

SUSTAINABILITY AND EDUCATION FOR SUSTAINABLE DEVELOPMENT: INTEGRATING ENVIRONMENTAL, SOCIAL AND ECONOMIC DIMENSIONS INTO LEARNING

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Abstract

Education for Sustainable Development (ESD) is a revolutionary understanding of education which incorporates environmental, social, and economic aspects of sustainability in the education process. It is a comprehensive review paper which explores modern studies on the implementation of ESD, pedagogical practices, curriculum implementation and learning objectives in the various learning settings. The results have shown that successful ESD entails the students in holistic, action-based learning experiences, that cultivate sustainability competencies that include critical thinking, systems perception, ethical decision-making, and change agency. Nevertheless, there are still considerable obstacles to implementation such as the presence of disciplinary silos, gaps in teacher preparation, time and resource constraints and conflicts between growth based economic paradigm and true sustainability ideals. The article summarizes the literature on effective ESD models, points out the potential of effective pedagogical applications, and suggests the potential ways of addressing the obstacles to implementation in order to promote the Sustainable Development Goals via education.

Keywords: Education for Sustainable Development, Sustainability Competencies, Pedagogical Practices, Sustainable Development Goals, Social and Economic Dimensions.

1. Introduction

The problems of sustainability faced globally such as global warming, environmental degradation, social inequalities and economic disparities are issues that require transformative solutions, especially on the educational sector. Education to Sustainable Development (ESD), or Education to Sustainability (EfS) has become a model and recommendation of the UNESCO to position education as a core of the attainment of the challenges of the Sustainable Development Goals (SDGs) of the United Nations and the creation of more sustainable, equitable, and economical communities.

In contrast to the conventional environmental education that aims at a one-sided approach addressing environmental issues, ESD incorporates three interconnected pillars of sustainability, including environmental protection and conservation, social equity and justice, and economic

viability (Gorski et al., 2023). This multidimensional way of thinking acknowledges that sustainability issues are not single disciplinary issues, instead they are interdependent systems issues that need interdisciplinary insights and concerted action at all levels.

The urgency of ESD has escalated with an increase in the evidence of the inefficacy of traditional educational methods in equipping graduates to be sustainability-conscious decision-makers and change agents. The studies have found that even though the institutional commitment to SDGs is broadly spread, sustainability is not taken in the majority of curricula in most cases implemented irregularly instead of systematically (Sidiropoulos, 2022). The review discusses the way in which education systems can be propelled beyond apparent devotion to substantive incorporation of sustainability principles by looking at evidence about the positive implementation of pedagogical methods, models of competence, assessment models and supporting mechanisms that facilitate transformative practices of sustainability learning.

2. Defining Education for Sustainable Development: Conceptual Frameworks

2.1 The Three-Pillar Model

There are three dimensions of sustainability conceptually connected to ESD (Vilmala et al., 2022). Environmental dimension includes the knowledge of ecological systems, biodiversity, climate interactions, resource/energy management, and human intervention on the natural systems. The social aspect incorporates the principles of equity, justice, human rights, cultural diversity, community well-being and inclusive governance. The economic aspect deals with sustainable livelihoods, fair trade, responsible consumption and production and economic systems that benefit the people and the planet.

More importantly, ESD has identified these dimensions as being inseparable. Economically disadvantaged communities are disproportionately the victims of environmental degradation, which can be used to show how the environmental and social aspects intersect. Economies that propel resources harvesting and consumption endanger ecological soundness as well as social symmetry. True sustainability entails combined strategies that deal with all the three aspects at the same time as opposed to isolating them (Glavi, 2020).

2.3 Relationship to Sustainable Development Goals

Some studies establish the key traits of ESD as compared to conventional environmental education (Gorski et al., 2023). ESD is transformative, and it is clearly focused on building the abilities of the learners to change the society and transform their lives, rather than the possibility to learn new knowledge. It is practice-based, involving students in the real world sustainability projects and real world problems. ESD puts much focus on the idea of systems thinking, it helps the learners to comprehend the complex interdependence between environmental, social, economic, and political phenomena (Sinakou et al., 2019).

Good ESD makes use of pluralistic, holistic pedagogies. Whole person takes into consideration human cognition as being both rational-analytical and emotionally, intuitively and spiritually (Sinakou et al., 2019). The pluralistic practices also respect a variety of worldviews and knowledge systems, such as Indigenous knowledge and ways of thinking that are traditionally pushed to the periphery of formal education (Demssie et al., 2020). ESD is becoming more and more about critical pedagogy that asks students to challenge what is assumed, to take apart power systems, and to see how institutionalized ideology goes into the discussion of sustainability (Kopnina, 2020). The Agenda 2030 formulated 17 interconnected Sustainable Development Goals with a lot of detailed targets. SDG 4, which assumes the inclusion and equitable access to quality education, has Target 4.7 specifically forbidding that only the former learners gain knowledge and skills

requisite to facilitating sustainable growth (Liu et al., 2020). ESD is the main educational process that may ensure this target and contribute to the development of other SDGs that focus on poverty, health, access to clean water, climate action, and other aspects.

Nonetheless, studies indicate the existence of conflicts between mainstream strategies of ESD and implicit underlying sustainability ideas. According to some researchers, this is because ESD is usually accommodating unsustainable economic growth paradigms, instead of confronting the underlying assumptions about economic systems (Kopnina, 2020). Other approaches which focus on the idea of degrowth, on ecocentric ethics and on Indigenous learning have much to contribute to counteracting market-based narratives of sustainability.

