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SOCIO-PEDAGOGICAL MECHANISMS FOR FORMING GREEN SKILLS IN ENVIRONMENTAL EDUCATION

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Abstract
The growing urgency of environmental challenges has placed "green skills" – competencies for sustainable development, circular economy, and ecological citizenship – at the core of modern education. This article examines the socio-pedagogical mechanisms that enable the effective formation of green skills within environmental education. It integrates insights from social constructivism, experiential learning theory, and community-based education to propose a multi-level framework. Key mechanisms include: curriculum integration across disciplines, project-based and place-based learning, teacher professional development, multi-stakeholder partnerships, and digital tools for environmental action. The article argues that sustainable green skills formation requires systemic alignment of pedagogical approaches, institutional culture, and authentic societal engagement.

Keywords: green skills, environmental education, socio-pedagogical mechanisms, sustainability competencies, experiential learning, education for sustainable development (ESD)

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Introduction

In the context of the climate crisis, biodiversity loss, and resource depletion, the concept of "green skills" has moved from vocational training to mainstream education. Green skills refer to the knowledge, abilities, values, and attitudes needed to live, work, and act in a sustainable manner (UNESCO, 2019). They encompass technical skills (e.g., renewable energy systems, waste management), transversal competencies (critical thinking, systems thinking, collaboration), and socio-emotional capacities (empathy for nature, environmental ethics).

Environmental education (EE) has historically focused on awareness and knowledge. However, the shift toward Education for Sustainable Development (ESD) emphasizes competence development and transformative action. The central question is: What socio-pedagogical mechanisms effectively foster green skills across different educational levels and contexts?

This article explores the mechanisms from a socio-pedagogical perspective – considering the interplay between individual learning, social interaction, institutional structures, and community practices. It synthesizes theoretical frameworks and empirical evidence to present an integrated model.

1.1 The Capability Approach

Amartya Sen's Capability Approach shifts focus from knowledge transmission to what learners are actually able to do and be. In green skills formation, this means education should expand learners' capabilities to lead sustainable lives – e.g., the capability to understand ecological systems, to participate in environmental decision-making, to innovate green solutions. Socio-pedagogical mechanisms must therefore be evaluated not just by curriculum coverage but by whether they enhance real freedoms and agency.

1.2 Critical Pedagogy and Environmental Justice

Paulo Freire's critical pedagogy reminds us that environmental issues are intertwined with social inequality. Green skills education should include critical analysis of power structures: who bears the burden of pollution, who benefits from unsustainable practices, and how marginalized communities exercise environmental stewardship. This perspective demands that socio-pedagogical mechanisms incorporate community-based participatory research, critical media literacy, and advocacy skills.

1.3 New Materialism and Posthumanism

Emerging theoretical perspectives challenge the human–nature dualism. They emphasize that material environments (soil, water, technologies) actively co-shape learning. For green skills, this suggests that the physical school environment – green spaces, renewable energy installations, sustainable infrastructure – acts as a pedagogical agent. Learning happens with and through material ecologies, not only about them.

2. Theoretical Foundations

2.1 Social Constructivism and Situated Learning

Vygotsky's social constructivism posits that learning occurs through social interaction within a zone of proximal development. For green skills, this implies that learners co-construct sustainability knowledge through dialogue, collaborative problem-solving, and participation in authentic environmental practices. Lave and Wenger's situated learning theory adds that legitimate peripheral participation in communities of practice (e.g., local conservation groups, urban gardening projects) enables deep internalization of green competencies.

2.2 Experiential and Transformative Learning

Kolb's experiential learning cycle (concrete experience → reflective observation → abstract conceptualization → active experimentation) is foundational to EE. When learners engage directly with environmental issues – conducting water quality tests, designing a school composting system – they move beyond abstract knowledge. Mezirow's transformative learning further explains how critical reflection on ecological dilemmas can shift worldviews, fostering a sustainability-oriented identity.

2.3 Socio-Ecological Systems and Action Competence

The concept of action competence (Jensen & Schnack, 1997) emphasizes the ability to act intentionally and responsibly toward environmental problems. It requires not only knowledge but also willingness, ownership, and confidence. Socio-pedagogical mechanisms must therefore create spaces for student agency, democratic participation, and real-world impact.

3. Socio-Pedagogical Mechanisms for Green Skills Formation

Based on a review of research and best practices, I identify six interconnected mechanisms.

3.1 Curriculum Integration Across Disciplines

Green skills cannot be confined to a single subject. Effective integration involves:

- **Infusion**: embedding sustainability concepts into science, geography, economics, civic education, and even arts and literature.
- **Interdisciplinary projects**: e.g., students calculate the carbon footprint of their school (math/science), design awareness campaigns (language arts/art), and propose policy changes (civics).

• **Competence-based frameworks**: aligning with UNESCO's eight sustainability competencies (systems thinking, anticipatory, normative, strategic, collaboration, critical thinking, self-awareness, integrated problem-solving).
Example: In Finland, the "phenomenon-based learning" approach often tackles real-world sustainability challenges, requiring students to apply multiple disciplines.

