Transforming School Education for Sustainable Development: Pathways to Achieving SDG 4

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Abstract

Transforming School Education for Sustainable Development is set to help achieve Sustainable Development Goal 4 (SDG 4) and its targets more quickly by focusing on education as a potent tool for sustainability. By emphasising essential education, it proposes a stringent synthesis of theories, policies, and practices between education and sustainability. The necessity to adapt education to sustainability governance has become more pressing at the local, national, and global levels as the world faces the omnipresent crises of the economy, the environment, education, and society, threatening not only the future of humanity but also the present of society. Education is a key to solving these complicated issues and creating a sustainable future. Thus, to ensure that education is sustainable, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) has given special focus to school education as one of the areas of intervention within its global Education for Sustainable Development (ESD) 2030 agenda.

Keywords: Sustainable development, quality education, SDG 4, school transformation, equity inclusion, teacher development, community engagement, policy reform, and education monitoring.

1. Introduction

The transformation of School Education towards Sustainable Development requires a stringent, evidence-based synthesis of theories, policies, and practices; introduce a formal, objective analysis in a clear, argumentative structure, with a clear connection to the SDG 4 indicators.

The world has found itself in an unprecedented crisis, one that has posed a significant threat to the economic, physical, and psychological health of people and society, as well as undermining the integrity of the planet's ecosystems and climate. In this regard, education systems across the globe are being challenged to rethink and change schooling and learning to create sustainable and prosperous futures for people, places, and time. It is encouraging that school education is moving towards a whole-system approach to Education for Sustainable Development (ESD) with the intention of integrating sustainability throughout the learning and teaching process. There has been widespread consensus that the world is ready to redesign education systems and strategies after COVID-19, and this is an extraordinary chance to advance these dreams with sustainable education. A global change in the system of school education can also be directly aligned with Sustainable Development Goal 4 (SDG 4): Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. Target 4.7 requires countries to ensure that all learners obtain the knowledge and skills required to foster sustainable development.

The current study outlines significant ways to fulfil these different aspirations by transforming school education to help countries create their national responses to these urgencies. It centres on the framework set by the general international environment of sustainable development and Education for All, to explain the global policy environment and the particular SDG 4 goals that relate to such a change. Some of the measures proposed include curriculum reform and pedagogical innovation to focus on sustainability, equity, inclusion and access; teacher professional development and institutional capacity building; community and stakeholder engagement and strong monitoring, evaluation and knowledge synthesis of implementation activities. In addition, exemplary strategies that clarify and elaborate on these measures are highlighted. The synthesis concludes with challenges, risks, and ethical issues relevant to such projects, as well as practical policy implications and a strategy for gradual implementation.

2. Theory of Sustainable Development and Education.

The concept of sustainable development can be interpreted in different ways, leading to several interpretations of the term (Koskela, 2019). The United Nations Sustainable Development Goals suggest a comprehensive definition of sustainable development: ensuring that human well-being is guaranteed while protecting the planet for future generations. Goal 4 is one of those, and it represents a broad

vision of education that goes beyond formal instruction to include quality lifelong learning facilities. It caters to diverse educational requirements and covers a wide range of learning content and approaches, all of which are considered crucial to equipping sustainable development with knowledge and skills, as well as values and attitudes. Education for All, as declared in the World Declaration on Education for All (1990) and the Framework for Action to Meet Basic Learning Needs (1990), is a global concept that goes far beyond the realisation of universal access to compulsory schooling. It emphasises the achievement of elementary education and the subsequent acquisition of knowledge. It has been conceived in a conceptual path, a synthesis of three intelligible words to a more expanded one that deals with broader views (Kingston Gladstone, 2018).