3. Theoretical Frameworks Guiding ESD Implementation

3.1 Action Competence and Agency

One of the focal ideas in the study of ESD is action competence, as it is the ability to comprehend sustainability issues and envisions the alternatives and make a significant step toward change (Husamah et al., 2022). Action competence involves expertise on sustainability problems, comprehension of social and political institutions that determine the state of the environment, collaborative problem-solving aptitude, and most importantly, readiness and the urge to do.

Studies draw a line between cognitive knowledge, practical skills and action motivation (Korsager and Scheie, 2019). The students can know but be without the power or capacity to do anything in the environment. On the contrary, a student whose either attitude is stimulated to take action without sufficient knowledge can participate in inefficient or reversing actions. Comprehensive ESD creates integrated action competence to all dimensions.

3.2 Sustainability Competencies Framework

Several models recognize competencies that should be developed by ESD (Eizaguirre et al., 2019). These typically include:

Systemic thinking: The capacity to see the interrelations and feedback loops of complex sustainability systems.

Anticipatory competence: Able to think about other possible futures and foresee the outcomes of the decisions being made.

Normative competency: Knowledge of various values and ethical models that guide sustainability decisions.

Strategic competence: Designing and instituting change measures.

Teamwork and relationship: Cross-differences working and vision-making skills.

Thinking critically: Ability to evaluate assumptions, evidence, and the ability to identify more than one point of view.

Emotional and social skills: Self-awareness, empathy, and skills to cooperate with others.

Significantly, such competencies are not limited to environmental knowledge that is technical, but include the affective, cognitive, behavioral, and conative aspects of the meaningful action.

3.3 The Powerful Learning Environment Framework

The studies involving the creation of effective ESD contexts suggest the model of Powerful Learning Environment where five elements are highlighted (Sinakou et al., 2019):

Action-taking: Participating in actual projects touching upon real challenges of sustainability.

Leadership: Students taking the leadership in sustainability initiatives.

Peer interaction: Learning with other various peers.

Community involvement: Relating the classroom learning to the community and society at large.

Interdisciplinary: The incorporation of inter-disciplinary knowledge.

These elements promote deep learning, long-lasting motivation, and acquisition of real sustainability agency when applied as a whole with the focus on the quality of pedagogies.

4. Current Status of ESD Implementation in Educational Systems

4.1 Adoption and Integration Patterns

The bibliometric analysis of the research in the ESD area indicates that the number of publications has increased exponentially in the last ten years, with the focus on higher education (Gorski et al., 2023). Nonetheless, such proliferation of research has not been translated in a consistent manner into curricular integration. Research on the different national contexts demonstrates that ESD is still peripheral and it is run using isolated projects and courses instead of transforming the curriculum.

An example is that physical education teachers acknowledge the relevance of SDGs but have no specific instructions on how to incorporate concepts of sustainability in their instruction, are not sure how physical education can contribute to the achievement of SDGs (Baena-Morales et al., 2022). Likewise, accounting teachers also have a hard time including sustainability concepts in profession-centred curricula, and most of the sustainability courses offered exist as optional courses, not as part of disciplinary routine (Twyford et al., 2024).

The most beneficial applications are done when ESD is specifically integrated at various levels: basic courses that provide sustainability-related ideas, discipline courses that analyse sustainability implementations in disciplines, and term projects that allow students to engage in sustainability implementation projects (Álvarez et al., 2021).

4.2 Geographic and Institutional Variations

No significant geographic and institutional patterns exist in terms of ESD implementation. Universities with clear sustainability missions that operate in developed countries have proceeded most in incorporating ESD. But even these establishments often do not have strategic frameworks that guarantee overall integration (Hinduja et al., 2023).

Less-developed countries and less-educated settings put a specific strain on the introduction of ESD because of a lack of resources, prioritization on other education factors, and teacher training. Nonetheless, such areas tend to represent new ways of integration between ESD and Indigenous knowledge systems, as well as localized challenges of sustainability (Demssie et al., 2020). A promising example of growth in the ESD sector in Pakistan despite structural limitations is available, and studies have revealed both positive improvement and major barriers to implementation (Hinduja et al., 2023).

4.3 The COVID-19 Pandemic Impact

COVID-19 interfered with the patterns of ESD implementation. A systematic sustainability in higher education review carried out in the period of 2020-2021 reveals troubling trends: in some cases, institutions have stepped up in sustainability activities, whereas in others, ESD has lost significance among educational systems shifted to emergency remote education (Crawford & CifuentesFaura, 2022). As the institution changed its priority and started to care about learning and teaching, the study found low rates of ESD documentation in the pandemic.

Nevertheless, the pandemic also triggered the awareness of the interdependence between environmental degradation, social vulnerability, and economic frailty, which are key ESD concepts, and this may boost the willingness to receive sustainability education after the pandemic (Crawford and CifuentesFaura, 2022).

5. Pedagogical Approaches and Teaching Methods for ESD

5.1 Problem-Based and Project-Based Learning

Empirical evidence gives the specific use of the problem-based and project-based learning (PBL) methods to be particularly effective in the context of ESD (Nguyen et al., 2024). Problem-based learning involves students in exploring real-life sustainability issues and finding solutions to those issues by collaboratively developing solutions to such problems and applying interventions that have real-life implications. ML When used in alignment with SDGs, PBL can be successful in various fields, and it is evidenced that the level of SDG intersects in the curriculum by using PBL practices is significant (Nguyen et al., 2024).

