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NBS EduWORLD Network Stream

Scenarios of Plausible Futures for NBS in Education

Deliverable D6.1

Version: 1.0



Funded by
the European Union

NBS EduWORLD is funded by the European Union (Grant Agreement No. 101060525). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the granting authority can be held responsible for them.

Action number	101060525
Financed under	HORIZON-CL6-2021-COMMUNITIES-01
Action acronym	NBS EduWORLD
Full title	Nature-Based Solutions Education Network
WP, Deliverable #	WP6, D6.1
Version	1.0
Date	15.08.2023
Dissemination Level	Public
Coordinator of the Deliverable	EA
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Please site this publication as	Katikas, L., Tsaknia, T., Sotiriou, S. et al. (2023). NBS EduWORLD - Scenarios of Plausible Futures for Nature-Based Solutions in Education – August 2023. Ellinogermaniki Agogi, Athens
Abstract	This document describes and analyses the different pathways for the transformation of the schools into Nature-Based Solutions (NBS) Living Labs (LLs) through the Whole School Approach (WSA), providing a structured set of Scenarios of Plausible Futures for Nature-Based Solutions in Education that can act as a reference point for the project's implementation with the large users' communities. The scenarios record and highlight key drivers, uncertainties, baselines, constraints, and opportunities for nurturing NBS in education. They are not predictions but serve as a perspective to provoke ' <i>what if</i> ' discussions, develop roadmaps, and delineate educational pathways. The overarching objective is to enhance our collective understanding of NBS in education and its future, supporting the vision of schools as NBS Living Labs and underlining the actions needed towards that vision.
Keywords	Nature-Based Solutions (NBS), Education, Living Labs, Whole School Approach (WSA)

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Abbreviations

CPD	Continuous Professional Development
EC	European Commission
ECEC	Early Childhood Education and Care
EGD	European Green Deal
ESD	Education for Sustainable Development
ESG	Environmental and Social Governance
EU	European Union
GreenComp	Green Competence Framework by JRC
HE	Higher Education
HEIs	Higher Education Institutions
IBSE	Inquiry-Based Science Education
ICT	Internet Communication Technologies
JRC	Joint Research Centre
LfS	Learning for Sustainability
LL	Living Lab
MOOCs	Massive Open Online Courses
NBS	Nature-Based Solutions
NGO	Non-Governmental Organisation
SD	Sustainable Development
SDGs	Sustainable Development Goals
STEAM	Science, Technology, Engineering, Arts and Mathematics
UN	United Nations
WSA	Whole School Approach

Executive Summary

Nature-Based Solutions (NBS) have emerged as a promising approach to address different sustainability challenges, ranging from climate change mitigation to enhancing human well-being and providing opportunities for green jobs. In recent years, NBS has gained recognition as an effective tool and research topic for fostering sustainable development and creating resilient communities. Recognizing the potential of NBS in educational settings, this document explores the Scenarios of Plausible Futures for Nature-Based Solutions in Education by delineating different pathways to introduce such a topic at schools in Europe.

Scenario-planning provides a structured way to get an impression of what the future might look like. The scenarios themselves show how to support the long-term strategy of mainstreaming NBS in education in different cases. They are rather ways to uncover the specific steps and challenges that must be considered when anticipating the future of integrating NBS in education.

Inspired by the past and ongoing experiences in different European countries, these 'NBS in education' futures can help identify potential opportunities and challenges for integrating innovative, engaging, and creative topics into Sustainability Education programmes. Besides, as [OECD Report 2020](#) highlights 'There are always multiple versions of the future – some are assumptions, others hopes and fears. To prepare, we have to consider not only the changes that appear most probable but also the ones that we are not expecting.'

To this end, this document aims to provide insights into the various ways Nature-Based Solutions can be harnessed to promote Learning for Sustainability (LfS), holistic well-being, and societal engagement within the education sector. It is noted that for the purposes of this deliverable, the term Learning for Sustainability (LfS) is used, which is recognised by the European Commission (EC) and is in line with the Education for Sustainable Development (ESD) definition.

The document is structured in five sections including the Introduction. Section 2 outlines the current status of NBS in education and how, based on this, the vision for the NBS Living Labs as enablers of a Whole-School Approach (WSA) is being shaped. In Section 3, the focus shifts to WSA, describing the methodology for establishing the NBS Living Labs, evaluating potential opportunities and challenges from previous case studies and how NBS EduWORLD intends to address them. Section 4 lays out the scenarios of plausible futures for NBS in education through the vision for the NBS Living Labs. At last, Section 5 summarizes the document by providing conclusions that reflect on the implementation process and the viability of the presented scenarios.

1. Introduction

The Nature-Based Solutions Education Network (**NBS EduWORLD**) aims to nurture an NBS literate, inclusive, and sustainable society by building synergies between NBS professionals and education providers across sectors, formal and non-formal settings, and ensuring free and easy access to high-quality NBS knowledge resources. Through this work, communities should become more prepared, cohesive, and participatory in engaging with nature and using the benefits of nature to solve local and global challenges and improve public health and wellbeing.

Driven by policy, environmental and economic imperatives, NBS education is increasingly emerging across disciplinary boundaries, knowledge silos, and skill sets to deliver integrated solutions to address the causes and consequences of climate change through education. These solutions can be delivered at a low cost compared to conventional infrastructure ([Price 2021](#)), broaden the scale of benefits for people and nature ([Kapos et al. 2019](#)), and, from an educational perspective, provide common ground to learners on the benefits of NBS to address sustainability challenges gaining at the same time the knowledge, skills, and attitudes needed for their own competences development ([Bianchi, Pisiotis, & Cabrera Giraldez 2022](#)).

Box 1 Definition of Nature-Based Solutions

Nature-Based Solutions (NBS) are: “Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services.”

Source: [European Commission, 2022](#)

In this context, this document focuses on how LfS will take advantage of NBS to establish more engaging and impactful education programmes or to transform schools to incubators for promoting NBS, tackling climate change, and promoting biodiversity. Hence, since NBS are closely aligned with the Sustainable Development Goals (SDGs) and ecological modernization, the question raises of whether this alignment between LfS, the SDGs, and NBS represents the desired future, the necessary future, or simply the inevitable future for ‘greening’ the curricula and promoting sustainability citizenship.

But what are the main ‘ingredients’ to succeed in this and move towards the desired futures for LfS? Key actions to go in this direction are introducing innovative topics for greening the curricula and transforming schools to sustainable learning environments, as well as using methodological and holistic schemes to highlight how schools can be transformed into lighthouses for tackling sustainability challenges, promoting sustainability citizenship and most importantly, developing competences and cultivating the cultural shift needed towards a more sustainable future.

After all, the crucial role of education in the face of the challenges that we are living and the assumption that we are not anymore in a “business as usual” mode are both indisputable facts. As schools become innovation hubs, they assume their share of responsibility. Being innovative means being open by involving local communities in the teaching and learning process and functioning as an incubator for exploring ideas and inventions.

A self-sustaining innovative open culture in schools that benefits the broader community whilst avoiding simply creating interesting but isolated pockets of experimentation is being achieved by empowering system-aware people and by implementing at scale a process that facilitates the transformation of schools into innovative ecosystems, acting as shared sites of learning for which leaders, teachers, students, and the local community share responsibility, over which they share authority, and from which they all benefit through the increase of their communities’ science capital and the development of responsible citizenship.

The benefits of accelerating innovation are many and for all. Everyone develops key skills since education is now linked to an open approach and to life-long learning. Learning opportunities are everywhere, available outside formal education, and their boundaries are becoming indistinct. The impact is community-wide, since everyone benefits from the increase in their communities’ science capital and the development of responsible citizenship. In addition, education is at the heart of society, and is becoming integral to local community development, since open schooling activities for NBS can stimulate real scientific work, are inspired by local needs and problems, and address NBS challenges, contributing substantially to EU Green Deal.

A **Whole School Approach (WSA)** provides a framework for reorienting and redesigning education considering the above-mentioned emerging global sustainability challenges, in which all educational processes that influence learning are addressed. It is an integrated approach, in which all educational processes that influence learning are addressed, and it invites a holistic, systemic, co-creative, and reflexive effort by all stakeholders involved in education to meaningfully engage students. The approach encompasses teaching and learning, vision, planning and governance, active learner and staff participation, involvement of families, management of buildings and resources, and partnerships with local and wider communities.

Box 2 Definition of the Whole-School Approach

The Whole-School Approach to Sustainable Development is: "a framework that supports schools in giving shape to education for a sustainable future, in consultation with all stakeholders and interested parties in and around the school. The WSA helps to integrate sustainability issues structurally and coherently into the school organization." A **Whole-School Approach** to sustainability seeks: "to embed learning for environmental sustainability across the institution. It adopts a systemic view of education creating opportunities for living and learning sustainability across the education environment."

Source: [European Commission, Leren Voor Morgen](#)

This process employs the **Living Lab (LL)** methodology that puts people in charge of the innovation process. Synergies and mutual learning can be a reality when students explore issues relevant not only to themselves but also to others, whereby community partners can offer insights but can also benefit from students' attention, research, and creativity. The teaching and learning processes must be interdisciplinary and transformative for realizing this learning. By establishing the school as a Living Lab with the local community, the students can also become more rooted in their habitat and gain a sense of place and connectedness.

Box 3 Definition of the Living Labs Concept

Living Labs (LLs) are: "Open innovation ecosystems in real-life environments using iterative feedback processes throughout a lifecycle approach of an innovation to create sustainable impact."

They focus on co-creation, rapid prototyping & testing and scaling-up innovations & businesses, providing (different types of) joint-value to the involved stakeholders. Living labs operate as intermediaries/orchestrators among citizens, research organisations, companies, and government agencies/levels.

Source: [European Network of Living Labs](#)

Therefore, NBS has emerged as a promising approach to address a range of environmental, as well as societal challenges through the protection, restoration, and sustainable management of ecosystems. On the other hand, to achieve this and address these challenges starting from schools, it is crucial to emphasize, enhance, and adapt policy instruments that promote education on NBS and in parallel, promote and support holistic schemes. This approach would enable and motivate both formal and non-formal education sectors to provide NBS education within and beyond schools and educational institutions.

Therefore, the scenario-planning exercise carried out in the context of this document was intended to provide a structured way to get an impression of the future and can be seen as a tool to help us invent our future.

2. Current State and Vision of NBS in Education

This chapter introduces and analyzes shortly the current framework for NBS in Education and presents the vision of the NBS Living Labs in Education as a way to respond to emerging calls to action for mainstreaming and upscaling NBS, describing in parallel the expected impacts on the communities inside and outside the schools.

To delineate the Scenarios of plausible futures for NBS in education, an extensive data collection process has been conducted. In conjunction with the State of the Art report for NBS in education and the NBS education resources and good practices, NBS experts were brought together with education stakeholders, to generate creative options for the project field trials in the NBS Living Labs at schools. Activities included focus groups, creative workshops, and futures thinking.

2.1 State of the Art and Guidance Framework for NBS in Education

The NBS EduWORLD State of the Art report for NBS in education indicates that there is great potential for integrating the interaction with nature and green infrastructure to the school curricula or extra-curricular activities in formal and non-formal education settings. It also refers to the fact that urban gardens and especially kindergartens and school gardens, can function as Service-Learning spaces particularly well-suited for intergenerational learning.

Box 4 Definition of Service-Learning

In a school context, **Service-Learning** can be defined as an experiential teaching method through which skills or contents addressed in the classroom are used to solve a real need of the community through a process that allows students to have initiative, to reflect on the impact they have in the community and demonstrate the newly acquired skills and knowledge.

Source: [European Union and the Council of Europe, 2021](#)

Overall, the majority of evaluated NBS projects and education initiatives provide evidence of multiple achievements and promote NBS education. These relate to the innovative governance structures, financial models, inclusion of vulnerable groups, involvement of teachers, examples of NBS formal education, and examples of outdoor education.

Even though there may be a lack of official education programmes concerning NBS, it is recognised that informal transmission of what children learn in formal education, practice, or informal learning from older people and the community, may flourish – although there are inherent risks in this approach in terms of the links between the schools and the local communities or the collaboration with external societal actors.

In particular, the NBS EduWORLD State of the Art report found that NBS lessons are challenging to deliver within the education sphere as relevant and detailed, with taught on-ground examples not always readily available. This is changing rapidly within the last 5 years as the EU-funded NBS project suite delivers research and demonstration outcomes.

Although there has been some progress in NBS in education in the past few years, there are still gaps that need to be addressed ([Utkarsh, S. \(2023\). Integrating Nature in Education: Unlocking the Potential of Transformative](#)):

- **Lack of teacher training:** Many teachers may not have the necessary training or knowledge to effectively incorporate NBS topics into their curricula. This can result in limited exposure to NBS education for students.
- **Difficulties to evaluate and assess the benefits:** The number of individuals capable of leading NBS education projects is low, as NBS encompasses various aspects that are challenging to master, particularly regarding monitoring and evaluating its co-benefits and effectiveness in addressing societal challenges.

- **Limited access to outdoor learning spaces:** Outdoor learning experiences are an important component of NBS education, but not all schools and communities have easy access to outdoor learning spaces.
- **Inadequate funding:** The development and implementation of NBS education programmes can be costly, and many schools and organizations may not have the necessary funding to support these initiatives.
- **Lack of integration across subject areas:** While there is a trend towards cross-disciplinary approaches to education, there may still be limited integration of NBS topics across subject areas in some schools and educational institutions.
- **Limited time and ‘space’ to the curricula:** The lack of flexibility and class time in public school programs limits the inclusion of specific NBS-related content and information.
- **Limited awareness and engagement:** There may be limited awareness and engagement among students and communities about the importance of NBS education and its potential benefits.
- **Lack of knowledge and communication:** While NBS is an umbrella concept that encompasses various sectoral and thematic areas, the outcomes of many national and European projects are often left unshared, with the knowledge being confined to their individual targeted sectors.

Related to that are also some key recommendations from the NBS EduWORLD Guidance Framework for NBS in Education:

- **NBS needs to be mainstreamed** more widely for awareness about NBS to grow, and for NBS projects and innovations to also be taken up **at a wider scale and be impactful and accessible to all**.
- To increase the take-up and know-how around NBS across communities, **holistic implementation and action are needed** both vertically (from individual to organisational and systemic changes) and horizontally – all the stakeholders acting in synergy for the promotion of NBS within the organisation.
- **Integrated policymaking** is crucial to strengthen NBS education and provide ecosystem benefits across different fields and to different stakeholders and is **strengthened by supportive financial mechanisms** (e. g. course funding).
- **Clear competence frameworks and learning objectives on NBS** should be created along with assessment systems mirroring these frameworks.
- It is necessary to **encourage cooperation and knowledge exchange** to enable more effective use of **NBS demonstrators** as part of an education program, a coordinated **EU or Member State initiative**, or a **collective education strategy** which can pool resources, particularly where remote access can be achieved if physical or funding barriers exist.
- The initiation of a funding pool to support education curricula development for NBS can be highly helpful, with a **focus on the existing or planned demonstration sites** in which continuation funding for the education materials is provided with extended

support of the NBS itself, potentially through multiple levels of government, education institutions, and community initiatives.

- **Teacher training** is necessary for shaping students' awareness, understanding, and engagement with environmental and sustainability issues. Without proper training, teachers may lack the necessary knowledge, skills, and competences to effectively teach NBS concepts and put them into practice for the students.
- **Curriculum integration and supportive pedagogies** can support teachers in integrating NBS and LfS into the curriculum across various subject areas, including science, geography, and social studies but also in language training.
- **Competence development** can help teachers develop their competencies related to LfS and NBS. In addition, **evaluating outcomes** can guide how to assess student knowledge and skills related to sustainability, including the use of formative and summative assessment methods.
- **Educational Institutions could collaborate much more with government agencies, NGOs, and private organisations to promote NBS in schools.**
- Ministries of Education could further promote the development and uptake of **Green Schools or Eco-Schools programmes** that encourage schools to adopt sustainable practices, including Nature-Based Solutions.

2.2 Generating Creative Options for NBS in Education

Based on the above findings and recommendations, two focus groups (February 2023, April 2023) and a workshop (June 2023) were conducted with a diverse group of stakeholders, including NBS professionals, education providers, policymakers, and researchers (see [Annex 1](#)). The discussions and co-design activities aimed to explore the challenges and opportunities of promoting NBS education and knowledge-sharing, and to identify strategies for creating NBS communities that facilitate synergies between NBS professionals and education providers, ensure free and easy access to NBS knowledge and resources for all, and support a just transition to a sustainable future following the Whole School Approach.

The main objective of these activities was to further discuss and analyse potential opportunities, barriers, and challenges regarding the vision of the NBS Living Labs and actions that must be taken into consideration before the field trials start. Participants' involvement in these activities was the enabling condition for accomplishing research and technical objectives towards the scenarios of plausible futures for NBS in education, analyzed in Section 4. All participants were motivated to collaborate in idea generation by providing their perspectives on facts, their wishes and needs. User participation was oriented toward user research and interaction design. These methods were effective in gaining insights into what motivated individuals from different target groups to envision how they see the school environment or the community around them as NBS Living Labs.

Key Findings

NBS involves understanding and working with complex ecological systems by comprehending the interconnections between nature, human activities, and environmental challenges. Environmental literacy encompasses knowledge about ecosystems, biodiversity,

climate change, and sustainability. Therefore, **schools can emphasize environmental literacy within the context of NBS, enabling students to understand the ecological principles behind these solutions.** They can also integrate activities that encourage students to critically evaluate environmental problems, explore different perspectives, and propose innovative solutions rooted in NBS.

There is a higher participation of teachers from urban areas in NBS activities. **Further promotion of NBS in schools in rural and coastal areas should be done.** The fact that rural and coastal areas are so much closer to nature means that there is a lot of potential to apply NBS to those areas. A start could be to identify the main societal challenges to be addressed in those areas. Forest management and ecosystem services, for instance, could play a pivotal role in integrating NBS into rural and/or coastal schools.

Hence, it is essential to recognize that rural and coastal areas are crucial for NBS education, as they are near to nature, and are ecosystems responsible for the deliverance of important services and assets, such as healthy water, food, climate regulation, soil fertility and for the protection against climate-related hazards. To effectively implement NBS in these areas, it is necessary to take a bottom-up approach and understand the main challenges and issues that need to be addressed.

It is also essential to personalize NBS for each area, **encouraging a sense of ownership and participation among local communities.** In addition to environmental issues, social and economic factors should also be considered, such as participatory planning and economic opportunities. By taking a comprehensive approach, we can ensure that NBS is effectively implemented in rural and coastal areas, creating a sustainable future for all.

Therefore, integrating NBS should be a whole-school effort. There is a need for a holistic approach that involves all stakeholders within the school community and it's important to create a shared vision and values around sustainability and to foster a culture of environmental awareness and responsibility. The role of school leaders is highlighted in providing support, allocating resources, and promoting professional development opportunities for teachers to effectively integrate NBS into their teaching practices.

Processes that could involve society as a whole may be ambitious, but can be an **ideal opportunity to test and prototype co-design processes** and use platforms for more active citizenship, where students and local communities are more involved in making proposals and discussing policies to promote and implement NBS. In this sense, the Living Lab methodology could act as a co-design and participatory approach making people more aware and involved in higher decision-making processes, engaging schools, neighborhoods, communities, and municipalities.

Another important finding concerned the opportunities presented by the Living Labs concept **to create links between formal, non-formal, and informal educational settings. This is a very important part of the Living Labs, as it supports and increases the openness of a school to society** by bringing the school into cooperation with NGOs, environmental organisations, science centers, universities, etc. As a result, potential opportunities may arise by creating collaborative spaces that integrate different educational approaches. Field trips, workshops, seminars, and training programmes can be organised to complement classroom

learning, creating a supportive learning environment that encourages self-directed exploration and discovery based on practical experiences related to NBS.

One of the challenges in implementing NBS in education is the lack of knowledge and understanding of its potential benefits among students and the school community. This can result in a lack of engagement in local policies, especially among younger students, who may feel intimidated by the idea of participating in citizen engagement activities. **However, this challenge also presents an opportunity for NBS educators to align the competences outlined in the GreenComp framework with the knowledge and skills required for understanding and implementing NBS** (Annex 2). Therefore, schools can effectively integrate these concepts into their curriculum and promote a holistic approach to LfS.

Education policymakers stress the importance of incorporating NBS into the education system through supportive policies. They suggest the development of national or regional guidelines that explicitly integrate nature and sustainability into the curriculum. These guidelines would provide a framework for schools to incorporate NBS across subjects and grade levels. Additionally, policymakers stressed the need for adequate funding and resources to enable schools to implement NBS projects and outdoor learning experiences.

Teachers and educators emphasize the need to integrate NBS into the existing curriculum across different subjects. They highlight the importance of designing interdisciplinary learning experiences that allow students to explore and apply ecological principles in real-world contexts. This could involve incorporating field trips to local natural areas, integrating NBS case studies, and engaging students in hands-on projects that address local sustainability challenges. **Teachers also emphasize the need to align assessment methods to capture students' understanding of NBS and their ability to apply this knowledge in practical ways through their skills development.**

Teachers and researchers stress the significance of partnerships and community engagement in successfully integrating NBS in schools. This collaboration could involve joint projects, expert visits to schools for co-creation activities, and leveraging community resources to provide authentic learning experiences for students. It could also act as a decompression valve for teachers, since they note numerous obstacles with the most pressing being the lack of time and their lack of skills, resources, and confidence (Tasiopoulou, et al., 2022). They also highlight the importance of involving parents and the school community in NBS initiatives, fostering a sense of shared responsibility, and creating a sustainable ecosystem of support for schools.

The term "Nature-Based Solutions" can be a barrier to understanding for some, so it may be more effective to focus on specific examples such as school/community or vertical gardens, or other forms of nature in the schools and beyond. Such examples were analyzed according to the six dimensions (generated interest, achieved competence, co-creation opportunity, effort needed, usefulness, and relatedness) of the compiled spider chart (Annex 3).

Overall, there is a common belief in the importance of integrating NBS in schools through the WSA, however, this can only be achieved in a structured and targeted way.

