NBS EduWORLD

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Nature-Based Solutions Education Network (NBS EduWORLD)

NBS Higher Education and Entrepreneurship Architecture

Deliverable D4.1

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Abstract	This report builds on the earlier NBS EduWORLD evaluation of Nature-Based Solutions (NBS) in education to advance institutional leadership through capacity-building initiatives. Building on this, a comprehensive set of innovative guidance materials are developed which aim at embedding NBS thinking within strategic and operational practices across higher education and industry. Central to this effort is the co-creation and delivery of interactive workshops designed to establish baseline knowledge. As a key output, the task involves the design of a suite of 50 modular learning units structured to support both formal accreditation and informal learning. These units cover foundational to advanced concepts and are mapped as 'steppingstones' within a sequential learning framework. The learning units offers a scalable, adaptable resource to embed NBS literacy into educational ecosystems and workforce development strategies.
Keywords	NBS, Higher Education, Learning Units
License	

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Acronyms

EC	European Commission
EQF	European Qualifications Framework
ERA	European Research Area
EU	European Union
LU	Learning Unit
NBS	Nature-Based Solutions
NBE	Nature-Based Enterprise

1. Executive Summary

The NBS Higher Education and Entrepreneurship Architecture advances capacity-building for Nature-Based Solutions (NBS) across the spectrum of higher education and professional training. It addresses university courses, vocational programs, non-formal education, and lifelong learning opportunities, aiming to embed NBS thinking in formal curricula and informal training alike (Dowling et al., 2024). The scope builds on insights from the project's earlier evaluation of NBS in education through the framework and guidance evaluation and partner experiences. This report also highlights the alignment of content with identified gaps. A key focus is fostering institutional leadership and mainstreaming NBS across disciplines and sectors, bridging academic knowledge with practical implementation. This effort comes at a time of rapidly growing demand for NBS expertise in cities and industry, where shortages of skilled professionals are emerging (Mačiulytė & Durieux, 2020).

50 learning units were developed through a participatory co-creation process leveraging transdisciplinary insights. Project partners, (including universities, local government networks, policy institutes, vocational education organisations, and non-profits) convened interactive workshops and focus groups to engage key stakeholders in co-designing the curriculum. These sessions gathered input from students, educators, policymakers, and nature-based enterprise (NbE) professionals on priority topics and skill needs. This collaborative approach ensured that each learning unit's content was informed by real-world needs and diverse expert perspectives, fostering peer learning among contributors (Dowling et al., 2025). The co-creation methodology also emphasised application-oriented design: case studies, problem-based workshops, and hands-on activities were built into the process to maximise practical relevance. Notably, different partners led development of subsets of units in their expert domains focused on university curricula, vocational training, community education, and NBS entrepreneurship to address various learner groups (Dowling et al., 2025). By combining stakeholder input with evidence-based insights, the higher education entrepreneurship architecture shows how participatory design can yield effective educational resources for NBS.

Each of these 50 learning units is a standalone module. The module is available to deliver online or in-person, designed to be completed in 45-50 minutes. The units are designed to support both formal accreditation and informal capacity-building. In formal settings, universities and training institutes can integrate these modules into curricula or certification programs for credit, building recognised NBS competencies. In parallel, the modules are suited for informal learning in professional development workshops or community training, benefiting local policymakers, practitioners, and NbE entrepreneurs. The learning units emphasise interactive, problem-based learning to ensure participants gain practical skills and experience. For example, topics span policy support for sustainable urban planning, cross-sector partnerships, procurement, impact measurement, innovative financing for NBS, and community project management – aligning with capacity gaps identified in the field (Kooijman et al., 2021; Mačiulytė & Durieux, 2020). Overall, this report presents a comprehensive educational framework that bridges the academic and practical domains. By leveraging participatory co-creation and transdisciplinary content, it delivers learning resources to support formal education pathways and continuous professional learning, building capacity for widespread NBS adoption.

2. Introduction

NBS, actions that work with nature to address societal challenges, are increasingly recognised as essential for a sustainable future. Governments and organisations worldwide have incorporated NBS into climate adaptation and biodiversity strategies. However, realising the full potential of NBS requires not only technical innovation but also education and capacity building across society. Integrating NBS into education at all levels is key to ensuring a greener and more resilient future, by equipping current and future decision-makers with the knowledge, skills, and values to implement and support nature-driven solutions (Goodwin et al., 2024). NBS EduWORLD is a Horizon Europe project at the crossroads of nature-based solutions and education, aiming to blend these domains through a network of researchers, educators, practitioners, and community members. The overarching goal is to mainstream NBS in formal, informal and non-formal education, so that citizens are aware of the value and transformative potential of nature in solving pressing environmental, social, and economic challenges.

The NBS EduWORLD State-of-the art report provided a review of NBS in education across Europe (Mulvik et al., 2023). That analysis revealed that while NBS can serve as a powerful, practical vehicle for teaching sustainability competences, it is often absent from current educational agendas. Learning programmes for sustainability seldom explicitly include NBS, especially in vocational education and training, and in certain geographies, such as coastal and rural communities (Mulvik et al., 2023). This gap represents a missed opportunity, as NBS offer concrete, place-based examples for interdisciplinary learning and for linking environmental science with societal benefits.

The state-of-the-art report also highlighted a variety of good practices in NBS education (mostly focused on urban greening and regeneration projects) but noted that a more cohesive framework was needed to integrate these practices into mainstream curricula and training programs. Additionally, existing sustainability competence frameworks (e.g. Wiek et al., 2011; UNESCO, 2017) only recently began to incorporate an explicit “nature” dimension. The new European sustainability competencies framework, GreenComp (Bianchi et al., 2022), for example, adds “promoting nature” as a core competence for learners, addressing a gap in earlier frameworks that overlooked the role of nature in sustainability learning. These insights underscored the need for targeted educational interventions to embed NBS knowledge and values across educational systems.

Responding to the gaps identified by the state-of-the-art report, this research focuses on advancing institutional leadership and capacity in NBS education, particularly in higher education and related professional domains. This report, ‘NBS Higher Education and Entrepreneurship Architecture,’ documents the process and outcomes involved in developing an integrated set of learning resources or ‘education architecture’ that can be used to incorporate NBS into university courses, vocational training programs, and entrepreneurship support initiatives. The intention is to create a suite of modular Learning Units that together form a flexible curriculum or toolkit, enabling educators and trainers to pick and choose modules appropriate for their audience and learning objectives. By structuring the content as modular units, the project facilitates both formal accreditation (e.g. incorporation into degree programs or certified courses) and informal learning (e.g. standalone workshops or online

learning for the general public). Central to the approach was a co-creative development process: the learning architecture would be built with input from stakeholders (educators, students, policymakers, industry, community groups) to ensure relevance and uptake.

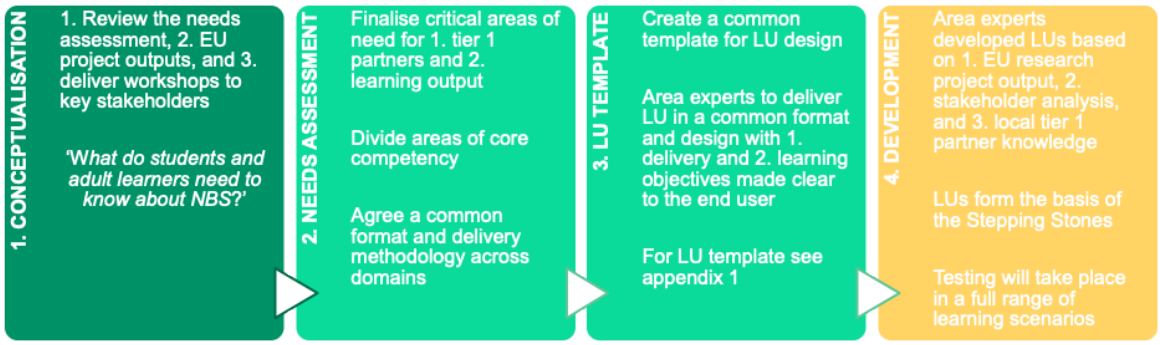


Figure 1. Learning Unit development process

2.1. Background

Higher education institutions play a critical role in catalysing the widespread adoption of Nature-Based Solutions. As hubs of research, innovation, and knowledge transfer, universities, vocational training centres, and lifelong learning providers are pivotal for developing the competencies needed for NBS design, management, and policy integration (Dowling et al., 2024). Universities contribute by embedding NBS in multidisciplinary curricula, fostering systems thinking, and producing graduates equipped with skills in sustainability, urban planning, environmental governance, and socio-ecological resilience. Furthermore, vocational and non-formal education providers expand NBS literacy beyond academic spheres, targeting municipal staff, entrepreneurs, community organisations, and policymakers who are instrumental in local implementation.