Project based learning programs in which students can conduct long term research of local sustainability issues, will build in both longer term sustainability skills and agency and motivation. Indicatively, learning outcomes in the cognitive, behavioral, and affective domain are seen in student projects, including waste management, renewable energy, or community resiliency (Owojori et al., 2022).

5.2 Action-Oriented and Participatory Approaches

The ESD studies pay significance to action-oriented pedagogy in which the students are engaged in real sustainability initiatives outside the classrooms. Service learning, community-based research, and citizen science programs help students to work on real environmental and social problems and also acquire competencies via real-life experience (Queiruga Dios et al., 2020).

The combination of science and community-based citizen research is an especially effective approach in creating scientific literacy as well as in building sustainability awareness. A systematic review of attaining beneficial effects of citizen science in formal education reported strong positive effects on the students' knowledge about sustainable development and interest in environmental management (Queiruga Dios et al., 2020).

Engaging the community makes learning expand past the classrooms and relates institutional resources to solving local sustainability problems. The informal learning research on sustainability in universities found out that among the wide range of student-led groups focused on sustainability through practice were some students who had developed significant competences due to their involvement in sustainability projects outside of the official curriculum (Gramatakos and Lavau, 2019).

5.3 Interdisciplinary and Systems-Thinking Approaches

True sustainability issues can not be solved in mono-disciplinary systems. Powerful ESD incorporates the views of natural sciences, social sciences, humanities, engineering, and professions. The interdisciplinary methods assist students in identifying complexity and interrelations that define the issues of sustainability (Jackson and Hurst, 2021).

Systems thinking is an essential pedagogical focus within ESD, but it can enable students to make sense of feedback loops, delays and unintended consequences of choices. The pedagogical resources needed to teach an understanding of systems thinking include deliberate moves beyond the traditional linear, reductionist thinking to an awareness of dynamic complexity and emergent characteristics of ecological, social, and economic systems (Jackson and Hurst, 2021).

5.4 Indigenous Knowledge and Alternative Worldviews

Inclusion Incorporating Indigenous knowledge and worldviews covers historical erasure of non-Western views in formal education, offering good alternative frameworks of comprehending human-nature relationships and sustainability. A study on incorporating Indigenous knowledge in current ESD methods discovered five learning design concepts, including acknowledging different

worldviews, knowledge systems, integrating sustainability orientations, active involvement by the learners, and building on the experience of the students (Demssie et al., 2020).

Nevertheless, this integration must be approached with special care that includes the elimination of appropriation and respecting the Indigenous intellectual property, as well as acknowledging the current right of Indigenous peoples to and ownership of traditional lands (Demssie et al., 2020).

5.5 Digital Tools and Technology-Enhanced ESD

ESD implementation is becoming stronger and stronger using digital technologies. The engagement with environmental data and complex modeling can be provided with the help of virtual reality applications, geographic information systems, environmental monitoring technologies, and mobile applications. A study of digital aids to environmental education showed that they have a positive effect on the sustainability awareness of students and their desire to take a pro-environmental action (Hajj-Hassan et al., 2024).

Geospatial technologies based on mobile learning with citizen science helps to develop environmental literacy and teacher skills in incorporating sustainability in instruction (Lpez & Miguel Gonzlez, 2020). Nevertheless, access in resource-constrained environments is restricted by digital divides and technical barriers, and digital tools cannot ensure learning, pedagogical quality is the most important (Hajj-Hassan et al., 2024).

6. Curriculum Integration Strategies and Subject-Specific Applications

6.1 STEM Education and Sustainability

ESD finds conceptual access to close with science and mathematics. Sustainability in chemistry can assist learners to learn about the environmental effects of chemical reactions and products and acquire critical views of the processes conducted industrially (Wissinger et al., 2021). Education in earth sciences with an increased focus on geoethics, which is the ethical responsibility towards managing the Earth systems, is especially pertinent to the formation of environmental insight and the ability to act (Vasconcelos and Orion, 2021).

The study of engineering is being pushed toward solution-oriented engineering, in which educational institutions are focusing more on how to provide solutions to issues of sustainability. Sustainable development principles incorporated into civil engineering curricula by means of problem-based and project-based strategies prove to be effective when it comes to building students capacity to accommodate environmental, social, and economic aspects of engineering design (Álvarez et al., 2021).

The studies of STEM integration and SDGs show that numerous initiatives incorporate multiple SDGs, but some of them do not get enough focus, and the implementation in the context of the emerging countries needs improvement (Nguyen et al., 2024). Intensive consideration of the need to maintain equal coverage of every aspect of sustainability will ensure that narrow technical methodologies that ignore the social and ethical niche are not pursued.

6.2 Business and Accounting Education

The education of business and accounting is subjected to specific challenges in the context of integrating authentic sustainability principles in the environment where professionalism is defined by the need to attain economic growth and maximization of profits. Nevertheless, more accounting educators see need to incorporate ethical, social and environmental aspects. The frameworks of transformative accounting education focus on producing technically-competent and ethically-focused practitioners who take into account the interest of the population, as well as the success of organizations (Twyford et al., 2024).

