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Creating sustainable school learning environments – a toolkit

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Creating sustainable school learning environments - a toolkit

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1. Introducing the toolkit

The Learning Spaces School Toolkit provides practical guidance on how to make education infrastructure and learning environments more sustainable and supportive of the development of sustainability competences, student health, well-being and learning.

Learning for sustainability supports people of all ages in fostering "the knowledge, skills and attitudes needed to live more sustainably, in changing patterns of consumption and production, in embracing healthier lifestyles and in contributing – both individually and collectively – to a more sustainable economy and society" (Council of the European Union 2022a, p. 2). Learning for sustainability empowers learners and sustainability competences, covering cognitive, socio-emotional and behavioural learning dimensions.

The toolkit has been developed in the context of the study on "School learning environments for sustainability in the EU", which supports the European Commission's commitment to help Member States integrate sustainability into education. The toolkit is based on the extensive literature review conducted for the study, as well as reports by national experts and input from experts on learning environments for sustainability, the whole-school approach, and learning for sustainability. The toolkit aims to inspire and guide transformation into learning environments that support learning for sustainability and follow the principles of environmental sustainability.

Who is the toolkit for?

The toolkit is aimed at all those involved in school infrastructure for primary and secondary schools in the EU. This includes school leadership and management, local or regional authorities, architects, school staff, pupils, parents and the wider community. The toolkit may also be useful for private sector partners, digital innovators, or NGOs who may be involved in school transformation and curriculum development.

Why should you read this toolkit?

Environmentally friendly schools and grounds play a crucial role in achieving climate goals and addressing sustainability challenges. They set an example as public buildings in various ways: (i) they provide spaces that support learning and the development of competences for sustainability; (ii) the renovation of school buildings creates significant potential for cost savings and improved financial efficiency; (iii) they can contribute to well-being and (iv) positively impact physical health.

When should you use the toolkit?

The toolkit is useful if you are involved in creating more sustainable learning environments in the classroom or in school, whether you are interested in a holistic transformation or small improvements. It provides step-by-step guidance, ideas and reflections for adapting existing classrooms or buildings, creating new classrooms or buildings, as well as making suggestions with regard to student participation and learning, and the professional development of staff.

How to use the toolkit

The Learning Spaces School Toolkit comprises five main chapters. These guide you through the process of ensuring the sustainability of educational infrastructure and learning environments. You will find ideas on how to assess the quality, use and efficiency of a classroom or a building, and how to analyse needs and opportunities for improvement. Practical guidance is provided on adapting existing classrooms or building or developing new ones, as well on their maintenance – with an emphasis on the whole-school approach, high-quality learning environments, and bioclimatic objectives.

2. What are learning environments for sustainability?

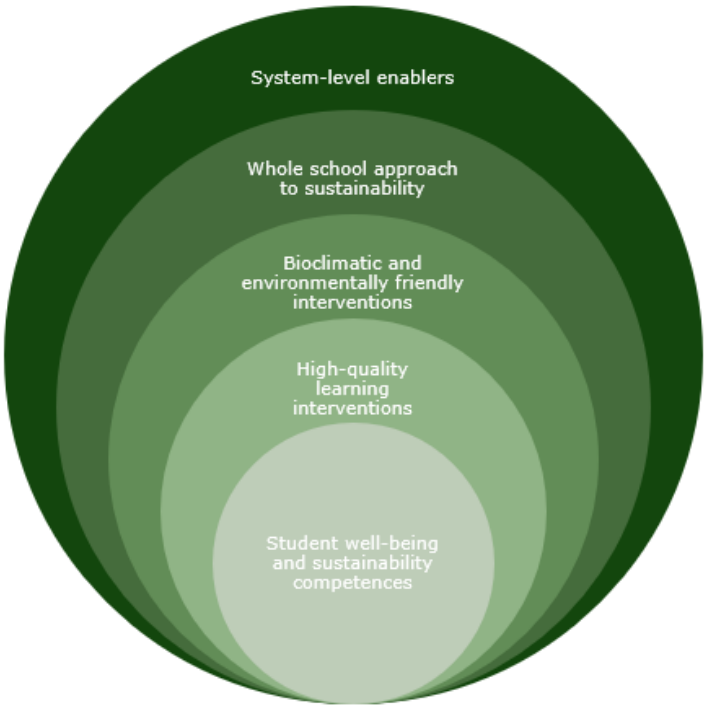
C.S. Lewis School, Bratislava, Slovakia. Learn more about the school in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

2. What are learning environments for sustainability?

Learning environments for sustainability support "teaching and learning for sustainability by encouraging engagement and connection with others as well as the environment and by inspiring hope and new visions or possibilities for a sustainable future"[1]. Such environments:

Figure 1 summarises how these approaches collectively influence the three primary outcomes of interest in this toolkit – student well-being, sustainability competences and sustainable happiness (planetary well-being and health).

FIGURE 1. LEARNING ENVIRONMENTS FOR SUSTAINABILITY – DIMENSIONS AND IMPACT



Source: PPMI (inspired by Barrett et al., 2017; Mathie and Wals, 2022; BREEAM, n.d.; Green Building Consultation and Engineering, n.d.)

[1] Tilbury 2023, p. 7

Such physical aspects relate to the concept of a *quality educational facility,* which emphasises the need to design physical spaces in ways that support learning and are in harmony with the environment.

At the same time, learning environments for sustainability are not just environment- and learning-friendly. They also create opportunities to address sustainability challenges and to envision sustainable futures more broadly (as well as addressing economic, social and cultural issues). Thus, in the long run, such spaces contribute to sustainability by building the knowledge, values, attitudes and skills of those who use them. Such gains can be made by, for example, creating open, engaging spaces and meeting rooms that inspire learners to connect, brainstorm and engage for sustainability. The last of these does not happen by itself, but through the pedagogical use of learning spaces for transformative learning for sustainability.

- Spending time in, and actively contributing to, nature-based environments such as green schoolyards, **reduces stress and anxiety**, **improves** students' **emotional resilience and mood**, and **restores students' focus and attention**, contributing to improved learning outcomes. This can directly enhance self-esteem and self-efficacy – key components of well-being. **Higher subjective well-being relates to higher academic performance**, suggesting that subjective well-being is an important aspect of a student's academic life.
- Good-quality environments that have clean air and water and provide green space and access to nature have been proven to positively impact key health indicators such as **quality of life and life expectancy**[2].
- Learning environments can influence **learning** and **sustainability competences**: Nature-based learning and outdoor learning pedagogies can **enhance** students' **understanding of ecological concepts** such as biodiversity, ecosystems and resource conservation, while fostering a **deeper connection with the natural world**. At the same time, they can deepen understanding of various subjects that are often cross-disciplinary, e.g. by merging scientific enquiry, cultural exploration, literature, historical analysis, geography and other disciplines[3].

Table 1 presents each of the dimensions and key concerns of learning environments for sustainability.

TABLE 1. DIMENSIONS OF LEARNING ENVIRONMENTS FOR SUSTAINABILITY

Contextual factors refer to the conditions that need to be considered in order to understand a specific context and pursue a specific action. These include looking at the school as a wider ecosystem and analysing how external factors such as climate, financial resources, the availability of materials, political will or demography influence the design of learning spaces for sustainability.