The project team implemented a series of interactive workshops and focus groups to gather baseline data on current NBS educational practices, needs, and opportunities. These consultations served to establish the status quo of NBS in participating institutions and communities, and to identify the most pertinent content and skill needs that the Learning Units should address. In parallel, the curriculum design drew upon established educational theory and best practices. For example, the team adopted an outcomes-based curriculum design approach (Kennedy, 2006), ensuring each learning unit has clear learning outcomes and assessment strategies. The pedagogy emphasises active learning, recognising that merely transmitting information on NBS is insufficient for deep learning (Kolb, 1984; Biggs & Tang, 2011). Therefore, interactive elements such as case studies, problem-solving exercises, debates, and reflections are embedded in each unit to engage learners in applying NBS concepts.

Central to this work in cultivating NBS in higher education is the creation of a suite of 50 modular LUs. These units provide structured yet flexible educational content covering key phases of NBS planning, implementation, monitoring, and upscaling. They are designed to

function as both standalone learning experiences and as part of formal degree or certification pathways, enabling their application across formal and informal educational contexts. In addition to content creation, research activities included extensive stakeholder engagement: a series of workshops and focus groups were organised with Tier-1 demonstrators (e.g., Offaly County Council, Almada Municipality, National Museum of Natural History Paris (MNHN)) to gather baseline data, identify thematic priorities, and refine learning objectives. This ensured that the architecture of NBS education responds to real-world challenges and opportunities, aligned with local needs and sectoral demands.

The learning units explicitly target different educational levels and professional pathways. For instance, the units for local government staff incorporate a step-by-step approach to navigating NBS project cycles, from exploration and prioritisation to monitoring and upscaling, making them practical tools for municipal planning teams. Similarly, entrepreneurship-focused units equip Nature-Based Enterprises (NbEs) with the business and governance acumen necessary to drive green innovation. By aligning learning outputs with the EU Green Deal goals and the Sustainable Development Goals (SDGs), this report aims to strengthen the role of education in fostering nature-positive economies and inclusive, resilient societies. Ultimately, the architecture developed here bridges gaps between research, practice, and community engagement, thus accelerating NBS adoption across Europe. The approach to learning design through this research draws on outputs from EU NBS projects, for example, the UrbanByNature methodology to offer a structured yet flexible framework based on seven cyclical steps for implementing NBS. This methodology was particularly influential in guiding the vocational training elements developed by ICLEI, which focus on empowering municipal staff and community actors to mainstream NBS in urban, rural, and coastal contexts. Moreover, other Learning Units draw on the Connecting Nature framework of planning, delivery and stewardship section of building NBS initiatives.

This report connects the educational outputs to the broader goals of stakeholder engagement and capacity building. Educating people about NBS is expected to have a multiplier effect: informed students, professionals, and community members are more likely to champion and implement NBS in their own spheres, thus accelerating the “wider adoption of NBS”. Notably, previous research on nature-based enterprises (businesses providing NBS) has shown that a lack of awareness and skills among both providers and public sector clients is a barrier to NBS implementation (McQuaid et al., 2021). Conversely, access to high-quality training and education is an important enabler for the success of such NBS initiatives (McQuaid et al., 2021). There is also growing demand: as cities and organisations seek to implement NBS to address climate and biodiversity goals, many report difficulty in finding professionals with the needed expertise (Mačiulytė & Durieux, 2020). This deliverable, therefore, tackles an urgent capacity gap by developing educational content to produce “NBS-competent” graduates, civil servants, planners, engineers, entrepreneurs and other stakeholders. In the next sections, we detail how the project team moved from workshops and focus groups (to diagnose needs) through to the design of the 50 Learning Units, and how these units are intended to be applied in various learning settings to mainstream nature-based solutions.

3. Methodology

This report continues from the analysis provided in the 'Initial Report on NBS in Higher Education' (Dowling et al., 2024). The design of the LUs draws on curriculum development good practice to ensure transparency on their purpose and the key learning on the topic, in this case themes related to NBS. The standardisation of the LU format, through the Excel template offers instructors clarity on the learning outcomes, that is, what learners (in vocational, professional, higher education or entrepreneurship settings) will learn, understand or be able to actively do following the LU.

This standardisation ensures that in the architecture development of the LU the curriculum designer teams are taking into consideration not only the content, but also the active ways that they can test and offer reflection points, case studies for discussion and activities that allow learners to show they have met the learning outcomes.

The plethora of EU literature and resources generated on NBS offers an excellent foundation to draw on theoretical concepts, policies, practical examples and case studies on NBS. Presenting content in an information transmission fashion is not sufficient to ensure there is deep learning by learners, therefore the architecture development of these LUs takes into account learning strategies (from reflection, debates, workshop activities, case study analysis among other activities) to offer active learning opportunities. In line with increased levels of awareness in policy and practice, demand for 'nature-based solutions', has increased exponentially in recent years. Challenges are now emerging on the demand side, with some cities reporting challenges finding skilled suppliers of nature-based solutions (Mačiulytė and Durieux, 2020).

Recent research has shed new light on the type of organisations engaged in the supply of nature-based solutions, including private sector enterprises, termed 'nature-based enterprises' (NbE) (Kooijman et al., 2021). An NbE can be defined as 'an enterprise, engaged in economic activity, that uses nature sustainably as a core element of their product/service offering (Kooijman et al, 2021). Within this context, nature may be used directly by growing, harnessing, harvesting or sustainably restoring natural ecosystems, and/or indirectly by contributing to the planning, delivery or stewardship of nature-based solutions. Nature-based enterprises contribute to biodiversity net gain. Previous research identified the key factors influencing the success of nature-based enterprises (McQuaid et al., 2021). Access to high quality education, training and skills development was considered an important enabler. This research also identified important barriers to success, including lack of public sector awareness and understanding of NBS, lack of evidence of NBS effectiveness and knowledge on measuring impact, financing and public procurement barriers.

A central methodological feature was the co-creation process, supported by a participatory design ethos. Extensive workshops, focus groups, and bilateral consultations were held with educators, students, municipal staff, nature-based enterprises (NbEs), and community leaders across the Tier-1 demonstrators (Offaly and Almada). This participatory phase provided both the baseline data and thematic priorities needed for targeted educational intervention.

	Tier 1 Objectives for Learning Units
1	Life-long education focusing on technical knowledge, financing and business models
2	Multi-disciplinary education activities
3	Cross-sector in-person learning activities for public officials
4	On site activities on environmentally and socially vulnerable communities
5	Upscaling and replication
6	Active learning approaches
7	Experiential, on the ground, and active learning approaches
8	Themes: NbS for urban regeneration, resilience and water management and NbS Policy landscape + cocreation
9	Stakeholder engagement
10	Digital tools for engagement
11	Long-term sustainability & maintenance of NbS
12	Reflexive Monitoring & adaptative management
13	Evaluation & impact assessment
14	Assessing funding opportunities for NbS upscaling
15	Guidelines for education for the commission

Table 1. Needs based objectives for LUs

The development approach was underpinned by curriculum design principles aligned with the European Qualifications Framework (EQF), Bloom's Taxonomy (Anderson & Krathwohl, 2001), and the European GreenComp competence framework (Bianchi et al., 2022). Each LU adheres to a standard template, which includes:

- Defined learning outcomes
- Target audience and level (mapped to EQF)
- Pedagogical approach
- Duration (typically 50 minutes)
- Content outline and case studies
- Interactive learning activities
- Assessment options

This consistent format allowed for coherence across the 50 LUs while allowing customisation to suit formal, informal, and non-formal learning environments. The units are designed for hybrid delivery—either online, in-person, or blended—and open-licensed for wide adoption.

The LU design also enabled curriculum design teams to align the NBS content to GreenComp and other EU policy documents. The design also takes into consideration the recognised teaching and learning trends in NBS education Project-based learning, Peer learning, Problem-based learning, Student-centred learning (Gras-Velázquez et al 2020).