Problem-based learning, business ethics and sustainability trade-offs case-studies, and experiential projects can help students to build advanced knowledge that technical proficiency without ethical awareness is not enough (Twyford et al., 2024).

6.3 Language and Social Studies

Sustainability is incorporated in language education by using intercultural communication skills and analysis of how language creates knowledge about environmental and social challenges. It is proposed that a greater focus in foreign language teaching is put on the teaching of environmental literature and discussions on sustainability in the foreign languages, as well as the learning of cultural relations with nature and environment.

ESD is inherently covered by social studies education by studying economics, social justice, government, and social relations between humans and nature. The teaching of history could help clarify how current sustainability problems represent a by-product of the former choices and how the future needs to grapple with historical injustices. An approach of geography education that focuses on a place-based knowledge of places and their interconnection with other types of places is especially beneficial to the integration of ESD.

6.4 Teacher Education and Professional Preparation

ESD integration presupposes sustainability competencies and knowledge of educators themselves. However, research has found that there is a high gap in teacher preparation to apply ESD. The pre-service teachers often do not have knowledge about the scope, principles, and pedagogy of ESD (Bezeliak et al., 2020). The concept of SD as witnessed by future physical educators, including, is frequently interpreted as environmental issues and not with references to social and economic aspects (BaenaMorales et al., 2022).

ESD needs to be carefully taught using sustainability skills combined with pedagogical training. The blended learning methods of digital tools, inquiry-based collaborative learning and practical implementation projects in schools indicate potential in teacher capacity building in ESD (Chin et al., 2018).

7. Assessment and Evaluation of ESD Learning Outcomes

7.1 Challenges in Assessing Sustainability Competencies

The problems of sustainability learning are unique in assessment. The conventional achievement tests that focus on content knowledge are not effective in the evaluation of action competence, ethics reasoning, or agency. The sustainability competencies that include systems thinking, normative understanding, and behavioral intention are difficult to be measurable (Greig and Pridle, 2019).

Studies demonstrate a conflict between standardized evaluation performance imposed externally and true performance of sustainability abilities. Intended to assess measurable content-related knowledge, high-stakes testing can in fact become counterproductive to ESD as it puts teachers under pressure to instruct on the basis of transmission instead of action-based learning (Parry and Metzger, 2023).

7.2 Multi-Dimensional Assessment Approaches

Good ESD assessment also utilizes various approaches that represent a variety of competencies. Portfolio that tracks students to sustainability projects in which they reflect on their learning offers more pictures as compared to one assessment. The analytical nature of systems thinking, ethical reasoning, collaboration, and action is assessed explicitly using the rubrics that show that these components are multifaceted, and students learn.

Studies of measuring the environmental competences of pre-service teachers investigated various aspects such as, environmental knowledge, attitudes, and future pro-environmental behaviours, and identified subtleties to understand complexity of sustainability competences (Ivarez-Garca et al., 2018). The conceptual modeling frameworks allow educators to visualize the progress of students as sustainability learners in dimensions of disciplinarity and pedagogical strategies (Greig and Pridle, 2019).

7.3 Participatory and Self-Assessment

Assessment practices that apply the principles of sustainability central to ESD are the participatory assessment activities that engage students and communities in assessing sustainability initiatives. Both student self-assessment and peer assessment ensure the development of metacognitive awareness and agency as well as an appreciation of student expertise in regards to learning about themselves.

The authenticity of sustainability projects evaluation lies in the community input on the actual effects of the project that classrooms alone do not evaluate.

8. Barriers to ESD Implementation and Systemic Challenges

8.1 Structural and Institutional Barriers

Although there is a rhetoric dedication to ESD, the practice of the same has significant obstacles. The educational institutions have silos of discipline, which limits the interdisciplinary means that are necessary with regard to ESD. These departments work in isolation and introduce disunity to ensure no systematic integration of the curriculum (Parry and Metzger, 2023).

Time pressure is a continuing problem, and it has been noted that teachers have been deprived of enough time to implement ESD as well as that their school schedules are so packed with other mandates that they lack time to implement ESD. Accountability pressures that are subject-specific and especially during highly-stakes testing, promote transmission-based instruction rather than action-oriented learning (Parry and Metzger, 2023).

Lack of professional development and support of the teacher hinder the ability of educators to effectively undertake ESD. Although there is research that has provided successful ESD pedagogy, not many teachers are trained on these methods. There is a substantial difference between the research-evident information and actually applied information in the classroom (Parry and Metzger, 2023).

8.2 Resource and Infrastructure Limitations

Action-based, community-based ESD implementation will render resources such as time so that teachers can be able to design initiatives, materials and supplies, technological infrastructure, and funds to be used in field experiences and community partnerships. The constrained schools and regions receive specific challenges such as offering quality ESD despite the fact that they are the ones usually faced with the challenge of sustainability.

Unequal allocation of resources exudes that students in better off communities are exposed to more advanced types of ESD experiences than those students in poorly resourced environments are exposed to limited opportunities, which can worsen educational inequalities (Parry and Metzger, 2023).

8.3 Ideological and Political Challenges

Basic contradictions exist among the ideals of ESD and paradigms of prevailing economics. Authentic sustainability threatens growth-at-all costs thinking that prevails in mainstream economic thinking, but educational systems exist within political economies where doubting growth is a controversial issue (Kopnina, 2020).