Education for All overlaps with the idea of sustainable development, and the overlap between the two images underscores the necessity of Education for Sustainable Development. Education for Sustainable Development promotes radical change in education. It advocates a holistic view of the world that is interested in the interrelationships, interconnectedness, and complexity among the economy, society, and the environment (E.J. Wals & Benavot, 2017). The report of the International Commission on the Futures of Education (2021) indicates that the world is increasingly becoming global, intricate, and volatile. Education should be transformed not only into a pedagogical issue but also into a socio-political movement that would build the capacity of humanity to think, act, and remake the precarious future. Education should be rethought, redesigned, and reoriented toward a more inclusive, equitable, and peaceful world. One of the major conditions for such change is to provide basic learning to everyone, as highlighted at the Global Education Meeting in Brussels in 2020. It has come to be called Education for Sustainable Development for Education to All. With this, the viewpoint of Education for Sustainable Development has come into the critical framework of Education for All.

3. The World Policy Context and SDG 4 Goal.

Representatives of 193 countries embraced 17 Sustainable Development Goals (SDGs) in the United Nations (UN) Headquarters in New York City in 2015, at the Sustainable Development Summit. Even though SDG 4 on quality education (and its targets and indicators) constitutes a particular part of the SDGs, primary and secondary education is essential for the effective implementation of the global strategies of the SDGs, the UN 2030 Agenda on Sustainable Development, and the Paris Agreement on climate change. The purpose of these initiatives is

to ensure that people worldwide have a healthy environment in which to live in balance with predicaments such as pollution, global warming, and natural disasters. In addition, modern shifts in society, including the Fourth Industrial Revolution, fuelled by Artificial Intelligence (AI), have changed the fundamental competencies needed by contemporary and future human resources (Mika, 2017). Here, primary and secondary education should be restructured to focus on Education for Sustainable Development, playing its part in achieving the anticipated objectives and in maintaining an international balance in sustainable living.

In light of these urgent issues, the Republic of Korea Ministry of Education has been determined to reform the school education system and upgrade its curriculum to support transformation and promote an educational environment conducive to sustainable development (Giangrande et al., 2019). The countrywide framework is based on the aspiration statement Leading the Future Together: Fostering Global Citizens and targets three tasks, that is, Shaping Future-oriented Education Contents, Strengthening Care and Support of Student Growth, and Building Future-oriented Educational Infrastructure as follows:

4. Reformed Curriculum and Pedagogical Innovation in the name of Sustainable Development.

To meet SDG 4, curriculum reform and pedagogical innovation should be adopted in education systems to enhance curriculum integration, advance cognitive abilities, focus assessment, and foster transformative learning. Education systems can facilitate the SDG 4 achievement by (i) incorporating sustainability, i.e. systems thinking, in disciplinary learning, (ii) equipping critical, creative and systems-based thinking with contextualised pedagogies, as well as (iii) developing assessment, evaluation and accountability systems that are in line with the SDG 4 goals (Balsiger et al., 2017). A conceptual clarity of sustainability as a multi-dimensional concept, i.e. encompassing the social, the economic, the cultural and the environment, and the emergent conceptual clarity of education as a sustainable development support a systems perspective of cross-cutting themes, cognate discursiveness, and the fundamental interrelation between education and sustainability (Giangrande et al., 2019).

4.1. Converting Sustainability into the Disciplines.

Beyond specific ESD courses, education for sustainable development (ESD) can also be integrated across various subject

domains and aligned with a wide range of topics. It is often suggested that sustainability concepts be thematically included in the curriculum (Giangrande et al., 2019). Thematic areas that could be suitable for cross-cutting include culture and cultural diversity, health, human rights, peace and non-violence, poverty eradication, and sustainable consumption and production (E.J. Wals & Benavot, 2017). There can also be subject synergies: the concepts of participation, empowerment, and social transformation are closely related to citizenship education, and interrelated concepts (e.g., sustainability or the environment) can foster dialogue between the natural sciences and social studies. They have developed various approaches to integrating thematic or subject-based curricula for education on sustainable development. Such integration strategies and special subject courses offer a variety of pathways to education on sustainable development to help meet SDG 4.