In addition, there is an alignment between the LU and key 21st Century Skills from engaging with NBS namely: Creativity, Information/Media Literacy, Collaboration, Critical Thinking and Communications (Ibid.). Finally, the LU template also offers a direct link to GreenComp

Sustainability Competence Framework, focused on the relevant competences related to NBS: Embodying Sustainability Values (Valuing Sustainability, Support Fairness, Promoting Nature); Embracing Complexity in Sustainability (Systems Thinking, Critical Thinking, Problem Solving); Envisioning Sustainable Futures (Futures Literacy; Adaptability; Exploratory Thinking); Acting for Sustainability (Political Agency, Collective Action).

Appendix 1 illustrates the structure of the LU design template. It visually aligns content and activities with learning outcomes, showing how progression occurs from basic understanding to applied knowledge and reflection.

3.1. Higher Education LU Development

Led by Trinity College Dublin (TCD), the development of LUs for the higher education stream targeted undergraduate and postgraduate levels (EQF levels 6–8). TCD applied an outcomes-based curriculum model (Kennedy, 2006), ensuring that each LU provided students with opportunities to develop sustainability competencies including critical thinking, systems thinking, collaboration, and anticipatory skills.

The learning design was also shaped by insights from earlier NBS EduWORLD research (WP2 D2.1), which identified limited integration of NBS in existing university programs. Several identified gaps were addressed in the higher education LUs: the need for interdisciplinary content, lack of clear pathways for sustainability careers involving NBS, and the absence of project-based learning focused on real-world applications. For example, one LU, 'Urban Green Infrastructure for Climate Adaptation,' introduces the concept of green infrastructure through European policy and case studies from Offaly's greenway development and Almada's climate-sensitive urban design. Students engage in scenario planning and stakeholder analysis exercises that simulate real-world decision-making processes.

The higher education LUs leveraged EU-funded research and innovation projects as a foundational input. This strategic alignment ensured the LUs were grounded in cutting-edge, evidence-based practices for Nature-Based Solutions (NBS), while also supporting European Commission priorities related to knowledge transfer, open science, and education for sustainability.

EU projects were used both as sources of content and as frameworks for structuring learning activities and assessment. A key goal of this process was to translate complex project outcomes into pedagogically meaningful material tailored to undergraduate and postgraduate learners across disciplines. More than twenty Horizon 2020 and Horizon Europe projects were reviewed, with in-depth integration from several major initiatives, including *CLEVER Cities*, *URBiNAT*, *NetworkNature*, *GoGreenRoutes*, and *Connecting Nature*.

For example, outputs from the *Connecting Nature* project were central to LU 10 'Implementing NBS where students analyse case studies of NBS business models and governance structures. Learners examine project documents and use the Connecting Nature Framework to propose hypothetical NBS strategies for European cities. Similarly, the CLEVER Cities co-creation model informed multiple LUs, particularly those focused on stakeholder engagement and participatory planning processes. These examples were selected not only for their

relevance to municipal decision-making but also because they represent real-world contexts that students can critically analyse and build upon.

To ensure academic robustness and coherence, each LU was developed using a backward design methodology (Wiggins & McTighe, 2005), beginning with clear learning outcomes aligned with the European Qualifications Framework (EQF) at levels 6 to 8. Learning outcomes were cross-referenced with project outputs to ensure alignment between what students are expected to learn and what knowledge and tools EU projects provide. For instance, a learning outcome such as “Evaluate NBS implementation strategies using systems-thinking approaches” was directly matched to conceptual tools from the *GoGreenRoutes* systems maps and urban well-being indicators.

The use of project-derived visual tools, policy briefs, datasets, and impact reports added credibility and depth to the content, bridging the gap between theoretical instruction and applied sustainability practice. Importantly, students are exposed not just to success stories but also to the operational, political, and technical barriers revealed through EU-funded pilot initiatives. This nurtures critical thinking and prepares students to engage with complex real-world challenges.

Moreover, the integration of EU projects strengthens the visibility and reuse of EC-funded knowledge, fulfilling the principles of the European Research Area (ERA) and aligning with Horizon Europe’s aim to “maximise impact by ensuring uptake of results in education, policy and practice.” The systematic alignment of LUs with European projects also contributes to the long-term sustainability of the NBS EduWORLD educational architecture, positioning universities as knowledge intermediaries who translate research into societal impact.

3.2. Vocational LU Development

ICLEI Europe and PPMI led the development of vocational and professional LUs, responding to needs among public servants, civil society leaders, and non-formal educators. The UrbanByNature framework (ICLEI, 2021), based on ISO 37101 for sustainable development in communities, guided curriculum content. The vocational stream used a cyclical 7-step model as an organising framework for units focused on planning, implementation, governance, monitoring, and upscaling of NBS.

LUs in this stream included:

- 'Multi-level Governance of NBS' (aligning local action with EU strategies)
- 'Public Procurement for Nature-Based Solutions' (barrier analysis and enabling mechanisms)
- 'Stakeholder Mapping and Engagement in NBS' (applied participatory tools)

These units are especially relevant for capacity-building in local governments. They incorporate adult learning principles, using role plays, real-world tender documents, and participatory mapping exercises. Focus groups conducted with Offaly County Council revealed a need for upskilling on NBS-related procurement regulations and co-design processes. Feedback from pilot implementations (described in D4.2) validated the relevance and usability of these vocational modules.

Figure 2 shows the UrbanByNature framework and its adaptation for education. Each step—Explore, Prioritise, Design, Implement, Monitor, Reflect, and Upscale—corresponds to one or more LUs. This visual framework aids curriculum planners in sequencing content and designing comprehensive training pathways.

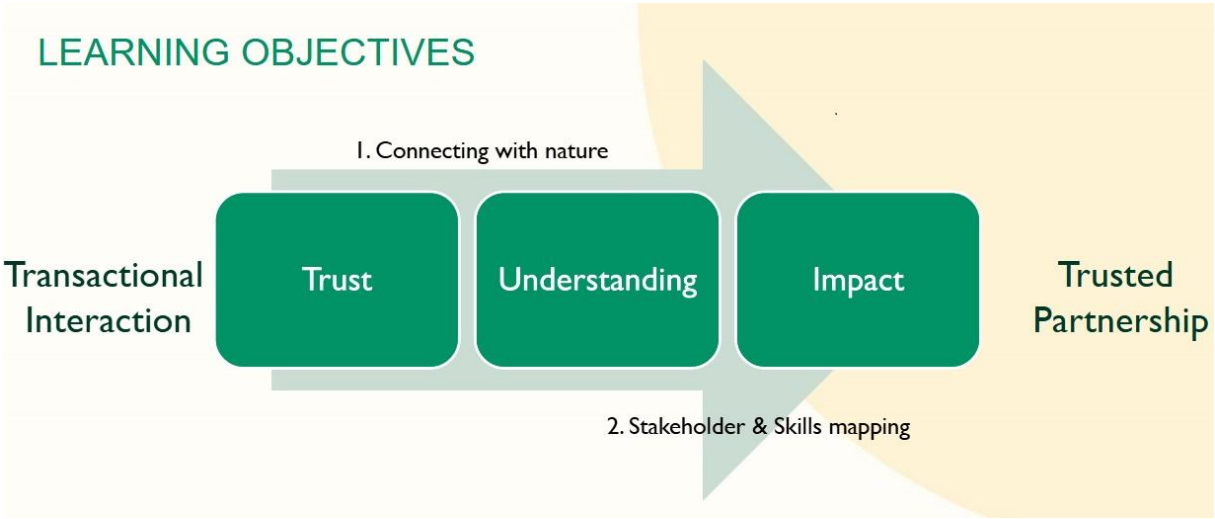


Figure 2. Learning Objectives Overview

3.3. Entrepreneurial LU Development

Horizon Nua led the entrepreneurship stream, targeting nature-based enterprises (NbEs) and business professionals. The unit development was grounded in Milestone 5 report findings, which included data from a large-scale survey and interviews with over 120 NbEs across Europe. Key knowledge gaps identified included financial planning, impact measurement, and ecosystem services integration into business models.

