



GREENING EDUCATIONAL INSTITUTIONS: FROM GREEN PRACTICES TO CLIMATE-READY AND SUSTAINABLE LEARNING ECOSYSTEMS

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RESEARCH ARTICLE



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Abstract

Environmental degradation, climate change, biodiversity loss, resource depletion and increasing levels of pollution have transformed sustainability from a peripheral concern into a fundamental educational imperative. Educational institutions occupy a unique position in this transformation because they are simultaneously consumers of natural resources, centres of knowledge production, social institutions and spaces in which future generations develop values, attitudes and behavioural patterns. The traditional understanding of a “green school” has generally emphasized renewable energy, water conservation, waste management, recycling, green buildings and plantation. However, contemporary approaches increasingly conceptualize institutional greening as a comprehensive process involving governance, infrastructure, curriculum, pedagogy, technology, community participation and sustainable behaviour. The present article examines the meaning, dimensions and significance of green practices in educational institutions. The article synthesizes established practices such as renewable energy, solar power, biodiesel, electric mobility, rainwater harvesting, waste segregation, recycling, green spaces and green auditing with emerging concepts such as whole-institution approaches, green curriculum, environmental entrepreneurship, circular education, green digitalization, nature-based learning, climate resilience and student-led sustainability innovation.

Keywords: *Green practices, green school, climate-ready school, green curriculum, renewable energy, environmental entrepreneurship, green audit, sustainability, electric vehicles, solar energy, whole-institution approach*

Introduction

The twenty-first century is witnessing a complex convergence of environmental, technological, economic and social challenges. Climate change, biodiversity loss, air and water pollution, increasing waste generation, resource depletion and unsustainable consumption patterns are affecting communities across the world. These challenges have also begun to affect educational systems directly. Extreme heat, floods, storms, droughts and other climate-related events can interrupt educational activities, damage infrastructure and affect the health and well-being of learners and teachers. UNEP has recently highlighted the importance of climate-resilient schools and reported that climate crises disrupted schooling for millions of learners across countries. (UNEP, 2026).

Education therefore cannot remain merely a sector that teaches students about environmental problems. It must become an institution that demonstrates how sustainable living can actually be practised. The school or college campus itself can become a learning laboratory where students observe renewable energy systems, participate in waste segregation, monitor water consumption, cultivate gardens, conduct biodiversity surveys, measure energy efficiency and design solutions to local environmental problems.

Green practices are defined as environmentally responsible and resource-efficient processes extending across the life cycle of development and identifies actions such as renewable energy use, conservation of flora and fauna, rainwater harvesting, e-waste management, recycling, reuse, reduction of non-renewable resources and green building practices. This understanding is highly relevant but can be extended further. Contemporary greening of education is no longer restricted to physical infrastructure. UNESCO's Green School Quality Standard conceptualizes a green educational institution through a whole-institution approach, integrating governance, facilities and operations, teaching and learning, and community engagement.(UNESCO,2024) Thus, the future of environmental education lies in transforming educational institutions from places where sustainability is taught into places where sustainability is lived, measured, experienced and innovated.

Conceptualizing Green Practices in Educational Institutions: Green practices may broadly be understood as systematic institutional actions designed to minimize environmental harm, conserve resources and promote ecological responsibility. They involve both physical and behavioural dimensions. The important institutional strategies of Green practices include green infrastructure, environmental entrepreneurship, integration of environmental education with core subjects, environmental clubs, waste reduction, energy conservation, renewable energy, green spaces, reduction of paper usage, recycling, rainwater harvesting and green audits. The concept, however, should now be expanded from green practices to green institutional transformation. A school may install solar panels and still remain environmentally unsustainable if it continues to waste water, generate unnecessary paper waste, ignore e-waste, use environmentally harmful procurement systems or treat sustainability as an occasional activity. Therefore, greening should be understood as a continuous institutional process rather than a collection of isolated environmental activities.

From Green School to Climate-Ready Learning Ecosystem: A significant recent development is the movement from the traditional idea of a “green school” towards the concept of a climate-ready learning institution. UNESCO's Green School Quality Standard defines a green school through a whole-institution approach to Education for Sustainable Development, emphasizing climate readiness, sustainable practices and the development of knowledge, skills, values and attitudes among learners.(UNESCO,2026). The climate-ready educational institution has two complementary responsibilities. First, it must reduce its environmental footprint. Second, it must increase its capacity to withstand environmental challenges. A climate-ready educational institution is not merely an institution that produces less environmental harm; it is an institution capable of preparing learners, infrastructure, governance systems and communities to anticipate, withstand and respond to environmental change. This conceptual shift is particularly important for developing countries and climate-vulnerable regions.