Other studies direct the claim more specifically against sustainability-through-growth narratives of mainstream ESD, and state that a real approach to sustainability entails facing the constraints of economic growth, and promoting alternative models that center on degrowth, circular economies, and Eco-centered ethics (Kopnina, 2020). Schools and colleges can be resisted when ESD goes beyond technical environmental issue solving into deeper challenges of challenging economic structures and the consumption culture.

In certain contexts, political polarization of climate change and environmental issues generates controversies around ESD, with critics being opposed to the inclusion of so-called political content in the curriculum (Parry & Metzger, 2023).

8.4 Assessment and Measurement Challenges

As mentioned earlier, constraints of the conventional methods of assessment consistent with the high-stakes testing regimes, exert pressures contradictory to quality implementation of ESD. Also, the challenge of quantitatively assessing the sustainability competencies results in policymakers and administrators undervaluing ESD in relation to the conventional subjects with well-established measurement tools.

9. Student Learning Outcomes and Impact Evidence

9.1 Knowledge Development and Sustainability Literacy

Scholarship indicates that ESD interventions enhance sustainability knowledge existing at various dimensions in students. The literature that evaluated sustainability literacy among Chinese students showed that they were very knowledgeable in sustainability issues, but the knowledge was concentrated on environmental components with little consideration of social and economic ones (Chen et al., 2022).

A PISA data concerning the environmental awareness of 15-year-olds found that science learning was associated with positive science attitudes and a higher level of environmental awareness (List et al., 2020). The cross-national study revealed that clear learning focus on environment-related professions, science-based disposition, and sustainability-based school climate are all linked to improved environmental awareness (List et al., 2020).

9.2 Attitude and Behavioral Change

The attitude and change in behavior are dependent variables (DVs) in this research question. The attitude and change in behavior are the dependent variables (DVs) in this research question.

ESD studies present conflicting results on change of behavior. Whereas knowledge development is a continuous process, there are less significant effects when it comes to behavioral adoption of pro-environmental practices. A study on students and their knowledge, attitudes and practices in waste management concluded that they were willing to engage in recycling but never spontaneously adopted sustainability practices without continuous support (Owojori et al., 2022). Notably, the external incentives may be required in some cases when it comes to behavioral change; the study found that 41-percent of students reported that economic incentives were necessary in order to encourage participation in recycling (Owojori et al., 2022). This highlights the fact that behavior change cannot be achieved without not only attitude change in an individual but also with structural, institutional and incentive change that promotes sustainability.

But also research finds variables that predict more significant behavioral effects. Action competence changing due to the participation in real projects is also associated with intention to continue sustainability action more than knowledge-based approaches (Korsager and Scheie, 2019).

9.3 Agency and Empowerment

Research on the issue of whether or not ESD can maximize student agency in taking sustainability action provides disturbing statistics. Studies of learning of higher education students towards sustainability concluded that, although some students gain greater knowledge, many do not feel empowered enough to do much about it (Sidiropoulos, 2022). Students often claim being crushed by the scale of global sustainability problems and powerless to do anything about it.

In addition, ESD disempowers at times unintentionally because it does not consider the systemic and structural variables that determine sustainability outcomes and concentrates on adopting individual behavior change. Students can absorb duties of the problem of environmental issues of which they have no power on one hand, and do not have the knowledge of the demands of systemic change on the other hand (Sidiropoulos, 2022).

Better methods are those that involve action and that include active participation in institutional, collective, and policy-level changer processes, which enlighten students on how sustainability is created by altered systems, not added-bursting behaviors.

9.4 Deeper Learning and Systems Understanding

Quality ESD contributes to the creation of thinking systems- seeing connections of environmental, social and economic phenomena. The qualitative research demonstrates that students who take part in action-oriented, and interdisciplinary ESD gain a more advanced knowledge about the complexity of sustainability than otherwise is found in traditional environmental education (Korsager and Scheie, 2019).

Nonetheless, studies also observe that the implementation of ESD alone does not ensure higher levels of learning; the quality of pedagogy, teacher abilities, and curriculum are the basic determinants of whether ESD would make the superficial compliance or ingrained insights (Korsager and Scheie, 2019).

10. Competencies Framework for Twenty-First-Century Sustainability

10.1 Integration of Knowledge, Skills, and Values

The lesson plan will incorporate learning of knowledge, skills, and values.

The modern ESD systems consider that sustainability skills encompass knowledge, skills, attitudes, and values (Eizaguirre et al., 2019). Instead of dividing these dimensions in small compartments, integrated frameworks acknowledge the fact that to comprehend the problems of sustainability, cognitive and affective involvement is a must.

Among sustainability competencies, there are:

Cognitive dimensions: The perception of complex systems, the ability to identify trade-offs, anticipate future situations, the ability to judge several viewpoints.

Behavioral dimensions: The practical skills to realize the solutions of sustainability, collaboration, cross bred communication.

Affected dimension: Care environment and social justice, responsibility, aesthetic perception of natural and cultural heritage.

Volitional dimensions: Motivation and agency to act, resilience and persistence, imagining meaningful futures.

These compounded competencies need to be developed with the help of educational methods that respect both rational-analytical and emotional-intuitive modes of understanding (Sinakou et al., 2019).