[2] EEA, 2022; EEA, 2023; WHO, 2022; McMahan, 2018
[3] Neville, Petrass, and Ben, 2023

The underlying principle of the **whole–school approach** is the learning takes place through content (learning *about* issues); that it should occur *"in"* the environment studied, *"through"* a supportive culture, and that it should foster actions and behaviours *"for"* sustainable development and global citizenship.[4] The whole-school approach adopts a holistic view of education, creating opportunities for living and learning sustainability across the institution.[5] It requires learning for sustainability to be considered in all aspects of the school's operations, as well as in its teaching and relationships.[6] The whole-school approach plays a critical role in establishing a **"culture of sustainability"** and in bringing sustainability into the heart of the school's vision and operations. Another crucial value of the whole-school approach is student engagement and participation in issues that matter to or affect them.

Following **environmental or bioclimatic principles for sustainable buildings** contributes to the whole-school approach by connecting what students learn through the curriculum with what is practised in the school environment. Ideally, reducing a school's ecological footprint becomes part of students' learning, the professional development of school staff, the curriculum, and of continuous efforts at school improvement. Bioclimatic design principles for sustainable buildings refer to various aspects such as **energy and water efficiency, climate resilience, life cycle assessment, the promotion of biodiversity and the reduction of waste and toxins** to help reduce the overall impact of the built environment on human health and the natural environment.

The concept of **high-quality learning environments** details how spaces should be designed to ensure quality teaching and learning. Several principles are relevant here. These include **naturalness, relationality, individualisation, stimulation, innovation, equity and inclusion.**

- **Naturalness** relates to the environmental factors necessary for physical comfort, such as light, sound, temperature, air quality, 'links to nature', and shade.
- **Relationality** means that a high-quality learning environment invites students and teachers to make connections with others through empathy and collective actions, with the non-human world, with materials, and above all, with each other. It recognises the social nature of learning and embraces values such as agency, connection and openness.
- The principle of **individualisation** refers to how well a learning environment meets the individual needs of a diverse group of children. Its parameters include ownership, flexibility, connection and inclusion.
- The principle of **stimulation** refers to how exciting and vibrant the classroom is. These factors motivate the learner and maintain their attention throughout the day. Key parameters such as the complexity of the design and the use of colours are relevant here.
- **Innovation** is another way to motivate and engage learners through the introduction of technology and new experiences, as well as focusing on tasks that bring out learners' creativity.
- **Equity, inclusion and accessibility** in school design involve making the school grounds accessible and tailored to persons with disabilities (universal access), neurodivergence, or people with mental and physical health issues. **Cultural inclusion** reflects diverse cultural identities in design and teaching, while **social equity** ensures equitable access to quality facilities across different regions or socioeconomic contexts.

[4] UNESCO, 1996
[5] Tilbury and Galvin, 2022
[6] Mathie and Wals, 2022

3. Teaching and learning for sustainability through the whole-school approach

Cours Oasis initiative, Paris, France. Learn more about the initiative in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

3. Teaching and learning for sustainability through the whole-school approach

As mentioned in the previous chapter, the whole-school approach is crucial to maximising the teaching and learning value of sustainable learning environments in schools. The whole-school approach embeds sustainability into a school's vision and mission statement (governance); into its day-to-day operations, to reduce the school's ecological footprint (institutional practices); and into student agency, community collaborations, engagement with parents or local stakeholders, and capacity building.

The curriculum offers a vital entry point for embedding an understanding of – and commitment to – a sustainable future. Equally crucial is how educators teach, and learners learn. This is because participatory approaches to learning offer greater opportunities to develop sustainability competences that not only relate to environmental and ecological values, but also support political and democratic values, global citizenship, equity, justice and fairness. This requires pedagogies that actively engage students with the learning environment, including the design of such spaces[7]. Such aspects include, for example, the layout, orientation and seating of students, and the use of equipment that is adaptable and flexible. Although most formal schools follow core curricula developed at national or regional level, they can often provide further guidance on pedagogy and assessment, or on teaching materials for specific areas of work that align with and enhance teaching and learning.

Viewing schools through the lens of the whole-school approach can strengthen teaching and learning for sustainability and create environments "**where learners learn what they live and live what they learn".**[8]

How can learning environments support teaching and learning for sustainability?

The following design principles outline key characteristics of effective learning environments for sustainability. They are accompanied by reflection questions to help assess how they are currently being applied, in what ways they are supported, and how you can further enhance their integration into teaching and learning. This approach involves the whole human being – not only their cognitive aspects, but also the socio-emotional and physical aspects. By addressing (often negative) emotions and fostering active hope, schools can empower students to develop empowerment, confidence and agency, and become change-makers.

- **Place-based education** is a pedagogical approach that emphasises the interplay between learning processes and the physical environment.[9] It encompasses a broad array of educational practices driven by local contexts, community involvement or ecological considerations, and serves as a unifying term for initiatives that foster deep connections between students and their surroundings. The significance of place-based education in sustainable learning environments lies in its holistic educational philosophy. This emphasises the integration of environmental literacy, ecological stewardship and community participation – **immersing students into local ecosystems, cultures and communities**. Place-based learning creates authentic learning opportunities that can extend beyond the

[7] Tucker and Izadpanahi, 2017
[8] Government of Ireland, 2022
[9] OECD, 2024

traditional boundaries of the classroom, as well as improving academic achievement and cultivating environmentally conscious citizens.[10]

Are there any existing partnerships with local organisations or community members to support place-based learning? How can these partnerships be further developed?

How can we strengthen the connection between students and their local surroundings? What barriers might prevent such integration?

- **Adaptable and multifunctional classrooms** that empower the use of a wide range of pedagogies allow educators greater **flexibility in their approach to teaching**, which is the outcome of various other factors (e.g. curriculum changes).

How flexible are our classrooms in supporting various teaching and learning activities and pedagogies such as project-based learning or collaborative group work?

How can the school empower teachers to use teaching methods based on students' needs and learning for sustainability?

How can we support students with different needs and tailor spaces accordingly?

What challenges are involved, and how can our school help to address them? Where can our school get support to address those challenges that are too large?

- **Activity-permissible classrooms** support active engagement and movement for learning.[11] This concept is supported by cognitive neuroscience studies, which show that physical activity can stimulate the brain.[12] Such spaces are designed to accommodate a variety of pedagogies and educational activities. These include **group discussions, project work and hands-on experiments**, with a stronger focus on movement in comparison to adaptable classrooms. Such a focus includes both **micro-movements** (e.g. students using chairs with wheels) and **macro-movements** (moving from one area to another). By providing students with opportunities for physical activity and exploration, activity-permissible spaces promote holistic development and cognitive growth.

- **Flexible** (possibly also **digital**) learning spaces can further facilitate **student-centred pedagogy and self-regulation, collaboration, and student autonomy and engagement**. These lead to improved learning motivation and well-being[13]. Designing learning spaces that enable learners to become more comfortable, focused, motivated and engaged in school contributes to learners' well-being and chances of success[14].

[10] Yemini, Engel, and Ben Simon, 2023
[11] Kilbourne, Scott-Webber, and Kapitula, 2017
[12] Blakemore, 2003
[13] Kariippanon et al., 2018
[14] Disterheft, 2023

How can our classrooms support physical movement and hands-on activities that promote engagement with sustainability topics?

Are students encouraged to move freely and interact in ways that enhance their learning experiences? If not, what obstacles are preventing this?

Do activity-permissible spaces contribute to students' overall well-being, and how can this be further improved?