4.2. Critical thinking and Learning Systems-based.

Critical competencies allow people to participate in the issue of sustainable development (Giangrande et al., 2019). Although most earlier models of competence have singled out knowledge, skills, attitudes, and values in relation to sustainability, the focus on sustainability is no longer narrowly defined by socio-ecological processes but rather broadens to an intricate society as a multi-level,

interdependent, and complex system. The present models emphasise more on understanding the whole systems- seeing the bits and components of an issue and the relation between these bits and the boundaries of each system- than considerations of sustainability-related actions, bearing in mind social justice and equity in the process. Systems thinking clarifies the interdependence of social, economic, and environmental outcomes, as well as the complexity of these interdependencies. Finally, sustainable development, be it discussed as a problem of inclusion, equity, fundamental rights, or the right to food and water, makes significant transformations in opportunities, choices, and capabilities for both people and communities, and for the planet.

To achieve systems understanding, it is not only necessary to have a robust knowledge base but also to work with complex, open-ended problems embedded across multiple systems and with tasks that are typically disconnected and lack clear endpoints (E.J. Wals & Benavot, 2017). Moreover, learners are obliged to see objectives and outcomes achieved within the context of broader systems outside the immediate task, such as realising that a local solution, for example, has unintended side effects on an adjacent location or system, and consequently proposing actions to alleviate or reverse those effects and explore further. Instructional methods

must allow learners to relate skills, topics, and concepts across otherwise dissimilar fields while still engaging deeply with each subject. The design of assessments must encourage students to make cross-disciplinary connections rather than pre-determining the specific linkages to be established.

4.3. Goal 4: Assessment, Evaluation, and Accountability.

It has been realised that quality education is one of the main pillars of sustainable development, and that this is impossible without proper evaluation and follow-up in its implementation. No accounting schemes to show outcomes at a larger scale, but locally relevant measures of achievement could include the number of years of engagement in knowledge creation and sharing, and the number of years of ESD publication in the last five years (Giangrande et al., 2019). The incumbency on School Education in Sustainable Development may be timely followed up on in each country on a set schedule to help maintain focus on implementation. In Education for Sustainable Development, there are different rubrics designed to monitor the situation, founded on clear learning outcomes in ESD. These rubrics prejudice universal and local user images in enhancing and judging ESD (Saini et al., 2023). The choice of progress indicators for School Education in Sustainable Development applies the core ESD competences to quality education through the Systems Approach to Education towards Sustainable Development guide. The learning outcomes at various levels also support such a choice. Follow-ups by School Education towards ESD are linked to a collective perspective of the education system, which may lead to successive shifts in national and territorial systems of funding and in barriers to quality change.

5. Equity, Inclusion, and Access in Education for Sustainable Development

In addressing disparities in education for sustainable development, policies have been proposed to promote students' equitably shared experiences of learning (Giangrande et al., 2019). With over half of the world's population lacking access to quality education, the challenge remains to advance education-access strategies accordingly while keeping the imperative of education for sustainable development firmly in view. Underrepresented groups in education often share common social conditions that reinforce barriers to participation, progress, and achievement across their full educational cycle (Ainscow, 2016). Marginalised sectors such as low socio-economic or geographically isolated groups must thus be targeted according to prevailing patterns and, more critically, the disabling codes that keep them socially disadvantaged.

Inclusive education and learning are necessary, of course, throughout assessment systems based on social factors that add up to compatible extra resources. These strategies cover all additional schooling needs on the same basis, regardless of configuration, and aim to generate equitable opportunities for every student to attain the further or final stage specified in the globally agreed (education-for-all) targets. Systematically differentiated curriculum frameworks and pedagogies that incorporate relevant knowledge and invite culturally valued ways of empowering students also play a vital role. By promoting globally sensible options, such practices help reconstitute national goals and commitments in ways that mitigate the effects of global economic pressures, even where fully elaborated national systems are unattainable.

5.1. Addressing Social Disparities

A school-aged child's opportunities for learning are shaped significantly at the local level by the family's social, human, cultural, and economic capital. Social determinants of education, such as parental education, migration status, socio-economic status, and domestic responsibilities, influence children's unequal access to educational opportunities. Socioeconomic status (SES), measured as the simultaneous effect of family income and parental education, also affects time and resources dedicated to homework and home-school relations, and therefore learning outcomes. Developing specific policies to foster equity and enhance educational facilities in the most disadvantaged areas and schools is essential to guaranteeing access to meaningful educational opportunities and quality outcomes for boys and girls. Comprehensive and complementary strategies that transcend the education sector, targeting nutrition, sanitation, and sensitivity to household needs alongside formal schooling, support educational equality. Early childhood development is particularly important, as inadequate physical and nutritional environments from birth affect cognitive development and are compounded by a lack of educational stimulation and parental support.