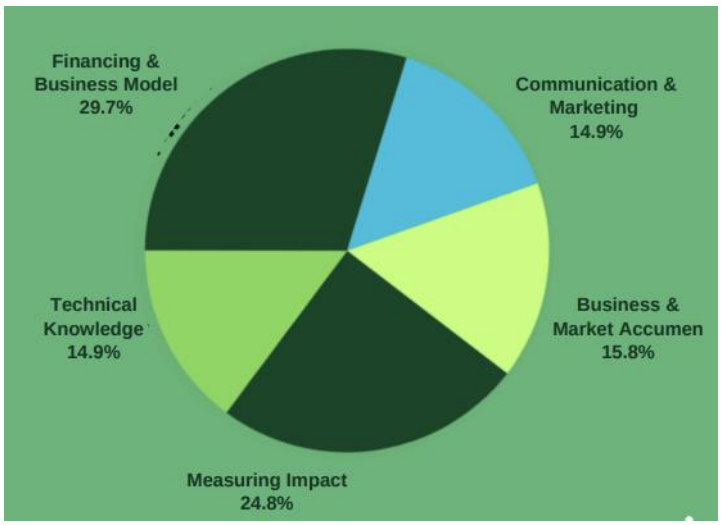
To address these, the entrepreneurship LUs were designed using applied business tools:

- Business Model Canvas (Osterwalder & Pigneur, 2010)
- ESG and Nature-Positive metrics (aligned with IUCN Global Standard)
- Impact value chains and Theory of Change models

LUs such as 'Pitching Your Nature-Based Business' and 'Financing NBS Startups' use experiential learning techniques, where participants develop their own pitch decks or investor proposals. These units were tested in pilot programs with NbE networks (e.g., Invest4Nature) and are suitable for incubator programs, innovation hubs, and professional upskilling.

Structure of NBE modules and expected learning outcomes: Responding to the findings of the research study, 10 NbE modules were developed. Following an introductory module (module 1), these learning modules responded to knowledge gaps in relation to financing and business models (modules 2,3,4,5) impact measurement (modules 6 & 7), business acumen (modules 8, 9) and communication (10). Technical knowledge gaps were not addressed in these modules given (i) the disciplinary focus on business (ii) the technical content provided in other NBS EduWORLD learning modules.

Figure 3 illustrates the key areas sought for entrepreneurial learners, highlighting progression from awareness-building to business launch, and showcasing how different learning units correspond to each stage of enterprise development.



Source: I4N Survey (n=124)

Figure 3. Results from poll of NbEs on capacity building and skills development needs

All LUs were co-created through an iterative process involving Tier-1 demonstrators and stakeholder groups. Participatory workshops were held in Offaly (April 2023, April 2024) Paris (2023) and Almada (2024), where key stakeholders discussed challenges around NBS, needs for development, and approaches to education were discussed. Methods used included:

- Thematic prioritisation through dot-voting
- Scenario analysis for contextual adaptation
- Stakeholder mapping exercises for NBS implementation planning

Data from WP2 and the design guidance document were used to triangulate findings and inform content development. Feedback from Tier-1 sites emphasised the need for accessible language, real-world relevance, and alignment with local policies and planning tools. The stakeholder engagement map used to identify roles, responsibilities, and learning needs for each LU stream. This demonstrates how partners co-produced knowledge by building on community inputs and professional expertise.

To facilitate scalability and inclusivity, all LUs are published as open educational resources on the NBS EduWORLD website. Each unit includes teaching guides, suggested activities, and presentation slides. Further research will explore AI-assisted learning customisation and micro-credentialing options.

A metadata tagging system allows users to filter LUs by:

- Audience (e.g., undergraduate, municipal staff, entrepreneur)
- Theme (e.g., co-creation, governance, entrepreneurship)
- Delivery format (e.g., lecture, workshop, field-based)

This system supports self-directed learning and integration into formal accreditation pathways. Users can construct personalised learning journeys using the 'steppingstones' model.

The LU development process closely aligns with the State-of-the-Art Report, Principles for NBS in Higher Education and Entrepreneurship, and policy inputs from other work packages. The design was also benchmarked against key EU policy frameworks, including:

- EU Green Deal
- EU Biodiversity Strategy 2030
- GreenComp (Bianchi et al., 2022)
- UNESCO ESD Learning Objectives (2017)

This alignment ensures policy relevance and supports the uptake of NBS education within national and European qualification systems. Furthermore, the content is compatible with existing EU initiatives on digital learning and green jobs under the Pact for Skills and the Digital Education Action Plan.

Long-term Sustainability of the Resources: After the project's end, the NBS EduWORLD website will be maintained for a period, of 2 years up to 2027. We will identify potential stable repositories like Oppla (the EU repository for nature-based solutions) or Scientix® (the community for science education) which could host the materials after this period. This would preserve access and allow future contributions. All materials are published under an open license (CC BY 4.0). Encouraging users to share modifications under the same license will build an evolving library of NBS education resources.

In conclusion, the methodology adopted through this research reflects a comprehensive, multi-layered framework designed to create, test, and disseminate high-quality Learning Units (LUs) for Nature-Based Solutions (NBS) education across three main educational streams: higher education, vocational/professional training, and entrepreneurship. Grounded in educational theory and stakeholder engagement, the development process ensured that the resulting architecture is modular, flexible, and capable of responding to varied learner needs and institutional contexts. The methodology combined educational best practices, stakeholder collaboration, and EU policy alignment to produce a flexible, modular, and evidence-informed NBS Learning Architecture. This architecture provides the foundation for subsequent testing and scaling efforts underway in future research for NBS EduWORLD.

4. Journeys to NBS

4.1. Pathways for Students, Instructors, and Institutions

By using the European Qualifications Framework as the basis for the LU design, this offers transparent and comparable educational level pathways related to LUs for students, instructors and institutions wishing to apply these NBS educational resources.

While some of the LUs offer similar titles, based on the various consultations with key stakeholders at vocational, entrepreneurial, professional and higher education level, the learning outcomes, content and activities offered in these LUs differ. This creates a

progression pathway of NBS learning from a basic level (transferring definition and basic knowledge on NBS) through to more professional, technical, analytical or evaluative way of understanding NBS. The learning outcomes offer this differentiator and begin a pathway of progress through these different levels of knowledge, skills and competences on NBS.

In addition, by building toolkits of NBS LUs, there is the creation of progression pathways on NBS. While this clusters LUs from the same educational level together, it allows for the scaffolding of learning on NBS from basic definitions, to building specialist knowledge, honing skills and competences through active learning strategies, such as case study analysis and NBS topic debates.

With the advent and popularity of micro-credentials as a form of further and higher education, there is potential to build pathways of NBS learning through the application of these LUs. For example, the Executive Education section of the Trinity Business School offers a series of MicroCreds (microcredentials) offering 5 or 10 ECTS (European Credit Transfer System) at postgraduate level that can be accumulated towards a qualification or can stand alone as key learning opportunity for professionals who wish to build their learning on a particular topic. NBS is one such topic that could be integrated into an executive education pathway. Moreover, other further education, entrepreneurship education or professional learning within an organisation can draw on these LUs to build pathways of learning that integrate NBS into existing courses of study.

Learning units are designed for use in the context of professional development. They are targeted at professionals at EFQ level 6 or above (i.e. third level certification/degree or above)

The NbE modules are targeted at a wide range of potential users including

- Individuals with an idea for a nature-based business. This idea might be working directly with nature e.g. agriculture, forestry, coastal/marine, water management, peatlands, ecosystem restoration or indirectly e.g. eco-tourism, health and wellbeing, ecosystem service consultancy etc.
- Existing nature-based enterprises, working with and for nature, who want to grow their business for sustainable impact. Businesses may come from for-profit or not-for-profit sectors.
- Existing businesses working with nature, who want to move towards more nature-positive business models, reducing negative impacts on people and nature.
- Public sector bodies interested in understanding more about funding and business models for nature-based solutions and nature-based enterprises.
- Economic development agencies interested in learning about the characteristics, potential and needs of nature-based enterprises as part of a broader transition to more sustainable economic development.
- CSR / Sustainability managers from large organisations who are looking to partner with Nature-based Enterprises as a part of their sustainability and climate action agenda.
- Anyone with an interest in entrepreneurship and in how to balance economic success with ecological and social well-being.