- **Technology** can be integrated into pedagogical approaches in order to strengthen learning and provide new learning experiences and venues. Digital education also enables **access to a greater pool of knowledge and information**, helping students to broaden their classroom experience. Digital technologies can give learners access to various resources and new experiences that improve learning. These include **digital platforms to connect learners with experts and other resources,** including those from different parts of the world. This can help students to **understand similarities and differences, enabling them to empathise and build relationships beyond their local contexts**.[15] The use of technology may also involve using **digital tools and augmented learning to create interactive and engaging learning experiences relating to sustainability.** By introducing new technologies, educators and learners can also explore the future in ways that seem more real and immediate.[16]

How are digital tools currently being used in our school to enhance teaching and learning for sustainability? To what extent do we use digital platforms to connect students with experts, resources and other learning opportunities on sustainability topics?

How can we leverage existing digital tools, such as data on energy-producing solar panels, into everyday learning experiences to enhance students' understanding of sustainability?

How can we ensure that technology is used to foster more interactive, engaging and real-world learning experiences, particularly those concerning sustainability?

[15] Ibid.
[16] Tilbury and Mula, 2023

4. Kickstarting the process

Escola Jaume I, Barcelona, Spain. Learn more about the school in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

4. Kickstarting the process

Developing a vision

Schools have different points of departure in terms of infrastructure and financial support, as well as different geographical locations and climates, cultures, planning stages and student backgrounds. To embark on the creation of sustainable learning environments, it is important to assess the school's current situation, culture and vision for learning, and to reflect on how sustainability can play a part. Highlight the connections between your needs and goals, and the goals of sustainability and learning for sustainability. The principles of the whole-school approach can guide you through this process. Involving and communicating with other actors in the school can ensure a better understanding of the vision throughout the school, leading to more successful implementation. Think about which objectives set out in the toolkit are relevant to your school and your role. Familiarise yourself with the toolkit, while focusing on your local context and needs.

Potential areas for action

Make creative use of platforms and communication channels (including digital platforms) within your school to raise awareness about learning environments for sustainability. Such methods could include posters, the school's website or social media, or school radio.

Emphasise the importance and potential benefits of learning environments for sustainability, such as improved learning, health and well-being, and (global) citizenship.

Start discussions. Listen. Make the pupils/students and the school community part of the conversation.

Co-investigate the key issues that emerge, think about possibilities for improvement, and agree on a way forward.

Think about how the activities can be part of the educational process.

The initiative **Cours Oasis** in **Paris, France,** transforms traditional school courtyards into multifunctional, sustainable outdoor spaces. These transformed spaces allow students to engage with sustainability topics through hands-on activities and experiential learning. **Co-design** is one of the cornerstones of the *Cours Oasis* programme, since it ensures that each courtyard transformation is tailored to the school's needs. Students, teachers, school administrators and parents at every stage of the process. Each project begins by presenting its goals and challenges to the school community. Students play a central role in this process, **participating in workshops to explore sustainability**, **describe the current use of the courtyard and brainstorm ideas**. These sessions result in a "wish list" in which participants articulate their aspirations for the space to be developed. A **pedagogical toolkit** is provided to the schools to support educators in integrating these discussions into the classroom. This suggests that participatory design maximises educational impact when embedded into the school's **physical fabric and pedagogical strategy**.

Reflective questions

What is our starting point? What is the school's current vision for sustainability, teaching and learning? What role, if any, do learning environments play in this?

What contextual factors should be emphasised that are relevant to our school, such as climate, human and institutional capacity, finances or energy resources?

How can sustainability play a greater role in the school's overall vision for teaching and learning, as well as for infrastructure and classrooms?

What practices do we already have in place to reduce the school's ecological footprint? Are these communicated as a part of the school's vision and culture?

How are the school plans and strategies usually created? What does the process consist of, and who participates in it?

Is there room for greater engagement of the school community (including students) in creating the school's strategies and vision? How can this be achieved in practice and in a meaningful way?

What pedagogies are currently being used in our school to support learning for sustainability? How is learning for sustainability integrated into the educational process? How can we develop a curriculum that employs learning for sustainability across all classes?

How can students' health and well-being be supported through sustainable learning environments?

How can we promote the school as a sustainable learning environment – to live and learn sustainably?

What concerns do the school leaders, teachers and children have when it comes to schooling and learning?

Rallying support

It is important to familiarise yourself with the support in relation to learning environments for sustainability that is available to your school at EU, national and local levels. Building regulations provide sustainability/energy efficiency standards for public buildings, as well as standards for schools in your country. Rallying support can also become part of an educational project, and hence connected to the curriculum or extra-curricular activities. You can involve students in familiarising themselves with the support available, letting them present their findings and suggestions to the school management and school community. It is also important that school management seeks other support. This could include funding opportunities and resources, networks, certifications and awards, training and guidance for architects and builders, training for educators and school administrators, guidelines for teachers, or support from private actors such as foundations or unions.

Potential resistance from stakeholders, including educators, parents and the construction industry, might also present a challenge to implementing sustainable learning environments. It is therefore important to find common ground while gaining the support of leadership and allies, and promoting the benefits for all.

Reflective questions

What kind of support does our school require in order to transform its vision into reality?

Who are the relevant stakeholders that can collaborate with the school and participate in the design phase?

As a teacher, how will I gain the support of school management? As a student, parent or school community, how will I gain the support of school management?

As school management, what types of support are available to the school, both financially and in terms of guidance? In what other ways could the school benefit from knowing about these resources, and how can such information be accessed?

At municipal level, a project coordinated by the Helsinki Metropolitan Region Recycling Centre in Finland produced a concise and practical guide book to support each **school's efforts to embed the goals of sustainable development into its everyday life** (Luomi et al., 2010). The guidebook includes practical examples that cover the many aspects of daily school life into which sustainable development goals can be meaningfully embedded through the actions of the school community. The guidebook also provides a checklist to help schools to set concrete and yearly goals, to divide responsibilities within the school for promotion and follow-up on these goals, and to evaluate each of **the nine dimensions of the programme**: saving energy; saving water and waste; recycling; sustainable consumption; sustainable food provision (all students receive a hot meal in Finnish schools); the surrounding neighbourhood; cultural heritage and multiculturalism; safety; and community spirit. In addition, the guide includes examples of school plans and questionnaires to map students' views on sustainable actions within the school.

Cultivating leadership

The involvement of school leadership is a key success factor in transforming learning environments. School leaders set the direction for a school's culture by taking the lead on strategic documents and operations, and supporting all other personnel in following a common vision. Engaging the school leadership can enable various pro-environmental changes or changes to the curriculum, ultimately leading to the development of students' sustainability awareness and skills.[17] Overall, it is beneficial for the school's leaders to be involved, as this can have positive ripple effect on relationships between learners and various personnel, as well as on overall well-being and student achievement. School leaders should support their own development and encourage others to learn and gain new leadership competences.

Reflective questions

What changes do we want to see in the school? How do we plan to communicate these desired changes?

What training is available to support the leadership through the change process? Which leadership competences needs to be strengthened through training?

Is there a network of school leaders we can tap into?

In the municipality of Copenhagen in **Denmark,** the **Department for Sustainable Development** (*Afdelingen for Bæredygtig Udvikling ABU*) is a peer-learning initiative and knowledge centre that specialises in sustainability education for children and youth. The centre works to motivate change towards sustainable learning environments, and provides **professional support** to schools, government structures and public institutions on sustainability education. Interested schools can sign up for dedicated one-to-one training sessions with the centre's experts, as well as registering for teacher training on these subjects. In collaboration with the municipality and the private sector, primary and early secondary school classes can also register via the centre's website for school field trips as well as experimental courses on energy and water production and supply, climate change and climate adaptation.