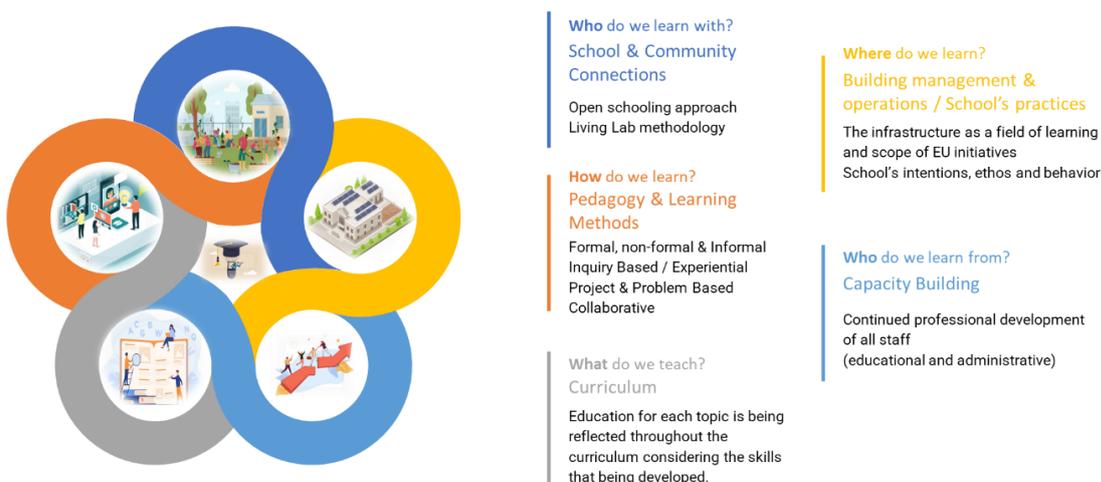
2.3 The vision of the NBS Living Labs in Education

Becoming an NBS Living Lab cannot be seen as an isolated ‘project’, as it demands a root and branch rethink, not just in pedagogies or the curriculum, but in every aspect of the school structure: its vision, culture, and the use of space, place, and time. Similarly to the Open Schooling concept, a school must act as an open, curious, creative, welcoming, and democratic environment that is supposed to support the development of innovative educational activities (Sotiriou et al. 2021). To this end, the vision of the NBS Living Labs is to create seamless and continuous learning pathways at all education levels, nurturing in parallel the understanding and implementation of NBS. By incorporating NBS principles and practices into the curriculum, students will develop the key competences towards pro-environmental behavior and action for addressing complex sustainability challenges. Therefore, schools have the potential to transform into incubators of social innovation where NBS acts as enabler of the WSA (Figure 1).

Some key steps of integrating NBS into each pillar of WSA are to:

- Form the vision of the organisation and invest in creating the right conditions. This includes the greening of the curriculum which means embracing a life-long learning approach that integrates NBS and sustainability into school curricula, training, workplace skills development, teaching materials, pedagogy, and assessment. The role of leadership is important to inspire people, guide and coordinate.
- Adopt an open culture of extroversion and collaboration with externals with the involvement of the whole organization community in meaningful and coordinated ways in proposing and co-creating approaches to what, how, and where they learn about the green transition and sustainable development.
- Monitor the processes and reflect on the long-term impact.

Schools as innovation hubs for the green transition: NBS as enabler of the Whole School Approach



Sources: The Whole School Approach Flower Model with its 6 key components (adapted from Wais and Matthe, 2022). <https://whtoleschoolapproach.lerenvoormorgen.org/en/>

Figure 1: NBS as enabler of the WSA

An “NBS Living Lab” school is both inward and outward looking and open in order to create a healthy habitat that invites and supports NBS and sustainability. It has adopted the concept of open schooling, and is an agent of community well-being by creating new partnerships with other local actors and addressing local issues relevant to them. In an NBS Living Lab school, students explore issues, relevant not only to themselves but also to others, and community partners can offer insights but also benefit from students’ interest, research, and creativity. The students are more rooted in their habitat and gain a sense of place and connectedness. For example, students, parents, and staff, with the support of a local NGO and the local authorities, can grow their food in a community garden or in the school garden, and use that food in the school canteen.

The teaching and learning are interdisciplinary and transformative. The learning methods and approaches are collaborative, experiential, inquiry and problem based, practically oriented, and relevant to local contexts. Much of the learning does not take place inside the classroom, but also in other spaces inside and outside the school building, as well as in the local community, in the marketplace, at the library, the museums, and through playing, reading, and sports activities. Visiting also a restored wetland or participate in its restoration. The boundaries between formal, informal, and non-formal learning are indistinct.

Basic pillars of education, such as design, content, and assessment for each topic are reflected throughout the curriculum considering the competences that are being developed. The development of the knowledge, skills, and attitudes of learners of all ages to live and act sustainably are supported by the GreenComp: the European sustainability competence framework which has been designed to support education and training programmes for lifelong learning. For example, by participating in the design and implementation of a pocket park, students develop competences such as promoting nature, supporting fairness, thinking critically, and acting for change. Bringing real-life projects to the classroom support also the development of 21st century skills.

An NBS Living Lab school acts as a learning building for sustainability. For example, it controls energy and water usage, waste management, the kind of food and nutrition that is offered, or the labeling of food options in the canteen menu so that students are aware of the environmental impact of their choices. It operates an organic school garden that, apart from acting as an open educational environment for all students, is producing a significant amount of vegetation being consumed in the school canteen. Or it reconstructs the schoolyard in a green space, and therefore a “cool island” during heatwaves, with the participation of students and external stakeholders in the co-design of the schoolyard, in the selection of the trees according to their characteristics and of course in the process of the planting. By interrogating, rethinking, and redesigning institutional practices, the hidden curriculum of unsustainability that is often present can also be exposed and addressed.

In an NBS Living Lab school all educators, whatever their discipline or sector of education, are considered as sustainability educators who need to support their learners in preparing for the green transition. For this reason, they have the expertise and continuous training opportunities to feel sufficiently equipped. Professional development is relevant also to all staff groups working at schools, e.g., cleaning the building, running the school canteen, maintaining the buildings and the school grounds, etc..

Under this vision, a planning exercise was done both for primary (Figures 2 and 3) and secondary schools (Figures 4 and 5) in Greece. The planning exercise aimed to represent schematically the vision of the schools as NBS Living Labs through the WSA.

Box 5 Structure of the diagrams for integrating NBS through the WSA in the Schools

For each grade, an NBS topic was chosen. Each NBS topic was linked to:

- the existing curriculum,
- various learning methods and approaches through different activities,
- potential stakeholders who will be involved,
- the societal challenges that will be addressed,
- the school building and the learning opportunities from this linkage,
- the necessary career professional development courses.

The compiled diagrams aim to be a point of reference and provide guidance for the transformation of the schools to NBS Living Labs through the WSA. A test exercise for the replication of the diagrams has already been done in one of the workshops that have taken place (Annex 4).

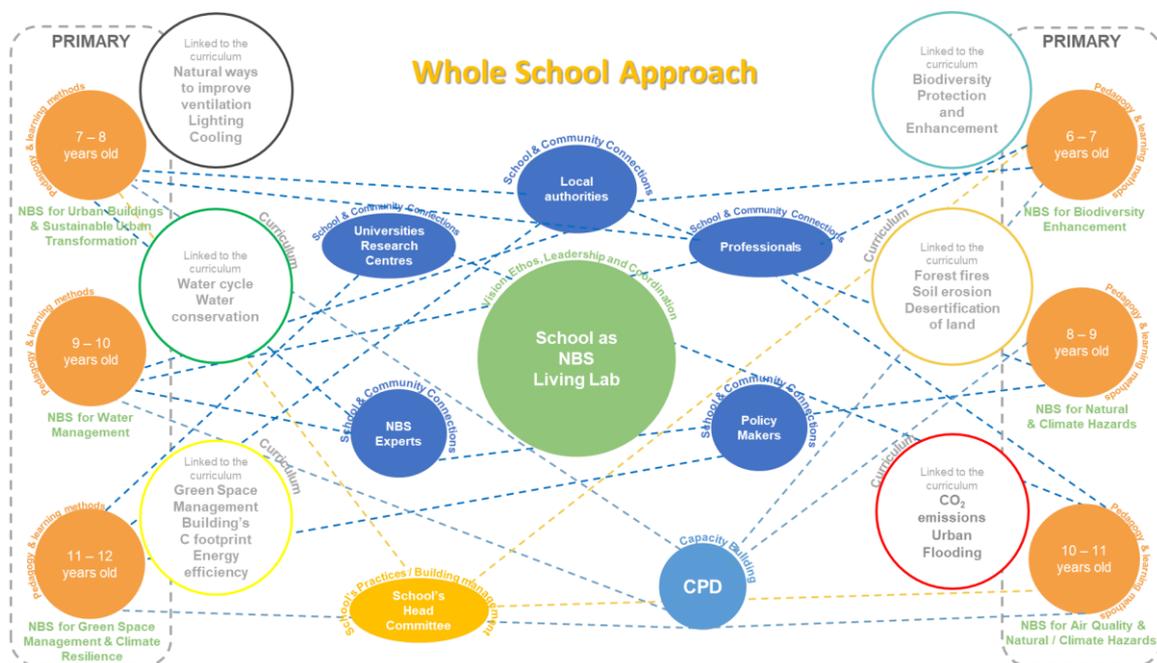


Figure 2: Diagram for integrating NBS through the WSA in the primary school

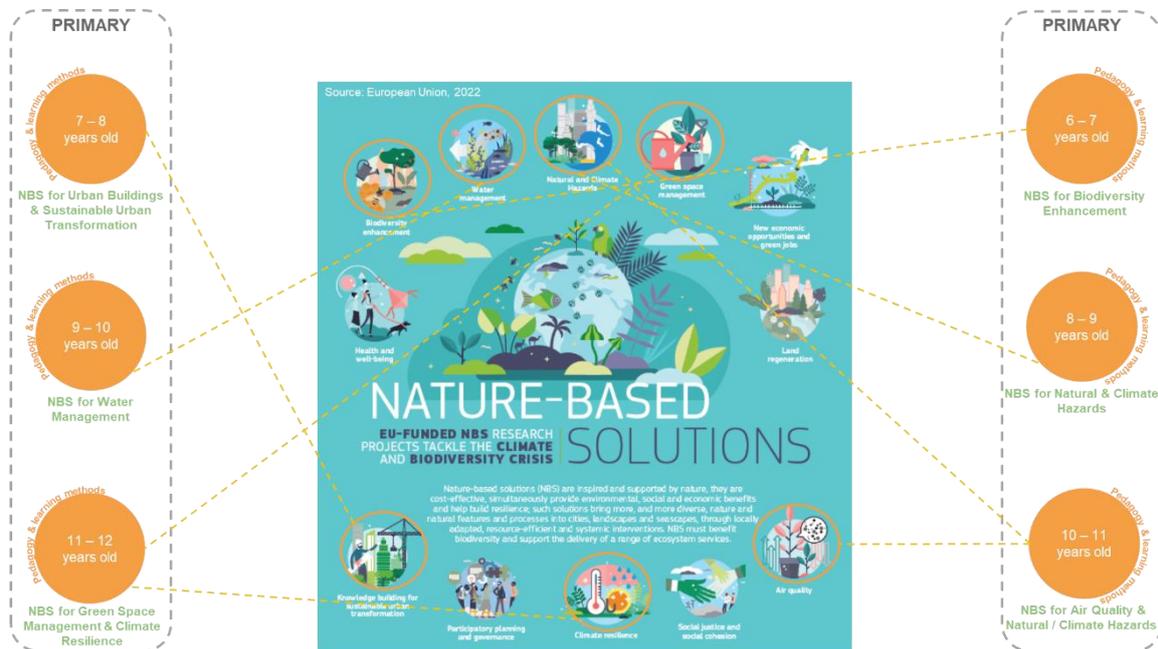


Figure 3: Linking selected NBS activities for each grade of primary to societal challenges¹

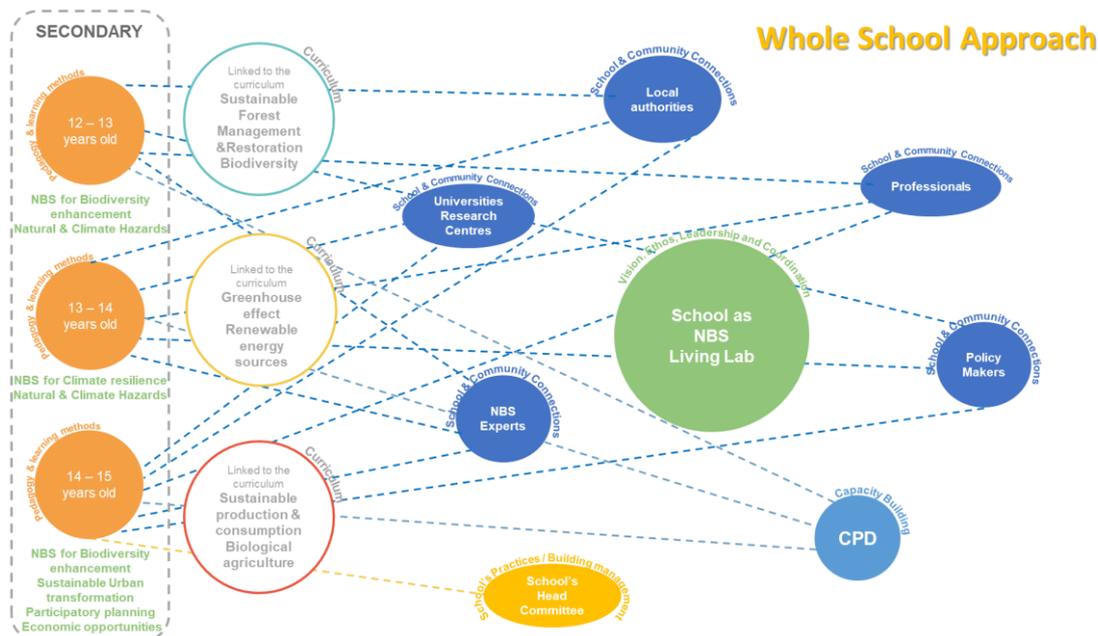


Figure 4: Diagram for integrating NBS through the WSA in the secondary school

¹ Image by European Union: <https://op.europa.eu/en/publication-detail/-/publication/aeb73167-0acc-11ec-adb1-01aa75ed71a1/language-en/format-PDF/source-227363718>

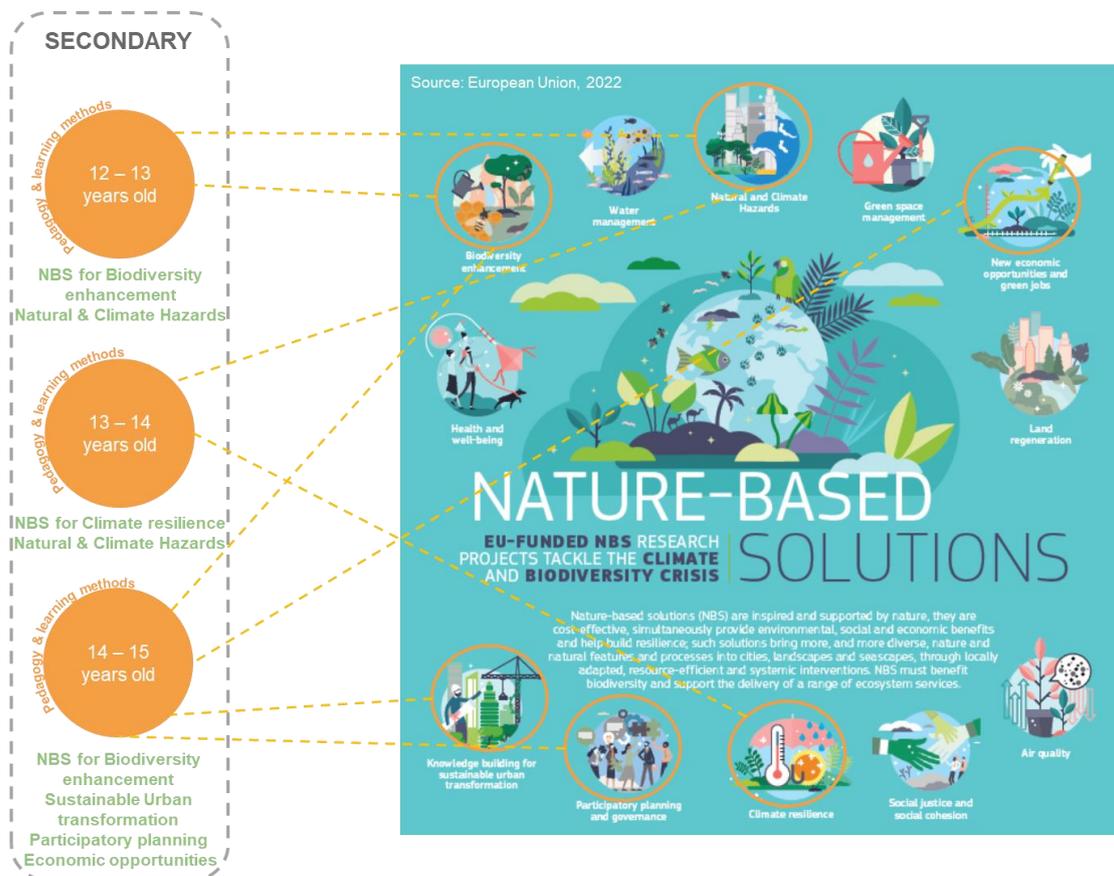


Figure 5: Linking selected NBS activities for each grade of secondary to societal challenges²

3. The Whole School Approach as a methodology for establishing the NBS Living Labs

After introducing the vision of NBS Living Labs as an enabler of the WSA in Section 2, the subsequent sections delve into a detailed analysis of the key pillars of the WSA, highlighting the key opportunities and challenges for establishing the NBS Living Labs. Furthermore, these sections examine how NBS EduWORLD intends to address the barriers and seize the opportunities that have emerged from various case studies worldwide either for NBS education or in a broader sense, on different NBS and sustainability-related projects at schools.

In this sense, and although the Whole School Approach (WSA) is not a new concept, in early 2022, a Proposal for a Council recommendation on learning for environmental sustainability³ identified that whole-institution approaches, where sustainability is incorporated into all areas

² Image by European Union: <https://op.europa.eu/en/publication-detail/-/publication/aeb73167-0acc-11ec-adb1-01aa75ed71a1/language-en/format-PDF/source-227363718>

³ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0011>

of activity, are not yet widespread in most educational institutions. Such approaches include teaching and learning, research and innovation, facilities, and operations and should engage students, staff, parents, and local and wider communities.

Thus, the WSA refers to a holistic, systemic, co-creative, and reflexive effort by all stakeholders involved in education to meaningfully engage students and in general, the school community in complex sustainability challenges. “Holistic” highlights the attempt to explore and address sustainability issues from multiple perspectives in an integrated and relational way. “Systemic” refers to considering key aspects of the education system simultaneously (formal, non-formal, and informal education, curriculum, pedagogies and learning, professional development, school-community relationships, school practices, vision, and leadership). “Co-creative” refers to the inclusion of multiple voices and stakeholders in the development of the approach within a given context either at a school or a policy level. At last, “reflexive” refers to the need for continuous learning, monitoring, evaluation, and re-calibration in response to an ever-changing world.

A WSA is a concept, in which multiple themes can be simultaneously addressed within the overarching umbrella of ‘sustainability’ or ‘sustainable development,’ not by reducing them to ‘learning tasks’, but as entry points to different ways of working and living, in light of current global challenges (Mathie and Walls 2022). In this sense, Section 3 provides an overview of how to transform schools into NBS Living Labs as enablers of the WSA in order to tackle sustainability challenges, introduce innovative topics and pedagogies, foster innovation, and strengthen collaborative and participatory learning and planning.

Analyzing some theoretical aspects of WSA and how NBS can strengthen WSA, a whole-school and interdisciplinary approach that includes students, teachers, families, and the broader community can help create a cultural shift towards a more sustainable future (Borgonovi et al. 2022). Hence, the creation of continuous learning pathways that begin in primary education through to secondary and higher education, is of paramount importance to ensure that young people are prepared to meet future sustainability challenges.

Tilbury and Galvin’s (2022:11) recent paper and Mathie and Wals (2022) highlight that WSA is the key to LfS and for applying it, the following starting questions need to be addressed by the school community:

- What is taught (curriculum; hidden curriculum)?
- Where does learning take place (classroom; school buildings; campus; community)?
- Who do we learn from (teachers; school staff; parents; partnerships)?
- How is learning taking place (action learning; participatory learning; critical reflective learning; values clarification)?
- Is there a culture of sustainability?
- Can staff, students, and wider community see the alignment between what, where, who, and how?

