


Green Digital Education: How Can We Incorporate Sustainability Into (Digital) Education?



Introduction

The digital age has provided us with unique opportunities to improve teacher training and raise awareness about sustainability. In this sense, the integration of sustainability into (digital) education has become crucial to raise younger generations that are not only technologically proficient but also environmentally aware (Echegoyen-Sanz et al., 2024).

Blended learning, which combines online digital media with traditional classroom methods, has been shown to be effective in integrating sustainability into education. In this sense, even social media platforms such as Facebook have been shown to be effective in developing students' critical thinking skills and commitment to sustainability projects (Chin et al., 2018).

Introducing Green Digital Education

When referring to Green Digital Education, it is important to understand that it is understood as the integration of digital learning methods with sustainable practices in order to promote environmental awareness and responsibility among learners. In this sense, such approaches embed sustainability concepts across different fields of study or disciplines. However, the concept also involves the use of technology for interactive learning and the implementation of green policies within educational institutions.


Another important aspect is that the development of digital pedagogical competencies has become critical in the strategy of integrating sustainability in education, especially when it comes to higher education and teacher training. Digital literacies need to be applied to develop educational sustainability, while a focus on pedagogical digital literacies needs to be part of professional development and student empowerment (see ref. 6, 8, 15).

One of the best examples in this sense is the DigCompEdu model, which has been applied to identify relevant teaching competences, while emphasising inclusion, educational quality and lifelong learning. Additionally, the EU Green Deal has promoted the adoption of sustainability assessment frameworks, such as digital twin (DT) and additive manufacturing (3D printing), for real-time evaluation and control of sustainability criteria in educational building (see ref. 4, 25).

Innovative pedagogical approaches for sustainability education

As sustainability education continues to evolve, incorporating innovative pedagogical approaches that enhance student engagement and understanding, there are two main prominent methods in this sense: (1) experiential learning and (2) interdisciplinary teaching (see ref. 28).

In terms of experiential learning, some of the most applied concepts relate to learning landscapes. Such a type proposes a student-centred holistic perspective that allows students to explore sustainability through practical and real-world contexts. Another, especially in the case of higher education, refers to campuses as living laboratories. In this sense, students can address real-world sustainability issues and integrate a multidisciplinary perspective along collaborative projects. Also, outdoor learning should not be neglected as part of an experiential pedagogy that could support sustainability literate graduates.



In terms of interdisciplinary teaching, a broad view of sustainability that enhances students' critical and reflective thinking could be provided through Sustainable Development Goals competencies. In addition, social laboratory classrooms could further engage students in participatory research on interrelated social sustainability issues. Problem and project-based learning strategies could provide a holistic educational design that makes sustainability concepts more accessible and relevant to students (see ref. 9, 33).



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Although the benefits mentioned above are hard to deny, there are several challenges that hinder their implementation. One such challenge is the scarcity of materials and trained sustainability educators. Another major barrier to effective implementation of sustainability education is the commitment of policy makers and senior management, as well as adequate support for teachers (see ref. 11, 16).

Another aspect is institutional inertia – there is considerable reluctance to adopt new teaching paradigms, as changes in curriculum and pedagogical practice are required to challenge current epistemologies and public discourses within the field. Last but not least, the implementation of interdisciplinary and experiential learning projects often involves logistical challenges and intensive collaboration, which can be daunting for both students and teachers (see ref. 1, 17, 23).

Conclusions

Integrating sustainability into digital education requires a well-thought-out strategy that includes policy development, targeted professional development and ongoing evaluation. By embedding sustainability education as a core element of the curriculum, providing teachers with comprehensive training programmes and maintaining a dynamic review process, educational institutions can produce environmentally aware individuals. These graduates will be equipped to meet the intricate challenges of sustainability in an increasingly complex world. Effective policies should encourage collaborative and holistic approaches, embed sustainability concepts across disciplines and promote interdisciplinary learning.

Educational institutions need to harness the digital tools for interactive and experiential learning to achieve this vision. Virtual simulations, digital storytelling, and gamified learning environments can immerse students in sustainability scenarios and improve their critical thinking and problem-solving. Aligning academic goals with sustainability goals through partnerships between schools, universities, and industry stakeholders can improve education. These collaborations highlight the social and economic importance of sustainability and inspire a deep commitment to environmental stewardship and responsible citizenship while bridging theory and practice.

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