[17] Scott, 2013

Mobilising staff

Staff, including both teachers and administrators, are in daily contact with students. They also act as role models and leaders in the eyes of students. The awareness and commitment of these staff can enhance transformation in schools and contribute to greater support for the expansion of environmental education within the school environment. Recognising that a lack of awareness and professional capacity can sometimes prevent the creation of learning environments for sustainability, it is important to strengthen this aspect of the process by providing appropriate training to relevant stakeholders, including leaders and teachers.

Reflective questions

How aware of school practices are the school's teaching staff? Such practices can include curriculum integration, professional development opportunities or community engagement.

How can the school ensure that its staff serve as role models for sustainability? Can we provide good examples of practice in various areas of sustainability?

What are the individual behaviours of students and staff, and how can these support the school culture for sustainability? What steps can be taken to align the school culture with the values of environmental education and sustainable living?

What training and development opportunities are available (e.g. training on learning for sustainability or training on nature-based solutions)? How is the participation of teaching staff and other personnel supported?

What innovative pedagogies can the school employ to support learning for sustainability? How can the school use sustainable learning spaces to support learning and to build students' sustainability competences?

In **Cyprus**, guidelines are in place for teachers and other school staff to optimise green learning environments and enhance learners' sustainability competences. Professional development programmes for educators, principals and education officers are being revised to include content, teaching and methodology in relation to sustainable development and the green transition. Such resources include continuous teacher education, as well as ongoing professional development programmes focusing on sustainability competences. These guidelines are differentiate between primary and secondary education levels, and are highlighted and applied in practice through the professional development courses for teachers on ESD.

Meanwhile, in **Norway**, Montessori Norge provides administrative support for a teacher training course that integrates various aspects of the whole-school approach and education for sustainable development. For example, Montessori teachers can enrol in a two-year programme in school gardening at the Norwegian University of Life Sciences. Such support increases the resources available to all teachers and ensures that more educators, in addition to those already involved, receive valuable, high-quality training.

Getting the community involved

A crucial factor in promoting and enhancing learning environments for sustainability is the use of multi-level practices and collaboration. This includes collaboration with government agencies, educational institutions, communities and non-profit organisations to leverage diverse expertise, promote the spread of good practice, and operate both locally and internationally. Community inclusion and engagement brings benefits in terms of student well-being and learning, as well as for the community. Building strong cooperation between schools and parents is also a crucial factor in shaping students' environmental attitudes.

Reflective questions

What connections does the school have with the community? How can collaboration with private actors and/or municipalities be established or strengthened?

How can we leverage such collaboration for sustainable learning environments?

How can school planners, designers and leadership teams ensure that students, teachers and communities are actively involved in – and take ownership of – the greening of learning spaces?

How can we explore the possibilities of opening school facilities to the local community and the public?

In **Germany**, an architectural practice in Berlin has developed the "**Baupiloten Method**" – an innovative approach to architectural design and construction that emphasises **participatory and experiential processes**. It involves engaging future users, such as children and educators, into the design process, to ensure that the resulting spaces are highly functional and tailored to their needs. A key element is the "Baupiloten Game", which facilitates collaborative brainstorming and the generation of ideas by encouraging participants to visualise and communicate their spatial and functional desires for the project. Through playful and imaginative exercises, this game helps to gather valuable insights and foster a sense of ownership and connection to the resulting architectural solutions.

Engaging youth

The inclusion of children and young people into policy and planning processes can significantly contribute to the meaningful use of learning spaces. It prevents situations in which children become disillusioned or critical of certain projects – which can, in the worst cases, lead to disillusionment with the very ideas that these projects represent. For example, a poorly designed recycling system that feels "imposed" on students may lead them to disregard recycling altogether. By empowering students to have a voice in the design of their learning environment, educators and architects can create spaces that are tailored to their needs and preferences, fostering a sense of ownership and belonging.

Reflective questions

How are students involved in the school community in general, and in school decision-making?

How can we help the students to become agents of change for their school and for sustainability in general?

How can we ensure that this process is inclusive and transparent?

The **More Sustainable Schools** (*Escoles més sostenibles*) network in Sant Feliu, Catalonia, **Spain**, is a pioneering local policy programme that supports schools in empowering students to take action on climate challenges through hands-on learning and community engagement. Established in 2007 across nine schools, the network has since expanded to include all 19 schools in the city, fostering a shared commitment between the municipality and schools. The city council provides training, as well as technical and financial support, while the schools implement student-led initiatives to address local environmental issues. A key focus of the programme has been the development of bioclimatic shelters designed through participatory processes between students, teachers and architects to enhance green spaces, biodiversity and climate resilience. Teachers have co-created learning scenarios, tailored to each educational level, which aim to deepen understanding, explore climate change and its local and global impacts, as well as solutions such as the greening of schoolyards. The initiative cultivates environmental responsibility, civic engagement and long-term urban sustainability by integrating climate education for various age groups through stories, games and real-world problem-solving.

5. Adapting existing learning environments

Escola Jaume I, Barcelona, Spain. Learn more about the school in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

5. Adapting existing learning environments

Maximising use and learning within a classroom or building

Most existing buildings and classrooms can be used in more efficient ways to support sustainability. Guided by the **whole-school approach** and behavioural nudging, you can unlock the potential of a classroom, building or the culture of the learning environment towards more sustainable use and becoming more supportive of learning for sustainability.

Reflective questions

How can our existing spaces be adapted to better support sustainability goals and learning for sustainability?

Which existing spaces already promote a culture of sustainability?

How can our school further enhance its potential to support learning for sustainability through redesign?

Reimagining and redesigning

Adapting and retrofitting a classroom or school usually starts with the design phase or with a brief that outlines problems and goals without necessarily describing solutions yet. Rather than being prescriptive and definitive, this brief should be a living document. All relevant stakeholders (including students, the community and experts) should be involved in its creation through a participatory process, taking into account various options, positions and aspects.

Reflective questions

How can the learning space be changed to foster collaboration and empower students to engage with sustainability challenges?

How can we improve and encourage small-scale interventions to maximise the use and efficiency of a classroom or building?

What resources or support do we need to implement our vision?

How can we support the staff to actively use sustainable learning spaces?

What challenges or barriers do we foresee in implementing these changes, and how can these be overcome?

How will we measure the success of the changes and interventions we plan to introduce?