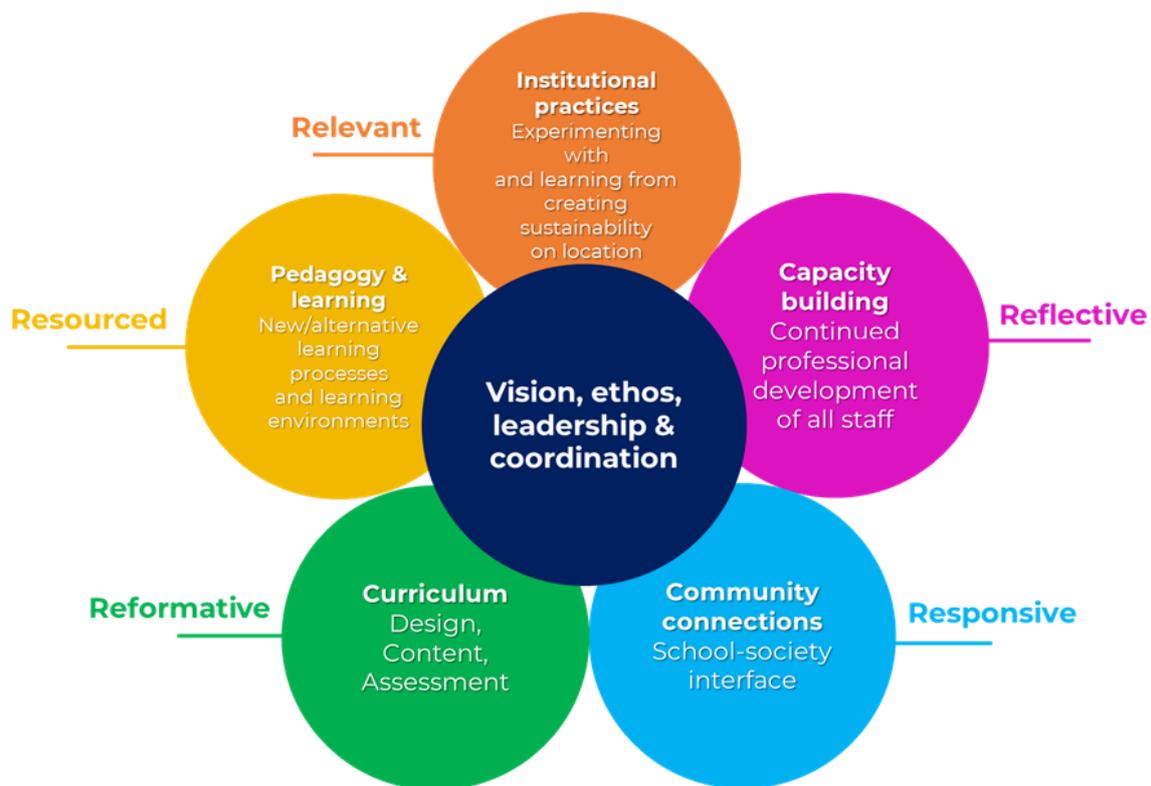


Figure 6: The Whole School Approach Flower Model with its six key components (adapted from Mathie and Wals (2022))

The input paper also concludes with a five-point summary, based on Henderson and Tilbury (2006), characterising an effective WSA scheme and vision:

- **Relevant** to the school’s mission; national educational priorities; community identity; as well as localised to the environmental priorities and regional needs.
- **Resourced** with expertise and support in sustainability and learning for sustainability; physical resources and technologies to make the transition; and medium-term financing opportunities to execute plans.
- **Reflective:** skilled in critical reflection and evaluation at all levels; developing critical thinking, digital and sustainability competences in its staff and students; striving to become a learning organisation.
- **Responsive,** by embracing a flexible structure and adapting to local and cultural settings; learners develop the capabilities to recognise complexity as well as the changing nature of sustainability challenges and reject a one size fits all approach to sustainability.
- **Reformative,** which means that the agenda is not simply one of adding environmental or SDG themes to the curriculum but involves reframing the entire educational experience.

Keeping in mind the above-mentioned characteristics of WSA, this section explores the application of the WSA as a holistic methodology for transforming schools into NBS Living Labs. Additionally, it presents the practical considerations and implementation strategies for establishing NBS Living Labs within the WSA framework, providing in parallel, the pathway of the scenarios developed (Section 4) for mainstreaming NBS education under the lens of WSA.

In conjunction with the key findings extracted and reported in Section 2, additional cases were reviewed with a strong focus on LfS with successful WSA case studies (partially or not) worldwide with a fifteen-year lifespan and they come from different countries including: Austria, Portugal, Greece, Cyprus, Germany, The Netherlands, Sweden, Norway, Finland, Malta, England, Northern Ireland, Turkey, Nepal, Japan, China, Uruguay, Kazakhstan, Canada, South Africa, Mongolia, India, Hong-Kong, Australia and the USA ([Shallcross and Robinson 2008](#); [WWF 2010](#); [Morgen et al. 2019](#); [Bosevska and Jeana Kriewaldt 2019](#); [Mulvik et al. 2021](#); [Mathie and Wals 2022](#); [Müller et al. 2022](#)). All case studies highlight how multiple aspects of a WSA can be engaged with, especially how these aspects can be integrated to mutually strengthen each other. In contrast, different drawbacks, obstacles, and concerns are reported to consider more effective, meaningful, and action-oriented WSA paradigms.

3.1 School's Vision and Leadership



The vision and leadership of a school within the WSA, aiming to integrate NBS, play a crucial role in promoting sustainability stewardship and practices. Such a vision emphasizes the recognition of the school as a hub for fostering connections between students, educators, and the natural world. By providing transformative learning experiences grounded in nature, the school cultivates a sense of responsibility and respect for the environment. The leadership of the school ensures the implementation of comprehensive policies and practices that prioritize sustainability and NBS, such as integrating nature and biodiversity topics into the curriculum, enhancing outdoor learning activities, and engaging with the local community to create a holistic and impactful educational environment.

To achieve this vision, the school's leadership must focus on integrating NBS into various aspects of school life. The leadership encourages teachers to incorporate nature-centered activities and field trips into the curriculum, fostering a deeper understanding of ecological systems and inspiring students to become eco-literate citizens. By creating opportunities for experiential learning, the school nurtures a sense of agency and empowerment among students. School principals, and overall the school administration, play a pivotal role in fostering NBS within their schools. They are responsible for establishing a collective vision that promotes a participatory process to engage the school community and external stakeholders. Moreover, principals need to prioritize the integration of LfS and inherently NBS principles into the daily life of the school, ensuring that sustainability practices are embedded in various aspects of the school's operations.

A school's vision and effective leadership also play a crucial role in forging partnerships. The school not only benefits from external expertise but also creates a broader impact by

spreading awareness and inspiring change beyond its immediate sphere. The leadership also allocates resources to improve the school's infrastructure, incorporating green technologies and renovation projects. Through these proactive measures and collaborative efforts, the school demonstrates its dedication to cultivating a sustainable and nature-centered learning environment (Müller et al. 2022). The case studies reported highlight as:

Strengths

- The existence of a powerful and convincing political vision and a structured legal framework.
- The existence of supportive management and long-standing school culture.
- The existence of strong leadership, vision, and sustainability coordinators.
- The ability to invest in sustainable solutions and funding opportunities and to seek external expertise where needed.
- The presence of consultation processes involving diverse groups of education stakeholders.

Challenges

- The teachers do not necessarily believe in its ethos or sustainability approach.
- Lack of support by national educational authorities to face the unique challenges.
- Finding staff who want to take on the coordination role.

Based on these statements, NBS EduWORLD aims at promoting a clear, long-term, and innovative vision for the NBS Experts Education community. Through Visionary Workshops, engagement with school principals, expert teachers, and a focus on co-design and futures thinking approaches, the project team aims to build a strong and dynamic community of practice centered around NBS in education. Organizing these activities at a local and international level shows an understanding of the importance of context and local relevance and this aspect is vital in ensuring that the “Vision” pillar aligns with the unique needs and characteristics of each community.

3.2 School and Community Connections



The process of forming school partnerships with external societal actors to enhance the implementation of NBS activities and projects raises questions such as:

- How are schools establishing partnerships with local environmental organizations, governmental and policy-making agencies, local businesses, NGOs, and universities to foster collaborations and access expertise, resources, and funding opportunities?
- How is networking and knowledge sharing encouraged among schools implementing NBS or those willing to be transformed into NBS Living Labs?

The answers are grounded on the Living Lab (LL) methodology and how schools can be transformed into initiators of co-creation and participatory processes or even prototypes of new ideas and concepts tailored to NBS. Thus, LLs seek the design principles and practices that constitute a potential field for creative innovation and support for promising initiatives on sustainability, offering competences, abilities, methodologies, and a unique viewpoint. Weighing in the ‘co-creative’ aspects, the LLs concept consists of a co-creative design offering an environment that aims to facilitate co-creation as an interactive scheme for collaborative research where multiple users play an active role (Munro 2017).

The LL methodology is issue-driven and exists within rich, complex, and contested real-world problems and challenges (Carew and Wickson 2010): those related to sustainable living. To this end, the theoretical basis for the co-creation methodology is transdisciplinary, in broader terms, defined as the attribution of knowledge from science in an issue-driven process (Hagy et al. 2017). The concept of LLs was introduced in academia in the 1990s by American scholars and proliferated in Europe from 2006 onwards when the European Commission started promoting the concept as part of its innovation policies. LLs are part of a broader family of laboratories that are operating in a real-world context (Urban Labs, Transition Labs, and Challenge Labs) and employing innovative approaches for the co-creation of technology, products, and services.

Many LLs are paying attention to the United Nations’ (UN’s) SDGs. Considering this, the European Network of Living Labs (ENoLL⁴), an umbrella organization for LLs, is defined as **“user-centred open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings”**. Openness (gathering many stakeholders from various domains with various expertise and competence), continuity (establishing trustful long-lasting relations between stakeholders), empowerment (enabling users to actively be engaged in the innovation process), realism (involved with real users in real-life settings during the development of the innovation), and spontaneity (detecting and analysing emerging need and ideas of stakeholder) are the key LL principles based on the description.

In this context, design-based participatory processes are suited to support youth development and empowerment, as long as they: i) provide spaces for experimentation, inviting youth to reflect and enact choices in a non-serious, playful environment; ii) offer opportunities for peer interaction, equal participation with adults, exploration of diverse identities, and elaboration of possible futures; iii) improve youth’s ability to understand and contribute to (trans)forming their life contexts, exercising skills for active participation and positive intervention (Windeløv – Lidzélius 2018).

Regarding educational settings and LLs, a representation of schools as LLs is too limited. According to Windeløv-Lidzélius (2018) there is a multitude of educational setups that may appear similar on an overall level, but on a more practical level are quite different. They conclude that it could be helpful for schools to understand how to better include, for instance, stakeholders wanting to test out technologies and processes, as well as how to go about being an innovation hub for the school community and the broader society. As such, concrete ways to approach science education programmes by fostering collaboration

⁴ <https://enoll.org/>

between schools and local communities, based on LL methodology and open innovation in Europe, are needed more than ever. Towards this pathway, several efforts are proposing to transform schools into LLs by adopting the concept of open schooling⁵ in science education.

In the 'Schools as Living Labs' (SALL⁶) project, the LL methodology is proposed as a new technique for the development of open schooling activities linked to science learning. Within the SALL project, 'Living Lab' is the methodology used to support the collaboration among different partners who want to address a concrete issue relevant for each of them, going through an LL cycle typically comprising of i) creating ideas together after exploring the issue, ii) quickly building some elements of the solution, which can be done in a cheap and fast way (often referred as prototyping) and finally, iii) testing the solution with users, and getting feedback to improve the solution. This cycle may be implemented several times, iteratively, to refine the solution at various levels. The key principles are (Vicini et al. 2012):

1. **Co-creation** and analysis including identifying needs, defining issues and coming up with ideas and a real solution, making use of the participants' personal experience,
2. **Exploration** and quick prototyping, as ideas are immediately put into practice and tested,
3. **Experimentation** by testing the prototype or scenario of the solution in real life and finally,
4. **Evaluation** by analysing the results of the experimentation to validate or improve the solution.

In the steps mentioned above, the central players are the school communities by initiating and participating in the co-design processes. Thus, schools were systematically engaged in the work of a project, involving students, teachers, and students' families in the processes of dialogue, mutual learning, and co-construction. As revealed from the project outcomes, teachers were more involved in the project planning and conceptualization process and more eager to express and reflect on aspects (of internal and external origin) that could facilitate or hinder the successful implementation of their school project.

However, some concerns are noticed about the actual practicability of such efforts, in particular - the LL concept consists of an ideal scheme to introduce such initiatives and actions. Nevertheless, the success of these approaches is dependent on effective communication, collaboration, and engagement of all stakeholders with the school community, which can be challenging in a complex and diverse educational setting. Overcoming these barriers will require a concerted effort from all education stakeholders, including educators, students, parents, and policymakers, to support the adoption and implementation.

Strengths

- The presence of experienced and flexible staff: professionals, who embrace projects.
- The support of the local community in the school's LfS projects.

⁵ <https://www.openschools.eu/>

⁶ <https://www.schoolsaslivinglabs.eu/>

- Successful collaborations with national and international organisations to provide an interactive and dynamic platform to learners.
- The existence of extra-curricular partners, out-of-school learning spaces.
- The financial support from partner municipalities and directorates.
- The creation of learning communities, linked by common goals in an informal and friendly atmosphere.
- Fostering extroversion through the involvement of external experts in LfS activities, that encourages pupils to evaluate the information given to them.

Challenges

- Lack of community engagement, since most parents want a “traditional” public school and not an alternative one.
- Collaborating with the local community and various stakeholders can be challenging, expensive, and time-consuming.
- Community motivation and budget constraints.
- Complexities of mobilizing a highly pluricultural community with different languages and perspectives.
- When referring to infrastructure maintenance, there is lack of budget and personnel to support maintenance activities.

Grounded on the Schools as Living Labs (SALL) methodology and the inherent participatory and prototyping design of NBS, the NBS Living Labs will provide a real-world context for LfS through numerous NBS challenges. In this way, the school community, including students, teachers, staff, parents, and local stakeholders, will collaborate in co-designing and developing hands- and mind- on NBS projects. Inclusivity ensures that diverse perspectives will be considered through the co-design processes, leading to more well-rounded and student/community-driven solutions. This process will be supported and guided by the NBS EduWORLD partners, the NBS EduHUB, and the NBS Experts Communities of Practice (CoP), as well as by already established networks with a strong focus on NBS and the LL concept from NetworkNature⁷ and SALL⁸ projects.

3.3 Building management – School practices



The potential opportunities of linking NBS to the physical and technical infrastructure and daily operations of the school are many, and include the transformation of the school building and the schoolyards to a sustainable, inclusive and beautiful learning space to teach different concepts in. Focusing on NBS, installation of green roofs, rainwater harvesting systems, green shady structures, tree planting, and overall, school yard

⁷ <https://networknature.eu/>

⁸ <https://www.schoolsaslivinglabs.eu/>

reconstruction, building management and operations, can encompass the engagement of the entire school and local community taking advantage of the LL methodology.

According to the “FIT FOR 55” legislative package⁹ that transposes the European Climate law¹⁰ into the national regulations, a European renovation wave that will concern almost all existing buildings, is proposed. Some of these examples are discussed in Sub-section 3.5.1, illustrating which of these renovations have already occurred in different European countries. In terms of sustainability, these plans are targeting a change of attitude in four dimensions:

- **Restoring nature:** So that we are prepared for rising temperatures, heat waves/storms, seasonal water shortages with a smart adaptation of the urban environment,
- **Increasing Environmental Handprint:** This will lead to profound behavioral change (knowledge, offers, and habits), with an increasing need for lifelong learning involving three generations working together to achieve sustainable global performance,
- **Footprint reduction:** Transitioning to reduced emissions, waste reduction and renewable energy is one of the most powerful ways for countries to reduce their Ecological Footprint with qualitative retrofitting and renovation in a circular approach.

Highlighting these dimensions, the creation of increased environmental handprint and decreased carbon footprint educational facilities, such as schools, universities, or science centers, involves a process that can promote formal, non-formal, and informal learning, foster healthy and high-performing learning environments, ensure responsible fiscal management of community resources, and showcase sustainability leadership by reducing the impact of the built environment. To this end, educational spaces hold great potential as innovation incubators and catalysts for sustainable design that is both attractive and affordable to everyone. The overarching goal of such actions is to engage students in the planning, co-design, monitoring, and renovation processes by collaborating with external experts, researchers, and different societal actors to promote the school’s vision, as presented in Sub-sections 3.1 and 3.2. In this context, students and overall, the whole school community see themselves as an integral part of the system as 'learning organisations' and 'central social centers'.

Building on these ideas, it has been agreed upon more recently that the right spatial articulation in schools offers the opportunity for hosting different activities. Education is a constantly evolving field with changes in pedagogy, technology, instructional programs, and enrolment, making it necessary for educational environments to be adaptable to constant change with minimal disruption and cost. Thus, the NBS Living Labs will be able to showcase innovative approaches and solutions, with the common goal of creating a school that promotes inquiry-, problem- and project- based learning and a sense of ownership among students and key stakeholders. Potential opportunities and challenges that are noticed are:

⁹ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

¹⁰ https://ec.europa.eu/clima/eu-action/european-green-deal/european-climate-law_en

Strengths

- The meaningful participation of students in decision-making about school life and their involvement in community-based decisions and actions.
- The realisation of staff about the importance of “unlearning” the deeply ingrained habits and expectations that stand in the way of sustainability.
- The long-term core staff members and long-term commitment to sustainability-oriented education.
- The cultivation of students’ innovative literacy and financial and economic literacy linked to entrepreneurial skills.

Challenges

- The uneven commitment by members of the educational team: due to national educational policies, teachers rotate and therefore there may be an unstable team.
- The different sustainability issues that schools in depopulated or rural areas are facing from those in urban areas even though the former are rich in nature and have strong human ties.
- The time and budget needed.
- The risk of greenwashing or the seeking of certification more as a label of merit, rather than as a way to promote real transformative changes at organisational level.

NBS EduWORLD, through the implementation of the NBS Living Labs concept, will support schools' institutional practices by incorporating sustainable practices, outdoor education, and student involvement in decision-making, as analyzed through the LL methodology. School gardens, green roofs, vertical gardens, pocket and biodiversity parks, and rainwater management concepts will be enhanced by community-based NBS projects and more advanced NBS concepts linked to disaster risk management, ecosystem services, and forest management. In this way, the project will create an enriched learning environment that fosters ecological awareness, critical thinking, and a deeper understanding of sustainability and NBS principles inside and outside school.

3.4 Pedagogy and Learning Methods



Over the years, scholars have continued to emphasize the link between sustainability, inquiry, and the founding principle that when it comes to addressing LfS, the pedagogy ‘is grounded in inquiry’ (Bosevska and Kriewaldt 2019). Hence, cognitive presence within a community of inquiry is found to be significantly related to both the reflection and critical reflection constructs of transformative and transmissive learning, and teaching presence is significantly related to the reflection subscale. In general, transformative learning, the process of ‘perspective transformation’, is an overarching concept that aims to develop autonomous thinking and to empower students to challenge old models and assumptions with tools of critical reflection and analysis. Critical reflection is fundamental to transformative learning, which invokes processes of reconstructing knowledge based on life

experiences and arriving at new ways of thinking and being ([Bosevska and Kriewaldt 2019](#)). The main practices and conditions essential for fostering transformative learning towards NBS education must incorporate:

- A safe and trustworthy learning environment that is democratic and open, and that promotes critical reflection and critical thinking.
- Experiential learning opportunities and linking formal and non-formal education.
- Learner-centered approaches to promote student autonomy.
- Feedback and self-assessment by ‘facilitators’ to participants, by participants to participants, and by participants to ‘facilitators’.
- Appropriate ‘facilitator’ characteristics, e.g., trustworthy, empathetic, authentic, caring, and sincere.
- The adoption of the cultural background of the participants in the school community.

The pedagogical approaches that need to achieve this, should be learner-centred, action-oriented, and transformative. While such pedagogical approaches describe the general character or guiding principles for designing learning processes in LfS, specific methods in line with these principles are still needed to facilitate the learning process. LfS favors methods that foster sustainability competencies through active learning and some methods may include ([Gough 2005](#); [Whitmarsh 2022](#)):

- Collaborative real-world projects, such as a service-learning project and campaigns for different sustainability topics.
- Vision-building exercises, such as future workshops, scenario analyses, utopian/dystopian storytelling, science-fiction thinking, and fore- and back- casting.
- Analysis of complex systems including community-based research projects, case studies, stakeholder analysis, actor analysis, modelling, and systems games.
- Critical and reflective thinking including through fish-bowl discussions and reflective journals.

These learning methods empower learners to take action to promote sustainable development under the lens of NBS. When teaching and learning methods for a specific setting or topic are chosen, they have to match the needs of the learner group (e.g., based on age, prior knowledge, interests, and abilities), the context in which the learning takes place (e.g., space in the curriculum, pedagogical climate, and cultural traditions), and the resources and support available (e.g., teacher competencies, teaching materials, technology and/or funding opportunities) ([Leicht and others 2018](#)). The strengths and challenges occurring in implementing such pedagogies, are defined as:

Strengths

- The location of the school (e.g., a small beach town), which facilitates students to work outside and connect with nature.
- The real-life responsibilities given to students.

- The raising enthusiasm among students to study with diverse learning methods and learning environments.
- The opportunity to integrate STEAM courses, citizen science projects, action research, cooperative learning, and storytelling into regular classes.
- The exploration of different ways, in which students can individually or collectively take action to address sustainability issues in practical ways.

Challenges

- To engage every teacher in the school and ensure that sustainability is implemented in different disciplines.
- The lack of significant pedagogical freedom for teachers.
- To engage students with topics that are unfamiliar to them, i.e., agriculture and school gardens.
- To keep track of all progress and have a clear action plan, when there is so much happening in multiple aspects of the school.
- To build hands-on experience for learners to understand problems and develop solutions, especially when there is a lack of teachers' confidence.
- The time needed for the preparation of new educational materials.
- Changing attitudes and social behaviors is a long-term effort that needs to bring students, parents, and teachers together.
- The different learning styles of the students. Varied tasks that suit and empower each student individually should be considered.
- Lack of teachers' knowledge and confidence to teach using these methods and approaches.

Through transformative pedagogies, NBS EduWORLD aims to engage the mind, body, heart, and soul for promoting a holistic learning experience. Since the heart of the NBS Living Labs will be the process where the students 'feel' the problems and the needs of their school and the local community, the focus of the NBS activities is on creating a pedagogical atmosphere of creativity, curiosity, collaboration, and participation. The philosophy of "head, heart, and hands" will guide the educational approach, ensuring a balanced integration of knowledge, emotions, and practical skills. Through place-based, experiential, and inquiry-based approaches, the school grounds and public spaces will be transformed into dynamic classrooms, offering hands- and minds-on experiences to foster a deeper connection to the environment.

To extend NBS EduWORLD's impact to students outside formal education, particularly to disadvantaged youth with limited access to school education, NBS EduWORLD targets STEAM Clubs and Youth Centres. Through interactive and participatory processes using performing arts methodologies, students, teachers, volunteers, and non-formal educators will collaborate to develop audiovisual products, raising awareness on different NBS concepts and sharing the knowledge acquired during the NBS EduWORLD activities.

In addition to that, non-formal and informal NBS education initiatives are part of a key goal of NBS EduWORLD through the implementation of projects or collective actions. Hence, long-term place-based non-formal NBS education initiatives promoted by three public organisations: i) Museum National d'Histoire Naturelle (MNHN); ii) Offaly County Council (OCC); and iii) Municipio de Almada (CMA), will comprise the main drivetrain for cultivating the mindset and supporting the institutional practices, not only in urban, but also in rural and coastal environments.