10.2 Social-Emotional Learning and Sustainability

New studies focus on the relationship between sustainability education and social-emotional learning (SEL) (Ferreira et al., 2020). The development of the sustainable world needs people able to control emotions, preserve relations, practice empathetic cognition of the difference, and cooperate with each other efficiently. Social awareness, responsible decision-making, relationship management, and self-awareness and self-regulation are some of the SEL competencies that are critical towards dealing with sustainability issues.

The inclusion of SEL into ESD is one of the pedagogical and developmental necessities, where affective and social skills are at the heart of ethical decision-making and collective action required to facilitate the change toward sustainability.

11. Emerging Issues and Future Directions

11.1 Artificial Intelligence and Emerging Technologies

Since the application of artificial intelligence and high-tech innovations to the realm of education becomes more and more complex, it is worth questioning how they can be applied to ESD. The use of AI in environmental monitoring, personalized learning based on the needs of individuals, and digital tools to collaborate on sustainability projects are potentially useful in some applications (Abulibdeh et al., 2024).

Nevertheless, there are unresolved issues of energy use of AI systems, the consequences that fall to the role of education, and threats of technological determinism viewing the technology as remedies to inherently social and ethical issues (Abulibdeh et al., 2024). Students should be taught ESD so that they can learn to be critical of technology as opposed to be blindly loyal.

11.2 Faith-Based Organizations and Diverse Knowledge Systems

The increased understanding of the potential importance of faith-based organizations (FBOs) in sustainability incorporates educational aspects. Having 8 percent of the habitable land in the world and as well as immensely influential through schools and community institutions, FBOs have a considerable potential to develop ESD. Scholarly study exploring FBO participation in climate change and sustainability training recognizes the possibilities to bridge the educational aspects of environmental FBO traditions and the new ESD (Boorse & Jablonski, 2024).

The inclusion of different worldviews on the issue such as religious views on creation care and stewardship makes ESD enriched without disregarding pluralism and inclusion (Boorse & Jablonski, 2024).

11.3 Just Transition and Equity

Tracing on, ESD scholarship has also put a growing focus on justice aspects of sustainability transitions. Just transition models: Just transition models acknowledge that transition to sustainable practices has disruptions that impact on workers and communities in different ways. ESD will need to equip students with the outlook of equity as a result of sustainability change and take part in transitions to benefit individuals impacted by an economic restructuring (Carey et al., 2020).

ESD in accord with justice frameworks looks at the beneficiaries and the costs incurred by sustainability initiatives by noting that any solutions that address the environmental issue might tend to widen the social injustices in case the solutions are not based on equity.

12. Implementation Framework and Recommendations

12.1 Systemic Integration Strategies

The shift of ESD towards the core of educational practice should not happen on a case-by-case basis but on a system-wide level. Multi-level and multi-point approaches are more effective in comparison to single-point interventions (Nguyen et al., 2024):

Policy level: National and institutional policies should require the inclusion of ESD in policies, distribute resources, develop learning standards and develop accountability frameworks that appreciate the sustainability competencies alongside that of traditional academic metrics.

Curriculum level: Discipline-wide systematic redesigns Curricula at all levels combine with disciplinary rigor to incorporate the principles of sustainability. Instead of addressing ESD as an isolated area, integration is implemented with conceptualising of the relationship of existing material to sustainability.

Pedagogical level: Teacher training courses help educators to form sustainability competencies and ability to introduce action-focused interdisciplinary strategies. Continuous professional learning helps teachers to adjust ESD to new conditions and demands.

Assessment level: Multidimensional assessments strategies represent a variety of competencies and they facilitate and not undermine quality ESD pedagogy.

12.2 Teacher Capacity Building

Quality ESD is entailed in comprehensive teacher development. The issue of sustainability competencies need to be taught explicitly in pre-service teacher education, and the ESD pedagogy should be taught in all teacher education programs and not only in environmental education specializations. Professional development should be in-service where teachers receive continuous support in the implementation of ESD (Parry and Metzger, 2023).

Successful teacher development is able to meet individual sustainability competence as well as pedagogical capacity. Such systems thinking, environmental and ethical reasoning, and sustainability agency require teachers to first conceptualize their own position before encouraging them in students (Bezeljak et al., 2020).

Professional learning communities involving teachers in developing ESD practices collectively, sharing materials, discussing the difficulties of implementation and reflection are much more effective than the isolated professional development (Chin et al., 2018).

12.3 Resources and Structural Support

To roll out quality ESD, there must be sufficient resources such as time to develop curriculum, instructional resources, teaching technology, community collaboration and field experience, and description of ESD in teacher evaluations and remuneration. The leader in education should press forward resources that favour ESD in preference to competing budget needs (Parry & Metzger, 2023).

The conditions that allow good implementation of ESD are the structure such as specialization on the role of ESD coordinators, time dedicated to the inter-disciplinary planning, development of the community partnership, and institutional policy that allows successful implementation of experience-based learning.

12.4 Community and Stakeholder Engagement

The effectiveness of ESD is significantly enhanced when schools are included as learning partners in the communities. Local environmental organizations, businesses, government agencies, Indigenous communities and civil society organizations provide expertise, resources and genuine chances of student involvement. Establishment of partnerships is a long term process that will be enforced by effective communication and true reciprocity that incorporates clearly that the communities are getting benefits in addition to learning opportunities being provided to students. The students shall enjoy interaction with the various stakeholders in the community who will have different views on sustainability issues and therefore, foster in them a delicate knowledge which is not limited to the school-based bubble.