Governance: vision, ethos, leadership, coordination

Actions to consider

- Brainstorm and involve staff and students in finding ways to reduce the school's ecological footprint
- Engage all staff (teachers, administrators, cleaning and maintenance staff) by organising learning workshops
- Actively involve pupils and students in decision-making processes and visioning
- Adopt green procurement into school's everyday operations, prioritising eco-friendly products and services such as sustainably sourced furniture, non-toxic cleaning supplies, recycled paper products, refillable and reusable stationary, and organic, locally grown and seasonal produce for school meals
- Encourage entrepreneurial thinking and allow space for discussion and feedback, fostering critical thinking and problem-solving while navigating sustainability challenges
- Lead by example (embed sustainability at the heart of the school; showcase and promote best practices at school level, or award prizes)
- Appoint a coordinator/committee to coordinate whole-school approach

Pedagogy and learning in and with the learning environments

Actions to consider

- Think of the school as a creative space and, if possible, adapt the classroom (change the way of seating, create circles, etc.) according to your teaching needs and the needs of the learners
- Display students' intellectual engagement, such as projects, in school – create a sense of ownership
- Use various rooms and spaces for teaching and learning, including the school grounds and the local neighbourhood
- Assess the current teaching practices, and create an inventory of these
- Co-develop a plan/strategy/list of priorities and a roadmap for reducing the school's ecological footprint within a learning process

Capacity building and continuous professional development of all staff

Actions to consider

- Training on learning for sustainability and the development of sustainability competences
- Training on leadership for sustainability
- Training on (new) forms of learning (e.g. socio-emotional learning, transformative learning, enquiry-based learning, place-based learning, etc.), as well as on new forms of assessment.
- Training on developing school–community relations

Community collaborations

Actions to consider

- Introduce outdoor learning in the schoolyard or outside of the school
- Increase awareness of the importance of native plants, animals and habitats, and increase species-richness within the campus area
- Collaborate with NGOs engaged in environmental education/learning for sustainability
- Give learners the opportunity to meet with policymakers and politicians to discuss sustainability, thereby fostering students' agency and engagement

Curriculum integration

Actions to consider

- Create space for a more localised or place-based curriculum
- Develop interdisciplinary projects
- Connect socio-emotional, cognitive, embodied and action-oriented learning
- Look for educational opportunities (projects, classes, excursions), for example on climate resilience

How to adapt a classroom or building

Redesigning or retrofitting a classroom or building involves taking into consideration bioclimatic principles and the principles of quality learning environments. It is important to recognise that many of the elements within these principles are neither independent nor contradictory, but can sometimes be mutually reinforcing.

The refurbishment and upgrading of school buildings is necessary due to their age as well as emerging ways of teaching and learning. Sustainable refurbishment is an effective way to extend the lifespan of a school while meeting sustainability standards. A sustainable refurbishment or retrofit of a school building should promote a clear understanding of the roles and responsibilities of key stakeholders, and should incorporate a tailored, holistic plan for the school from the early design stage[18]. Encouraging small-scale interventions can improve the use of classrooms or buildings.

Reflective questions

Which bioclimatic principles are relevant to our school?

What aspects should we focus on, given our budget as well as other contextual and bioclimatic factors?

What specific goals do we want to achieve and how should we prioritise these?

What changes will achieve the greatest impact on students' learning, health and well-being?

[18] Le et al., 2018

How are the school's classrooms and spaces equipped and adapted to reflect the needs of learning for sustainability?

Does our school have various spaces and facilities to meet teaching needs and the requirements of the curriculum?

Does the school infrastructure reflect the needs of active teaching methods and digital tools?

What outdoor spaces or places in the neighbourhood are available to our school? How accessible are these?

Incorporating bioclimatic principles into redesign

Adaptability

Adaptable classrooms that promote resource efficiency by optimising space as well as the use of furniture and equipment. In doing so, they minimise waste and reduce environmental impact while enhancing comfort, productivity and well-being. Adaptable classrooms can also be multifunctional, easily converted into spaces for alternative uses, thereby allowing the building to restructured for various purposes during or after school.

Actions to consider

- Redesign classrooms to enable them to be adapted easily to teaching needs and for different uses such as workshops or group work
- Use modular furniture or movable boards
- Create a space designated for rest

Structure design efficiency

Structure design efficiency refers to a built structure to maintain its strength and stability throughout its lifespan, ensuring it can withstand all applied loads without failing. This bioclimatic objective is also related to other objectives. For example, if the design of the structure has not anticipated future potential increases in load, it may not be possible to place solar panels on its roof, or to change energy systems or add a library or classroom in line with the needs of the school. Therefore, when considering structure design efficiency, account needs to be taken of the principle of adaptability.

Actions to consider

- Use recycled materials whenever possible (balanced against the need for durability)
- Incentivise education staff to prioritise second-hand and recycled materials when procuring items for the school (make this a requirement, with the possibility of exceptions, e.g. where there are severe durability/quality issues)

Efficiency in materials

Sustainable materials can mitigate climate change, reduce carbon emissions and minimise resource depletion through the use of natural resources and innovative technologies, thereby benefitting the environment. Sustainable buildings require durability; hence, some

of the crucial characteristics of green building materials are durability, longevity, thermal insulation and high strength (Cullen, 2010; Nasr et al., 2023).

Actions to consider

- Choose sustainable, locally sourced materials that support bioclimatic goals
- Consider the characteristics of materials (e.g. naturalness or durability) and integrate a life cycle assessment[19]
- Use renewable energy sources in construction
- Use non-toxic, renewable or recycled materials from construction waste. Use materials that are free from contaminants (such as mould, finishing materials that emit volatile organic compounds[20], or formaldehydes)
- Use natural insulation materials (sheep wool, cork, natural fibres), paints (clay, chalk) and finishes
- Adopt recycling programmes and practices, such as composting or reducing the amount of single-use plastic waste
- Use non-toxic natural cleaning products
- Use thermal mass and insulation, as this stores and regulates heat and maintains consistent indoor temperatures
- Use craft classes as an opportunity to communicate and showcase material efficiency to students, and even to create or mend sustainable materials that the school can use (e.g. sanding and oiling old cutting boards for the school's kitchen)

Energy efficiency

Energy efficiency is crucial for maintaining the comfort and air quality of school buildings, which directly impacts running costs. Due to large share that schools represent in the total national building stock, they contribute significantly to overall energy consumption and thus, to costs in national budgets. For schools themselves, energy costs are the most significant operational expense after teacher and staff salaries.

Actions to consider

- Monitor energy consumption, set energy saving targets, and follow up with concrete actions
- Involve students as part of monitoring and thinking of solutions
- Reduce energy consumption
- Prioritise natural lighting (this needs to be balanced against ventilation and heat-loss issues)
- Install LED and other energy-saving light bulbs
- Improve ventilation systems (heat recovery ventilators and energy recovery ventilators)
- Improve the resistance of windows to heat loss
- Control lighting (maintain a good level of natural lighting, a warm temperature for artificial lighting and a sufficient level and quantity of light to avoid eye strain and fatigue)
- Control shading (sun protection)

[19] Life Cycle Assessment explained on the following link.
[20] Volatile organic componds include acetone, formaldehyde, and butanol. They lead to indoor air pollution and cause adverse health effects.

- Control heating and cooling (adjustment, efficiency – setting lower temperatures for nighttime or holidays)
- Incorporate features such as solar panels or wind turbines that complement bioclimatic principles

Water efficiency

Research suggests that in the UK, up to 3,100 litres of water could be saved every day in every school (Walton, 2022). A 3 mm diameter stream of water from one running cold tap can waste 330,000 litres over the course of a year. Preventing this would mean an annual saving of GBP 580. A 15-litre urinal flushed via a timing device every 10 minutes will use 800,000 litres. If this flushing is not related to usage for half of the time, this would result in 400,000 litres of wasted water, GBP 800 per urinal, per year, which could otherwise be saved. For this reason, introducing innovations such as vacuum toilets or using rainwater to operate toilets in schools could offer an efficient way to save water and improve water efficiency[21].