5.2. Differentiation and Inclusive Pedagogy

In educational reforms for sustainable development, increasing attention is being paid to differentiation and inclusive pedagogy. Universal learning design, a broad framework that encompasses inclusive and differentiated practices, provides guidelines to foster greater participation by all learners while reducing reliance on specialised adaptations (Miles et al., 2018). This framework, aligned with equity and inclusive education goals, also serves as a lens to guide the design of SDG 4 in education for sustainable development.

Mathematics provides a core platform through which to develop capabilities through differentiation: an essential element of personalisation.

Two potential pathways for transformative pedagogies that develop a systems view while providing inclusive access to learning offer further strategies for attaining equity, inclusion and access. Culturally responsive teaching emphasises the importance of local contexts to foster strong connections between learners' lives and curricular concepts, actively engages students in imagining and observing relationships, and provides multiple ways for learners to demonstrate their understanding.

Table 1: Equity, Inclusion and Access – Barriers and Strategies

Barrier/challenge	Policy/school strategy	Expected outcome for learners
Poverty and low socioeconomic status	Scholarships, free textbooks, mid-day meals, and conditional aid	Increased enrolment, attendance, and reduced dropout
Rural/remote location	Residential schools, transport support, and digital connectivity	Better access to schools and online learning
First-generation / low parental education	Parent outreach, community meetings, and learning camps	Stronger home–school link, improved support for study
Disability and special learning needs	Inclusive pedagogy, resource rooms, and UDL-based adaptations	Participation in regular classrooms improved learning

Barrier/challenge	Policy/school strategy	Expected outcome for learners
Language barriers (mother tongue vs medium)	Early-grade mother-tongue teaching, multilingual materials	Better comprehension, stronger literacy and retention
Gender norms and safety concerns	Separate toilets, safe transport, sensitisation, and female staff	Increased girls' participation and continuation

5.3. Language of Instruction, Multilingual Education, and Cultural Relevance

The choice of the language of instruction, policies to support bilingual or multilingual education, and dialogue about the cultural relevance of what is being taught are critical aspects of education systems worldwide. These features have received considerable attention in the context of Sustainable Development Goal (SDG) 4 (Kreeft Peyton, 2015). Instruction through the mother tongue, or the first language learned, has been found to enhance students' access to education, learning and achievement (Benson & M. Wong, 2015). Furthermore, it has been advocated as a tool to attain global goals of quality and equity in education (Karigu Nyaga, 2015).

In a multilingual situation, a compromise is often reached with a transition policy under which at least the first grades are taught in the mother tongue, after which children switch to another language or languages, without further opportunities to acquire their mother tongue or culture through education. Experience around the world has shown that such transition policies are consistently unsuccessful. Multilingual education must also support mother tongues, both for the well-being of children and for the general health of cultural diversity and of languages as vehicles for knowledge and creativity.

6. Teacher Professional Development and Institutional Capacity Building

Knowledge-sharing systems strengthen teacher education and professional development on Education for Sustainable Development (ESD). Peer-learning structures, such as professional

learning communities and collaborations with external stakeholders, enhance education policy and curriculum agenda setting. School-based professional learning and multi-school learning enhancement contribute significantly to advancing SDG 4 through ESD. Teacher development initiatives need to be strategically aligned with overarching SDG 4 targets and national education priorities. Enhancing the capacity of educational institutions to provide quality ESD and quality learning requires systemic investments across interconnected areas, including learning resources, infrastructure, digital connectivity, and ongoing operational support (Bourn et al., 2017).

Building capacity in education systems to advance ESD and to meet quality learning requirements for all learners in Goal 4 requires additional actions.