Teaching and learning trends employed: Given the professional audience, the emphasis of each module was on project-based and problem-based learning with a strong peer-to-peer learning component. Lessons were structured to encourage the application of learning to

professional projects/business contexts, identify potential challenges and exchange with peers on potential solutions.

21st century skills: Learners acquired skills relating to creativity, collaboration, critical thinking and communication. GreenComp European Sustainability Competency Framework: Learners acquired skills at all levels of the GreenComp framework i.e. Embodying Sustainability Value, Embracing Complexity in Sustainability, Envisioning Sustainable Futures and Acting for Sustainability.

The LUs can be adopted by local authorities and organisations elsewhere. The idea is that our demonstrator partners will integrate NBS modules into their ongoing training programs. For example, Offaly's Climate Action Team could incorporate certain LUs into the induction training for new staff or into public workshops they hold for community climate action. Almada might include NBS modules in the professional development courses for their urban planners or engineers. By embedding the content into existing structures, the knowledge gets institutionalised.

Integration into formal education: On the academic side, the project partners in universities are planning to integrate the LUs into their curricula:

- Trinity College Dublin plans to embed some of the higher education units into relevant undergraduate courses (e.g., a module on "Innovation for Sustainability" could use the NBS entrepreneurship unit as one week's topic). Additionally, these resources can support student projects – for instance, a geography student might use the LUs as a starting point to design a local NBS intervention as a class assignment.
- Other academic partners and associate institutions (like those in the Advisory Board or the project's network) are encouraged to use the materials in their courses. Because the LUs are open and modular, a lecturer in any university can pick up a unit ("NBS and Community Engagement") and slot it into their lecture series on climate adaptation. This lowers the barrier to teaching NBS, which previously might have required an instructor to spend time gathering case studies and data. Now a ready-made, peer-reviewed lesson is available.
- Importantly, some LUs can be combined to form new electives or training programs. For example, a university could create a short course or certificate in "Nature-Based Solutions for Sustainable Communities" by compiling 5-6 of the units across categories. Students completing that short course (possibly as an extra-curricular certificate) would get a broad overview from technical to social aspects of NBS. This kind of offering can attract not just current students but also external learners (professionals coming back for continuing education), blending formal and continuing education.

Vocational training and professional development: The vocational-oriented LUs are finding pathways into professional training:

- Through ICLEI's network, city representatives beyond the core partners have shown interest. ICLEI can use the LUs in its capacity-building workshops for cities (they regularly conduct trainings on urban sustainability). By adding NBS-specific sessions drawn from NBS EduWORLD content, ICLEI amplifies the reach to dozens of cities in Europe. This supports a **"Network of Networks"** approach identified in WP2,

leveraging existing platforms like NetworkNature or disseminate NBS education resources.

- National or regional training agencies (like LOETB in Ireland) can adapt the content for their audiences. For instance, a training centre for civil servants could adopt the procurement and governance units into a module for public sector upskilling. Because the materials are aligned with EU frameworks and include references to EU policies, they resonate with public sector learners across member states.
- **Non-formal education adoption:** NGOs and environmental education centres can use simplified versions of the units to educate youth or community groups. While the LUs are primarily designed for tertiary/professional level, many concepts can be distilled for general audiences. The emphasis on interactive activities is particularly useful for non-formal workshops. For example, a community NGO might organise a "Nature Solutions for Our Town" workshop using some exercises from the LUs, like mapping local natural assets or brainstorming NBS ideas (these might come from an activity sheet in one of the units).
- Lifelong learning platforms: Lifelong learners – anyone interested in self-study – can access the materials from the NBS EduWORLD portal. In the age of digital learning, individuals like a retired teacher, a volunteer, or a city councillor can download the teaching notes and slides and walk themselves through a topic. The availability of **teaching notes and references** in each unit also means motivated learners can further explore the topic using the bibliography provided.

Stakeholder engagement and capacity building: The process of developing and implementing the LUs has, by design, strengthened stakeholder engagement:

- Many of the stakeholders who participated in workshops and focus groups early on have continued involvement, for instance by attending the pilot trainings or reviewing materials. This sustained engagement transforms them from consultees to **co-educators or ambassadors**. An Offaly council member who helped shape a unit on community engagement might now champion that unit being used in all community meetings about green projects. A teacher who participated via Green Schools could adapt some content for their classroom and share it with the wider teacher network.
- By creating a shared set of resources, the project has fostered a **community of practice**. Different cities or institutions using the same learning unit can compare notes. The project has facilitated introductions between, say, Offaly and Almada staff so they can discuss how each used the materials and what outcomes they saw. This kind of cross-pollination is invaluable for capacity building: peers learning from peers about what works in teaching NBS.
- The learning units also embed stakeholder engagement principles within them. For example, units on co-creation literally train participants in stakeholder engagement methods (e.g. how to run a participatory mapping exercise). Thus, as people learn from the units, they also learn how to involve others in NBS. This meta-effect means the reach of the project could grow exponentially – those trained are better equipped to train or engage further people (a "train the trainer" effect).
- The NBS EduWORLD consortium includes some unique partners, e.g. a theatre organisation (not detailed earlier). While they were not primary developers of LUs, their presence ensures that dissemination isn't limited to conventional channels. For

instance, they might create a storytelling workshop around NBS, inspired by the content. This creative outreach ties into the project objective of exploring **new dissemination and mobilisation strategies** for lifelong learning on NBS using 21st-century technologies and unconventional methods. In essence, the learning units provide the content backbone, which can be delivered in innovative ways to engage broader audiences.

Formal recognition and incentive: To promote uptake, the project is also considering ways to formally recognise those who complete a series of learning units. While not an initial deliverable, discussions have included:

- Developing a **micro-credential or digital badge** system. Learners who engage with a certain cluster of units (e.g. all five vocational units) could receive a badge certifying their knowledge in "Nature-Based Solutions for Local Governance." This could be offered through partner universities or professional bodies. It gives an extra incentive for professionals to undertake the training, as they can showcase the credential in their CV.
- Aligning the units with existing qualification frameworks. The mention of EQF levels ensures that if, for example, a vocational college wanted to create a new module on NBS, they could easily see how it fits into level descriptors and credit systems. In Ireland, for instance, these units might be used in a Level 7 diploma for continuous professional development.
- Engaging professional associations (planners' institutes, landscape architects, etc.) to endorse some of the units for continuing education credits. If a planners' institute recognises completing the NBS governance units as counting toward a planner's required learning hours per year, that will encourage more participation.

Promoting NBS through education: Ultimately, the application of these learning units is a means to a larger end: **mainstreaming NBS as a common approach in tackling societal challenges.** By educating across formal, vocational, and informal channels, NBS EduWORLD is helping to cultivate a culture that values nature-based solutions. Some anticipated long-term impacts related to Higher education include:

- **Greater inclusion of NBS in curricula and textbooks:** As universities adopt these materials, future editions of textbooks or course syllabi in relevant fields may start to include chapters on NBS (where previously they might not). The project's reference list and academic framing (e.g. linking to GreenComp competencies, SDGs, EU policies) provide a scaffold for academic discourse on NBS, hopefully ensuring NBS gains a permanent spot in sustainability education alongside concepts like renewable energy or circular economy.
- **Increased multi-disciplinary collaboration in education:** The project brought together disciplines (engineering, ecology, business, policy) to create content. This approach can spill over such that universities might create interdisciplinary courses around NBS, or vocational programs might integrate environmental science with social science. For instance, an urban planning program might collaborate with an environmental science department to co-teach using these units. Breaking silos in education can eventually lead to breaking silos in professional practice.

- **Empowered communities and practitioners:** On the ground, a council official who learned about co-creation might initiate more community dialogues for a new park project; an entrepreneur who learned about pitching an NBS business might successfully secure funding for a startup that installs green roofs. These individual actions, multiplied across many learners, drive the *actual implementation* of NBS. In a few years, one could trace how the knowledge imparted by these units translated to new NBS installations or programs in various localities.

It is also worth emphasising that the LUs champion an approach of **inclusion and participation** in line with sustainable development values. They encourage engaging youth, considering gender and social inclusion in NBS projects, and acknowledging indigenous and local knowledge. For example, one future direction identified is the importance of involving Indigenous Peoples and Local Communities (IPLCs) in NBS design and training. While this is more relevant outside Europe or in specific contexts, the ethos is built in: effective NBS require diverse stakeholder voices. So, an educator using these units will hopefully carry forward that inclusive message.