Actions to consider

- Raise awareness about water usage within the school (e.g. posters next to water sources)
- Collect and reuse rainwater, e.g. for uses such as irrigation and toilet flushing, introduce devices with variable flushing
- Implement a limit on how long water runs for (e.g. in showers and fountains)
- Create permeable surfaces (often used in walkways and parking lots) to allow rainwater to filter into the ground. This reduces flooding, recharges groundwater and prevents water pollution
- Invest in landscaping (drought-resistant plants, rain gardens and efficient irrigation to reduce water consumption and support sustainable land management)

Enhancing the quality of the indoor environment

Enhancing the quality of the indoor environment relates to conditions inside the building. These include air quality, but also access to daylight and views, pleasant acoustic conditions, and control by occupants over the lighting and thermal comfort. It is therefore closely related to the principle of naturalness in design.

Actions to consider

- Install effective sun protection – shading (devices), shutters or external blinds
- Address the use of vegetation and reflective materials to control heat gain in warmer climates or enhance heat retention in colder areas
- Install adequate sound insulation
- Monitor sound levels in the school, making students aware of and part of the monitoring process

Reducing waste and toxins

Construction waste can cause environmental degradation and harm human health and sustainable development. One way of reducing such impacts is to apply the principle of the

[21] Walton, 2022

"3 Rs"– reduce, reuse, recycle[22] – which is widely applied in construction waste management research and practice.

Actions to consider

- Distribute a sufficient number of waste recycling bins
- Provide waste management education and training (e.g. on composting)
- Remove any asbestos (safely)
- Monitor food waste, and make students aware of and a part of the monitoring process

Transport

Sustainable school campuses should also encourage sustainable transportation options for students and staff who travel regularly to school. Through small-scale infrastructure enhancements, school management can support sustainable mobility to and from school.

Actions to consider

- Install bike racks and shelters, and create repair shops in the school
- Provide electric vehicle charging stations at parking spots
- Make it easier to access public transport, e.g. by improving paths
- Encourage car-pooling among education personnel and parents, e.g. by creating or promoting the use of digital platforms via which people can find carshare partners, or introduce car pool parking discounts
- Raise awareness of the benefits of cycling, and negotiate bike repair and maintenance discounts for students and staff
- Introduce free or low-cost bike-sharing programmes on campus, as well as opportunities to rent or share cycling equipment

Promoting biodiversity

Promoting biodiversity involves taking steps to increase awareness in schools of the importance of native plants, animals and habitats, and increasing species-richness within the campus area. School gardens can play a crucial role in preserving biodiversity in the local community and fostering a sense of responsibility and environmental stewardship among learners.

Actions to consider

- Promote biodiversity through educational activities
- Create a permaculture garden
- Plant trees
- Cultivate vegetables
- Install insect and bird feeders, houses and baths, as well as boxes for bats and nesting boxes for common swifts
- Start beekeeping in collaboration with a local beekeeper
- Create local wetlands

[22] Yuan et al., 2011; Wang et al., 2015

Climate resilience

Climate adaptation involves taking actions to prepare for and adjust to the current and projected impacts of climate change, and being resilient to various effects that are relevant in the local context. Climate resilience also refers to decarbonisation and efforts to cut greenhouse gases. These efforts are essential to mitigating potential damage to ecosystems and people from human-induced climate change.

Actions to consider

- Create climate-resilient water systems
- Introduce green infrastructure and nature-based solutions (e.g. green roofs and walls can play a significant role in insulation, as well as reducing "heat island" effects and providing aesthetic and ecological benefits)
- Use renewable energy sources (e.g. install solar panels or heat pumps)
- Create outdoor learning spaces that integrate bioclimatic strategies (e.g. by integrating nature-based solutions) to foster comfortable and sustainable teaching environments

High-quality learning environments through redesign

Naturalness

The principle of naturalness relates to the environmental factors necessary for physical comfort. These are **light**, **sound**, **temperature**, **air quality**, **links to nature,** and **shade**.

Actions to consider

- Position buildings and classrooms to take advantage of sunlight and prevailing winds. In this way, energy use can be minimised, reducing the need for artificial lighting, heating and cooling
- Use natural ventilation – cross-ventilation and passive cooling make use of natural airflow to maintain air quality and regulate temperature, reducing the need for mechanical cooling systems. This improves indoor comfort while conserving energy
- Expose children and staff to natural light (this is related to lighting and shade)
- Keep good sound insulation in mind when designing flexible spaces, as these need to accommodate students with different needs and tend to be noisy, due to the various activities taking place. Good sound insulation helps to prevent noise travelling between rooms, making the environment quieter and more comfortable, enhancing focus and well-being by reducing distracting sounds

Individualisation

The principle of individualisation relates to how well a learning environment meets the needs of a diverse group of children. It comprises the parameters of **ownership**, **flexibility**, **connection** and **inclusion**.

Actions to consider

- Create intimate and personalised spaces, which are better for absorbing, memorising and recalling information

- Create activity-permissible classrooms that support active engagement and movement for learning
- Design learning spaces in which learners can become more comfortable, focused, motivated and engaged
- Make school grounds accessible and tailored to the needs of persons with disabilities or neurodivergence, as well as those with mental and physical health issues

Stimulation

The principle of stimulation relates to how exciting and vibrant a classroom is, which motivates the learner and maintains their attention throughout the day. Stimulation comprises two key parameters, which are linked to emotions: **complexity** and **colour**.

Actions to consider

- Use appropriate colours which stimulate student learning and well-being (depending on psychology and cultural context)
- Create communication and information boards, seating and playing areas, and staff rooms to stimulate social connections

Innovation

Motivating and engaging learners in an innovative way can be achieved through the introduction of technology and new experiences, as well as focusing on tasks that bring out learners' creativity.

Actions to consider

- Use digital tools and virtual platforms for learning, as well as online collaboration tools and smart classroom systems such as tracking green data, mindfulness applications or virtual outdoor explorations
- Ensure that the digital tools and platforms are not only accessible but are also adaptable to a variety of learning styles, and foster inclusion and participation in digital spaces
- Pay attention to promoting the reuse, refurbishment and recycling of ICT devices (the use of digital technologies should not contradict the school's climate and sustainability efforts)
- Prioritise technologies from companies with a commitment to sustainability, and which consider long-term responsibility. Try to avoid companies that engage in "greenwashing"
- Provide space for learners to be creative and explore their creativity (e.g. provide art rooms and art supplies or games for practising creativity)

6. Crafting new learning environments

GRG7 Kandlgasse Gymnasium, Vienna, Austria. Learn more about the school in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

6. Crafting new learning environments

Imagining and designing

Building a new classroom or school usually starts with a design, which can be contextualised in a brief. The design phase or brief outlines problems and aims, and does not necessarily need to define or prescribe solutions. In most cases, it is a lively document. All relevant stakeholders (including students, community or experts) are involved in its creation, which makes the process participatory. The brief can consider various options, positions and aspects. Learning environments for sustainability should be analysed through the lens of the whole-school approach. Emphasis should be placed on the adaptability, flexibility and material efficiency of the new classrooms and buildings.

Reflective questions

How does our school envision and imagine a new learning environment?

What specific space requirements do we have for the new classroom or building?

How can we involve stakeholders such as teachers, students or parents? What other stakeholders can we involve into the planning stage?

How can we ensure that the process is participatory, transparent and inclusive?

How can we involve experts, architects or municipality?

What design features are likely to have the greatest positive impact on the learning, health and well-being of students?

Should we consider using board games or other interactive activities with the architects during the planning stage?

How to construct a new classroom or building

While many of the previous suggestions for adapting existing spaces to make them more sustainable also apply to creating new classrooms or buildings, we also provide some additional ideas below.