6.1. Professional Learning Communities and Teacher Collaboration

A Professional Learning Community (PLC) is a structure that fosters collaboration among teachers across various professional, horizontal, and vertical learning communities. The PLC framework encompasses a school-wide mission that is shared, valued, and widely reflected upon in the learning community (Carrera Martínez & Dalla Vecchia, 2022). An effective approach is to allocate time and a specific

pedagogical focus to each group of interested teacher participants. Each workshop allows for deepening knowledge, sharing practice, and enriching experience in one or several educational topics (Stanton, 2009). The overall process contributes to rethinking roles and revitalising educational practice.

The existence of Professional Learning Communities constitutes a key mechanism for fostering collaboration and channelling teachers' collective know-how to overcome doubts and difficulties in educational processes. PLCs are a more appropriate form of shared work than ordinary meetings because they drive collective reflection on enduring professional concerns that teachers can identify. They not only facilitate professional development but also help faculty consider how to address specific concerns about teaching practice, thereby stimulating work and enriching personal approaches across the faculty.

6.2. Resource Provisioning, Infrastructure, and Digital Inclusion

Ensuring access to sufficient learning resources, adequate infrastructure, and digital technologies is essential for realising SDG 4. Adopting universal design for learning principles enables mainstream systems to accommodate learners with diverse needs (CHI, 2018). Setting policy priorities and planning for

facility establishment, maintenance, and sanitation ensures equitable access to quality infrastructure across settings. Comprehensive access to necessary equipment, connectivity, and digital tools supports inclusive education. Ongoing maintenance, upgrading, and sustainability planning keep education supplies and technologies in working order.

Provisioning adequate resources, facilities, and technologies is essential for schools to offer equitable education opportunities aligned with the aims of sustainable development and to support SDG 4. These factors constitute fundamental inputs, learning, and governance; they underpin broader aspirations for equity and inclusion. Adopting universal design for learning principles provides a framework for mainstream systems to accommodate diverse learner needs. Setting policy priorities on resource and facility establishment, maintenance, operation, and sanitation supports equitable access to quality infrastructure across contexts. Comprehensive provision of necessary equipment, connectivity, digital tools, and open educational resources promotes equal engagement among underserved groups. Ongoing maintenance, upgrading, and sustainability planning help to ensure education supplies, technologies, and related ecosystems remain operational.

6.3. Leadership and Policy Alignment in Schools

Effective schooling is undergirded by strong leadership and policy alignment across three interconnected domains: national education policies, institutional leadership, and classroom practices (Kysburn Agi et al., 2016). To actualise SDG 4 with a focus on education for sustainable development, countries must devise and implement coherent education policies. These policies should empower education leaders to guide transformative change within their organisations, which in turn should be reinforced by holistic curriculum and pedagogical reforms.

Education leaders play a pivotal role in implementing reforms aimed at sustainable development and the flourishing of all learners (Miller, 2019). The school system is a cornerstone of sustainable reforms, making the alignment of education policy across levels imperative. However, when policy prescriptions from higher authorities and system-level initiatives diverge, the chaotic interplay between competing goals can undermine overall progress.

7. Community and Stakeholder Engagement in SDG 4

Community participation is vital to achieving SDG 4. It fosters deeper values, knowledge, skills, and attitudes through education for sustainable development (ESD). Schools include families and

community partners in building experiences that meet local needs, enabling everyone to shape local and global futures (Giangrande et al., 2019). The rapid spread of the COVID-19 pandemic redefined education systems, prompting recognition of their central collective role in local progress. New stakeholder engagement aims to co-create pathways to sustainability and resilience for communities experiencing hardship while reinforcing interconnectedness. By supporting the national movement for SDG 4, schools internationalise their lessons to broaden outreach. Partnerships with higher education institutions, vocational education and training providers, and non-formal learning organisations enhance smooth transitions and reinforce sustainable development content across all learning venues (Buyung Agusdinata, 2022).