The project's website and community portal (NBS EduHub) will continue to be a hub for users to share experiences, ask questions, and update content. As NBS is a rapidly evolving field, the education materials may need updating beyond the project's lifetime. Thus, part of the application strategy is to hand over these resources to the community with an open license, inviting continuous improvement. Already, interest from international organisations has been noted: for instance, the UN Institute for Training and Research (UNITAR) or the International Union for Conservation of Nature (IUCN) might leverage some units in their global capacity-building efforts, given they also run NBS training (IUCN offers a professional certificate on NBS standards; ITCILO has a course on "Decent Work through NBS"). NBS EduWORLD's materials complement these by providing a more holistic educational package.

In summary, the application of the 50 learning units is actively fostering **stakeholder engagement and capacity building** across a spectrum of learning environments:

- In **formal education**, by enriching university and college programs and producing graduates who are literate in NBS.
- In **vocational and professional training**, by equipping current practitioners with the skills to implement and advocate for NBS in their jobs.
- In **non-formal and lifelong learning**, by raising awareness and understanding among community members, decision-makers, and enthusiasts outside traditional classrooms.
- In the **entrepreneurial ecosystem**, by supporting innovators who will supply NBS and scale up green businesses.

Through these efforts, education becomes a driving force to overcome barriers to NBS (such as lack of awareness, expertise, and evidence) and to amplify the enablers (such as informed leadership, community support, and cross-sector partnerships) (McQuaid *et al.*, 2021). The next section concludes the report with reflections on the outcomes and recommendations for future work to ensure the momentum for NBS education continues to grow.

5. Conclusion

This report set out to develop an NBS Higher Education and Entrepreneurship Architecture which involves, a robust framework and toolkit for integrating nature-based solutions into education and capacity-building programs. Through a rigorous process of stakeholder engagement, needs analysis, and collaborative design, the NBS EduWORLD project has delivered a comprehensive suite of 50 Learning Units that address identified gaps in NBS knowledge and skills. The deliverable demonstrates a clear narrative progression: starting from baseline insights (what is the state of NBS education and what do people need), moving to content development (creating targeted learning modules), and culminating in practical application (piloting the modules and planning their wider use).

Several key **findings and achievements** emerge from this work:

- **There is a high demand and necessity for NBS education** across different sectors. The project confirmed that many educators, professionals, and community stakeholders are eager to learn about NBS once materials are made accessible. The lack of NBS in many university curricula was often not due to lack of interest, but a lack of structured content – a gap this deliverable fills.
- **Co-creation with stakeholders greatly enhanced relevance.** By involving end-users (students, city officials, etc.) in the design process, the Learning Units were tailored to real needs. This bottom-up input is reflected in the diversity of topics covered and the practical orientation of the modules. It also built “buy-in”; stakeholders feel ownership of the outputs and are thus more likely to use them.
- **Modularity and flexibility** proved to be effective strategies. The decision to create discrete, stand-alone units has paid off, as different combinations of units can serve different purposes. Feedback from pilots indicates that users appreciate the ability to pick only what they need. At the same time, the standardisation in format means the quality and approach is consistent, which helps maintain a high level of pedagogical integrity.
- **Active learning approaches** embedded in the units have been well-received. Participants in the pilot workshops noted that the interactive elements (like group problem-solving scenarios) made the sessions engaging and memorable. This aligns with educational theory that engagement leads to better retention of knowledge. By not defaulting to lecture-only content, the units also serve as a model for how sustainability topics can be taught in a more participatory way.
- The project successfully linked **higher education with vocational training and lifelong learning** under a unified theme. This is somewhat unique – often projects focus on one level. Here, the architecture spans multiple levels, facilitating knowledge transfer between academia, industry, and the community. For example, a case study used in a vocational unit might also appear in a university lecture, creating continuity and shared reference points between future graduates and current practitioners.
- The integration of **theoretical frameworks** (like sustainability competencies and inquiry-based learning) ensures that the content is not just ad-hoc but connected to broader educational movements. By referencing frameworks such as GreenComp (Bianchi *et al*., 2022), the LUs place NBS education within the context of developing

sustainability mindsets and values (e.g., *valuing nature* as a sustainability value). This theoretical underpinning adds credibility and facilitates adoption since educators can align NBS lessons with their established curriculum goals (such as developing critical thinking or systems thinking in students).

The creation and initial implementation of the NBS learning architecture is a significant step toward mainstreaming nature-based solutions. However, education and capacity building are ongoing endeavours. Based on the experiences and findings of this research, we outline several recommendations and future directions:

1. **Localisation and Language Adaptation:** One clear recommendation is to adapt and translate the learning units for different languages and local contexts. As noted, the term "NBS" and many case studies are currently presented in English and often Eurocentric contexts. To truly broaden the impact, partners (and future users) could create localised versions where possible – for example, translating units into Portuguese for use in Almada's schools, or into French for stakeholders in Paris. Localisation also means tweaking examples to fit local ecosystems (coastal erosion modules for coastal communities, drought-focused NBS for Mediterranean regions, etc.). This will make the content more relatable and address the gap highlighted by Lemo *et al*. (2025) regarding the lack of nationally or locally tailored NBS courses. It ensures that learners everywhere can see themselves and their environment in the curriculum.
2. **Continuous Stakeholder Engagement:** Maintain the participatory spirit by establishing a feedback mechanism as the LUs get widely used. A community of practice or user forum (possibly hosted on the NBS EduWORLD platform) should allow educators and learners to share their experiences and suggestions. This could lead to periodic updates of the LU materials. As NBS is a fast-moving field with new research and policy coming out (e.g., new EU regulations, or new success stories), the content should be updated to remain current. Engaging original stakeholders in these updates or expanding to new ones (like additional cities or universities outside the consortium), will keep the materials fresh and relevant.
3. **Expanding Partnerships for Dissemination:** We recommend leveraging networks and institutions to amplify dissemination. For instance, working with the **European Commission's education and environment directorates** could integrate these resources into Europe-wide initiatives (e.g. Education for Climate Coalition, EU's Skill Agenda for green jobs). At a global level, partnerships with UN agencies (UNEP, UNESCO) or international NGOs could bring the NBS EduWORLD approach to other regions with adaptations as necessary. The more these materials are championed by influential bodies, the more legitimacy and uptake they gain in educational systems.
4. **Formal Accreditation and Integration:** Encourage and assist educational institutions in embedding NBS units formally into curricula. This might involve accrediting a set of modules as an official certificate or diploma (perhaps a joint offering by some consortium members). It could also involve creating Erasmus+ Knowledge Alliances or similar projects to allow universities to exchange best practices in teaching NBS. On the vocational side, integration into **national training frameworks** (for example, including NBS content in the curriculum for landscape architect licenses or urban planner training programs) would ensure long-term sustainability of the effort.

5. **Monitoring and Evaluation of Impact:** It's recommended to set up an evaluation plan to track how the learning units are impacting knowledge and behaviour over time. This could involve surveys of learners pre- and post-training to measure knowledge gains, or follow-ups with organisations to see if those trained go on to initiate NBS projects. Metrics such as number of institutions adopting the units, number of learners reached, and qualitative feedback on confidence in implementing NBS should be collected. This data will be crucial to demonstrate the value of NBS education and make the case for further funding or policy support. It will also highlight which areas might need additional educational resources (perhaps new units if a gap remains, or advanced versions of units if demand for deeper learning arises).
6. **Linking Education to Implementation Opportunities:** Education should be coupled with opportunities for practical application. We recommend creating more **experiential learning opportunities** in tandem with the units – for instance, internships or project-based assignments with the demonstrator sites or other living labs. If a student takes the NBS modules, connecting them to a local NBS project (via volunteer programs or thesis projects) will consolidate their learning and also benefit the community. Similarly, for professionals, pairing training with on-the-ground pilot projects (as done in Offaly and Almada) is a model to replicate. This ensures that capacity building directly translates to implemented solutions, bridging the infamous gap between knowledge and action in sustainability.
7. **Ensuring Inclusivity and Equity:** As the NBS education program grows, it should continue to focus on inclusivity. That means proactively reaching out to under-represented groups in the environmental field – for example, ensure materials are accessible to those with limited prior knowledge or from disadvantaged backgrounds. The content might need adaptation for different learning needs (like more visual content, or community languages). Also, incorporating traditional ecological knowledge and values of local communities (when applicable) to enrich curriculum. This aligns with the note on Indigenous and Local Community Engagement. Europe has its own local knowledge systems (e.g., traditional landscape management practices) that can be tied to NBS education for cultural relevance.