3.5 Curriculum



The principle behind holistic approaches to LfS is that students can learn through both a formal curriculum, and informally through the messages and meanings in their cultural surroundings. Teachers can serve as role models for students, and the messages conveyed in the classroom can be reinforced or hindered by the actions of other staff members, the general functioning and appearance of the school, and the school's link between students, parents, and the community.

The main characteristics of WSAs, not only in LfS, also rely on the existence of i) coherence, ii) policies, iii) transparency, iv) practice, and finally v) continuing professional development. Coherence in this context refers to the alignment between the formal curriculum and the specific LfS agenda of a school. Here, it is referred to as 'holism', in the sense of making LfS part of the ordinary school improvement process rather than an optional educational perspective. Policy and transparency refer to the degree, to which the purpose of school practice is shared and understood at all levels in the school, i.e., by students, staff, parents, and the community.

An essential aspect of creating an engaging and dynamic LfS program is to integrate it with relevant skills across various subjects and disciplines. This integration allows for a more seamless developing of skills, as they become part of daily educational activities and are not only limited to specific topics. A WSA to sustainability acknowledges that students' learning goes beyond the formal curriculum. Instead, schools acknowledge that the 'hidden curricula' is a powerful way of engaging learners in change and that its alignment with sustainability is necessary to support the principle of 'living what they learn' (Whitmarsh 2022). It is also believed that this more integrated and empowering approach can help replace a sense of fear and powerlessness with a pedagogy of hope and action when facing sustainability challenges (Bosevska and Kriewaldt 2019; Protopsaltis and Salomon 2022).

While teachers pass along the hidden curriculum, the information students gain from schooling is not explicitly taught. Field experiences, such as outdoor lab work, field trips, and on-site observations, have proven extremely successful in boosting students' knowledge of and engagement with the curriculum, as well as different soft skills, such as self-efficacy and communication. Such informal learning occurs, through self-directed, unintended, and tacit learning outside of curricular planning, when learners experience or co-shape the daily (un)sustainable practices at an educational organisation (Holst 2022).

Thus, through WSAs, all formal informal, and non-formal learning for sustainability is embedded within its localised socio-physical surrounding, implying that both governance,

communication, and the built and natural environment consistently practice sustainability. Such an orientation of both the visible and the hidden curriculum of sustainability aims to create an authentic sustainable learning environment in which everyone involved is empowered to design and create sustainable futures.

Strengths

- The connection of the curriculum to the GreenComp Framework¹¹ and the UN's SDGs¹² offers an immense opportunity for inquiry-based learning.
- The Top-down commitment from the national curriculum to support a WSA to LfS through the enactment of a Sustainable Environmental Education Policy.
- The provision of guidelines and encouraging of LfS.

Challenges

- The obligation for some schools, depending on the country, to follow the national curriculum.
- Teachers' focusing only on curriculum delivery.
- The lack of assessment and accreditation structure for following a LfS national curriculum.
- The lack of time to work with the subjects.
- The provision of more autonomy to the schools.

Part of the review of NBS EduWORLD focused on curricula mapping, with a view to the proactive integration of NBS in a whole-school scope and sequence towards LfS education. In Greece, as part of the national curriculum, the NBS Living Labs are set to be pilot-tested. The recent curriculum renewal has provided an opportunity for the development of comprehensive LfS practices, as LfS is an integral component of the Environmental Education Programmes. Consequently, schools have incorporated sustainability-related subjects into the existing curriculum at both primary and secondary levels, employing an 'implicit' curriculum approach through the skills labs concept. This approach, outlined in Section 2.1, fosters the integration of local and global issues and encourages the exploration of contradictions, tensions, and ambiguities. The successful implementation of environmental programs that align with the school administration's approval facilitates this vision.

3.5.1 Linking NBS to the Learning for Sustainability Education programmes

In Europe, the latest NBS-related climate initiatives aimed at transforming school environments, are typically carried out through co-design approaches, involving both current and potential users (i.e., the school community) of these spaces from the early stages of the design process. Despite the growing scientific evidence supporting the advantages of NBS in school transformations for climate resilience, the implementation challenges, and

¹¹ https://joint-research-centre.ec.europa.eu/greencomp-european-sustainability-competence-framework_en

¹² <https://sdgs.un.org/goals>

opportunities for scaling up such projects have not been thoroughly comprehended or systematically studied (Baró et al. 2022). In addition, there is no clear evidence or further insights on how NBS projects and activities are linked to the national curricula, taking advantage of different NBS topics to teach not only thematic areas related to sustainable development but to the broader concept of STEAM disciplines. For instance, linking NBS to geometry, biology, chemistry, or art classes.

Up until this point, there are creative and innovative pilot initiatives that strive to enhance schools' resilience to climate change effects while simultaneously creating healthier, more playful, and educational environments for children. These initiatives primarily focus on introducing some NBS interventions in schoolyards. Some of these notable projects include Oasis¹³ (implemented in Paris, France), Climate Shelters¹⁴ (in Barcelona, Spain), Care in School Environments¹⁵ (in Madrid, Spain), Patios for Clima¹⁶ (in Barcelona and Madrid, Spain), and the playgrounds renovations in the city of Poznań as part of the Connecting Nature project.¹⁷ These cities serve as examples, where NBS has been carried out in schoolyards and school neighborhoods with diverse socioeconomic and environmental conditions.

Nevertheless, it is highlighted that the co-creation aspects at all, or even some, stages of development of such projects of NBS with students/teachers and the entire school community to meet curricula requirements, are still missing. Hence, most of the examples linking NBS to LfS programmes, involve non-formal education and NBS experts, landscape architects, and engineers, however, the development of skills to be able to meet the needs of the school community and other community actors is not always the main component and driver of the co-design process.

Despite the fact that there is no clear evidence and analytical reports on how different NBS projects can be in line with the topics taught in the curriculum, the NBS EduWORLD State of the Art report for NBS in education highlights that it is feasible to integrate NBS also in formal education and by way of cross-curricular approaches. Strategies and best practices for incorporating NBS education into the formal curriculum involve linking students' learning with the practical implementation of NBS principles throughout the school's management, operations, procurement, and outreach efforts like in the above-mentioned projects for building and schoolyard renovations. Hence, supporting teachers in seamlessly integrating NBS and LfS, these strategies enable the inclusion of NBS across various subject areas including science, geography, social studies, and foreign language courses.

In addition, to further elaborate on the widespread adoption of NBS education, Ministries of Education and other educational institutions, including schools, have the opportunity to develop specialized curriculums that incorporate NBS as a fundamental component of their broader approach to education for sustainable development. Enhancing credibility and accessibility, establishing a dedicated online portal directly linked to the Ministries' websites

¹³ <https://climate-adapt.eea.europa.eu/en/metadada/case-studies/paris-oasis-schoolyard-programme-france>

¹⁴ <https://www.barcelona.cat/barcelona-pel-clima/en/barcelona-responds/specific-actions/climate-shelters-network>

¹⁵ <https://fontenebroschool.com/en/our-school/eco-school/>

¹⁶ <https://elglobusvermell.org/serveis/actuaciones/patios-x-clima-2/>

¹⁷ <https://connectingnature.eu/blog/modern-nature-based-solutions-pozna%C5%84-kindergartens>

for each country could serve as a valuable resource hub, providing teachers and educators with essential materials and information to enrich their NBS-focused curriculums. For example, the Learning Scenarios by pilot teachers in the EC-funded Integrating Nature-Based Solutions in Education Pilot project¹⁸, available in the NBS EduWORLD¹⁹ and Scientix²⁰ resource repositories and accessible for teachers worldwide, are an excellent tool for this. Yet, it hinges on the availability of learning materials for teachers and students, and teachers having a prior interest in NBS and support from their surroundings to teach project-based learning.

3.5.2 Green Competences and Assessment Schemes

In January 2022, the European Commission published GreenComp, as a reference framework for sustainability competences, followed by the GreenComp Community²¹, created for individuals and organisations to exchange and work together on green competence development. To assist in understanding, consistency, and integration of sustainability and LfS, GreenComp can be used in education and training programmes in formal, non-formal, and informal settings and for learners of any age. GreenComp identifies the competences for sustainability across four competence areas (values, embracing complexity, envisioning, and acting) (Bianchi, Pisiotis, and Cabrera Giraldez, 2022). The framework has already been applied, adapted, and further developed in several projects from early childhood education and care (ECEC) through to adult learning. These projects include two Erasmus+ Teacher Academies (Teaching Sustainability²² and CLIMADEMY²³) that focus on teacher professional development, as well as the Horizon2020 programme with projects, such as ECF4CLIM²⁴ and GreenScent²⁵, which enhance and apply the GreenComp across different levels of education and highlight the broad applicability of the framework.

Regarding the GreenComp and the abovementioned projects, the inherent need for competency-based education is highlighted that helps students not only to know a subject, but also to act on it. That is exactly what needs to be achieved, for the green transition and for NBS as enablers of the green transition. In this context, **GreenComp stands out as the most current and comprehensive sustainability competence framework**. It was developed under the auspices of the actions for the European Green Deal (EGD), emphasizing its significance in supporting educational efforts. Consequently, it possesses inherent flexibility, enabling it to cater to diverse objectives and allowing for customization to suit specific needs and competence areas (see Annex 2 for NBS-related competences).

It is also noticed that there are no other clear competence frameworks on NBS and only some, which mention NBS competences implicitly. Yet, there have been numerous other efforts to define specific competences for sustainability in academia (Waltner, Rieß, and Mischo, 2019; Barth et al., 2007; Vare et al., 2019). The 17 SDGs are closely linked to the

¹⁸ <https://www.scientix.eu/nl/projects/steam-partnerships/nbs>

¹⁹ <https://nbseduworld.eu/>

²⁰ <https://www.scientix.eu/>

²¹ <https://education-for-climate.ec.europa.eu/community/GreenCompCommunityGroup/about>

²² <https://tap-ts.eu/>

²³ <https://climademy.eu/>

²⁴ <https://www.ecf4clim.net/>

²⁵ <https://www.green-scent.eu/>

challenges NBS aims to address, and thus UNESCO's learning objectives for achieving the SDGs are very relevant (UNESCO, 2017). Several sustainability competences or SDG learning objectives may be relevant to teaching and learning NBS due to their relevance for NBS implementation (e.g., participatory processes, innovation, and ability to take action).

Other potential points for linkages could go through the emphasis on participation and connectedness in sustainability, which is also a crucial part of NBS. Another link is that NBS can contribute to innovation, creativity, and critical thinking in sustainability education. Thinking more broadly, NBS underpins the SDGs by, for example, supporting vital ecosystem services, biodiversity, access to fresh water, improved livelihoods, healthy diets, and food security. Improving biodiversity through NBS helps to mitigate climate change and create healthy ecosystems for all species. The link between NBS and sustainability competences, and in particular to the GreenComp Framework of the European Commission's Joint Research Centre is also being explored in detail throughout the work of NBS EduWORLD (e.g., in the MOOC for teaching NBS in the classroom, Learning Scenario templates, focus groups, (creative) workshops, events, etc.).

As highlighted by Sourgiadaki and Karkalakos (2023), there is no published research that is based on GreenComp yet. Consequently, it should be acknowledged that developing transferable assessment materials and methodologies to assess sustainability competences, especially tailored to NBS, might be challenging. The main reasons are identified as the lack of specific NBS-related competence areas, as well as the complex nature of NBS education that often requires a place-based and context-specific approach. Hence, this gap presents a challenge for educators to find helpful resources in developing their assessment methods. According to the NBS EduWORLD 'Assessment framework and guidance for the project's findings', the following statement is quite critical:

'To not assess students' NBS learning in any structured way, apart from observing whether the students seemed to be enjoying the class or hearing their informal feedback.'

(Interview with secondary school teacher for SOTA report).

In the assessment framework, it is also underlined that this example brings up the broader debate on the topic of sustainability competences assessment, pointing to the issue that there is still no explicit consensus on what is being assessed and whether assessment – at least in terms of traditional and standardized assessment – is effective. Since LfS requires a high degree of complexity and development of such competences as critical, systems and futures thinking, standardized assessments, such as exams and conventional testing, are increasingly seen as not apt for the job (Tilbury 2023). Thus, teacher observations and feedback may provide constructive assessment loops on their performance, leadership, systems thinking, teamwork, and problem-solving skills. Also, project- and performance-based assessments that focus on the competences developed during an NBS project may be beneficial by simply assessing students' level of engagement and motivation and the main reflection outcomes (i.e., hands-on activities, crafts, presentations, reports, or multimedia content showcasing their understanding and application of NBS principles).

Ultimately, self-assessment and reflection tools could be effective to encourage students and the school to self-assess their green competences through reflective exercises and questionnaires. This allows students and the school community to critically evaluate their

growth, evolution, and understanding of integrating NBS into LfS programmes. Another critical aspect of using self-assessment and reflection tools is to assess schools' openness and to what extent they were transformed into NBS Living Labs. Some key characteristics of the open schools and inherently the NBS Living Labs are (Sotiriou et al. 2017):

- **Promotes the collaboration with non-formal and informal education providers**, enterprises, and civil society enhanced to ensure relevant and meaningful engagement of all societal actors.
- **Supports schools to become an agent of community well-being** by creating a model of collaboration with local stakeholders and by using activities that require the involvement of different actors, linking the schools to their local communities on a much deeper level.
- **Promotes partnerships** that foster expertise, networking, sharing, and applying science and technology research findings, and that bring real-life projects to the classroom.
- **Develop and promote innovative educational applications**, share and apply research findings, support competencies, and competence-based curricula through creative problem-solving, discovery learning by doing, experiential learning, critical thinking, and creativity, investing in real scientific work and real-world problems.
- **Focus on effective parental engagement** i) embedded in a whole school or service strategy, ii) with an effective leadership and structured plan, iii) with active collaboration with parents and should be proactive rather than reactive, and iv) with strategic planning which embeds parental engagement in whole-school development plans, sustained support, resourcing and training, community involvement.
- **Teaching science for difference** encompassing gender issues and inclusiveness by replacing the competitive-type classroom environment with more and more inclusive instructional approaches in which enough time and conditions are given to think, inquire, and understand thoroughly.

Hence, assessing the effectiveness of the Open Schooling approach as a part of the WSA approach to schools needs appropriate tools that are sensitive to analyse the key characteristics of these environments mentioned above. Such self-reflection tools center on three key areas of growth, including i) school management, ii) school processes, and iii) teachers' continuous professional development. Through this approach, school community stakeholders have the opportunity to provide a detailed description of the current situation in their school by simultaneously utilizing the findings to formulate specific recommendations for future actions and improvements (Sotiriou et al. 2021).

3.6 Capacity Building



Continuing professional development (CPD) refers to the potential of LfS to profoundly change LfS education over time. In this sense, CPD is fundamental to the growth and improvement of the entire school community, since it ensures that all educators, administrators, and staff are on the same page regarding the school's vision, objectives, and

forward-looking ideas. CPD is not only essential for robust leadership, but it also enables teachers to stay updated with the latest pedagogical approaches and teaching methodologies, to develop skills in community engagement and partnership-building strategies, as well as to effectively integrate LfS into the curriculum and assess their students' competences development. Past experiences highlight the following strengths and opportunities, including:

Strengths

- LfS competencies at multiple levels (pupils, students, teachers, school leaders, school owners, and other university employees) through research and development projects, seminars, meetings, and field trips. Educating the whole school, not just a few teachers.
- The role of the educational advisor or LfS coordinator is to develop new projects and connect the ideas of the different working groups of teachers supporting 'in-house' capacity building.
- Training and other forms of personal development or team-building activities can help to motivate teaching staff.
- Training activities among schools and peer-to-peer teacher training schemes, for example, using web-based collaborative platforms.
- Parent teachers and professionals from the local community engaged in running workshops.
- Workshops and dissemination activities conducted by researchers from various universities, along with other external research projects (i.e., ERASMUS and HORIZON2020 projects) or partnerships.
- Top-down support, e.g., from the Ministry of Education for the Environment/ Sustainable Development or relevant governmental body.
- It is necessary to start from the level of "getting used to the community" and explore the field in ways that are suitable for the individual.
- School's capacity made stronger by being part of international networks or at local, national, and international partnerships.
- National mandates for teacher professional development each year.

Challenges

- In most EU countries, LfS is only an elective part of this obligatory in-service training.
- Teachers need more professional development concerning LfS and connected pedagogical approaches.
- Most of the teachers were in favour of the redevelopment, however, only about one fifth of the school's teaching staff became actively engaged.
- Developing teacher assessment instruments, evaluation schemes, or advanced training programmes is always a challenging task.
- Limited time is crucially preventing teachers from engaging in training activities.

- Too few LfS professionals to train teachers in the basic principles of what competences they need to acquire in order to teach LfS.
- What pedagogical practices to employ when tackling different LfS topics, and what innovative concepts/ learning tools to use to engage the classroom.
- Educational institutions fail to secure funding either due to a lack of national support or poor funding strategies to support CPD courses for LfS.

Following the opportunities for and the barriers of CPD, the NBS EduWORLD Academy for expert teachers aims to ensure and safeguard a long-term impact by implementing a series of training activities at local, regional, national, and international levels. These activities will assist teachers in designing highly effective and engaging lessons, numerous NBS projects, and embracing the LL methodology to the school's vision.

Additionally, teachers will have access to various educational resources, and tools, including rich scientific data archives and virtual and remote experimentation resources, to enhance learning experiences in their schools. This training will encourage teachers to adopt a fresh perspective on their students' understanding and engagement with NBS concepts and challenges. One recent opportunity in this direction is the MOOC "Exploring Nature-Based Solutions In your Classroom"²⁶ organised by NBS EduWORLD with the support of Scientix and Trane Technologies, ([European Schoolnet Academy, 2023](#)). These programs can cover a range of topics, from NBS concepts and practices to pedagogical techniques for teaching NBS and working with real-world problems to develop learning scenarios. They can also provide teachers with access to teaching materials and resources, as well as opportunities for collaboration and sharing of best practices.

4. Scenarios of Plausible Futures for NBS in Education

The European Commission works towards a higher level of focus and development in Europe on mainstreaming NBS in education and biodiversity awareness. To support these efforts from a long-term perspective, a scenario-planning exercise was done under this chapter. Scenario planning provides a structured way to get an impression of the future and can be considered as a tool to help us invent our future. Hence, the scenarios should not be read as end objectives in themselves: rather, they are ways to uncover the specific steps and challenges that have to be taken into account in bringing NBS in education when anticipating the future. The scenarios were constructed to provide 'food for thought' about longer-term developments for NBS in education. The foresight process facilitates understanding, informs decision making and highlights the triggers and dynamics of change.

Therefore, the scenarios are used to identify key 'drivers', uncertainties, baselines, constraints, opportunities, and potential points of mainstreaming NBS in education. They describe possible futures, but are not predictions. They are only meant as a perspective on

²⁶ <https://www.europeanschoolnetacademy.eu/courses/course-v1:Scientix+NBS+2023/about>

NBS in education to help provoke ‘what if’ discussions, develop roadmaps and discuss critical factors. The aim is to improve the collective understanding of the development of NBS in education, and its possible future. This in turn helps improve the vision of schools as NBS Living Labs and our understanding of the actions necessary for working towards the vision.

Why the scenarios (rationale)?

The rationale in delineating scenarios is to reveal and test assumptions, stress-test and future-proof plans, and generate shared visions for the future of LfS to support actions in the present. As the ‘Four OECD Scenarios for Schooling’ underlines, scenarios are fictional sets of alternative futures, they do not contain or consist of predictions or recommendations and recognise that there is not only one pathway into the future but many. Some of them can be imagined or described and other might be still unexplored or difficult to be delineated. To this end, section 4 analyses and discusses different scenarios of plausible futures of NBS in education considering three key aspects (OECD 2020):

- **Gain knowledge:** plausible scenarios provide a secure environment for education stakeholders to engage in constructive disagreements and challenge each other’s assumptions. By exploring potential future scenarios, we can release ourselves from deeply entrenched beliefs that may prove to be detrimental if left unexamined.
- **Surpassing obstacles:** Incorporating plausible scenarios allows us to contemplate the possible implications of a future, where the prevailing paradigms of our thinking have undergone a significant shift. This broader perspective enables us to grasp the ‘big picture’ of the future of LfS.
- **Shared vision:** plausible scenarios serve as valuable tools for establishing a shared understanding within schools and organizations, guiding their actions. Crafting scenarios as compelling narratives with distinct characters, events, and logical progression ingrains them into a broad thought process about future policies, initiatives, and actions needed toward LfS programmes.

It is crucial then to expand our perspectives beyond the confines of traditional policy boundaries and past individual experiences (at the school level) of LfS education and recognize the potential intersections among various developments. The rapid pace of change may be outpacing the capabilities of our deliberate and often time-consuming education policy processes. As exponential change unfolds, the education system must become more agile to effectively adapt and respond. To address this challenge, strategic foresight involves systematically considering future possibilities to make better decisions in the present. This approach is based on the understanding that predicting the future is limited, but by envisioning and exploring different futures, informed and well-grounded decisions can be made. Hence, such approaches offer the following benefits (OECD 2020):

- **Anticipation:** identifying what is changing and how to prepare for it; avoiding blind spots; considering developments that do not seem intuitively relevant, likely, or impactful.
- **Policy innovation:** revealing options for action that is meaningful under new circumstances reframing or refreshing our understanding of the present.

- **Future - proofing:** stress-testing existing plans, strategies, experiences, or policies by subjecting them to varying conditions.

Using these scenarios can help identify the opportunities and challenges that could be in store for mainstreaming NBS. Working with scenarios is useful for reflecting on the scenarios themselves as well as in the intervening processes of change, both in terms of broader social developments and potential reactions to them from the LfS.

What about LfS and NBS (overarching goals)?

Our schools are deeply rooted in our societies and our current ways of living, seeing, and thinking. Driven by policy, environmental and economic imperatives, NBS education is increasingly emerging across disciplinary boundaries, knowledge silos, and skill sets to deliver integrated solutions to address the causes and consequences of climate change. This can make using the scenarios a testbed of radical thinking, creativity, and imagination. But what are the main goals taken under consideration while structuring these scenarios?