Bioclimatic principles

Adaptability

Actions to consider

- Create classrooms with modular, lightweight, foldable or stackable furniture that can easily be adapted to various needs
- Introduce movable or retractable walls to allow classrooms and other spaces to be reconfigured for different group sizes, activities or teaching styles, thereby promoting a dynamic learning environment
- Create multifunctional and easily convertible spaces for alternative uses, allowing the building to restructured for different purposes, both during and after school

- Integrate technology infrastructure, ensuring that classrooms and other spaces are designed with built-in technology capabilities to support a variety of learning tools and digital resources, including support for easy upgrades as technology evolves

Structure design efficiency

Actions to consider

- Plan for future expansions – design spaces with the capacity to easily integrate additional floors or other functional spaces
- Integrate renewable energy infrastructure
- Utilise local and sustainable materials
- Ensure passive design principles – take advantage of natural heating and cooling by using materials with high thermal mass (e.g. concrete, stone) in order to regulate indoor temperatures and reduce reliance on mechanical heating and cooling systems

Efficiency of materials

Actions to consider

- Use sustainable materials to reduce carbon emissions, and minimise resource depletion through the use of natural resources and innovative technologies
- Use natural insulation for roofs and walls, as well as non-toxic and recycled materials
- Lay down the characteristics of the classroom/building in advance: durability, longevity, thermal insulation, high strength, contributing to long-term environmental sustainability
- Encourage recycling and reduce waste through the on-site recycling of construction waste

Energy efficiency

Actions to consider

- Introduce on-site renewable energy sources such as solar panels, setting up a bicycle that generates electricity, or generating electricity from food waste
- Ensure that the building's design optimises natural daylight
- Use energy-saving technologies such as LED lighting
- Incorporate smart heating and cooling systems – use energy-efficient heating, ventilation and air conditioning systems with smart controls for temperature adjustments based on occupancy or time of day
- Maximise thermal insulation – ensure that walls, windows and roofs are well-insulated to minimise heat loss and enhance energy efficiency, particularly in colder climates

Water efficiency

Actions to consider

- Install toilets with a low-flush option
- Ensure good permeability of outdoor spaces – retention basins, temporary flooding zones, green roofs, ponds

Enhancing the quality of the indoor environment

Actions to consider

- Ensure thermal, acoustic and visual comfort
- Install soundproof, retractable walls
- Maximise natural ventilation and daylight – ensure that the building design allows ample natural light and airflow, thereby reducing the need for artificial lighting and improving indoor air quality
- Install shading solutions to optimise natural light and prevent heat gain, ensuring comfort and energy efficiency

Reducing waste and toxins

Actions to consider

- Employ the "3 Rs" principle during the construction phase: reduce, reuse, recycle
- Reduce hazardous waste
- Design and incorporate sustainable waste management practices – dedicated spaces for composting and food waste, recycling, and systems for reusing building materials

Transport

Actions to consider

- Provide good and safe access (e.g. due to the location of the school) by foot or by bike
- Create bicycle paths in collaboration with local municipalities
- Install secure bike racks and shelters
- Include charging infrastructure for electric vehicles

Promoting biodiversity

Actions to consider

- Install insect and bird feeders, houses and baths, as well as boxes for bats and nesting boxes for common swifts; allow gardens to grow and do not cut the grass too early; plant gardens with local wildflowers
- Build green roofs
- Use permeable pavement instead of concrete surfaces

Climate resilience

Actions to consider

- Design and incorporate climate-resilient infrastructure that can withstand the impacts of climate change and extreme weather events
- Build green spaces to reduce the "heat island" effect and improve air quality
- Design nature-based solutions to manage storm water, reduce flooding, improve the local microclimate and support biodiversity

High-quality learning environments through design

Naturalness

The principle of naturalness relates to the environmental factors necessary for physical comfort. These are **light**, **sound**, **temperature**, **air quality**, **links to nature** and **shade**.

Actions to consider

- Create rooms that are designed with spaces that minimise noise
- Ventilate (using outside air), and protect from pollutants
- Bring in 100% outside air (unless this air is toxic)
- Maintain appropriate exhaust systems
- Comply with air quality standards
- Install air filters into the heating, ventilation and air conditioning (cooling) system that meet certain standards, e.g. a specific minimum score for cleaning air of pollen, mould spores or dust, such as MERV (Minimum Efficiency Reporting Value)
- Install walk-off mats at entryways
- Integrate or plant indoor plants
- Use only low-emission/non-toxic materials and green housekeeping products

Individualisation

Actions to consider

- Creating physical spaces that have the ability to be reconfigured enables educators to tailor learning environments to specific instructional objectives, learning styles and collaborative activities
- Create adaptable and multifunctional classrooms
- Create activities-permissible classrooms. This includes micro-movements (e.g. students using chairs with wheels) and macro-movements (moving from one area to another)
- Use circular tables and digital communication platforms
- Create therapeutic gardens for children of all abilities to engage in nature play
- Think about the openness of school facilities (e.g. the schoolyard) to the public and the local community outside of school hours

Stimulation

Actions to consider

- Use appropriate colours for room which positively influence students' well-being and learning, taking into account cultural context
- Create dynamic, sensory and interactive spaces that enhance creativity, provide flexible arrangements, and stimulate social connections. Create spaces for relaxation, study and play that are vibrant and inspiring but also not so complex that they cause distraction.

Innovation

Actions to consider

- Install digital technologies and tools such as smart classrooms, virtual learning platforms and online collaboration tools
- Create adaptable and inclusive digital spaces and ensure they are flexible and accessible
- Support the sustainable use of technology– implement strategies and rules for use
- Reuse, recycle and refurbish ICT devices
- Design dedicated spaces for students to explore and express their creativity, such as art rooms, music studios and interactive play areas, to inspire innovation and hands-on learning

Once you have constructed a new classroom or building, this is a great opportunity to explore how to maximise its use. Remember to revisit section: **0 Maximising use and learning within a classroom or building** for helpful insights!

7.Optimising and prolonging the life of existing buildings and grounds

Keplero High School, Rome, Italy. Learn more about the school in the Collection of Case Studies.
Source: own - taken by the research team during the field visit.

7. Optimising and prolonging the life of existing buildings and grounds

Technical aspects

The technical aspects of optimising and prolonging the life of primarily relate to buildings and to functional and technical requirements such as safety, comfort or energy performance. However, technical aspects may also be linked to the curriculum and teaching processes, providing hands-on experiences and teaching through real-life examples in classrooms.

Monitoring and evaluation of interventions

- Conduct simple and regular monitoring, and evaluate this with technicians and experts (consumption monitoring)
- Co-create monitoring indicators within schools that allow students and educators to develop context-specific, reflective questions that capture meaningful impacts, such as student motivation and agency
- Engage students and incorporate the monitoring process into the curriculum
- Create milestones and checklists
- Showcase the results of the monitoring in an simple and comparable way, making the results easily digestible
- Gather feedback (evaluation, feedback, satisfaction)

Technical aspects and recommendations

- Organise training to ensure the proper use of infrastructure
- Conduct proper and regular maintenance and monitoring of infrastructure with technicians and experts, in accordance with the technical specifications
- If necessary, undertake repairs
- Make use of adaptability – carry out minor transformations or alterations of spaces
- If necessary, undertake major renovations or extensions

Cultural aspects

The cultural aspects of transformation focus on long-term sustainability thinking, the acquiring of sustainability competences and qualities, and contributing to a more sustainable world in the long term.