5.1. Next Steps

Building on the foundation laid in this report, the subsequent phase of work, encapsulated in the implementation of NBS stepping stones, will focus on rigorous field testing and refinement of the NBS educational architecture. Specifically, we will implement the pilot 'steppingstones' approach to lifelong learning in the 21st century, exploring multiple learning pathways and emerging forms of accreditation. This next stage will involve applying the 50 Learning Units across diverse educational and professional settings: Testing will be conducted with higher education institutions, entrepreneurial training providers, and Tier-1 demonstrator partners to validate the toolkits developed under through this work package.

A selection of 10 learning units will be developed into a toolkit for each Tier 1 partners (three Toolkits of twn learning units specific to the individual case characteristics). These toolkits will encompass customisable modules suitable for degree-awarding courses, vocational (non-degree) programs, CPD training, and upskilling or reskilling initiatives. A major innovation in

this phase will be the integration of digital and AI-enhanced learning platforms, enabling more personalised and accessible educational experiences. Tailored materials will be adapted for local contexts, and the results of these interventions will be reported, analysed, and uploaded to the People and Knowledge Hub repository. This contributes to ensures NBS education becomes a scalable, adaptable, and effective solution for sustainability education across all tiers of the NBS EduSystems.

In closing, the higher education architecture has established a strong foundation for integrating nature-based solutions into education. This aligns well with and supports broader policy objectives, such as the EU's aim to foster a climate-literate and environmentally conscious citizenry and to create the green jobs of the future. As the world faces escalating climate and biodiversity crises, the need for professionals and citizens capable of deploying nature-based solutions is greater than ever. Through stakeholder-driven design and innovative educational practices, NBS EduWORLD has charted a path forward to nurture such capacity. The continuing challenge will be to maintain momentum, scale up these efforts, and ensure that the seeds planted through this educational architecture grow into a widespread transformation in how we learn *with* and *about* nature to build a sustainable future.

6. Bibliography

Bianchi, G., Pisiotis, U. and Cabrera Giraldez, M., (2022) *GreenComp The European sustainability competence framework,* Punie, Y. and Bacigalupo, M. editor(s), EUR 30955 EN, Publications Office of the European Union, Luxembourg, 2022 https://publications.jrc.ec.europa.eu/repository/handle/JRC128040 [accessed 08/04/2025]

Biggs, J. and Tang, C., 2011. Train-the-trainers: Implementing outcomes-based teaching and learning in Malaysian higher education. *Malaysian Journal of Learning and Instruction*, *8*, pp.1-19.

Dowling, C.M., McQuaid, S., Uketesh, S., Mulvik, I.B. & Donnelly-Cox, H. (2024) *Initial report on principles, NBS content, pedagogy, gaps, and priorities for NBS in higher education and entrepreneurship architecture*. NBS EduWORLD Project, Milestone 5. Horizon Europe Grant Agreement No. 101060525.

Europass, European Union. 'Description of Eight EQF Levels' web page [accessed on 01/04/2025 https://europass.europa.eu/en/description-eight-eqf-levels]

Gastaldo, Denise; Magalhães, Lilian; Carrasco, Christine & Davy, Charity (2012a). Body-map *storytelling as research: Methodological considerations for telling the stories of undocumented workers through body mapping*, http://www.migrationhealth.ca/undocumented-workers-ontario/body-mapping

[accessed 08/04/2025].

Goodwin, S., Olazabal, M., Castro, A.J. and Pascual, U., 2024. Measuring the contribution of nature-based solutions beyond climate adaptation in cities. *Global Environmental Change*, *89*, p.102939.

Gras-Velázquez, À., Mulvik, I. B., Campodonio, A., Nada, C. & Pocze, B. (2020) Nature-Based Solutions in education - Validation report, European Commission, August 2020 [accessed on 25/03/2024 https://files.eun.org/NBS/NBS-pilot-validation-report-final.pdf]

Kennedy, D, (2006) *Writing and Using Learning Outcomes: A Practical Guide.* Cork: UCC-HEA [accessed 02/04/2025 https://cora.ucc.ie/bitstream/handle/10468/1613/A%20Learning%20Outcomes%20Book%20D%20Kennedy.pdf?sequence=1

Jullien, R.E.M.I. and Kolb, M., 1984. Hierarchical model for chemically limited cluster-cluster aggregation. *Journal of Physics A: Mathematical and General*, *17*(12), p.L639.

Kooijman, E.D., McQuaid, S., Rhodes, M.L., Collier, M.J. and Pilla, F., 2021. Innovating with nature: From nature-based solutions to nature-based enterprises. *Sustainability*, *13*(3), p.1263.

Maciulyte, E. and Durieux, E., 2020. Public procurement of nature-based solutions Addressing barriers to the procurement of urban NBS: Case studies and recommendations. Report by the European Commission—Directorate-General for Research and Innovation. 48pp. *Report by the European Commission—Directorate-General for Research and Innovation*.

McQuaid, S., Kooijman, E.D., Rhodes, M.L. and Cannon, S.M., 2021. Innovating with nature: factors influencing the success of nature-based enterprises. *Sustainability*, *13*(22), p.12488.

Venckutė, M., Mulvik, I.B., Lucas, B. and Kampylis, P., 2020. Creativity–a transversal skill for lifelong learning. An overview of existing concepts and practices. *Publications Office of the European Union, Luxembourg*.

Henriques, M.H. and Brilha, J., 2017. UNESCO Global Geoparks: A strategy towards global understanding and sustainability. *Episodes Journal of International Geoscience*, *40*(4), pp.349-355.

Wiek, A., Withycombe, L. and Redman, C.L., 2011. Key competencies in sustainability: a reference framework for academic program development. *Sustainability science*, *6*, pp.203-218.

7. Appendices

7.1. Learning Unit Template

1			NBS EduWORLD					
2	**NBS EduWORLD - Project Education Learning Unit Template**							
3	***Prepared by: Prof. Gemma Donnelly-Cox, Dr Conor Dowling, Dr Maria Gallo - Trinity Business School - Last revision 30th July 2024***							
4	**Learning Unit (LU) Planning Template - High Level Overview**							
5	**Name of Learning Unit (LU) Topic**							
6	NBS Context (e.g. urban rural, coastal)	NBS keywords **complete checklist at the end of the document**	Other Keywords (topics other than NBS) **add in Other below**	Linked or complementary concepts to NBS (to assist curriculum integration)	Prior learner knowledge of NBS (high, moderate, low/none)	Prior instructor knowledge/ skills/ competences of NBS or equivalent	Key EU NBS resources used (for instructor preparation) include link	Type of LU - lecture, workshop, field trip/site visit, case study
7								
8	Target academic subject / discipline / professional area or group	Target learners/ groups [age range of learners] if applicable	Min/ Max # of learners (if applicable)	Sector (e,g, professional, higher education, community)	Prerequisites required of learners if applicable (education)	EQF (European Qualifications Framework) level (or Irish NFQ) indicative only	Time for LU (aim is 50 minutes per learning unit	Course delivery format (e.g. in-person, hybrid, online)
9								
10	Overall Purpose							
11	LU Summary (2-3 sentences)							
12	Learning Outcome 1							
13	Learning Outcome 2							
14	Learning Outcome 3							
15	Learning Outcome 4							

19	*Aim that each learning unit include at least 4 activities for an interactive learning experience*							
20	Time (duration of activity, typically 50mins)	Aims - linked to NBS concepts or topics)	Link to Learning Outcome	Learning Activity [PPT Slide # - if applicable]	Teacher action/ activity (Learner action/activity)	Confirmation of learner's learning (assessment of learning)	Link to online NBS resources	Offline resources and materials (e.g. post-its,)
21								
22								
23								
24								
25								
26	NBS- Application of Curriculum, Trends and Skills							
27	Curriculum integration (how it may connect to curriculum)							
28	Teaching & Learning Trends employed **Highlight all that apply** (Source)	**Project-based learning**: e.g., students work in groups on a research project on greenhouses and the greenhouse effect, alternatives to waste management or investigate what are the views of their peers on climate change.	**Peer learning:** e.g., students work in groups, evaluate the work of their peers, or develop assessment questions to assess peers.	**Problem-based Learning**: e.g., students are introduced to a problem and challenged to find a solution together based on the information provided to them.	**Student- centred learning:** the learning scenarios are not based on classical instruction by the teacher, but they are expected to actively engage students in the lessons.			
29	21st Century Skills **Highlight all that apply** (Source)*	**Creativity:** e.g., students think of various solutions for promoting a better lifestyle in their communities or encourage greener solutions to their schools' issues.	**Information/ Media literacy:** students explore examples of NBS, research similar solutions in other communities.	**Collaboration:** e.g., students work in groups and engage in task division to produce outputs.	**Critical thinking:** e.g., students learn that a debate on deforestation or climate change does not consist of two opposing camps only but involves many stakeholders with different perspectives.	**Communication:** e.g., students present their work to the whole class and learn to put forth strong arguments based on facts.		

