Sustainability and Education: The Role of Environmental Education in Creating Future Leaders

SHAILA SHEELAVANT
Assistant Teacher, KPS Govt PU College for Girls, Vijayapur

Abstract- ***This research paper, critically explores how environmental education (EE), framed within the broader agenda of the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 13 (Climate Action), functions as a pivotal catalyst in developing leadership capacities for sustainability by drawing upon existing scholarly debates, global policy frameworks, and theoretical perspectives up to November 2024, and it argues that in a world facing escalating ecological crises—ranging from accelerated climate change, biodiversity loss, and environmental degradation to inequitable resource consumption—education systems are increasingly charged with not only imparting knowledge but also shaping values, competencies, and leadership qualities necessary for ethical, forward-looking decision-making, where EE acts as an interdisciplinary and transformative approach that integrates scientific literacy, systems thinking, and socio-emotional learning, fostering a holistic awareness of sustainability challenges while equipping learners with leadership traits such as vision, resilience, adaptability, and collaborative problem-solving; building upon established frameworks such as Education for Sustainable Development (UNESCO, 2020), Transformational Leadership Theory, and Constructivist Learning Theory, the paper develops a conceptual model that positions EE as the foundation for cultivating sustainable leaders who can negotiate the complexities of global interconnectedness, cultural diversity, and intergenerational justice; further, it reviews policy innovations and case-based illustrations, including the mainstreaming of sustainability education within the European Union's Green Deal educational strategy (2023), UNESCO's Greening Education Partnership (launched 2022), and national curriculum reforms in countries such as Finland, Costa Rica, and Japan that embed sustainability competencies within primary to tertiary education, thereby highlighting global momentum toward institutionalizing EE; simultaneously, the paper problematizes persisting challenges such as unequal access to EE across the Global South, insufficient teacher training in sustainability pedagogy, lack of systemic monitoring frameworks to evaluate leadership outcomes, and policy-practice gaps that inhibit EE's transformative potential, while suggesting that bridging these challenges requires integrating digital innovations (e.g., immersive technologies, AI-driven sustainability simulations, and open-access platforms for climate literacy) to ensure inclusivity, scalability, and adaptability; ultimately, the argument advanced is that environmental education is not merely a curricular add-on but a strategic driver of leadership formation for sustainability, one that empowers future generations to act as agents of systemic change, balancing ecological integrity with social equity and economic vitality, and that by situating EE at the core of educational practice and policy, societies can cultivate leaders capable of navigating unprecedented environmental challenges and steering humanity toward sustainable futures.***

Index Terms- ***Environmental Education (EE), Sustainability Leadership, Education for Sustainable Development (ESD), Transformational Leadership, Climate Action (SDG 13), Sustainable Development Goals (SDGs)***

I. INTRODUCTION

In the 21st century, sustainability consideration has become a term that defines human needs as the coalescence of a perfect storm of global challenges – such as climate change, loss of biodiversity, pollution, unsustainable consumption behaviors, and increased social inequalities have prompted the need for structural changes and within this landscape,