7.1. Partnerships with Families, Civil Society, and Local Authorities

Transforming School Education for Sustainable Development requires partnerships with families, civil society organisations, and local authorities, as these partnerships empower diverse stakeholders to co-create effective, context-sensitive approaches through inclusive dialogue. Formal collective engagements of this nature are characterised by open and flexible communication channels, a focus on

shared interests, and a shared ownership of all curricular and extra-curricular activities co-created within the partnership.

At a systemic level, partnership dialogues clarify shared focal points of significance, thereby enabling the selection of relevant community organisations and associations that can contribute to and reinforce collaborative SDG 4 efforts (J. Kolbe et al., 2015). Existing education- and health-related partnerships, for instance, help to establish connections that improve access to vital services and bring new resources, expertise, and practices into the education system (P Mavuso & Duku, 2014). In South Africa, national legislation established parents as partners in school governance, creating a formal framework of collaboration that generates common goals and community-wide buy-in.

Partnerships with local authorities, civil society, and the business community contribute critical information, diverse support, and urgently needed resources to sustain a relevant educational vision. Community-engaged curricula, such as community service-learning, and the installation of school-community links can strengthen the frequency and intensity of student learning (Miller & Krause, 2015). Schools and the community formalise collaboration through existing organisations or by establishing new ones, facilitating

resource acquisition and issue identification that draw on students' advances in local knowledge and the interdependence of community and educational change.

7.2. Linkages with Higher Education and Vocational Training

Pathways connecting school education with higher education and vocational training can reinforce efforts to realise SDG 4 and the other SDGs. Education systems need to establish smoother transitions to upper secondary education and alternative education models, such as vocational education and training (VET), when students are at risk of dropping out and seek alternatives after leaving school. In upper secondary education, pathways that articulate general education and vocational education and training (VET) can facilitate choice and allow students to study both, as well as arrange dual training programs with employers (Dumitrescu et al., 2022). Transitions from higher education to lifelong learning, employment opportunities that still reinforce the competencies acquired during education, and links between further education and adult education can also contribute to SDG 4.

Higher education also has a systemic, reciprocal role in promoting school education for sustainable development (Giangrande et al., 2019). Higher education institutions can prepare future teachers and design professional development programs aligned with the competencies required for sustainable development. At the same time, specific training requirements for higher education programs in sustainability can also establish coherent articulation pathways. Higher education institutions can also build partnerships with schools by shaping school projects aligned with sustainable-development competencies, providing pedagogical and institutional support, and elaborating evaluation systems to help monitor progress.

8. Monitoring, Evaluation, and Knowledge Synthesis for SDG 4

Education systems face significant challenges in advancing the Sustainable Development Agenda and achieving Sustainable Development Goal (SDG) 4. Appraising and documenting which systems perform better and which practices promote quality education for sustainability can help to identify effective policies and reforms. Education systems in national and local contexts can learn from promising experiences and align curriculum and pedagogy to enable learners to acquire the knowledge and skills required to build a peaceful, prosperous, and sustainable future.

A systematic inquiry into policy options and pedagogical strategies to ensure that every young person acquires the knowledge and skills required to engage in and advance the sustainability agenda has been conducted to formulate

evidence-based recommendations. The analysis engages with both curriculum content and pedagogical approaches. The recommended pathways centre on:

(a) integrating sustainability across the disciplines;

(b) fostering critical, systems-based thinking; and

(c) embedding assessments that monitor students' progress towards sustainability knowledge and skills.

The proposed strategies are intended to help education policymakers and practitioners identify context-specific solutions that advance local, national, and international sustainability objectives while responding to SDG 4 targets and indicators (Saini et al., 2023) (Giangrande et al., 2019).