30 *Gras-Velázquez, À., Mulvik, I. B., Campodonio, A., Nada, C. & Pocze, B. (2020) *Nature-Based Solutions in education - Validation report, European Commission, August 2020* [accessed on 25/03/2024 https://files.eun.org/NBS/NBS-pilot-validation-report-final.pdf] p.8.

30 https://files.eun.org/NBS/NBS-pilot-validation-report-final.pdf] p.8.

31	GreenComp - European Sustainability Competency Framework **Highlight all that apply** (Source) 1- Embodying Sustainability Values and 2 - Embracing Complexity in Sustainability (see pp.13-14)	**1.1 Valuing Sustainability:** To reflect on personal values; identify and explain how values vary among people and over time, while critically evaluating how they align with sustainability values	**1.2 Support Fairness:** To support equity and justice for current and future generations and learn from previous generations for sustainability	**1.3 Promoting Nature:** To acknowledge that humans are part of nature; and to respect the needs and rights of other species and of nature itself in order to restore and regenerate healthy and resilient ecosystems	**2.1 Systems Thinking:** To approach a sustainability problem from all sides; to consider time, space and context in order to understand how elements interact within and between systems.	**2.2 Critical Thinking:** To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions.	**2.3 Problem Solving:** To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time and geographical scope, in order to identify suitable approaches to anticipating and preventing problems, and to mitigating and adapting to already existing problems
32	GreenComp - European Sustainability Competency Framework **Highlight all that apply** (Source) 3- Envisioning sustainable futures and 4 - Acting for Sustainabilty (see pp.13-14)	**3.1 Futures Literacy:** To envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.	**3.2 Adaptability:** To manage transitions and challenges in complex sustainability situations and make decisions related to the future in the face of uncertainty, ambiguity and risk. generations and learn from previous generations for sustainability	**3.3 Exploratory Thinking:** To adopt a relational way of thinking by exploring and linking different disciplines, using creativity and experimentation with novel ideas or methods.	**4.1 Political Agency:** To navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.	**4.2 Collective Action:** To act for change in collaboration with others.	**4.3 Individual Initiative:** To identify own potential for sustainability and to actively contribute to improving prospects for the community and the planet
33	Author and organisation to credit when using the LU						
34	*NB: This Learning Unit is available as part of the Creative Commons 4.0: This allows others to download this Learning Unit and share it with others as long as they credit the author/organisation, but they can't change them in any way or use them commercially.*						

7.2. List of 50 Learning Units

	Learning Unit Title	Theme	Context	NFQ	Partner
1	Understanding Nature-Based Solutions: An Introduction	Common	All	7	TCD
2	Harnessing Natural Processes for Climate Change Mitigation	Common	All	7	TCD
3	The Role of Nature in SDGs	Common	All	7	TCD
4	Ecosystem Services and Nature's Benefits	Common	All	7	TCD
5	Exploring Biodiversity and Conservation Strategies	Common	All	8	TCD
6	Urban Green Spaces: Enhancing Cities through Nature-Based Solutions	Common	Urban	8	TCD
7	Restoration Ecology: Healing Landscapes with Nature	Common	Rural	8	TCD
8	Tools to analyse NBS understanding	Common	All	8	TCD
9	NBS and community engagement	Common	All	8	TCD
10	Implementing Nature-Based Solutions	3rd Level	All	8	TCD
11	Policy and Governance Frameworks for NBS in Europe	3rd Level	All	8	TCD
12	Nature-Inspired Design: Planning a field trip	3rd Level	All	8	TCD
13	Social Inclusion and NBS	3rd Level	All	8	TCD
14	Socio-Economic Impacts of NBS	3rd Level	All	8	TCD
15	Rewilding and Biodiversity Conservation with NBS	3rd Level	All	8	TCD
16	Enhancing health and wellbeing through NBS	3rd Level	All	8	TCD
17	Future of NBS in Cities	3rd Level	Urban	8	TCD
18	Green Finance	3rd Level	All	8	TCD
19	In and Out Lab	3rd Level	All	8	TCD
20	"What is a Nature-Based Enterprise?"	Entrepreneurial	All	7	HNUA
21	Business Models for Nature-Based Enterprises	Entrepreneurial	All	7	HNUA
22	Financing NBS	Entrepreneurial	All	7	HNUA
23	Governance and Stakeholder Engagement for NBS	Entrepreneurial	All	7	HNUA
24	Measuring Impact: how and why should NBEs measure impact	Entrepreneurial	All	7	HNUA
25	Communication and Marketing for NBEs	Entrepreneurial	All	7	HNUA
26	Agriculture based NBS entrepreneurship	Entrepreneurial	Rural	7	HNUA
27	Forestry based NBS entrepreneurship	Entrepreneurial	Rural	7	HNUA
28	Water based NBS entrepreneurship	Entrepreneurial	Coastal	7	HNUA
29	City based NBS entrepreneurship	Entrepreneurial	Urban	7	HNUA
30	Creating Sustainable Learning Spaces through NBS - Opportunities for Policy Action	Vocational	All	7	PPMI
31	Inter-sectoral collaboration and partnerships for NBS	Vocational	All	6	PPMI
32	Public procurement for NBS	Vocational	All	6	PPMI
33	NBS Community Project Management	Vocational	All	6	PPMI
34	Multi-level Governance: Bridging High-Level Strategies with Local Action for NBS	Vocational	All	6	PPMI
35	Applied Learning Seminar I: Join and explore waste water treatment NBS	Vocational	All	6	ICLEI
36	Applied Learning Seminar II: Prioritise, Commit and Plan NBS	Vocational	All	6	ICLEI
37	Applied Learning Seminar III: Implement NBS	Vocational	All	6	ICLEI
38	Applied Learning Seminar IV: Monitor NBS	Vocational	All	6	ICLEI
39	Applied Learning Seminar V: Upscale NBS	Vocational	All	6	ICLEI
40	NBS Case Study: Seaweed Farming	Common: Case Study	Coastal	8	TCD
41	NBS Case Study: SUDS	Common: Case Study	Urban	8	TCD
42	NBS Case Study: Pocket Parks	Common: Case Study	Urban	8	TCD
43	NBS Case Study: Dune restoration	Common: Case Study	Coastal	8	TCD
44	NBS Case Study: Water and bog management	Common: Case Study	Rural	8	TCD
45	Workshop I: Planning NBS Co-Production	Common: Workshop	Urban	7	TCD
46	Workshop II: NBS Delivery	Common: Workshop	Coastal	7	TCD
47	Workshop III: NBS Stewardship	Common: Workshop	Rural	8	TCD
48	Future of NBS	Common	All	8	TCD
49	Skill for NBS	Common	All	8	TCD
50	NBS in Review	Common	All	7	TCD

7.3. Project partners

European Schoolnet

PPMI

ICLEI Local Governments for Sustainability EUROPE

Centre for Experiments in Urban Studies CEUS Centar za eksperimente i urbane studije

Big Van Ciencia

ELLINOGERMANIKI AGOGI

Comhairle Chontae Uibh Fhaili Offaly County Council

REPUBLIC OF TÜRKİYE MINISTRY OF YOUTH AND SPORTS

Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin

VERDE E MOLDOVA

CMA CÂMARA MUNICIPAL DE ALMADA

Horizon Nua

MUSEUM NAL HIST NATURELLE

COMUNE DI GENOVA

natural solutions

NBS EduWORLD

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