Learning versus Education for Sustainability: Learning is not confined to traditional educational settings like schools; it also occurs formally, non-formally, and informally within the broader school community, families, societal actors, leisure and sports, and casual conversations. Nowadays, knowledge is readily accessible through various forms and channels, thus, specific teaching methods play a crucial role in converting practices like inquiry, experimentation, reflection, and critical examination of ideas into ingrained habits or routine ways of learning. Therefore, schooling continues to foster a solid foundation of trans- and inter- disciplinary knowledge, essential for grounding and advancing these learning practices. Could teachers and schools as well as education policy more widely address formal, informal, and non-formal learning together to a greater extent?

Conventional schooling or Open Schooling: The expectations regarding knowledge, skills (curriculum), and social norms in schools are not always experienced in the same way by all learners. Some students find these expectations congruent with those of their personal space bubble (i.e., family, friends) and community, while others perceive them as entirely distinct domains. These variations significantly impact how students navigate their school lives, influencing their academic performance, level of engagement, and sense of belonging within the educational environment. Looking ahead, it becomes even more crucial to consider how LfS is perceived within the broader social, economic, and cultural context. Furthermore, the question arises of whether conventional schooling or alternative education approaches can effectively address these challenges.

Localized or national pathways and initiatives: The above-mentioned concern regarding conventional or open schooling brings us to the participatory governance mechanisms that aim to improve shared vision and ownership by involving a wide variety of stakeholders in the policy-making processes. Nevertheless, the creation of public values for SD and LfS is subject to varying and occasionally contradictory perspectives, leading to tensions and inconsistencies between national (or international) priorities and local ones. For instance, when considering NBS, there are different needs, societal challenges, and sustainability problems to be addressed even in a different geographical context (i.e., urban, coastal, and rural environments). The processes of defining, measuring, and evaluating schools' objectives and their ability to achieve them can be influenced by different competing

perspectives and aims. The main question remains in the form of ‘Do we really need’ high-level policy driven approaches, locally-driven development, or both?’

Plausibility or business as usual: History has shown that integrating more complex sustainability topics (like NBS) into educational contexts, considering the complexities and constraints faced by teachers and learners, remains a challenging endeavour. A further drawback arises when such topics are introduced into schools without adequate pedagogical considerations (see Sub-section 3.5.1). One crucial aspect of introducing and integrating them into school policies for LfS is lifelong learning. However, formal education tends to prioritize training during the early stages, when teachers have less experience, offering fewer opportunities later in their careers when they have gained expertise. Transforming teachers to NBS Expert educators is not an easy task, nevertheless, striving for a more equitable distribution of quality resources and advanced training opportunities might be the key. Teachers’ networks, school collaborations, and strong links with the community may enforce such lifelong learning opportunities, but how is that more likely to happen?

Seeking for change - investing in the cultural shift: A cultural shift is essential to foster the adoption and integration of NBS in schools. This shift involves transforming mindsets, values, and practices to create an environment that embraces and nurtures NBS effectively. This encompasses direct funding and financial support, professional expertise, technical infrastructure, and active engagement of the school community, parents, and a diverse group of societal actors. Past experiences showed that there is space of plausibility to integrate such interventions in a school environment. Green roofs, harvested rainwater, floating stairs, photovoltaics, recycled water, and insulated floors are some of the cutting-edge technologies that have been introduced at school buildings²⁷ since 2017, however, some critical questions remain: Do these schools maintain these innovative interventions? Did they manage to act as incubators for their local communities? Are top-down approaches and just providing funding opportunities the key to success, or are more hybrid approaches needed (top-down and bottom-up) when we are seeking to create a culture towards sustainability challenges?

Who is interested?

Since education systems have evolved into more complex structures, involving a wide array of stakeholders and multiple governance levels responsible for decision-making and implementation is even more challenging. Notably, local autonomy has granted space for a diverse range of actors to actively participate in shaping educational policies even at smaller scales. That said, these stakeholders contribute through increased levels of engagement, feedback and support, but they may also express resistance to certain initiatives or reformations. This has led to the emergence of various formal and informal networks, such as school-to-school and teacher professional partnerships, as well as collaborations between educational services and providers in other sectors.

In this context, we must carefully assess the responses and reactions from diverse stakeholder groups to determine how they may either support or impede progress and visions towards desired policy objectives for LfS. Therefore, it may be necessary to reformulate goals collaboratively to ensure successful policy implementation.

²⁷ <https://www.ekathimerini.com/society/219169/modern-sustainable-schools-rise-up-in-attica/>

Scenarios of Plausible Futures Development (How)?

The primal step for delineating the different scenarios for NBS in education is to identify key challenges, opportunities and potential futures thinking, based on current knowledge and findings from the desk research conducted. Moving a step forward, multi-level co-creation activities were organized, involving various stakeholders, such as school principals, educators, coordinators of LfS education, education policymakers, NBS experts, and researchers. The scope of these activities was to facilitate open discussions and co-design activities to explore different perspectives on mainstreaming NBS in education, potential barriers, and ideas for future developments and needs. Individual interviews, focus group discussions, and one creative workshop were conducted based on design thinking methodologies, in order to ideate and envision future scenarios for NBS in education and how the NBS Living Labs will act as enablers of WSA.

Figure 7 illustrates the elements and the process for identifying the rational, common themes and user needs, the opportunities, and finally, the challenges that could be in store for NBS in education.

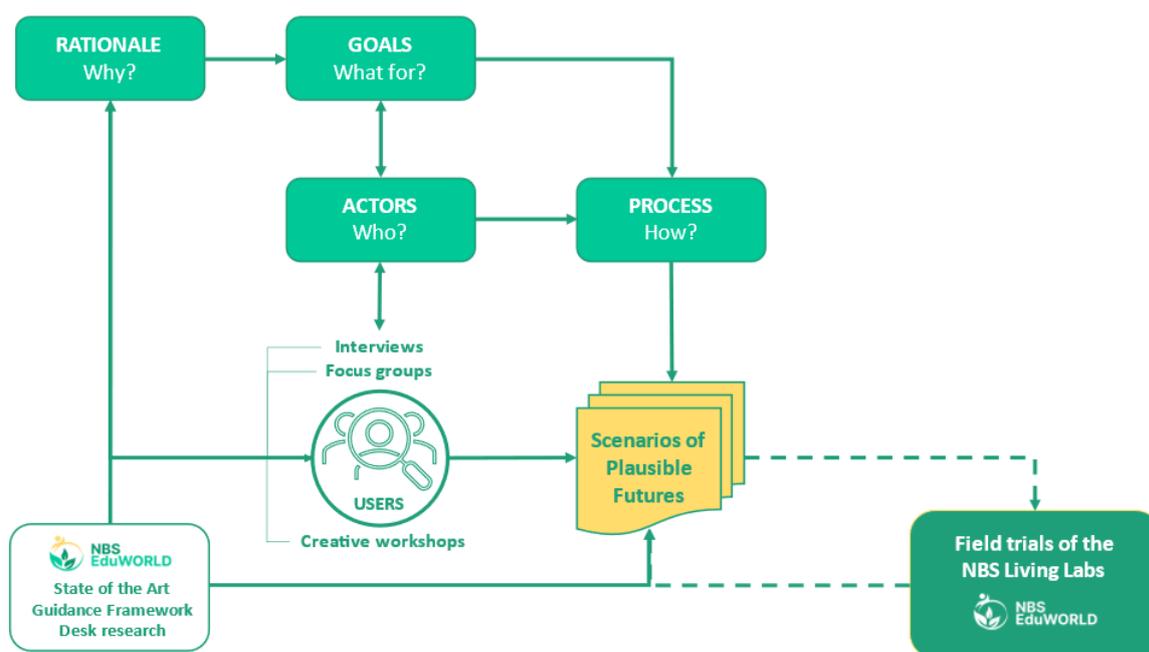


Figure 7: Structuring the Scenarios of Plausible Futures for NBS in education

Thus, by consolidating the insights and ideas generated and identifying these common themes, strategies, patterns, and emerging trends related to NBS in education, scenarios of plausible futures were developed. By sharing the developed scenarios with the stakeholders and seeking feedback and validation, suggestions, and refinements incorporated, we have been able to ensure that these scenarios are comprehensive and realistic representations of potential futures for NBS in education. In the following sections, the scenarios are presented, as well as how they match the identified users' needs.

What should be highlighted, however, is that the scenarios presented at this initial stage are only one starting point for the field trials of the NBS Living Labs. Through the evaluation of

the implementation experiences and the user's feedback generated, the scenarios will be further revised, enhanced, and analysed, so that they describe potential futures that best respond to the various local and national needs, priorities, and circumstances.

4.1 Transformative Elements and Critical Factors

The scenarios presume that schools are transformed into NBS Living Labs following the WSA. This transformation must be studied in light of some critical factors and is promoted by certain transformative elements.

Transformative Elements

Renewed Education and Training Systems. The traditional boundaries of education and training are becoming increasingly fluid. Inequities in education throughout one's life necessitate personalized and integrated approaches to enhance skills in schools and beyond. To facilitate learning, educators and trainers must rethink their everyday working activities, while collaborating with communities, businesses, NGOs, and other learning providers. The demand for entrepreneurship, innovation, and creativity in the job market requires educational institutions to create environments that embrace trial and error, allowing for failure not only among students, but also among teachers. This transformation extends beyond the education system and requires a broader societal shift starting with parents.

'If we teach today as we taught yesterday, we rob our children of tomorrow'.

John Dewey - philosopher and educational reformer

Fostering diverse talents and competencies calls for less competitive and more participatory learning approaches that enhance the civic and social skills of learners and contribute to dynamic democratic processes. It also demands a significant shift in attitudes and teaching methods. These changes necessitate new responsibilities and roles within the education system, including ensuring the well-being of learners and teachers, providing digital support, coordinating stakeholders, and more. To navigate complex and interdisciplinary contexts, school leaders, teachers, trainers, and other educational staff require robust support systems, as well as increased social recognition and improved working conditions.

Enhancing Skills and Competences serves as a pivotal driver for promoting sustainable behaviors and enabling individuals to lead more environmentally conscious lives. A significant majority of European citizens believe they can actively contribute to the ecological transition and recognize their responsibility in doing so, creating a crucial foundation for behavioral change.

In addition to the aforementioned points, transitioning towards sustainable lifestyles necessitates the acquisition of new skills and competences. Sustainability competences empower individuals to comprehend the challenges associated with climate change and the environmental impacts of human activities, enabling them to engage in actions that foster a sustainable future. These competences include valuing sustainability, promoting nature, and necessitating regular exposure to nature to appreciate its significance for human well-being.

Establishing an education system and raising awareness about sustainable and healthy lifestyles can facilitate long-term cultural shifts towards sustainability when supported by a comprehensive framework and empowering individuals. Children play a pivotal role as change agents, as young activists drive governments and businesses to prioritize environmental consciousness, while many parents acknowledge that their children inspire sustainable behavior at home.

Intergenerational activities can further strengthen the influence of environmentally conscious lifestyles when integrated into lifelong learning systems. Existing lifelong learning systems need to adapt to implement inclusive, participatory, and cross-sectoral actions for sustainability. Personal, social, and civic competences are indispensable for driving change. Skills, such as: adaptability, systems thinking, critical thinking, futures literacy, political agency, collective action, individual initiative, and self-awareness, are vital for personal fulfillment, social inclusion, continuous employability, and active participation in society. Businesses increasingly emphasize the importance of qualities such as flexibility, collaboration, empathy, and entrepreneurship for future employment. However, schools and students report declining levels of well-being, as well as widespread cyberbullying, hindering effective learning and impeding the prospects of many young individuals. Social and emotional learning can nurture competences, such as curiosity, creativity, resilience, and tolerance, serving as essential building blocks for the mental and physical health and well-being of both children and adults.

The Digital Transformation of both the economy and the public sector presents new prospects in terms of career opportunities and access to services. However, it also brings forth challenges related to equality and the protection of fundamental rights. Developing digital competencies is crucial for individuals, including children and adults, to responsibly utilize and engage with digital technologies in areas such as education, employment, and societal participation.

These competencies encompass skills like information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. All citizens must possess basic digital skills to effectively communicate, actively participate in society, and access public services. Additionally, all forms of learning should integrate essential digital competencies to equip young people and adults with the ability to adapt to future jobs and societal changes. Teachers and trainers, therefore, need to regularly update their own digital competencies to effectively facilitate teaching, learning, and assessment activities.

People as drivers for change. The significance of nature, relationships, and the need to uphold well-being while promoting sustainability is increasingly acknowledged. In this regard, society is actively exploring novel democratic practices and innovative models that empower individuals to drive social change and reassess the social contract.

The European Union is taking on a more proactive role as an agent of transformation. Simultaneously, the need for coordination and alignment of policies across various levels has emphasized the crucial involvement of regions, cities, and other societal actors in effectively executing a comprehensive set of policies, given the escalating complexity and interconnectivity of crises.

Critical Factors



Culture of Openness. Having such a culture means that educational institutions partner and engage with families and local communities to enhance teaching and learning. Education is linked to the development of skills and life-long learning. The learning opportunities are available outside formal education and the boundaries between formal, informal, and non-formal are indistinct. To this end, education is at the heart of society, and is becoming integral to local community development, since open schooling activities can stimulate real scientific work, are inspired by local needs and address real challenges.

Society-Nature Relationships. Understanding the dynamics of society-nature relationships extends beyond mere natural resource management, as it is crucial to grasp how societies engage with and perceive the natural world. It involves comprehending the values, norms, and institutions that shape each country's population connection with nature and exploring how these elements can foster sustainable forms of development.

Geographical characteristics. Geographical characteristics play a significant role in determining the feasibility and effectiveness of implementing NBS in schools. Therefore, schools need to be classified based on the socio-economic and environmental challenges pertinent to a specific local context.

The location of a school, whether it is situated in an urban, coastal, or rural area, directly impacts the types of interventions that can be integrated into the school environment. For instance, schools located in urban areas with limited green spaces may face challenges in implementing large-scale NBS like creating gardens or natural play areas. However, they can explore alternatives, such as vertical gardens or rooftop green spaces to optimize the available area. In contrast, in rural areas people are usually closer to nature, both in their personal and professional life and schools may have more access to natural resources and outdoor spaces, allowing for a broader range of interventions, such as nature trails or wildlife habitats.

Additionally, the climate and the biodiversity of a region influence the choice of NBS. Schools in regions with abundant rainfall may consider implementing rainwater harvesting systems, while those in arid areas might focus on water conservation initiatives. In the case of coastal ecosystems and low-lying areas, communities living close to the coastline – specifically with poor socio-economic backgrounds dependent on coastal resources – are most likely to suffer from the adverse impacts ([UNDRR 2019](#)) and must examine other alternatives. Overall, the geographical characteristics of a school's location profoundly influence the design and implementation of NBS interventions, requiring adaptation and customization to maximize their benefits for students and the surrounding environment.

Socio-economic characteristics. Green and blue spaces are particularly beneficial for the health and well-being of certain socio-economic and demographic groups. People of lower socio-economic status reap greater benefits from urban green space than more privileged groups, especially in terms of reducing stress and improving mental health ([Thompson et al. 2016](#); [Marselle et al. 2020](#)). However, there is unequal access to urban green space, and evidence from across Europe shows that green space is available less in lower-income urban neighbourhoods, than in higher-income ones. Moreover, green space in neighbourhoods of lower socio-economic status is often of lower quality than that in wealthier

neighbourhoods, reducing people's motivation to use it (Csomós et al. 2020; de Vries et al. 2020; Vierikko et al. 2020).

Concerning children and young people, the United Nations Children's Fund²⁸ recommends safe public access and provisions for various groups to use green space simultaneously. For instance, the greening of school grounds is strongly recommended, as this can lead to more active play, as shown by the example from Flanders. Moreover, the example from Paris (section 3.5.1), shows how greening school grounds benefits not only children, but also the wider community, when school grounds are open to the public during heatwaves. Community gardens, or urban farms, provide direct contact with nature, physical activity, and a source of fresh food for disadvantaged and vulnerable groups. In addition, they offer opportunities for social integration, education, and even professional development and small scale entrepreneurship (Interreg Europe, 2020; Oscilowicz et al., 2021). The participation of vulnerable groups in the planning of green space can support their social inclusion, ensuring that specific needs are taken into consideration, and fostering their trust in and identification with the project. This participation is likely to increase future usage of the space (Hansen et al., 2017; Wilk et al., 2020).

In practice, as stated in the NBS EduWORLD State of the Art report for NBS in education, including disadvantaged groups can be a challenge.²⁹ According to an interviewed expert, when the school organises a visit to the park with bicycles, students of more humble backgrounds usually report sick that day because they don't have bicycles to join the visit. This requires further thinking on how to include socially disadvantaged groups as well as to remove any stigma they might experience, as they report being sick to cover the real reason for not attending a visit to the NBS education-related park.

Collaboration between all stakeholders involved inside and outside the schools, is essential for a comprehensive blend of measures. For public and private investments to yield desirable outcomes, they must be accompanied by an updated regulatory structure. Furthermore, education and public involvement play crucial roles in fostering harmonious connections with emerging business models that prioritize environmental and social sustainability over resource extraction. A win-win approach appears to be more efficient.

Bonding and maturity of the communities. When communities come together, develop strong relationships, and exhibit a sense of unity, they create an environment conducive to embracing the value of nature and its preservation. Through shared experiences and a common goal, the community fosters an appreciation for the natural world and recognizes the importance of sustainable practices. By collaborating with community members, schools can leverage local expertise and resources to design educational programs that emphasize environmental conservation, biodiversity, and the implementation of NBS. The bonding and maturity of communities empower schools to nurture future generations with a deep understanding of the interconnectedness between humans and nature, fostering a sense of responsibility towards protecting the environment.

²⁸ [United Nations Children's Fund](#)

²⁹ <https://www.eea.europa.eu/publications/who-benefits-from-nature-in>

4.2 Scenario 1: Flourishing from inside out

In this scenario, innovative schools, which already have a vision and effective leadership, follow the WSA and they are transformed into NBS Living Labs showing the way. The schools themselves are the initiators, the designers, and the leaders of the processes:

- **Innovative schools could act as learning buildings** and prioritize resilience-building. The school buildings themselves could be designed as green spaces with climate-resilient biodiverse rooftop gardens, vegetable/herbs gardens, renewable energy installations, orchards and composters, and interventions, e.g bio-climatic canteens, which would be integrated into the learning process.
- **Innovative schools could follow interdisciplinary approaches and outdoor learning** for teaching about NBS concepts, with dedicated nature classrooms and outdoor nature trails. They could actively engage their students in solving environmental challenges and project-based learning, by participating in hands-on activities, such as planting trees, creating rain gardens, and designing green infrastructure. In this way, students gain practical skills and knowledge, and develop a deep appreciation for nature.
- **Innovative schools could become centers for capacity building**, providing training programs for school members, both educational and administrative.
- **Innovative schools could prioritize community engagement and collaboration** with local communities, government agencies, and environmental organizations to implement NBS projects and share best practices. They could leverage partnerships with universities and research institutions to enable students to have access to state of the art research facilities, where they could work alongside scientists and experts. Students could participate in service-learning projects, working closely with community members to design and implement NBS. The schools could serve as knowledge-sharing platforms, hosting conferences, seminars, and exhibitions that attract researchers, policymakers, and practitioners from around the world. By involving the wider community, schools would foster a sense of ownership and promote sustainable practices beyond the school grounds, creating a resilient and ecologically aware society.

Analyzing and providing more specific potential futures on the '**Flourishing from inside out**' scenario, we have to consider the different ways, in which schools could potentially delineate their own pathways for NBS education. The pillars of the WSA that are initially fully activated, are 'Capacity Building' and 'Community Connections', acting as enablers of innovative pedagogies, taking advantage in parallel of the institutional infrastructure as a field of learning. Partly activated is also the 'Curriculum' pillar, since this kind of schools usually propose their own curricula, even if there is no related supportive policy (see Figure 8).

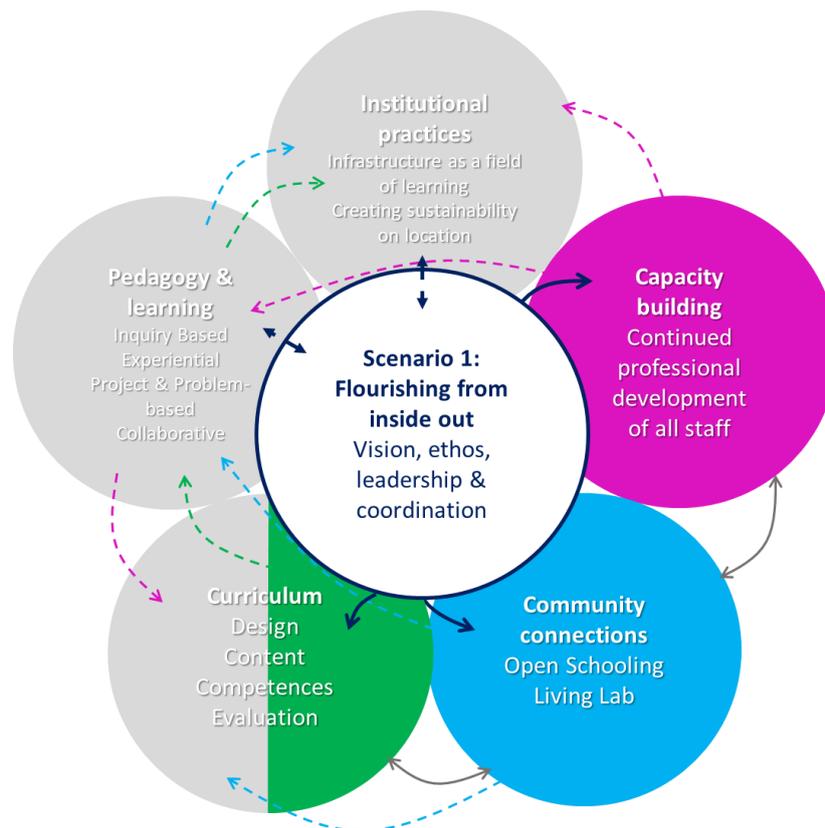


Figure 8: The WSA-activated pillars in the “Flourishing from inside out” scenario

Some shining examples, or ‘ingredients’, of schools taking the lead and inspiring positive change in their communities by integrating NBS education, may include the following aspects as part of sub-scenarios and actions needed to transform a school into an NBS Living Lab:

Leadership, vision, and community outreach: The key pillar is an innovative school with a strong commitment to LfS and effective leadership, investing in training opportunities for both principals and teachers. In this way, the school community recognizes the urgent need for cultivating the mindset and integrating NBS inside and outside the school and is determined to take action. The school could take on a leadership role and act as the lighthouse and the initiator in promoting NBS education within the local community. To succeed, both principals and teachers would participate in numerous training programmes and projects at national and international levels (i.e., ERASMUS KA1 Mobility Actions³⁰ and the Teacher Academies³¹). Also, they would organize workshops, seminars, and awareness campaigns to inspire the school and the local community to share knowledge and adopt NBS practices. These activities could be co-organized with local organizations, universities, research centers, and municipalities.