Table 3: Assessment and Monitoring of SDG 4 in Schools

Dimension/area	Example indicator at the school level	Data source/method
Access and participation	Net enrolment rate, attendance percentage	Admission register, daily attendance records
Retention and completion	Annual dropout rate, grade completion rate	Class registers, school completion records
Learning outcomes	% students at/above grade-level in language and mathematics	Term exams, standardised tests, and FLN assessments
Equity and inclusion	Enrolment and completion by gender and disadvantaged groups	Disaggregated school EMIS / records
Teacher capacity for ESD	% teachers trained in ESD / NEP-aligned pedagogy	Training records, staff meeting minutes

Dimension/area	Example indicator at the school level	Data source/method
School learning environment	Availability of safe classrooms, toilets, and drinking water	School infrastructure checklist, inspection
Community and stakeholder engagement	Number of SMC/SDMC meetings held, parent participation	Meeting minutes, attendance registers
Use of data for improvement	Existence of a school improvement plan using assessment data	School development plan, review reports

8.1. Indicators, Data, and Evidence-Based Practice

Efforts are underway to examine the relationship between the indicators of Sustainable Development Goal (SDG) 4 and to identify the real-time status of SDG-4 in India (Saini et al., 2023). Worldwide, nations aim to improve and make education accessible to all. SDG 4 focuses on providing quality education by removing barriers such as poverty, discrimination, and resource constraints. India has made changes through the release of national education policies. This study investigates progress toward SDG 4 by analysing indicators and current efforts, with a focus on the associations among SDG 4 indicators. The last few decades have witnessed an increasing awareness about the interaction between education and sustainable development. Quality education is essential for a nation's economic growth. Moreover, it is a fundamental human right recognised in numerous U.N. mandates and covenants. Despite a significant expansion in education, numerous children (664 million) still lack basic numeracy skills, particularly in developing countries. Quality and ICT-enabled education at all levels has attracted considerable policy attention. Several European and American countries emphasise enhancing basic education by establishing institutions such as schools,

libraries, and laboratories. Countries such as Korea, China, Singapore, Bangladesh, and Venezuela invest heavily in varied human resource skill development, including basic, technical, vocational, and higher education. Realising the importance of education, the government of India prepared a new National Education Policy (NEP) in 2020 to make the Indian education system more holistic, flexible, multidisciplinary, aligned with 21st-century needs, and to bring out each student's distinctive capabilities.

8.2. Reporting Mechanisms and Transparency

A range of reports from national bodies and international organisations document progress in education for sustainable development and its contribution to SDG 4. Specifications for SDG 4.7 are outlined. Reporting covers implementation and progress on policies, strategies, and comprehensive frameworks to integrate education for sustainable development into all educational settings. The formats of publication, dissemination, and associated spacing are detailed. Reports are made publicly available.

International reports from the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and other United Nations bodies address both the SDG 4.7 specification and the broader

development dimensions. Such reports ought to reflect a broad perspective and global developments, with country-specific reports examining national policies. The timing of such reports varies by the organisation producing them, incorporating various perspectives, including educational ones. The indicators and reporting proximity reflect this variety. Such a report provides the foundation for knowledge synthesis and learning.

Indicators that describe transversality, competencies, approaches, and assessment of education for sustainable development contribute to refining the broader perspective of national evaluation and support a comprehensive exploration of education for sustainable development and the attainment of SDG 4 (Giangrande et al., 2019)

8.3. Scaling Successful Models and Knowledge Transfer

Efforts to scale up successful models of education for sustainable development and facilitate knowledge transfer face similar challenges across diverse contexts, albeit with important variations. Systems thinking helps clarify these challenges and inform the design of effective policies, strategies, and actions in specific circumstances. When prompted to describe the conditions for successful scaling and replication of education for sustainable development

projects, practitioners observed that wider adoption often requires a compelling vision that responds to local needs, along with supportive policies that promote continuous dialogue among educational stakeholders across institutional levels (Cavallera et al., 2019). Successful innovations usually operate in the shadow of larger sociopolitical systems. Certain projects initiate change across multiple fronts, compelling stakeholders to reconsider established expectations regarding resource availability, logistics, timeframes, and collaboration that had long constrained desired trajectories. Efforts to transform education for sustainable development can therefore benefit from systemic analysis aligned with the characteristics and dynamics of particular contexts. Accordingly, prevailing perspectives on scaling models and knowledge transfer within education for sustainable development merit exploration (Giangrande et al., 2019).