Major Dimensions of Greening Educational Institutions

Green Infrastructure: Infrastructure constitutes the physical foundation of institutional sustainability. Green infrastructure includes energy-efficient buildings, natural ventilation, daylight utilization, rainwater systems, solar power, water-efficient sanitation, green roofs, gardens, tree cover and environmentally responsible construction. This emphasizes on renewable energy, water-saving technologies and green areas as important components of green infrastructure. However, future green infrastructure should move towards net-zero and climate-responsive infrastructure. Buildings should be designed not only for lower energy consumption but also for thermal comfort, resilience, accessibility and long-term resource efficiency.

Renewable Energy and Solarization: Solar energy is among the most promising renewable-energy options for educational institutions. Solar photovoltaic systems can generate electricity for classrooms, laboratories, hostels, administrative buildings, libraries and other campus facilities. Solar energy is renewable, inexhaustible and capable of being converted into electricity or heat through solar panels and related technologies.

Solarization of educational institutions can produce three simultaneous benefits:

- a. **Economic benefit:** reduction in long-term electricity expenditure.
- b. **Environmental benefit:** reduction in dependence on fossil-fuel-based electricity.
- c. **Educational benefit:** students can observe renewable-energy technologies in real-life operation.

This creates the idea of the Campus-as-a-Laboratory Model, under which the solar system itself becomes an instructional resource for physics, environmental science, mathematics, economics, geography and vocational education.

Sustainable Transportation and Electric Vehicles: Transportation contributes significantly to air pollution and greenhouse gas emissions. Educational institutions can encourage walking, cycling, public transportation, carpooling and electric mobility. Electric vehicles operate using electricity stored in batteries rather than conventional petrol or diesel fuels. Lower operating costs, lower maintenance requirements, reduced noise and the possibility of charging through renewable energy are significant advantages of electric vehicles.

Biodiesel and Alternative Fuels: Biodiesel provides another example of renewable energy application. It can be produced from vegetable oils, animal fats and waste cooking oils. Educational institutions can use biodiesel as a topic for interdisciplinary learning involving chemistry, agriculture, environmental science, economics and entrepreneurship. Nevertheless, the sustainability of bio-fuels should be evaluated through their entire life cycle. Questions concerning land use, food security, feedstock sourcing, biodiversity and production emissions must be considered rather than assuming that every bio-fuel is automatically environmentally beneficial.

Circular Education and Zero-Waste Campuses: Circular education extends the principles of the circular economy into educational practice. Instead of viewing discarded materials as waste, institutions can regard them as resources for learning, innovation and productive reuse. For example, old furniture can be repaired rather than discarded, paper can be reused, food waste can become compost, organic waste can support school gardens, used cooking oil can become a potential biodiesel feedstock, electronic devices can be repaired or responsibly recycled and students can design products using discarded materials.

Green Curriculum: Environmental education should not remain confined to environmental science or occasional awareness programmes. UNESCO's recent Greening Curriculum Guidance promotes a lifelong approach in which climate education is integrated into curricula, teaching materials, pedagogy, assessment and teacher education. It identifies four principles: action-oriented, justice-promoting, quality content, and comprehensive and relevant. (UNESCO, 2026)

Green Pedagogy and Experiential Learning: Green education becomes more meaningful when learners participate directly in environmental problem-solving. For example, rather than merely teaching students about water scarcity, students can measure campus water consumption, identify wastage points, design conservation strategies and calculate potential savings. Similarly, instead of only explaining renewable energy theoretically, students can calculate the energy produced by a solar installation. This leads to the concept of Learning by Greening. Students learn sustainability by participating in actual sustainability practices.

Environmental Entrepreneurship: Environmental entrepreneurship as an emerging opportunity and proposes projects involving sustainable products, green technologies and environmental awareness campaigns. Environmental entrepreneurship can be expanded into Green Innovation Education. The objective is not simply to produce entrepreneurs but to develop problem-solving citizens capable of identifying environmental challenges and developing socially useful solutions.

Green Digitalization: A New Dimension of Sustainable Education

Digital technology has both environmental benefits and environmental costs. Digital learning can reduce paper consumption and physical transportation. It specifically identifies digital assignments and paperless communication as methods of reducing paper use.