13. Critical Perspectives and Alternative Frameworks

13.1 Growth Critique and Alternative Paradigms

As it has been mentioned, there is an officer of the view that mainstream ESD blindly merges economic growth paradigms that are not compatible with real sustainabilities. The critical ESD scholars (such as Helen Kopnina) are unsure whether education about sustainable development based on inclusive, sustainable economic growth is sufficient response to the escalating environmental crisis and species extinction (Kopnina, 2020).

Other models highlighting the importance of degrowth, ecocentric ethics with the intrinsic value of non-human nature in the center and planetary boundaries approaching education in different ways. Although these critiques are the views of minorities, they provide meaningful challenges that ESD practitioners should explore the assumptions in the mainstream frameworks (Kopnina, 2020).

13.2 Decolonizing ESD

According to post-colonial scholars, ESD has been colonized in itself, where western views are predominant with the marginalization of indigenous knowledge and other non-western world views and the Southern aspect of development. The process of decolonizing ESD should focus on prioritizing the Indigenous knowledge systems, challenging the Western development paradigms, as well as the self-determination of the Indigenous people in relation to their territories and resources (Demssie et al., 2020).

This effort is still in its infancy but one that is essential towards making sure that ESD keeps true sustainability and not the repetition of colonial dynamics in different ways.

14. Conclusion

Education for Sustainable Development can be seen as crucial response to intertwining ecological, social and economic threats that require radical change in the organization of human activity in societies. Studies indicate that quality ESD, which combines environmental, social, and economic aspects based on action-oriented interdisciplinary pedagogy, can form competencies to support sustainability developments.

However, the present implementation is still incompleteness. In most educational systems ESD has been marginalized in a way blocked by structural factors, resource limitations, orientation failures in teacher preparation and closure between ESD ideals and the economic paradigms. To achieve the transformative potential of ESD, systemic commitment is necessary that involves allocating a lot of resources, left-shifting the curricula, building teacher capacity and establishing institutional cultures that support sustainability competencies in addition to the traditional academic indicators.

As it is evident, education can truly have an impact of authentic sustainability only by comprehension of those that are peripheral or programs which are added on. Rather, ESD should be integrated as basic educational orientation in recognition of the fact that all learning takes place within environmental and social realms and should equip graduate students with experiences to negotiate and facilitate transition into sustainability. Each of the disciplines adds some input into sustainability; each pedagogical option facilitates or annihilates sustainability learning.

With global crises gaining more and more momentum especially climate emergency, the enforcement of quality ESD grows more urgent. Whether the readiness to change the existing order in the education system and equip it to generate the knowledgeable, skilled, ethically grounded, and empowered agents of change that the system demands faster is a question that will be answered

in the coming years. Education to Sustainable Development is a challenge and opportunity to education gainfulness in line with true sustainability demands.

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References

- Abulibdeh, A., Zaidan, E., & Abulibdeh, R. (2024). Navigating the confluence of artificial intelligence and education for sustainable development in the era of industry 4.0: Challenges, opportunities, and ethical dimensions. *Journal of Cleaner Production*, 437, 140527.
- Baena-Morales, S., Prieto-Ayuso, A., Merma-Molina, G., & González-Víllora, S. (2024). Exploring physical education teachers' perceptions of sustainable development goals and education for sustainable development. *Sport, Education and Society*, 29(2), 162-179.
- Boorse, D. F., & Jablonski, L. M. (2024). Strengthening partnerships for the Sustainable Development Goals: engaging faith-based organizations and scientists in youth climate change learning and action. *Sustainable Earth Reviews*, 7(1), 7.
- Carey, J. C., Beitelspacher, L. S., Tosti-Kharas, J., & Swanson, E. (2021). A resource-efficient modular course design for co-teaching integrated sustainability in higher education: Developing the next generation of entrepreneurial leaders. *Entrepreneurship Education and Pedagogy*, 4(2), 169-193.
- Bezelsjak, P., Scheuch, M., & Torkar, G. (2020). Understanding of sustainability and education for sustainable development among pre-service biology teachers. *Sustainability*, 12(17), 6892.
- Chen, C., An, Q., Zheng, L., & Guan, C. (2022). Sustainability literacy: assessment of knowingness, attitude and behavior regarding sustainable development among students in China. *Sustainability*, 14(9), 4886.
- Chin, C. K., Munip, H., Miyadera, R., Thoe, N. K., Ch'ng, Y. S., & Promsing, N. (2018). Promoting education for sustainable development in teacher education integrating blended learning and digital tools: An evaluation with exemplary cases. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(1), em1653.
- Crawford, J., & Cifuentes-Faura, J. (2022). Sustainability in higher education during the COVID-19 pandemic: A systematic review. *Sustainability*, 14(3), 1879.
- Demssie, Y. N., Biemans, H. J., Wesselink, R., & Mulder, M. (2020). Combining indigenous knowledge and modern education to foster sustainability competencies: Towards a set of learning design principles. *Sustainability*, 12(17), 6823.
- Eizaguirre, A., García-Feijoo, M., & Laka, J. P. (2019). Defining sustainability core competencies in business and management studies based on multinational stakeholders' perceptions. *Sustainability*, 11(8), 2303.
- Ferreira, M., Martinsone, B., & Talić, S. (2020). Promoting sustainable social emotional learning at school through relationship-centered learning environment, teaching methods and formative assessment. *Journal of Teacher Education for Sustainability*, 22(1), 21-36.
- Glavič, P. (2020). Identifying key issues of education for sustainable development. *Sustainability*, 12(16), 6500.