Collaborating with the local communities: Gaining expertise on NBS through training and knowledge sharing, the school could reach out to environmental organizations and NBS experts and researchers, seeking collaboration and support. The main goal is to start forming

³⁰ <https://erasmus-plus.ec.europa.eu/opportunities/opportunities-for-organisations/>

³¹ <https://education.ec.europa.eu/education-levels/school-education/erasmus-teacher-academies>

partnerships to access knowledge, resources, and practical guidance for their NBS projects. Through experiential non-formal and informal activities, e.g., field visits, virtual and remote learning tools, students would engage in multi-level NBS activities and projects. They could observe and document the changes in a restored ecosystem, conduct research and analyze data to understand the ecological impact, investigate the added value of a green roof or a pocket park, or how researchers are managing natural disasters based on NBS. To complement the on-site learning experience, the school could provide students with access to virtual and remote learning tools or case studies from different NBS projects.

Initiating the NBS Living Lab and integrating NBS in the curriculum: Having been exposed to different NBS-related activities and training, the school could take the initiative to be transformed into an NBS Living Lab, hence, mainstreaming NBS-related activities at all grades and linking these activities to the curriculum (i.e., environmental education programmes, sciences classes, skills labs, sustainability clubs). Integrating NBS and greening the curriculum would not be done at random, e.g. by merely linking some activities or projects to different grades. This process would be based on the learning outcomes and the competences to be developed. The school would identify teachers, who might have an interest and/or expertise in environmental science, ecology, and ecosystem restoration. These NBS teacher experts would become the driving force behind the design and implementation of the NBS Living Lab curriculum. In addition, based on the motivation and willingness of the NBS teacher experts, the school would form NBS Clubs to engage students in various NBS projects and awareness-raising campaigns. The NBS Clubs, with the support of teachers and administration, would integrate NBS principles into the school's curriculum, focusing on LfS across subjects like science, geography, and social studies.

In this way, the NBS Living Lab idea becomes an integral part of the school's curricular and extracurricular activities. Teachers incorporate NBS concepts into various subjects, such as biology, geography, and social studies, fostering inter- and trans- disciplinary learning. The overarching goal is to create continuous learning pathways, where the students start to be 'exposed' to NBS at an early age, ending at the secondary school to be experts on different sustainability challenges by acquiring green, digital, and transversal skills. The school involves students, teachers, parents, education experts, and sustainability coordinators in the process, garnering support for their ambitious vision.

4.3 Scenario 2: Open the way from outside in

In this scenario, Ministries, Directorates, Municipalities, and Organizations collaborate to develop a stepwise design to scale up NBS in Education establishing the schools as NBS Living Labs. They develop comprehensive frameworks that integrate NBS principles into the curriculum at all educational levels. The transformation comes through policy integration, capacity building, funding mechanisms, and collective knowledge exchange and networking, fostering a sense of ownership among all stakeholders. Embedding NBS as part of effective LfS education programmes in all education and training policies, is vital to building the skills and competences needed for the green transition. Hence, NBS in education becomes a systematic approach supported by a strong governance structure, including the following potential ways of action:

- **Ministries of Education (MoEs)** could look into:
 - establishing a comprehensive framework that integrates NBS principles into the curriculum at all educational levels, and provide guidance and resources to schools, ensuring that teachers receive training and are equipped with the knowledge and skills to incorporate NBS into their teaching practices.
 - revising educational policies and guidelines to prioritize NBS implementation in schools and develop flexible policies and regulations that encourage experimentation and innovation in educational practices.
 - allocating dedicated budgets for NBS implementation in schools, ensuring that financial resources are available for the necessary infrastructure development, teacher training, and project implementation.
 - organizing national conferences and workshops, where educators, policymakers, and practitioners come together to share experiences, knowledge, and success stories related to NBS in education.
 - establishing platforms for collaborative policymaking, involving all stakeholders in shaping the vision and goals of NBS integration in education.
- **Directorates** could work with schools to create outdoor learning spaces and transform schools into sustainable learning environments. They could provide training workshops and resources for school administrators, helping them understand the benefits and logistics of implementing NBS projects in schools. They could establish platforms for networking and knowledge exchange, facilitating collaboration between schools and local communities. Directorates could provide schools with the autonomy and support needed to design NBS projects tailored to their local context and work with municipalities to establish grant programs that schools can access to fund NBS initiatives. They could also engage in continuous dialogue with schools, teachers, and students to co-create NBS strategies and implementation plans. Directorates of environmental protection and urban planning work together to develop guidelines for designing green and resilient schools.
- **Municipalities** play a crucial role in providing funding, coordinating community involvement, and ensuring the implementation of NBS projects. They could establish partnerships with schools, providing financial incentives and technical support for implementing NBS projects. They could also establish partnerships with businesses, research institutions, and communities, fostering a dynamic environment for knowledge exchange and collaboration. They could encourage community involvement and citizen participation, fostering a sense of ownership and responsibility for NBS projects.
- **Organizations could** conduct research, share best practices, and monitor the impact of NBS interventions. They could collaborate with government bodies to develop monitoring and evaluation frameworks, ensuring an effective and sustainable scaling-up process. They could also offer specialized training programs for education professionals and provide support in securing external funding through partnerships and grant applications.

The pillars of the WSA that are initially fully activated in this scenario, are the ‘Institutional Practices’ and ‘Innovative Pedagogies’. They act as enablers of collaborations with external societal actors, and professional development. Partly activated is also the ‘Curriculum’ pillar, since we have a top-down approach even if there is no support from the (school) community

(see Figure 9). Discussing in more detail potential exemplary cases, the following potential policy-led actions are highlighted:

LfS curriculum integration: Ministries of Education could perhaps explore the idea of working with environmental organizations and educational experts to develop a comprehensive framework as part of an Environmental Education Programme to integrate NBS principles and topics into the curriculum at all educational levels, starting from kindergarten, up to the upper secondary school level (high school). Such policy would ensure that NBS-related topics, e.g., biodiversity conservation, urban greening, and climate resilience, are incorporated across different subjects and education schemes, fostering a holistic understanding of NBS among students.

An indicative example is the case of Greece and the National Strategy for Biodiversity 2014-2029 and its accompanying 5-year Action Plan for integrating biodiversity conservation into the society's value system. To achieve this, it refers to the promotion of formal and non-formal education on biodiversity, the environment, and sustainable development, targeting students of all ages, and life-long learning programmes aimed at expanding and developing teachers' knowledge and competences. Similar national policies are reported for the Estonian Lifelong Learning Strategy (ELLS) and the long-term strategy 'Estonia 2035', the Austrian Strategy for Education for Sustainable Development - ÖSTRAT, the National Action Plan on Education for Sustainable Development in Denmark or the Concept for the Development of Environmental Education, Training and Awareness of the Slovak Environment Agency, among others (Mulvik et al. 2021).

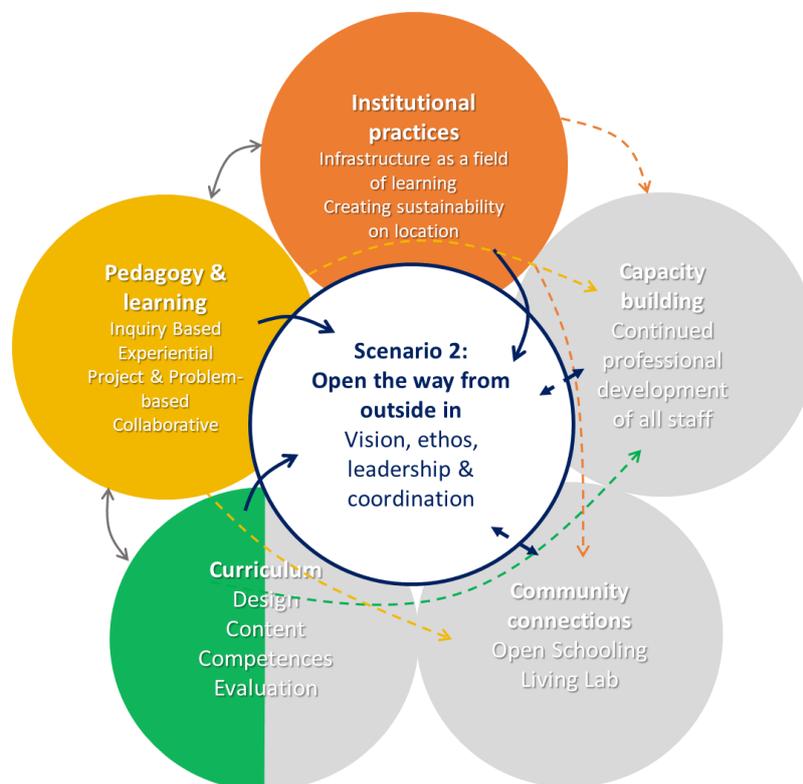


Figure 9: The WSA-activated pillars in the “Open the way from outside in” scenario

The key aspect of these curriculum reformations is to provide teachers and the school administration the means to adapt and revise the curriculum of their own will. Hence, it is of paramount importance that each school or group of schools delineates their own learning pathways towards LfS education and NBS.

NBS-related programmes and collaborative grants: This refers to the mobilisation of national and EU funds for investment in infrastructure, training, tools, and resources to further support the institutional practices at schools. At first, collaborating Ministries, Directorates, and Municipalities could perhaps design policies that provide funding opportunities and networks for schools to renovate their buildings and schoolyards based on the NBS principles. These policies and funding opportunities could align with the New European Bauhaus (NEB) initiative, emphasizing sustainable design, inclusive and accessible green infrastructure³². Schools could then be able to access grants and subsidies to support their NBS Living Labs on their premises, fostering a sustainable learning environment that showcases numerous NBS practices.

To further support the schools' institutional practices, Ministries and Municipalities could perhaps create collaborative grants for schools and organizations to work together on NBS projects with the support of the university research funds, landscape designers' companies and networks as well as with industries having strong focus on Environmental and Social Governance (ESG) programmes. Such policies could encourage schools to collaborate with external stakeholders and undertake ecosystem restoration initiatives, however, all these actions are policy-driven. However, within the EU, grants are the predominant financial instruments used to fund NBS, and the majority of funding for nature-based projects comes exclusively from public sources, with only a few exceptions (EIB 2023).

Sustainability and NBS Teacher Training Programmes: To build capacity among educators, horizontal training activities and certification programmes must be provided. Ministries could perhaps collaborate with Teacher Training Institutes to establish a Green Teacher Training Program. This policy offers specialized training to teachers on NBS concepts, pedagogical approaches for sustainability education, and innovative teaching methods. The trained teachers would become advocates for NBS in education, driving its implementation in schools. In addition, municipalities and Education Directorates could establish an NBS School Certification Program. This policy would encourage schools to actively implement NBS principles and document their sustainability efforts. Schools meeting specific NBS criteria would receive recognition and additional benefits, such as access to further funding opportunities and participation in regional or national sustainability events.

NBS Schools Certification Program: Either a Municipality or a Directorate could perhaps consider implementing an NBS Schools Certification Program, encouraging schools to adopt NBS practices, such as school biodiversity and vegetable gardens, green roofs, vertical gardens, or planting trees in the nearby streets. Schools could also be asked to embed NBS topics into the school's institutional practices and curricula and into extra-curricular activities. Schools that meet the NBS criteria, e.g. such as those that obtain the upcoming NBS school certification of NBS EduWORLD and the Scientix STEM School Label, could receive further recognition and incentives from the local public authority in collaboration with the Institution

³² https://new-european-bauhaus.europa.eu/about/neb-lab_en

of Educational Policy. In addition, Directorates could perhaps consider a policy mandating outdoor learning for a certain number of hours per week in both primary and secondary schools to further support the NBS Certification Programmes. Linked to the NBS Teacher Training Programmes, NBS expert teachers and school principals could also receive training that enables them to design and deliver effective pedagogical schemes, engage in NBS projects, or even allocate funding to support nature-based programmes and projects in their schools.

National Youth Sustainability Citizenship Programmes: A national policy initiated by either the Ministry of Education (and the Ministry of Environment) or the Institution of Educational Policy, could perhaps be considered, to establish a Sustainability Citizenship Program for supporting young individuals to lead NBS initiatives in their schools, universities, and their communities. Such a program could provide training, resources and funding to empower youth to develop sustainability competences and promote NBS as the main enabler to fight against climate change and enforce urban sustainability and ecosystem services. National authorities could perhaps collaborate with youth organizations, environmental NGOs, and NBS-related organizations (landscape designers, architects, and environmental engineers) to establish national platforms for youth-led NBS initiatives. Such platforms and connection streams would empower young individuals to contribute to sustainable development by cultivating the cultural shift needed and implementing small-scale NBS projects.

Research, knowledge sharing, and networking platforms: A collaborative governance structure involving Ministries, organizations, and research institutes could support collective knowledge exchange and participatory engagement on NBS projects, where researchers, educators, and NBS practitioners share best practices, case studies, and research, technical and educational outcomes. Such platforms facilitate evidence-based decision-making and help in refining NBS implementation strategies inside and outside schools, when considering scaling up different NBS concepts.

4.4 Scenario 3: Crossing Paths

In this scenario, a hybrid situation is presented, where individuals, NBS experts in their field, teachers or school principals, and professionals outside the school meet each other or follow an initiative, policy, or framework, and in this way, transform schools to NBS Living Labs following the Whole School Approach:

- **NBS expert teachers or/and principals could be inspired by an initiative** that encourages individuals, including teachers and school principals, to establish and maintain nature gardens within their schools, incorporating elements like native plants, wildlife habitats, and sustainable gardening practices. They could embrace the concept and integrate school gardens into the school curriculum. They could work collaboratively with students and local community members to develop and maintain these green spaces, fostering environmental stewardship and hands-on learning experiences.
- **NBS expert teachers or/and principals could also be inspired by a framework** that encourages teachers and school principals to incorporate outdoor education and

experiential learning into their teaching practices. Teachers or/and principals could receive self-determined training, enabling them to design and deliver engaging lessons that take advantage of natural environments.

- **NBS expert teachers or/and principals could be following an environmental education policy** that emphasizes the importance of NBS in education and highlights the role of schools in fostering environmental consciousness and sustainability. Teachers and school principals could align their teaching practices with the policy's objectives, integrating NBS activities, field trips, and environmental projects into the curriculum. They could collaborate with local environmental organizations and experts to provide students with authentic learning experiences and inspire them to become environmental stewards.
- **NBS expert teachers or/and principals could be inspired by a public-private partnership** that promotes the implementation of green infrastructure within schools. They could embrace this initiative and work towards transforming their schools into learning buildings and eco-friendly spaces. They could collaborate with architects, landscape designers, and sustainability experts to incorporate features like green roofs, rain gardens, and permeable pavements.

It is worth noting that all pillars of the WSA are partially activated from the beginning in this scenario, since policies and school engagement co-exist. (Figure 10).



Figure 10: The WSA-activated pillars in the “Crossing Paths” scenario

Overall, in the **‘Crossing Paths’ scenario**, the WSA is present in all pillars, as NBS expert teachers and principals take the lead in transforming their schools into NBS Living Labs, following various initiatives, policies, and frameworks, investing in the continuous training and capacity building of all staff. The collaboration between the school community, NBS, and environmental experts and organizations is evident, since both the schools and external stakeholders have already built a collaborative scheme in past policy- and school- driven initiatives.

These experiences, as well as the school administration and the expert teachers’ experience have led to different curriculum integrations, since these schools already have access to educational resources, self-reflection, and assessment tools and they are prepared to move a step further in establishing competence-based NBS activities. Consequently, these schools have already implemented and tested innovative pedagogies, such as experiential, project-based, and collaborative learning methods. With such foundations in place, these NBS expert schools are encouraged to further collaborate with the local community and the local/national authorities, e.g., by embedding NBS projects both within and outside the school premises, identifying financial opportunities to support these initiatives, and actively participating in citizen science projects and community-led initiatives.

School Gardens Initiative: A regional or national policy could support schools in establishing and maintaining vegetable gardens within their schools. NBS expert teachers and school principals are inspired by this initiative and embrace the concept. They could integrate the school gardens concept into the school curriculum, using elements like biodiversity conservation, native plants and wildlife habitats, and sustainable food systems, since all vegetables produced are transferred to the school canteen. Students, parents, and local community members could collaborate to design, develop and maintain these green spaces, fostering environmental stewardship and hands-on learning experiences. Training, exhibitions, and sustainable food systems fairs could be organized monthly, and the school grounds could be accessible to the parents, neighborhood, and local community members.

Green Infrastructure and schoolyards renovation: After participating in training courses and workshops led by Erasmus+ mobility actions, or in training and visionary workshops led by the Erasmus+ Teacher Academies or HORIZON Europe projects like NBS EduWORLD, they could be envisioning renovating the school playgrounds. Therefore, they could invite NBS experts to deliver guest lectures, co-design workshops, and interactive sessions for teachers, students, parents, and members of the local community. These interactions could focus on connecting the school community (teachers, pupils, and families) and education experts, as well as residents in the neighborhood in expressing their needs and suggestions and contributing to the selection of the technical and pedagogical solutions for the school transformations.

With the support of the Municipality and the Directorate, all societal actors could promote the initiative and seek for public-private partnerships that promote the implementation of green infrastructure within schools. Collaborating with architects, landscape designers, and sustainability experts, they could incorporate features of pocket parks, green infrastructure, water management practices, and permeable pavements. Financial opportunities could perhaps be found for both public (i.e., the Municipality) and private agencies (i.e., Landscape designers and architects’ companies/associations) to commit funds.

National Curriculum Integration and training opportunities: At national level, a country's Ministry of Education could perhaps consider including NBS as a core component in the curriculum. This policy could ensure that all schools incorporate nature-based learning into their learning and teaching practices. Simultaneously, individual schools could take the initiative to conduct training sessions for principals and teachers on how to integrate NBS effectively into their schools either from a technical, or a pedagogical point of view. Thus, teachers could participate in small-scale workshops organized by the Directorates, training courses organized by different Institutes of Educational Policies, and/or they are enrolled in MOOCs identified by the NBS Expert teachers, since the school is already participating in NBS-led initiatives and projects. The combination of policy-led and school-led teacher training support would ensure a consistent and well-implemented approach to further mainstream NBS in educational settings, propose curricula reformations, and pilot-test activities, projects, and pedagogical schemes to further improve LfS practices through NBS.

International collaboration on research and knowledge sharing: Partnerships from different countries (i.e., Erasmus+ and Horizon Europe) could collaborate at an international level to share research, best practices, and resources related to NBS in education. This knowledge-sharing initiative could help each country to learn from others' experiences, establish networks and implement successful strategies for implementing and allocating funding for nature-based projects at schools. On the school-led side, educational institutions could participate in the pilot-testing educational activities, citizen science projects, and community-led initiatives. Gaining knowledge and expertise, school administration could then get involved more actively on such topics by participating and getting funded in such partnerships. Widening participation and spreading excellence actions under Erasmus+ and Horizon Europe, could contribute to building research and innovation capacity in schools for further supporting the vision of becoming incubators for their local communities through the NBS Living Labs.

Corporate partnerships for sustainable infrastructure: A national initiative could perhaps encourage corporations to invest in sustainable infrastructure projects in schools, sports clubs, and youth clubs, such as rainwater harvesting systems, biodiversity parks, and green roofs. This could align with the organization's eco- and STEAM- led projects, where students and citizens work on hands-on NBS initiatives. This opportunity will potentially foster a holistic approach to NBS formal, non-formal and informal education within and outside the school environment. Schools could organize joint workshops and events with sports clubs and youth clubs to raise awareness about NBS, e.g., tree planting, clean-up campaigns, and educational sessions on biodiversity conservation.

At the same time, athletes and youth participating in sports events could engage in NBS-related activities, organizing sports events in green spaces to highlight the importance of natural areas. Together, they could create and promote urban gardens and green roofs to school buildings and sports infrastructure, establish green spaces in sports facilities, or even organize NBS competitions and challenges for exploring and scanning the neighborhoods for NBS implementation linked to walking, hiking, and cycling activities.

4.5 Reflections on the Scenarios of Plausible Futures for NBS in Education

The **‘Crossing Paths’** scenario could be achieved rather early on. The interventions and changes needed are relatively incremental build-outs of existing approaches. It is a hybrid scenario, in which supportive policies, teachers’ engagement, innovation in schools, and up to a point, collaborative action, coexist (Figure 11). Therefore, it is more plausible (see Figure 12). The key challenge appears to be the number of NBS expert/motivated teachers and/or principals. Hence, the next steps for scaling up, are to enrich the NBS expert teachers and/or principals pool, and strengthen the networks and connections with policymakers.

The **‘Flourishing from inside out’** scenario is also nearer-term. The interventions and changes needed are focused mainly on the potential activation and efficient collaboration with policymakers, in order to offer substantial support. Besides, it outlines a more individualistic approach with schools as initiators, designers, and leaders of the processes, and limited supportive policies (Figure 11). Therefore, it is less plausible to be achieved than the ‘Crossing Paths’ scenario (see Figure 12).

The key challenges again seem to be the number of schools that have the vision, effective leadership, and support mechanisms, as well as the rigid curriculum in some countries that leaves little room for innovative and interdisciplinary approaches. There is a great risk of ending up with isolated pockets of innovation and only a few schools for privileged groups having access to such an educational model.