- Raise awareness and foster continuous learning in and with learning environments for sustainability
- Make the school environment a model for the wider community; reinforce a sense of collective responsibility and promote sustainability beyond the school grounds
- Provide learning opportunities outside the school's boundaries, not only for learners but for the whole community
- Engage students, staff, parents and the wider community, ensuring that everyone has a voice
- Expand collaboration with parent associations, NGOs or other stakeholders from a local or national setting
- Cultivate students' ability to act, collaborate and think critically about complex environmental challenges

- Foster climate-resilient communities and generations – prepare students to address sustainability challenges by not only educating them about the science of climate change, but also providing them with the tools and mindset needed to adapt and advocate for sustainable solutions and a sustainable future
- Incorporate sustainability into governance, policy and the curriculum – ensure that sustainability practices are embedded within decision-making processes at all levels of the school
- Empower students, and encourage them to participate and take the lead on sustainability challenges. Such roles can foster a sense of ownership and responsibility, and further enhance their sustainability competences
- Celebrate achievements with the community – this can inspire others to join, take action or lead sustainability initiatives

8. Glossary

Term	Definition
Sustainability and sustainable development	The core of sustainability concerns the long-term goal of human development meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987; Hajian and Jangchi Kashani, 2021). Sustainable development refers to the many processes and pathways to achieve this goal through activities and policies across social, economic and environmental pillars.
Learning for sustainability	Learning for sustainability denotes efforts to support people of all ages in fostering "the knowledge, skills and attitudes needed to live more sustainably, in changing patterns of consumption and production, in embracing healthier lifestyles and in contributing – both individually and collectively – to a more sustainable economy and society" (Council of the European Union, 2022a; p. 2). Aside from this, learning for sustainability also embraces holistic, action-oriented, transformative pedagogy that helps learners to understand the root causes of unsustainability and how to address them. While learning for sustainability is the preferred term in EU documents, other relevant terms, such as education for sustainable development (ESD), may be used in certain EU Member States and around the world.
Sustainability competences	Competences are defined at EU level (2018b, p.1) as a combination of knowledge, skills and attitudes. In the context of this study, competences are seen from a comprehensive perspective that encompasses several dimensions of learning (values, facts and capabilities). Sustainability competences "empower learners to embody sustainability values and embrace complex systems, in order to take or request action that restores and maintains ecosystem health and enhances justice, generating visions for sustainable futures" (Bianchi, Pisiotis and Cabrera, 2022). GreenComp, the European sustainability competences reference framework, conceptualises four key sustainability competence areas: (1) embodying sustainability values; (2) embracing complexity in sustainability; (3) envisioning sustainable futures; and (4) acting for sustainability.
Sustainable learning environments	These are environments that support "teaching and learning for sustainability by encouraging engagement and connection with others as well as the environment and by inspiring hope and new visions or possibilities for a sustainable future" (Tilbury, 2023; p. 7). This term can be seen as a combination of the terms "learning for sustainability" and "learning environment", described above.
Quality educational facility	Studies have shown that a high quality of school infrastructure positively impacts children's learning outcomes. Although evidence of a causal relationship is rare, non-experimental studies strongly support these findings. Critical requirements for good-quality school infrastructure are safe and healthy locations (reasonable distance to schools; relatively small; good-quality outdoor and indoor environments); the physical characteristics of learning spaces (good natural conditions such as light and air quality; flexibility and connectivity; consideration of the local climate and cultural conditions); pedagogical practice and participatory design involving multiple stakeholders; and relationships with the wider community (Barrett et al., 2019). A quality educational facility is "a physical space that facilitates the learning process and demonstrates cost-effectiveness over time; one that respects and is in harmony with the environment; and one that encourages social participation, providing a healthy, comfortable, safe, secure and inspirational setting for its occupants" (OECD 2006, p. 18). This term is closely social sustainability. It adopts a narrower vision of

	the learning environment than other terms restricting it to physical space.
Well-being and sustainable happiness	The World Health Organization (WHO) defines well-being as "quality of life and the ability of people and societies to contribute to the world with a sense of meaning and purpose (…) A society's well-being can be observed by the extent to which they are resilient, build capacity for action, and are prepared to transcend challenges" (WHO, 2021). Well-being is linked to health, since the definition of health covers physical, mental, social and emotional health (Aavik and Dobewall, 2017). As defined by the WHO, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 2022). In addition to this, well-being and community-level goals can be viewed through the lens of broader community objectives that go beyond considering well-being only at an individual level. These broader goals are often termed "sustainable happiness" or "global/planetary health/well-being". Sustainable happiness is "happiness that contributes to individual, community, or global well-being without exploiting other people, the environment or future generations" (O'Brien, 2010).
Whole-school / Whole-institution approach	The whole-school approach "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." (Tilbury and Galvin, 2022; p. 8). In other words, all relevant stakeholders should act together to make the critical aspects of the education system (curriculum, professional development, infrastructure, etc.) support sustainability while regularly learning and assessing their efforts (Mathie and Wals, 2022). The whole-school approach is a crucial term, as it outlines the fundamental principles on the basis of which learning environments should be redesigned and developed in order to achieve sustainability goals (e.g. through student and community participation, professional development, changing operations and practices in schools) (Mathie and Wals, 2022; p. 5).
Green infrastructure	Green infrastructure is "a strategically planned network of natural and semi-natural infrastructure areas with other environmental features, designed and managed to deliver a wide range of ecosystem services while enhancing biodiversity" (European Commission, 2024). It is important to note that the network of green (land) and blue (water) spaces improves the health of the natural environment, the health of citizens and the quality of life (European Commission, 2024). This definition of green infrastructure includes green and blue spaces as well as earth (soil).
Nature-based solutions	Nature-based solutions are innovations that are inspired and supported by nature, and which bring environmental, social and economic benefits. Such solutions are natural and diverse, locally adapted, resource-efficient and systemic. They support biodiversity and ecosystem services. Green infrastructure in sustainable learning environments can include nature-based solutions.
Decarbonisation	Decarbonisation is a key trend in the EU. It refers to the reduction or elimination of CO2 emissions from the atmosphere caused by human activities. The aim of decarbonisation is to mitigate the climate crisis and transition from a fossil fuel-based society to cleaner, low-carbon or carbon-neutral energy sources and technologies. It combines energy efficiency and conservation measures with a rapid shift to the use of renewable sources and energy from waste.

9. Further reading and other relevant materials, toolkits and good practices

Materials for guidance on vision

1. **Inner Development Goals Toolkit**
2. **Self-Study Guide. Regenerative Leadership for Systems Transformation. For (aspiring) changemakers**

Practical guidance and tools for transforming learning environments

1. **Coolschools: how to turn your schoolyard into a nature-based climate shelter**
2. **LETI Climate Emergency Design Guide**
3. **My school, a quality space. Guide to basic education**
4. **Repair manual for schools from Finland**

Guidance on education and learning for sustainability

1. **Learning through Landscapes**
2. **Education for sustainable development: a roadmap**
3. **Educating with a Rounder Sense of Purpose**
4. **Learning to transform the world: key competencies in education for sustainable development**
5. **Designing Transformative Learning**

Community and societal outreach

1. **Urban Living Labs**

Tools in other languages

1. **Renovate your school holistically** (in Danish)
2. **Plan for Green schools** (in Danish)
3. **Get more from your school** (in Dutch)

Deliverables of the EU study on school learning environments

Final report, Compendium, Case studies

Publications Office
of the European Union