Alliance” is a network of cultural organisations that explores the connections between art, culture, and environmental sustainability. It started as an EU-funded project in 2012 and today networks institutions in Europe, Asia and Latin-America. The project organised workshops, residencies, conferences, and exhibitions that addressed topics such as climate change, biodiversity, waste management, and renewable energy;
- “Art4Act: Art in support of education for sustainable development” aimed to enhance the quality and relevance of education for sustainable development (ESD) in schools, by integrating art-based methods and tools. The project developed a curriculum framework, a teacher training programme, and a toolkit for ESD through art.

Nevertheless, there are some challenges in implementing art-based approaches in the bioeconomy. For example, some artists may face resistance or scepticism from scientists who are not familiar or

comfortable with artistic methods or outcomes, therefore it is important to find strategies to dealing with power dynamics and tensions across paradigms that may hinder collaboration and integration between artists, scientists, and other stakeholders. At the same time, it is important to develop appropriate criteria and methods for evaluation and assessment that can ensure rigor and validity of the outcomes, therefore measuring or demonstrating the impacts, benefits, or added value of art-based projects for the bioeconomy education.

Moreover, some art-based initiatives may struggle to find suitable funding sources, venues, or platforms that recognize and value their contributions to the bioeconomy and sustainability. Therefore, it is need to create conducive conditions for implementation and dissemination, by securing adequate funding, time, space to support more art-based research projects and initiatives in the future.

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