Hence, the next step for scaling up, is this bottom-up approach to serve as a model for a public policy (top-down) to safeguard that such innovative educational approaches reach all schools, especially in marginalized areas. Another way to scale up is to move forward with monitoring the development and measuring over time school progress. This monitoring can be very valuable and can help the school showcase the results of its work to the community and inspire others, also considering the leadership of other schools.

The **‘Open the way from outside in’** scenario is further out on the time horizon than the two other scenarios because it implies significant interventions and changes. It describes a framework, in which a strong governance structure co-exists with supportive policies (Figure 11). Therefore, it is the least plausible scenario to be achieved (see Figure 12). There is a need for a shift in public policy by establishing new priorities that guide public finance, aligning them with new mechanisms that offer flexibility and adaptability. These mechanisms play a vital role in enhancing the ability of involved actors to initiate the required changes across different societal levels.

Furthermore, the implementation of challenge-driven strategic interventions requires strong collaboration between the public and private sectors. The key challenges appear to be the orchestration of policies towards adopting a comprehensive policy mix, coordination across government levels, and substantial engagement of all the stakeholders involved, especially the school community. Otherwise, there is a risk of unsustainability and application of isolated pillars of the WSA. Hence, the next step for scaling up is the monitoring and evaluation of the approaches that are supported by regional, local, or national governance

structures and the cooperation for exchanging experience and tools and the establishment of partnerships, as the example of UNESCO, Greening Education Partnership³³.

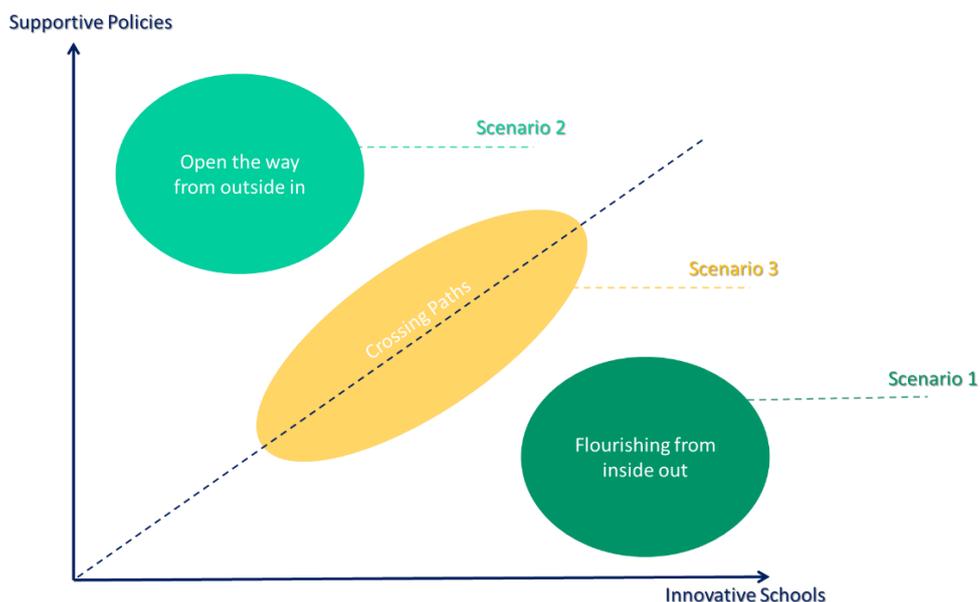


Figure 11: The Scenarios as a function of supportive policies and innovation in schools

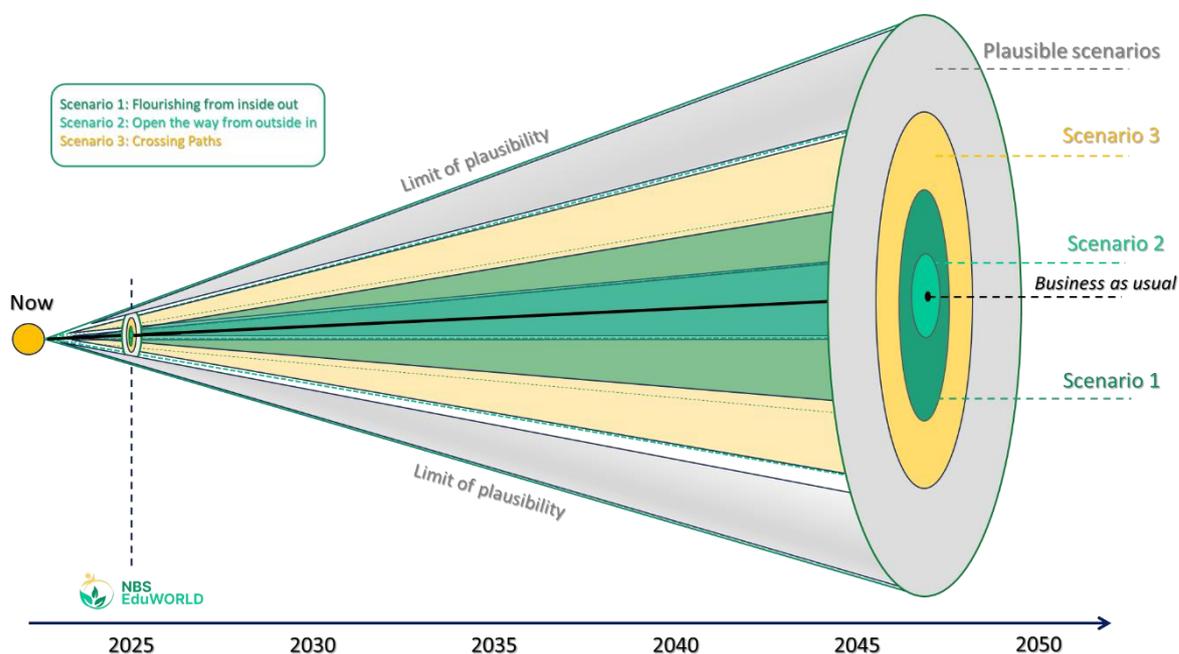


Figure 12: The Scenarios for NBS in Education and their plausibility

³³ <https://www.unesco.org/en/education-sustainable-development/greening-future>

5. Conclusion

The scenarios analyzed in Section 4 play a crucial role in illuminating primary directions and providing strategic choices for education in the long run by examining the policy challenges that emerge in various potential futures. Thus, in this deliverable, NBS EduWORLD delved into the fundamental aspects and consequences of the scenarios, shedding light on the opportunities and challenges that necessitate careful consideration when contemplating the future of NBS in education through the NBS Living Labs concept. Exploring the dimensions that currently characterise NBS and overall, LfS, allow for a holistic consideration of how they could be altered and combined in alternative scenarios of plausible futures for NBS in education.

Grounded on the concepts of the WSA, open schooling and schools as LLs, the NBS Living Labs can significantly contribute to establishing more engaging and impactful learning opportunities for LfS. WSA emphasizes the comprehensive integration of NBS principles into all aspects of a school's functioning. It goes beyond merely incorporating NBS into the curriculum and extends to various school activities, training opportunities, infrastructure, and community engagement. This involves transforming the school's physical environment and thereby, providing opportunities for students to engage with nature directly. Therefore, the idea that learning should not be confined to the traditional classroom/school settings becomes more relevant than ever.

Instead, educational institutions should open up to the surrounding community, engaging in real-world experiences and addressing local challenges, linking in parallel formal and non-formal educational experiences. One of the main driving forces to support this transformation is the Living Labs concept. Schools as NBS Living Labs can act as dynamic spaces for experimentation, innovation, and learning. For NBS in education, this concept enables schools to become centers for raising awareness, capacity building and knowledge exchange. Focusing on competences development, gaining practical skills and knowledge, while contributing to the development of sustainable solutions, the NBS Living Labs may foster partnerships with universities, research institutions, and NBS experts, providing students and in general, the school community with access to educational resources, NBS research, and expertise from different NBS projects.

In order to mainstream and nurture these concepts towards the NBS Living Labs, three different scenarios were developed, each showcasing a unique approach for integrating NBS principles into different educational settings. In the first scenario, it is imagined that schools with experience in LfS take the lead, transforming themselves into NBS Living Labs. These schools prioritize NBS challenges, focusing on green spaces with climate-resilient features, water management processes, and in general, participatory and co-design processes to enhance biodiversity in their schools and the local communities. They emphasize inter- and trans- disciplinary approaches and outdoor learning to teach NBS concepts, engaging the entire school community in projects to develop sustainability competences. Moreover, these schools serve as centers for capacity building, providing training programs for all school staff and the local communities. Consequently, they prioritize community engagement, collaborating with government agencies and environmental organizations to implement NBS

projects, they share best practices, foster a sense of ownership, and promote sustainability beyond the school grounds.

Upscaling the first scenario at policy level, the focus shifts to a collective effort involving Ministries, Directorates, Municipalities, and organizations to mainstream horizontally NBS in education. In this context, it is imagined that they establish a comprehensive framework to integrate NBS principles into the curriculum at all educational levels and provide guidance and resources to schools. Ministries of Education play a pivotal role in revising policies and guidelines, allocating budgets and financial opportunities for NBS projects implementation, and organizing capacity-building programmes for knowledge exchange and the education stakeholders' competences development. Directorates could work closely with schools to create sustainable learning environments and establish platforms for networking and knowledge sharing. Municipalities could provide funding, coordinate community involvement and ensure the successful implementation of NBS projects, bridging partnerships with businesses, research institutions, and the local communities.

At last, the third scenario illustrates a potential hybrid approach where schools, NBS experts, and university and education policymakers play a pivotal role in transforming schools into NBS Living Labs. However, all actions initiated either at the school or policy level would be 'orchestrated' at a smaller scale. Inspired by initiatives, frameworks and policies, NBS expert teachers and principals could incorporate NBS principles into the curriculum, design outdoor learning activities and projects and collaborate with the local communities to create localized plans supporting NBS and LfS. The smaller-scale planning allows for localized plans aligned with broader initiatives and policies, making it adaptable to different educational contexts.

Overall, the transformative potential of schools as living NBS laboratories should be highlighted, regardless of the approach taken. Schools may play a pivotal role in fostering sustainability, resilience, and environmental awareness among the wider community. Whether initiated by innovative schools, collaborative efforts among education stakeholders, or inspired individuals, NBS Living Labs can provide valuable learning experiences and contribute to building sustainable societies upon NBS. Through partnerships, capacity building and community engagement, NBS in education may become a systematic approach supported by strong governance structures and collective knowledge exchange.

Reflecting on the scenarios, it is likely that the third scenario, where schools with some experience in LfS and NBS are supported by policies, would be the most plausible option for mainstreaming and nurturing such concepts towards the NBS Living Labs. In the same framework, innovative schools that already prioritize sustainability challenges and have experience in implementing NBS projects are the very next plausible option to embrace the WSA and transform themselves into NBS Living Labs. Upscaling this approach at a policy level, as outlined in the second scenario, might require more significant coordination among various stakeholders. While this might be a direction for the future, the current situation may have some challenges in terms of immediate policy implementation and resource allocation.

This document serves as the cornerstone during the implementation phase of NBS EduWORLD and inherently, the NBS Living Labs field trials. The focal point of this document lies in the development and refinement of scenarios, which will play a pivotal role in shaping NBS EduWORLD's field trials via the LLs in Greece and the implementation of NBS activities

in Spain and in other European countries (WP6). These scenarios, carefully constructed and thoughtfully designed, will serve as the foundation upon which the implementation strategies will be built. They provide a structured framework that enables the step-by-step evaluation, rethinking, and comprehensive study of each aspect, guiding the gradual realization of the project's objectives for mainstreaming NBS in LfS education. This iterative process of continuous refinements and adjustments will ensure a robust and adaptable approach to implementation, aligning the project with the evolving needs and dynamics of the educational landscape.

Furthermore, the scenarios of plausible futures outlined in the deliverable will not only guide the implementation phase but also extend their influence on the broader goal of fostering deeper collaboration within and outside the school community. These scenarios will serve as a catalyst for schools engaged in the project along with external societal actors, inspiring their active participation and interest in becoming integral contributors to the initiative. In addition, as the project progresses into the WP5 and WP6 activities, the scenarios will offer a shared foundation for schools to express their enthusiasm for deeper involvement, thereby fostering a sense of ownership and commitment towards NBS education. This positioning of the deliverable within the project plan underscores its pivotal role in steering NBS EduWORLD and the NBS Living Labs towards successful realization and lasting impact within the educational learning ecologies towards effective and impactful LfS programmes.

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Annexes

Annex 1. Profile of participants in focus group discussions & the creative workshop

	Education Stakeholder	Teacher	NBS Expert	Researcher	Policy Researcher	TOTAL (involved persons)
Focus Group 1						
NBS EduWORLD partner				2		10
NBS EduWORLD partner	3					
NBS EduWORLD partner			2			
NBS EduWORLD partner					1	
NBS EduWORLD partner				2		
Focus Group 2						
EA R&D Department				2		7
Primary school		1				
Primary school	1					
Secondary school		2				
Secondary school	1					
Creative Workshop						
EA R&D Department	1			2		15
NBS EduWORLD (Teacher Advisory Board)		2 (1 Primary + 1 Secondary school)				
NBS EduWORLD partner				2		
Primary School	1					
Secondary School	1	1				
LfS Coordinator for primary (Ministry of Education)	1					
NBS EduWORLD partner			2			
NBS EduWORLD partner					2	

Annex 2. Focus Group 1 – Integrating NBS into GreenComp Framework

Task: Provide some examples of how NBS can help someone value sustainability, support fairness and promote nature:

Value Sustainability	Support Fairness	Promote Nature
Attitudes of commitment to sustainability and appreciation for the value of natural systems and biodiversity.	Awareness of social equity and cohesion considerations associated with NBS implementation and management.	Appreciation for the value and beauty of natural systems and the importance of preserving biodiversity and ecosystem services.

Task: Provide some examples of how NBS can help someone think critically, and systematically and solve the problems addressed to the NBS challenges:

Think Critically	Think Systematically	Solve Problems
Skills in analyzing and evaluating scientific and technical information relevant to NBS project design and implementation.	Understanding of ecological processes and systems, such as carbon sequestration, water filtration, and pollination.	Ability to design and implement green infrastructure projects, such as green roofs, pocket parks, and wetlands.

Task: Provide some examples of how NBS help citizens to envision their future sustainability, be adaptable, and think by exploring and linking different disciplines:

Envision the future of sustainable	Be adaptable	Thinking by exploring and linking different disciplines
Knowledge of future trends and scenarios related to climate change, biodiversity loss, and sustainable development, and the potential role of NBS in addressing these challenges.	Attitudes of flexibility and openness to new ideas and approaches regarding NBS.	Skills in experimenting with and testing new NBS approaches and technologies.

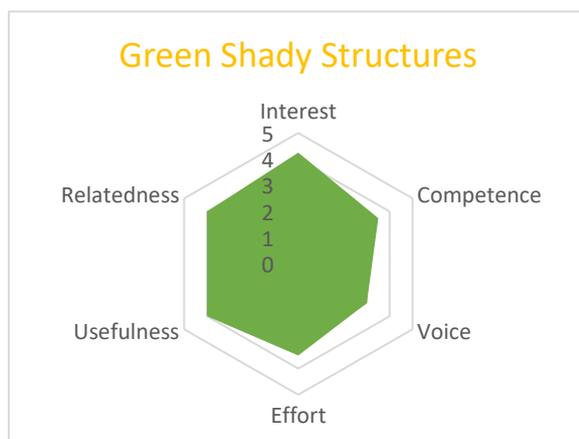
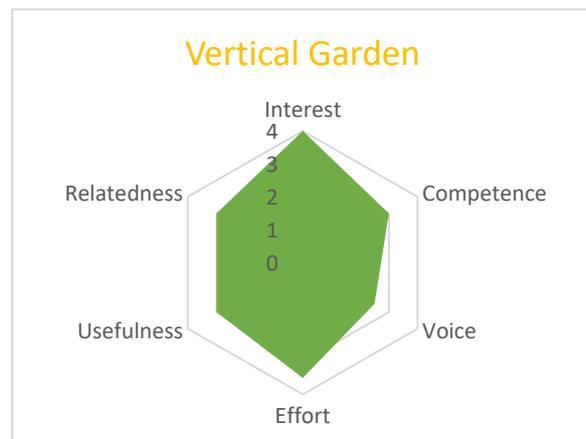
Task: Provide some examples of how NBS can enable citizens to act for change individually and collectively and navigate the political system:

Act for change individually	Act for change collectively	Navigate the political system
Attitudes of personal responsibility and commitment to making a positive impact on the environment and society using NBS.	Skills in collaborating with diverse stakeholders to implement NBS projects that benefit multiple groups and address shared challenges.	Skills in engaging with political and institutional stakeholders to advocate for NBS and to address institutional barriers to their adoption.

Annex 3. Focus Group 1 – Spider Chart for different NBS

During the focus groups, the participants selected one or two of NBS examples to analyze their own position about the six dimensions of the compiled spider diagram:

- **Interest** refers to the intrinsic motivation for a specific NBS thematic area.
- **Competence** refers to the abilities, skills, and knowledge acquired under an NBS.
- **Voice** refers to participation opportunities for the co-creation of an NBS.
- **Effort** refers to the implementation and exploitation difficulties of an NBS.
- **Usefulness** refers to the added value of an NBS for the local community.
- **Relatedness** refers to the consistency of an NBS to the EU definition.



Annex 4. Creative Workshop – Integrating NBS into my school

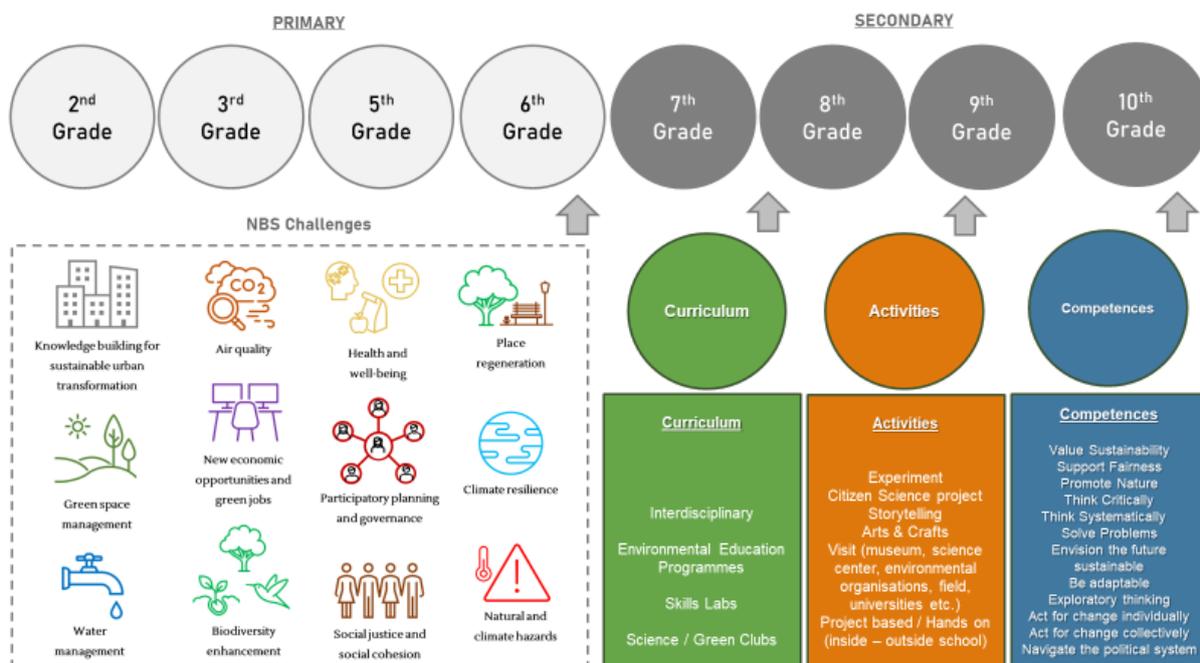
The creative workshop aimed at generating implementation ideas for integrating NBS into schools using the WSA. The workshop focused on envisioning the introduction of various NBS projects for establishing the NBS Living Labs in primary and secondary schools, creating continuous learning pathways related to LfS.

The main activities during the creative workshop focused on: i) integrating different NBS challenges to different grades of both the primary and secondary schools, ii) identifying opportunities to link NBS to the curriculum, iii) identifying competence areas that can be developed through NBS projects, iv) types of activities/projects to engage students and finally v) how all these pillars can be supported under the lens of a WSA and mainstreamed at all education levels following different scenarios of plausible futures.

During the first part of the workshop, participants attempted to replicate the vision of the schools as NBS Living Labs by exploring practical ways to incorporate NBS projects into schools. They brainstormed ideas on how to engage students at different grade levels, considering activities that foster green competences and increase knowledge of NBS. They also linked different NBS challenges to hands-on experiments, storytelling sessions, field trips, citizen science projects, and craft-based activities.

A collaborative process was followed, having schools' principals/teachers and stakeholders (education experts/researchers/NBS professionals) working together.