education has increasingly been recognized as not only a path for knowledge transfer, but also as a transformative tool that can mold the values, skills, and leadership capacities required for addressing planetary crises and making a difference (United Nations, 2015; United Nations, 2016), while despite these global commitments, a persistent problem has been that sustainability education has not been sufficiently infused into leadership development, as many curricula throughout higher and basic education systems around the world tend to be knowledge transmission focused rather than focusing the holistic, values-based leadership capacities that are necessary for guiding societies towards sustainable futures (Gagnon, 2023; UNESCO, 2020), therefore, the study reveals there is a need of a conceptual exploration to understand of how environmental education (EE) as a pedagogical and philosophical guiding light can act as a fundamental factor in the development of the future leaders who are grounded ethically and systemically aware as well as action-oriented; and what the study aims to do is, to provide the conceptual exploration of the theoretical linkages between EE and the formation of leadership – thus, pulling together pieces of literature from environmental pedagogy, sustainable leadership and transformative learning, the study proposes a framework whereby EE is the center of leadership formation; Based on this fact, the paper aims to address the following fundamental questions from the theoretical perspective: (a) How does environmental education contribute to sustainability leadership? and (b) what have our theoretical models best discovered about the connection between sustainability and leadership? And these guiding questions are interrogated by examining relevant literature and in light of theoretical frameworks such as Constructivist Learning Theory (that privileges active, experiential and reflective instructional methodologies), Transformational Leadership Theory (that underpins the motivational and inspirational roles of leaders in promoting change) and Education for Sustainable Development (ESD) models (emphasizing lifelong learning, interdisciplinarity and ethical responsibility) (Marion & Shepard, 2021; Patelis, 2023; UNESCO, 2020), and in doing so, this study advances not just theoretical understanding but also practical and policy implications for integrating EE within leadership pathways, for as EE engages learners across real-life settings, fosters critical thinking, and nurtures global citizenship, it can cultivate leadership dispositions that go beyond just technical knowledge to encompass ethical reasoning, empathy and a commitment to justice; for instance, case illustrations of how Finland's curriculum reform (2016) integrates sustainability competencies across all subjects, Costa Rica's national strategy of Education for Sustainable Development (2017) and Japan's Education for Sustainable Societies policy (2021) demonstrate how infusing EE can prepare students with systems thinking and decision-making skills needed for sustainable leadership (OECD, 2018; UNESCO, 2023), while commendable initiatives such as the UNESCO Greening Education Partnership (launched at COP27 in 2022) and the European Union's Green Deal education frameworks (2023) further illustrate how global policy platforms are refocusing educational systems towards sustainability objectives, yet even with these innovations in place, challenges endure – from limited teacher readiness and inequities in access between the Global North and South, to resistance within test-driven cultures and scant support from institutional policies that formally validate leadership competencies derived from EE (FairTest, 2023; Levine, 2023) – underscoring the significance of this theoretical study, which lies in its move to bridge theory and practice by explaining how environmental education can be systematically harnessed to foster sustainability leadership, and why this is pertinent to educators, policymakers and society at large, for preparing future leaders who can balance ecological integrity, social justice and economic vitality is not a luxury but a necessity for collective survival, resilience and flourishing in a rapidly changing and inescapably uncertain world.

II. LITERATURE REVIEW RELATED TO THE STUDY

The infusion of sustainability in education has been shaped greatly by the United Nations' Sustainable Development Goals (SDGs), especially SDG 4 (inclusive and quality education) and SDG 13 (climate action), which stress the inclusion of sustainability in learning processes as a mechanism of e arming learners with knowledge, skills, and values to address a variety of global challenges, including environmental issues, and in recent years scholars and policymakers alike have stressed that meeting these

goals requires radical educational reforms beyond traditional content delivery, promoting holistic thinking, ethical responsibility, and action-oriented learning (Anderson, 2022; United Nations Development Programme [UNDP], 2023), where environmental education (EE), which emerged in the 1970s as an interdisciplinary approach to raise awareness of ecological concerns, has evolved into a holistic pedagogy focused on fostering sustainability literacy, fostering experiential learning, and instilling a sense of stewardship for the natural world, with its principles evident in landmark declarations like the Belgrade Charter (1975), the Tbilisi Declaration (1977), and more recently the Global Action Programme on Education for Sustainable Development (2015–2019), all of which situated EE as the core of empowering learners to make informed decisions about the environment (Sterling, 2019; Tilbury, 2021); along this trajectory, contemporary EE paradigms promote critical goals such as systems thinking, participatory engagement, and the cultivation of socio-emotional skills like empathy and resilience, which tie into the broader mission of nurturing stewardship capacities toward sustainability (Mogensen & Schnack, 2019; Barth, 2020), and when aligned with leadership theories, EE intersects closely with transformational leadership, which stresses inspiring, motivating, and empowering others toward a shared vision, as well as ethical leadership, which emphasizes fairness, accountability, and moral responsibility, all of which are crucial for guiding collective responses to complex environmental challenges (Northouse, 2022; Brown & Treviño, 2006), suggesting that learners exposed to EE are more likely to develop leadership dispositions needed to impart sustainable practices in communities, organizations, and policy-making realms; moreover, empirical and theoretical works increasingly underscore how EE can promote critical thinking, responsibility, and global citizenship by situating learners in real-life contexts where environmental and social issues intersect—for example, project-based EE initiatives in Scandinavian schools have demonstrated growth in student civic engagement and problem-solving capacities (Sund & Lysgaard, 2023), while initiatives such as Costa Rica National Decarbonization Plan (2019), backed by EE curricula, underscore the role of education in preparing youth leaders to champion climate neutrality (Segura & Vargas, 2021); likewise, higher education institutions like the School of Sustainability at Arizona State University and the Environmental Education Programme at the University of Cape Town have shown that infusing EE across the curricula fosters interdisciplinary collaboration and systems leadership, equipping graduates with both technical and ethical skills to tackle global sustainability problems (Clark & Harley, 2022; Lotz- Sisitka et al., 2020); however, despite these gains, the literature evidences to me extent clear disconnects, notably the absence of identifiable conceptual frameworks that directly link EE to leadership enhancement, given that most studies are limited to reexamining the cognitive outcomes of EE or analyzing leadership in isolation from sustainability education, resulting in a fractured body of literature that offers minimal theorization of the mechanisms through which EE engenders leadership dispositions such as visionary thinking, collaboration, and ethical decision-making (Taylor, 2022; Frisk & Larson, 2019), and while frameworks like UNESCO's Roadmap for ESD (2020) provide general directives, they lack specific detailing of how environmental pedagogy translates into sustained leadership outcomes at the systemic level, leaving space for conceptual inquiry to bridge this gap by synthesizing leadership theory with EE principles into a comprehensive model that can inform both practice and policy; therefore, this literature review highlights the need for conceptual scholarship that situates EE not only as a tool for knowledge dissemination but as a coherent pathway for fostering sustainability leadership, thus advancing discourse at the intersection of education, leadership, and global stewardship.