- Álvarez, I., Etxeberria, P., Alberdi, E., Pérez-Acebo, H., Eguia, I., & García, M. J. (2021). Sustainable civil engineering: Incorporating sustainable development goals in higher education curricula. *Sustainability*, 13(16), 8967.
- Gorski, A. T., Ranf, E. D., Badea, D., Halmaghi, E. E., & Gorski, H. (2023). Education for sustainability—Some bibliometric insights. *Sustainability*, 15(20), 14916.
- Gramatakos, A. L., & Lavau, S. (2019). Informal learning for sustainability in higher education institutions. *International Journal of Sustainability in Higher Education*, 20(2), 378-392.
- Greig, A., & Priddle, J. (2019). Mapping students' development in response to sustainability education: A conceptual model. *Sustainability*, 11(16), 4324.
- Hajj-Hassan, M., Chaker, R., & Cederqvist, A. M. (2024). Environmental education: A systematic review on the use of digital tools for fostering sustainability awareness. *Sustainability*, 16(9), 3733.
- Hinduja, P., Mohammad, R. F., Siddiqui, S., Noor, S., & Hussain, A. (2023). Sustainability in higher education institutions in Pakistan: a systematic review of progress and challenges. *Sustainability*, 15(4), 3406.
- Husamah, H., Suwono, H., Nur, H., & Dharmawan, A. (2022). Action competencies for sustainability and its implications to environmental education for prospective science teachers: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(8), em2138.
- Jackson, A., & Hurst, G. A. (2021). Faculty perspectives regarding the integration of systems thinking into chemistry education. *Chemistry Education Research and Practice*, 22(4), 855-865.
- Kopnina, H. (2020). Education for the future? Critical evaluation of education for sustainable development goals. *The Journal of Environmental Education*, 51(4), 280-291.
- Korsager, M., & Scheie, E. (2019). Students and education for sustainable development—what matters? A case study on students' sustainability consciousness derived from participating in an ESD project. *Acta Didactica Norge*, 13(2), 6-26.
- List, M. K., Schmidt, F. T., Mundt, D., & Foeste-Eggers, D. (2020). Still green at fifteen? Investigating environmental awareness of the PISA 2015 population: Cross-national differences and correlates. *Sustainability*, 12(7), 2985.
- Liu, Z., Yang, H. C., & Shiau, Y. C. (2020). Investigation on evaluation framework of elementary school teaching materials for sustainable development. *Sustainability*, 12(9), 3736.
- Sebastián-López, M., & de Miguel González, R. (2020). Mobile learning for sustainable development and environmental teacher education. *Sustainability*, 12(22), 9757.
- Alvarez-García, O., Sureda-Negre, J., & Comas-Forgas, R. (2018). Assessing environmental competencies of primary education pre-service teachers in Spain: A comparative study between two universities. *International Journal of Sustainability in Higher Education*, 19(1), 15-31.
- Nguyen, L. T. V., Cleveland, D., Nguyen, C. T. M., & Joyce, C. (2024). Problem-based learning and the integration of sustainable development goals. *Journal of Work-Applied Management*, 16(2), 218-234.
- Owojori, O. M., Mulaudzi, R., & Edokpayi, J. N. (2022). Student's knowledge, attitude, and perception (KAP) to solid waste management: A survey towards a more circular economy from a rural-based tertiary institution in South Africa. *Sustainability*, 14(3), 1310.

- Parry, S., & Metzger, E. (2023). Barriers to learning for sustainability: a teacher perspective. *Sustainable Earth Reviews*, 6(1), 2.
- Queiruga-Dios, M. Á., López-Iñesta, E., Díez-Ojeda, M., Sáiz-Manzanares, M. C., & Vázquez Dorrio, J. B. (2020). Citizen science for scientific literacy and the attainment of sustainable development goals in formal education. *Sustainability*, 12(10), 4283.
- Sidiropoulos, E. (2022). The influence of higher education on student learning and agency for sustainability transition. *Sustainability*, 14(5), 3098.
- Sinakou, E., Donche, V., Boeve-de Pauw, J., & Van Petegem, P. (2019). Designing powerful learning environments in education for sustainable development: A conceptual framework. *Sustainability*, 11(21), 5994.
- Twyford, E. J., Musundwa, S., Tanima, F. A., & George, S. (2024). Bridging the gap: sustainable development goals as catalysts for change in accounting education and society. *Meditari Accountancy Research*, 32(5), 1758-1786.
- Vasconcelos, C., & Orion, N. (2021). Earth science education as a key component of education for sustainability. *Sustainability*, 13(3), 1316.
- Vilmala, B. K., Karniawati, I., Suhandi, A., Permanasari, A., & Khumalo, M. (2022). A literature review of education for sustainable development (ESD) in science learning: What, why, and how. *Journal of Natural Science and Integration*, 5(1), 35.
- Wissinger, J. E., Visa, A., Saha, B. B., Matlin, S. A., Mahaffy, P. G., Kümmerer, K., & Cornell, S. (2021). Integrating sustainability into learning in chemistry. *Journal of Chemical Education*, 98(4), 1061-1063.