Such innovations frequently adapt existing materials rather than produce something entirely novel, and they assume distinct forms that researchers have classified by basic characteristics. One hybrid model involves layering a new concept or dimension onto familiar content areas that remain essential to national curricula, facilitating both inter-institutional alignment and consideration of wider environmental factors. Meshing new pedagogical practices with lessons organised chronologically, by discipline, grade level, or established student sequences also supports wider continuity. Complementary hybrid procedures used by other initiatives further modify these principles. By attending explicitly to context, cross-context transfer becomes thinkable, and the capacity to transfer models between regions rather than across national boundaries expands.

9. Challenges, Risks, and Ethical Considerations in Transforming School Education

Disparities in social and economic development, administrative capacity, public service delivery, and external threats—such as the ongoing COVID-19 pandemic—pose key barriers to attainment of SDG 4. Education for Sustainable Development (ESD) presents additional challenges; SDG 4.7 outlines essential outcomes but warns against promoting specific worldviews at the expense of others. Design, development, and delivery must account for context-specific characteristics; cultural, ethnic, and geographical differences; and differences in personal identities, values, and belief systems—while also remaining true to the principles of sustainable development, sustainable lifestyles, and climate change.

Ethical considerations must similarly inform education and development efforts: How can ESD play a meaningful

role in addressing climate change and ensuring a sustainable future? Recent disasters worldwide underscore the urgency of reorienting education. It is necessary to foster empathy toward the natural environment and awareness of its changes, as well as people's responses to these changes. Understanding that climate change—initiated in the name of development—is not a distant issue but rather a phenomenon currently impacting the lives of many, vulnerable youth must be made part of the solution. Schools everywhere—especially in countries at the greatest risk—must consider climate change and disaster risk reduction as priority human rights issues. Recognising that climate change and associated disasters threaten every aspect of human life and that today's youth are potential victims of this artificial disaster, priorities should also include learning to build resilience against external shocks, embrace change, and influence decision-making.

10. Policy Implications and Strategic Roadmaps for National and Subnational Education Systems

Strategic analysis of policies, coordinated interventions, and clearly prioritised actions bolsters the ambition and determination of education stakeholders to mobilise the resourcing urgently needed to scale up the transformation that SDG 4 demands. There is strong international recognition of the education-related SDG targets across regions and systems, and a growing consensus on reform directions, key pedagogies, and implementation measures. While not yet widespread, the political connectivity between whole-system reform, investment and transformative education frequently uses similar vocabulary. It offers common principles (Vaccari & Gardinier, 2019), especially when articulated in terms of adaptive whole-system approaches to transformation, multiple individual rather than organisational systems, knowledge and large-scale. Whole-system S4 investment in a wide range of education policies collectively overwhelms efforts to address ongoing global crises, such as climate change, inequity, unsustainable consumption, and resource depletion, thereby obscuring potential synergies or misalignments among education-related SDG targets (Giangrande et al., 2019). Efforts need to link the expansion of the education-related SDG target knowledge base directly to countries' emergence into SDG 4 reform discussions and to influence broader education reforms that promote whole-system strategies and ensure education attainment.

11. Conclusion

School education remains an important factor in achieving global sustainable development. Although different types of programmes exist, fulfilling the

underlying mission requires transforming school systems to enable generative and effective educational change. This mass transformation towards education for sustainable development (ESD) must address:

(i) school curriculum reform and pedagogical innovation,

(ii) equity, inclusion and access,

(iii) teacher professional development and institutional capacity building,

(iv) community and stakeholder engagement,

(v) monitoring, evaluation and knowledge synthesis,

(vi) overcoming challenges, and

(vii) devising strategic roadmaps and policy implications.

Education holds a unique position in the Sustainable Development Goals (SDGs). As a concrete means to achieve sustainable development, it is embedded in the 2030 Agenda and has its own dedicated goal (SDG 4). School education plays a pivotal role in every country's commitment to deliver high-quality education for all, everywhere, and throughout a person's life course (Giangrande et al., 2019). Education is essential to every one of the 17 interlinked Sustainable Development Goals, whether it serves as motivation for youth employment, participation in creating peace and justice, or assessing the state of the planet (Mónus & Lechner, 2017).

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