3.2 Experiential, Place-Based, and Project-Based Learning

Direct interaction with local environments creates meaningful contexts for skill development.

• **Place-based education**: uses the local community and ecosystem as the primary learning laboratory. Students conduct biodiversity inventories, restore local habitats, or partner with municipal environmental agencies.

• **Project-based learning (PBL)**: engages learners in extended, inquiry-driven projects that produce tangible outcomes (e.g., a school garden, a recycling system, a community awareness event).

• **Outdoor education**: fosters direct emotional connection with nature, which is essential for developing pro-environmental values.

Mechanism in action: In Costa Rica, schools participating in the National Program of Environmental Education implement school eco-projects (reforestation, water conservation) that integrate academic content with practical skill development.

3.3 Teacher Professional Development and Pedagogical Support

Teachers are the primary agents. Yet many lack the confidence or competence to teach green skills. Essential components:

- Pre-service and in-service training on ESD pedagogies (inquiry-based, participatory, reflective).
- Collaborative teacher communities (professional learning communities) focused on sustainability.
- Availability of teaching resources, local case studies, and mentorship from environmental educators.

Evidence: A study by Cebrián & Junyent (2015) showed that teacher competence in ESD significantly increases when training combines theoretical grounding with practical school-based projects.

3.4 Participatory Governance and Democratic School Culture

Green skills thrive in environments where students have a voice and responsibility.

- **Eco-Schools** and similar programs involve student-led environmental committees that make decisions on energy use, waste reduction, etc.
- Democratic processes (voting on sustainability initiatives, student-led conferences) cultivate negotiation, leadership, and collective action skills.
- Whole-school approaches embed sustainability in school management (procurement, infrastructure, culture), making the school a model of sustainable practice.

3.5 Multi-Stakeholder Partnerships and Community Engagement

Learning extends beyond school walls. Partnerships amplify authenticity and resources:

- Collaboration with local governments, NGOs, green businesses, universities.
- Service-learning: students contribute to community-defined environmental goals (e.g., tree planting, environmental monitoring).

• Intergenerational learning: involving elders, indigenous knowledge holders, and local experts.

Example: In the Philippines, the Gulayan sa Paaralan (School Vegetable Garden) program partners with the Department of Agriculture and local governments to teach sustainable agriculture skills while improving food security.

3.6 Digital Tools and Virtual Environments

Digital technologies offer new avenues for green skills formation:

• GIS and mapping tools enable students to analyze environmental data and plan interventions.

• Online platforms for citizen science (e.g., iNaturalist, Globe.gov) connect learners to global research.

• Virtual exchanges allow cross-cultural collaboration on sustainability projects, fostering global citizenship skills.

• Simulations and serious games (e.g., climate change decision-making games) develop systems thinking and anticipatory competence.

4. Illustrative Framework: Integrating the Mechanisms

The mechanisms do not operate in isolation. A holistic socio-pedagogical model can be visualized as concentric layers:

1. **Core**: Learner agency, critical reflection, and values formation.
2. **Pedagogical layer**: Experiential, inquiry-based, and participatory methods.
3. **Institutional layer**: Supportive school culture, teacher capacity, green infrastructure, democratic governance.
4. **Community layer**: Family involvement, local partnerships, authentic civic engagement.

5. **Policy layer**: National curriculum alignment, funding, monitoring frameworks.

When all layers align, green skills become an integral outcome of education rather than an add-on.

5. Challenges and Enabling Conditions

Despite the promise, several barriers hinder effective implementation:

- **Curriculum overload**: teachers perceive sustainability as an extra burden.
- **Insufficient teacher training**: many educators lack ESD competencies.
- **Limited resources**: schools in low-income areas may lack outdoor spaces, materials, or connections.
- **Assessment gaps**: green skills (e.g., collaboration, systems thinking) are not easily captured by traditional tests.

Enabling conditions include:

- Clear policy mandates (e.g., national ESD strategies).
- Investment in teacher education and school infrastructure.
- Development of authentic assessment tools (portfolios, performance tasks, self-assessments).
- Recognition of schools as learning communities that continuously improve sustainability practices.

Conclusion

Forming green skills in environmental education is not merely about adding new content; it requires a fundamental shift in how education is conceived and practiced. The socio-pedagogical mechanisms outlined – integrated curriculum, experiential learning, teacher development, democratic participation, community partnerships, and digital tools – form a synergistic system. When these

mechanisms are implemented coherently, learners develop not only technical environmental competencies but also the critical, collaborative, and ethical capacities to become active agents of sustainability.

Future research should focus on longitudinal studies that track the retention and transfer of green skills into adult life, as well as comparative studies across different cultural and socioeconomic contexts. Policymakers and educators must commit to embedding these mechanisms into educational systems worldwide, recognizing that green skills are essential for both individual flourishing and planetary survival.

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