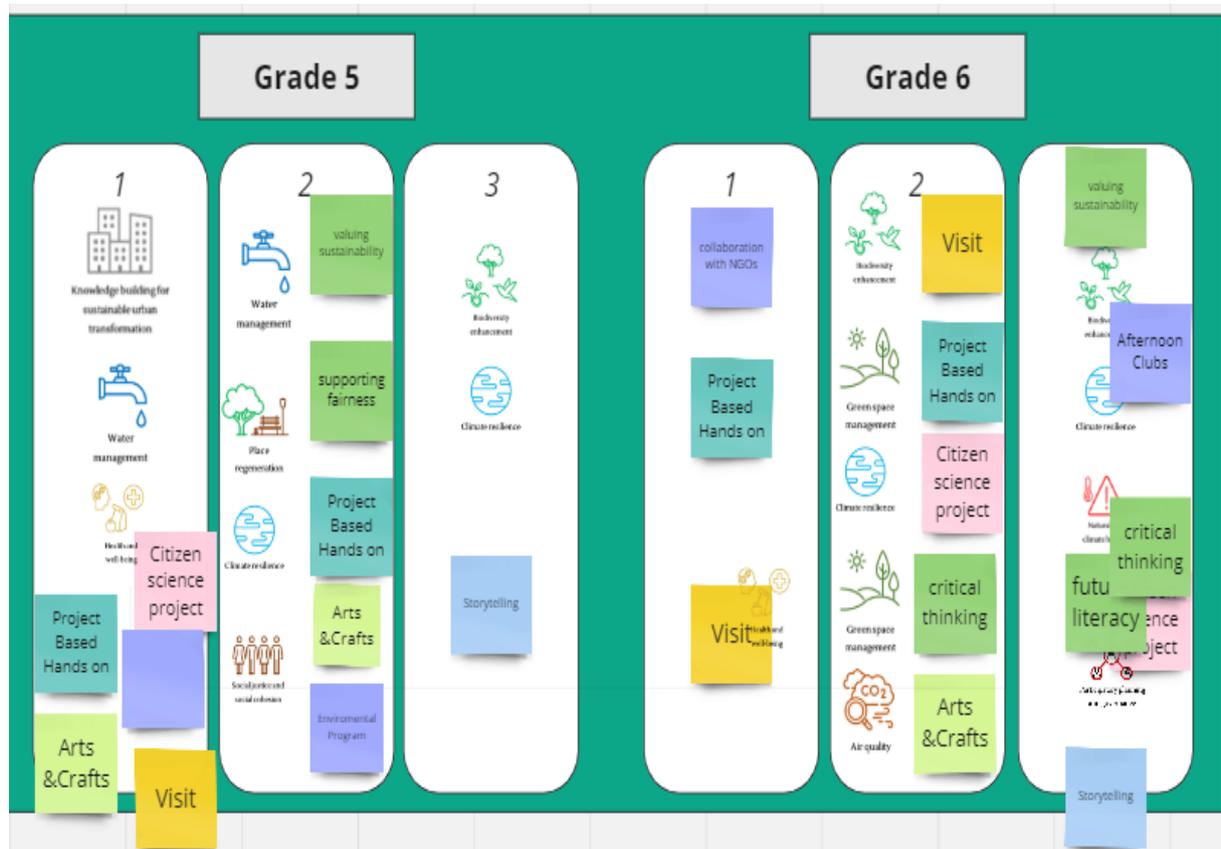
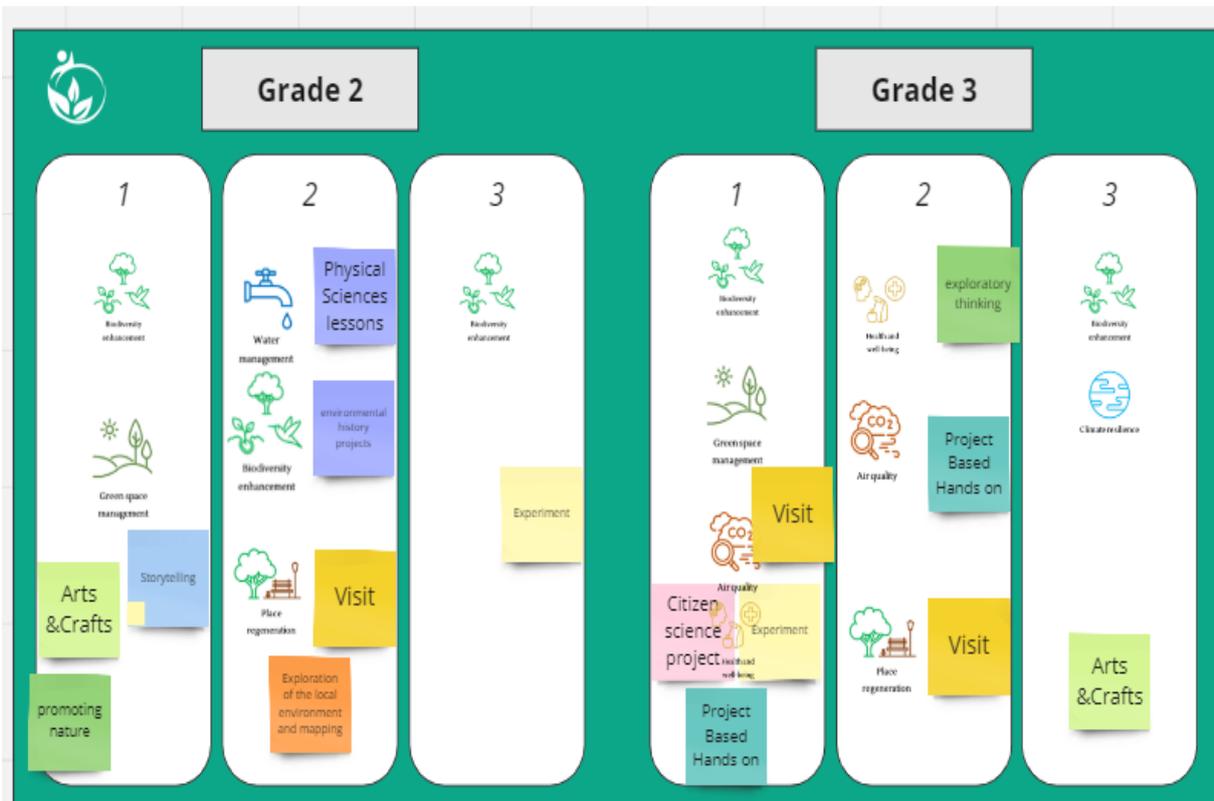
Activity 1 - Aggregated Results - Integrating NBS into my school (primary and secondary)



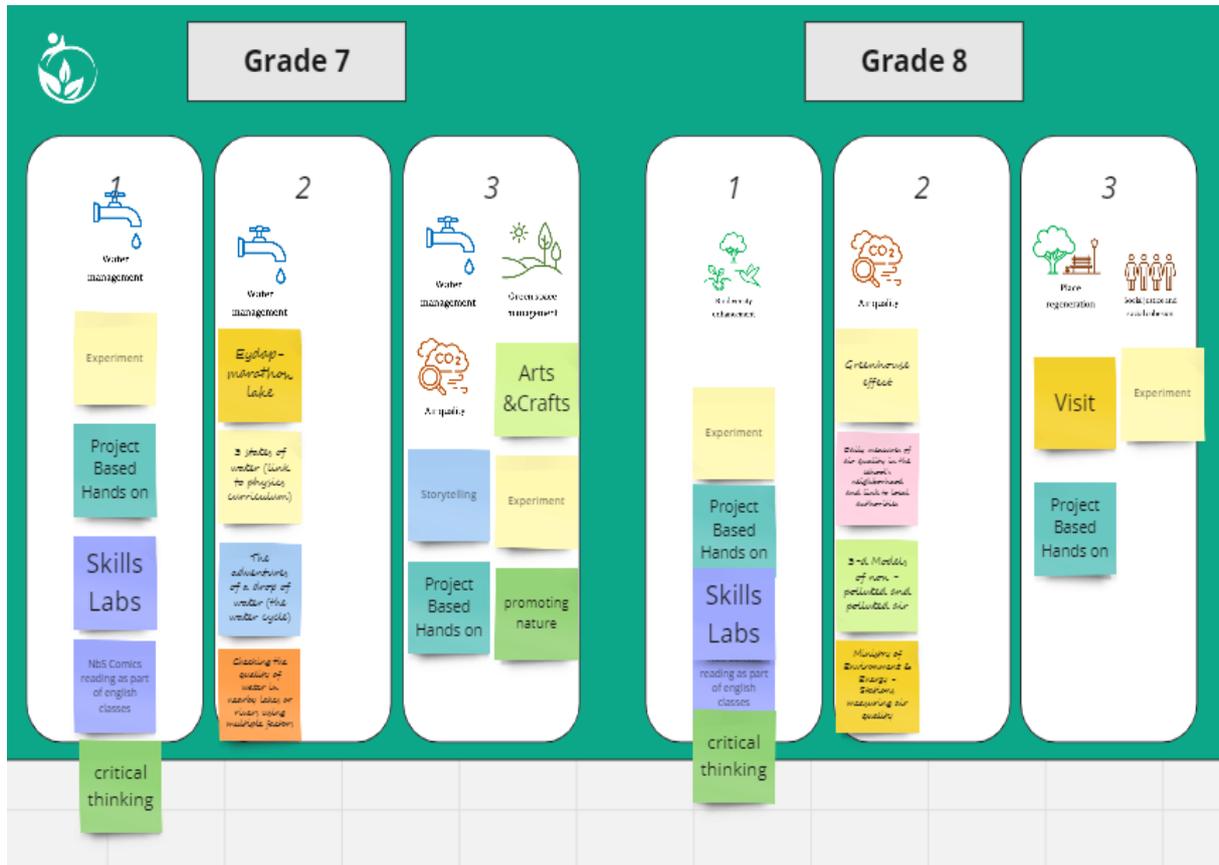
***PRIMARY:** 2nd Grade refers to 7-8 years old students / 3rd Grade refers to 8-9 years old students / 5th Grade refers to 10-11 years old students / 6th Grade refers to 11-12 years old students.

***SECONDARY:** 7th Grade refers to 12-13 years old students / 8th Grade refers to 13-14 years old students / 9th Grade refers to 14-15 years old students / 10th Grade refers to 15-16 years old students.

Activity 1 - Screenshots of the workshop - Integrating NBS into my school (primary)



Activity 1 - Screenshots of the workshop - Integrating NBS into my school (secondary)

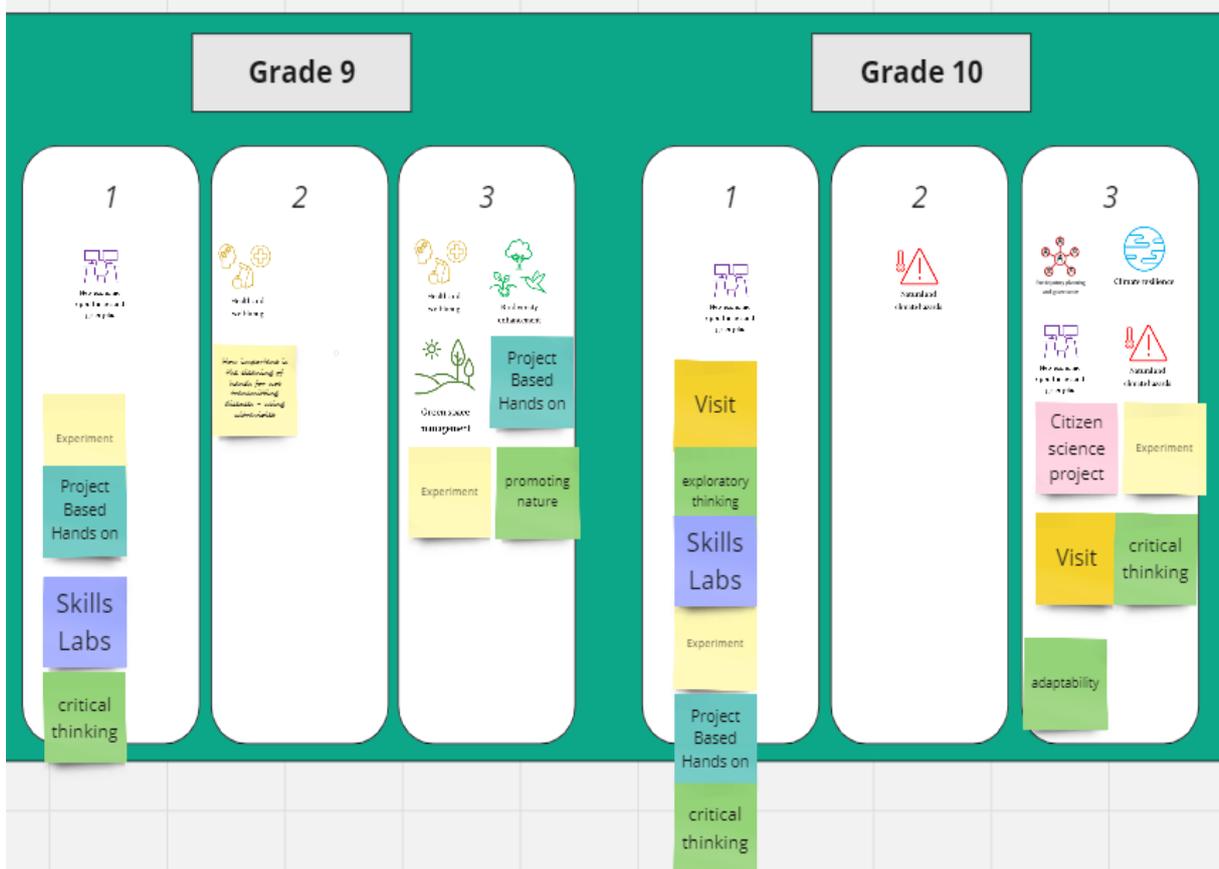


Grade 7

- 1 Water management**
 - Experiment
 - Project Based Hands on
 - Skills Labs
 - NBS Comics reading as part of english classes
- 2 Water management**
 - Experiment - Eyedrop-investigation lake
 - 3 levels of water (link to physics curriculum)
 - The advantages of a drop of water (the water cycle)
 - Checking the quality of water in nearby lakes or rivers using multiple scales
- 3 Water management & Green space management**
 - Arts & Crafts
 - Experiment
 - Storytelling
 - Project Based Hands on
 - promoting nature

Grade 8

- 1 Air quality**
 - Experiment
 - Project Based Hands on
 - Skills Labs
 - reading as part of english classes
 - critical thinking
- 2 Air quality**
 - Greenhouse effect
 - How measures of air quality in the school environment link back to each other/where
 - 3-4 Models of how - polluted and polluted air
 - Museum of Environment & Energy - Students measuring air quality
- 3 Plant regeneration & Sustainable construction**
 - Visit
 - Experiment
 - Project Based Hands on



Grade 9

- 1 Water management**
 - Experiment
 - Project Based Hands on
 - Skills Labs
 - critical thinking
- 2 Water management**
 - How important is the delivery of water for our surrounding climate - using multiple scales
- 3 Water management & Green space management**
 - Project Based Hands on
 - Experiment
 - promoting nature

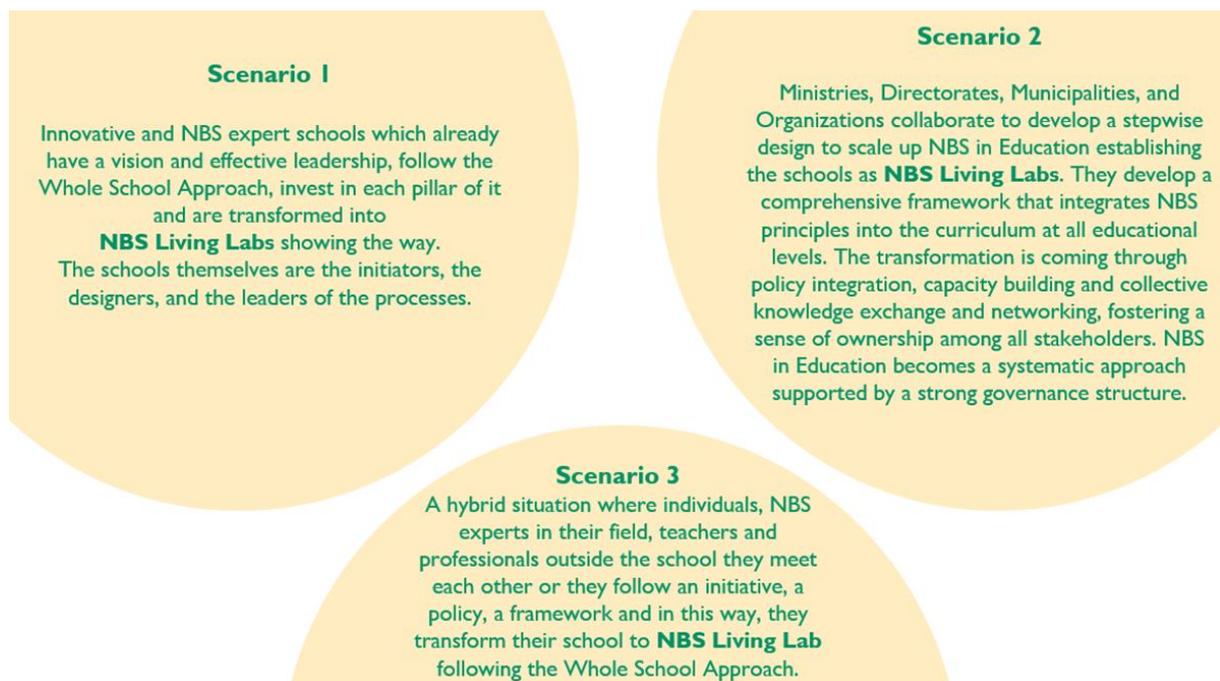
Grade 10

- 1 Water management**
 - Visit
 - exploratory thinking
 - Skills Labs
 - Experiment
 - Project Based Hands on
 - critical thinking
- 2 Hazardous climate risk**
 - Experiment
- 3 Hazardous climate risk & Citizen science**
 - Citizen science project
 - Experiment
 - Visit
 - critical thinking
 - adaptability

During the second part of the creative workshop, the participants engaged in identifying potential opportunities, barriers and challenges, related to the implementation of NBS Living Labs as enablers of WSA. The questions posed to the participants were related to the main pillars of WSA, i.e., the importance of the school vision, integration opportunities of NBS to the curriculum, requirements to test innovative pedagogies, how to track and engage external stakeholders, and effective strategies for continuous professional development. The questions were the same for all participants. The differentiation element was that participants responded from their point of view, placing themselves in each scenario, according to their professional roles and expertise.

Activity 2 – Screenshot of the workshop – Questions related to the main pillars of WSA





The key findings of the second part of the creative workshop are:

- The **school's vision sets the stage for change and the leadership determines the organizational and investment choices** that align with that vision. The school is fundamental in carrying out projects, related to Nature-Based Solutions (NBS) and directly impacting students. Each school decides the importance it gives to NBS and promotes it based on its interests.
- Integrating the building's operations into the learning process requires creativity and the ability to **use any innovation in the building/schoolyard as a reference point**.
- Real-life problems can be presented to students to encourage them to find solutions, fostering a hands-on approach.
- **Building strong cooperations and unlocking financing opportunities can be challenging.** This involves sharing the vision and engaging stakeholders in the community. Demonstrating the real need for NBS in the school and the local community, emphasizing not only environmental benefits but also economic and social ones, is crucial. Various funding sources are available for making public buildings and public spaces climate-friendly, accessible, and inclusive.
- Implementing **NBS into the curriculum can be done by integrating it into citizenship projects and individual disciplines.** The national curriculum offers opportunities for integrating NBS, and posing problems or projects to students can stimulate their engagement.
- **Evaluating** the skills developed through NBS implementation can be done through **direct observation of students' work**, assessing their communication within teams, and **evaluating their attitude and involvement**.
- **Lifelong learning poses challenges and requirements**, including the need for **teacher motivation** and the increasing difficulty of adaptation and learning as one gets older.

Diving into a more detailed discussion, in **Scenario 1: Flourishing from inside out**, visionary workshops and distributed leadership are essential. Leadership has to do with delegating duties and choosing the educators that support that. Building operations can be integrated into the learning process by involving the school and local communities or even neighbourhoods. This is highly complicated, and it mainly lies in the way management will schedule and organise an interaction and cooperation among building operation experts, educators, parents, and the local community. To this end, examples of good practice and persistence are necessary for strong collaborations and for unlocking financing opportunities.

Regarding pedagogies, project-based teaching and learning, cultivating a sense of ownership, commitment, and teacher re-skilling opportunities are important for effective learning methods. It is also noticed that an Inquiry-based approach might also include a mapping exercise of the disciplines required to address a challenge making the **students 'feel' the needs and challenges to be addressed inside and outside their school**. As the participants highlighted, integrating NBS into the curriculum requires addressing authentic problems and providing teachers with examples of good practice. Constant reassessment and refocusing are needed for living lab methodology in the school community.

In **Scenario 2: Open the way from outside in**, visionary workshops, funding support, and involvement of various stakeholders are also emphasized. An integral part of this process should be always bringing in students' voices and including the entire school community in the development and consolidation of visions and goals at a greater scale. Also, policymakers could connect with education and NBS experts to support and/or prepare guidelines for schools or use their networks to share their knowledge on NBS co-design processes. In this way, school leaders and the school administration may be more likely to read and apply the guidelines and implement holistically such interventions. However, funding allocation is always a challenging task, and therefore, partnerships with EU funded projects and initiatives that enable infrastructure investments are crucial.

Discussing pedagogies and curriculum reformations needed, problem-solving, curriculum flexibility, and reskilling teachers' competences are the key concerns for applying innovative learning methods. Interdisciplinary learning, skill labs, and student portfolios can help integrate NBS into the curriculum and assess the impact of these changes on the school community and the students' science and career motivation as well as to act in a more sustainable way. Identifying training opportunities or even establishing principal academies are essential for lifelong learning and strong leadership.

Collaboration with stakeholders, such as municipalities, NGOs, museums, and protected areas, as well as engaging externals from the start of the school year and fostering a sense of ownership, are noticed as critical factors for applying co-design approaches and building strong long-lasting collaborations with externals. Nevertheless, teachers are not familiar with these concepts, and they might also struggle to identify who are the potential stakeholders they can collaborate with and how to engage them in such projects.

For **Scenario 3: Crossing Paths**, the school's vision and leadership set the direction for innovation and for integrating NBS into schools. It is also noted that strong cooperation and financing opportunities require community engagement and sharing a common vision for the entire school community. Delving into the learning aspects, it was highlighted that

experiential learning and LfS in place upon real challenges is the key to triggering students' interest. Learning methods need to address challenges and leverage alternative approaches; NBS can be integrated into a wide-ranging curriculum, thus, skills development can be evaluated through observation and communication assessment.

However, these processes present challenges, such as the time-consuming nature of the assessment frameworks and the lack of tools to assess sustainability competences. It was also highlighted that the limited class time, especially in secondary schools, is a major drawback. An idea to mainstream NBS into the curriculum is interdisciplinary by integrating NBS activities into citizenship projects, to use virtual labs and Science Clubs that can complement traditional approaches. Overcoming these barriers requires proactive efforts to engage external stakeholders, including leveraging online teacher forums and platforms, involving public officials, and fostering a sense of ownership among participants. Finally, the teachers highlighted that lifelong learning requires motivation and support that most of the time is lacking.

Project partners





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