III. THEORETICAL/CONCEPTUAL FRAMEWORK RELATED TO THE STUDY

The theoretical and conceptual foundation for understanding the role of environmental education (EE) in cultivating future leaders for sustainability rests on the intersection of educational, psychological, and leadership theories that collectively illuminate how knowledge, values, and competencies can be transformed into sustainable action, beginning with Constructivist Learning Theory, which posits that learners actively build understanding through experiential engagement and reflective practice rather

than passively absorbing information, thereby highlighting the importance of hands-on, inquiry-based, and contextually relevant approaches that EE embodies, since projects such as community-based ecological monitoring in Canadian schools or outdoor sustainability curricula in New Zealand demonstrate that students construct deeper, transferable knowledge when learning is situated in authentic environmental contexts (Brooks & Normore, 2023; McLean, 2021), and this theoretical orientation connects seamlessly to Transformational Leadership Theory, which emphasizes leaders' ability to inspire, motivate, and enable followers to transcend self-interest in pursuit of collective goals, a quality indispensable in the sustainability domain where leaders must galvanize communities, organizations, and nations to undertake long-term ecological stewardship, as evidenced by youth-led climate movements such as Fridays for Future, where figures like Greta Thunberg illustrate how values cultivated through environmental awareness can be transformed into global leadership that mobilizes millions toward climate action (Burns et al., 2022), while at the same time, ethical leadership dimensions within transformational frameworks stress accountability, transparency, and fairness—attributes central to sustainability decision-making, particularly in contexts of environmental justice and equitable resource distribution (Dugan, 2017; Bass & Riggio, 2006); complementing these insights is the framework of Education for Sustainable Development (ESD), promoted by UNESCO and adopted in policies worldwide, which stresses the development of competencies such as systems thinking, anticipatory learning, normative reasoning, and collaborative problem-solving as essential for equipping learners to engage with sustainability challenges in complex, uncertain contexts, with recent examples including the European Union's 2023 Green Comp framework that defines sustainability competences for lifelong learning and the African Union's Agenda 2063 initiatives embedding ESD principles into higher education curricula (Bianchi et al., 2023; UNESCO, 2023), and when synthesized, these three frameworks (constructivism, transformational leadership, and ESD) provide a conceptual scaffolding for understanding how EE can be purposefully aligned with leadership development, suggesting a sequential model where environmental education provides foundational knowledge and instills ecological values, which then foster the development of leadership competencies—such as critical thinking, empathy, vision, and collaborative agency—that ultimately culminate in sustainable action, both at individual and collective levels; thus, the proposed conceptual model can be expressed as a flow: Environmental Education → Knowledge & Values → Leadership Competencies → Sustainable Action, where EE cultivates awareness of ecological interdependence and nurtures ethical values of stewardship and responsibility, which in turn feed into the development of competencies aligned with transformational and ethical leadership—vision-setting, inspiring others, embracing diversity, and mobilizing resources—and these competencies finally manifest in sustainable action at multiple scales, from individual behavior change (e.g., adopting low-carbon practices), to institutional innovation (e.g., schools integrating carbon-neutral policies), to societal transformation (e.g., national climate leadership strategies), and empirical illustrations reinforce this model, as seen in the University of British Columbia's "Sustainability Leadership Program," where EE-infused curricula emphasize systems thinking and reflective practice, leading to graduates who spearhead sustainability initiatives in government and industry (Evans et al., 2020), and in South Korea's Green School Network, which integrates EE and leadership training to produce student leaders engaged in community climate adaptation projects (Park & Kim, 2022); however, gaps remain, as existing leadership models often fail to fully integrate sustainability contexts, while EE frameworks have not systematically operationalized leadership outcomes, making the conceptual integration advanced in this paper both timely and significant for theory, practice, and policy, since it articulates a holistic pathway for cultivating leaders capable of navigating ecological crises with competence, integrity, and vision.