Green Audit as a Tool for Institutional Transformation: A green audit provides an evidence-based mechanism for assessing environmental performance. Green auditing is the systematic identification, quantification, recording, reporting and analysis of environmental components

An outline of a Comprehensive Institutional Green Audit

Area	Indicators
Energy	Electricity consumption, renewable-energy generation
Water	Consumption, leakage, harvesting
Waste	Segregation, recycling, composting
Biodiversity	Tree cover, gardens, species diversity
Transport	EVs, cycling, public transport
Buildings	Energy efficiency, ventilation
Digital systems	Device life cycle, e-waste
Curriculum	Sustainability-related content
Behaviour	Student and staff practices
Community	Environmental partnerships

Green Governance: Sustainability cannot succeed through student activities alone. Institutional leadership must create policies, budgets, accountability mechanisms and monitoring systems. UNESCO's Green School Quality Standard identifies governance as one of the four core dimensions of institutional greening, alongside facilities and operations, teaching and learning, and community engagement. This represents a major conceptual development: sustainability becomes a governance responsibility rather than merely an environmental activity. (UNESCO, 2024)

Student Agency and Green Citizenship: Students should not be treated merely as beneficiaries of green education. They should become active agents of institutional transformation. The goal should be the development of Green Citizenship. Green citizenship refers to the knowledge, values, competencies and behaviours necessary for individuals to participate responsibly in solving environmental problems. This concept extends environmental education beyond personal behaviour towards democratic participation, collective responsibility and community action.

Nature-Based Learning and Biophilic Educational Spaces: Educational institutions can use natural environments as learning resources. Trees, gardens, ponds, wetlands, biodiversity parks and kitchen gardens can function as outdoor classrooms. UNESCO's recent greening initiatives explicitly recognize the importance of learning environments and whole-institution approaches in which sustainability is embedded in everyday educational experiences. Thus, the green campus should not simply contain green spaces. It should use green spaces pedagogically.

Community Engagement and Local Sustainability: Educational institutions are embedded in communities. Therefore, campus sustainability should connect with local environmental problems. UNESCO's Greening Education Partnership emphasizes community engagement as one of the central dimensions of greening education and promotes partnerships among educational institutions, communities and other stakeholders. This creates the concept of the Green Community Learning Hub—an educational institution that becomes a centre for local environmental knowledge, innovation and action.(UNESCO, 2024)

Challenges in Implementing Green Practices

Despite their importance, green practices face several challenges.

- 1. Financial constraints:** Solar systems, energy-efficient infrastructure and EV charging stations may require substantial initial investment.
- 2. Lack of awareness:** Teachers, students and administrators may not possess sufficient sustainability knowledge.
- 3. Inadequate institutional leadership:** Without administrative commitment, green initiatives may remain temporary.
- 4. Behavioural resistance:** Changing established consumption patterns are difficult.

5. **Technology limitations:** Some institutions may lack access to advanced technologies.
6. **Poor maintenance:** Green infrastructure requires continuous monitoring and maintenance.
7. **Fragmented implementation:** Environmental activities are often organized as isolated events rather than integrated into institutional planning.
8. **Lack of assessment:** Institutions may implement projects without measuring their environmental outcomes.
9. **Digital sustainability challenges:** Increasing digitalization can generate additional energy consumption and e-waste.

Conclusion

The transformation of educational institutions into green and climate-ready learning environments is no longer an optional environmental initiative. It is increasingly a central component of quality, relevant and future-oriented education. Traditional green practices such as solar energy, biodiesel, rainwater harvesting, recycling, waste reduction, green spaces, energy conservation, electric vehicles and green audits remain important foundations. The source material provides a strong basis for these practices and emphasizes their application within schools and educational institutions.

However, the emerging global agenda requires a much broader vision. UNESCO's recent Green School Quality Standard places greening within four interconnected dimensions—governance, facilities and operations, teaching and learning, and community engagement. Its Greening Curriculum Guidance further emphasizes action-oriented, justice-promoting, comprehensive and relevant climate education across learning and curriculum systems. Consequently, the future educational institution should not simply be a green campus. It should become a Climate-Ready and Sustainable Learning Ecosystem.

The most important conceptual transformation is therefore from environmental awareness to environmental agency. Students should not merely know that climate change exists; they should acquire the knowledge, skills, values and confidence to participate in solving environmental problems. In this sense, the green educational institution becomes both a model of sustainable living and an engine of sustainable transformation. The ultimate objective is not simply to create institutions that consume less. It is to create institutions that learn, innovate, conserve, regenerate and inspire.

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