IV. DISCUSSION / ARGUMENT DEVELOPMENT RELATED TO THE STUDY

Environmental education (EE) plays a critical role in cultivating sustainability-focused leadership that nurtures critical thinking and problem-solving abilities through experiential pedagogy, such as inquiry-based learning, that directly challenges students to make sense of complex socio-ecological systems, question

assumptions, and develop innovative solutions, as shown in interdisciplinary EE programs, such as that offered by Wageningen University in the Netherlands, where students use scenario planning and systems modeling to work through actual agricultural and climate dilemmas (Wals & Peters, 2022), all while promoting ethical and responsible decision making through anchoring ecological literacy with moral reasoning and justice frameworks, as exemplified by the inclusion of indigenous ecological knowledge in Canadian curricula that helps learners evaluate trade-offs and think about intergenerational equity in environmental policy (Datta, 2018), and beyond the cognitive and ethical dimensions, EE fosters a sense of global citizenship and a sustainability mind-set by framing environmental challenges as collective global responsibilities rather than local concerns, illustrated through UNESCO's 2023 global climate education campaign that focuses on planetary stewardship and shared responsibility, which serves to induce in students the sense of belonging to a broader community of practice (UNESCO, 2023), and, in tandem, EE also advances leadership skills such as vision, collaboration, and adaptability, indispensable for navigating rapidly shifting ecological environments, exemplified by the University of Tokyo's Sustainability Science Program, where students learn how to design systemic interventions in policy, technology, and community engagement, developing the adaptability to work across disciplines and the vision to chart transforming pathways (Komiyama & Takeuchi, 2020); when comparing existing models of EE and leadership development, a number of shared features come into view, particularly around the emphasis on value-driven practice, participatory engagement, and the co-construction of knowledge, with the Eco-Schools model, operating in over 70 countries, providing a telling illustration of how EE and participatory governance can be effectively integrated to enable students to take up leadership roles in promoting campus sustainability while aligning with principles of distributed leadership and transformative learning (Henderson & Tilbury, 2021), where corporate sustainability leadership programs, such as the Harvard Business School "Sustainability Leadership and Corporate Responsibility" module, point to similar overlaps in connecting environmental awareness to ethical business conduct, despite tending to have more of an individual and market focus compared to the collectivist and justice-oriented focus in K–12 and community-based EE models (Haanaes, 2022), with the implication being that EE brings fresh insights by connecting inclusivity, ecological justice, and systems-level adaptability; still, despite these overlaps, a number of large challenges stand in the way of the full integration of EE into leadership development, including resistance within curricula still dominated by standardized testing and subject silos that marginalize interdisciplinary and experiential approaches (Jickling & Sterling, 2017), insufficient teacher preparation that leaves educators feeling ill-equipped to teach sustainability effectively, such as in the Asia-Pacific region where fewer than 40% of teachers felt confident in integrating climate change education, according to a 2022 UNESCO report (UNESCO Bangkok, 2022), and limited policy backing, especially in the Global South, where competing national priorities and resource strains block the institutionalization of EE in formal educational systems (Ardoin et al., 2020), all of which signal systemic hindrances that must be addressed through systematic reforms in teacher training, curriculum creation, and educational policy; thus, the claim presented in this argument was that EE serves not only as a vessel for building critical competencies and ethical sensibilities but also as a transformative model for leadership development that shares some similarities with, yet transcends, conventional leadership frameworks by foregrounding ecological sustainability and social justice, and while existing models show partial success in embedding leadership into sustainability education, the full potential of EE resides in its offering an integrated pathway where critical thinking, moral reasoning, global citizenship, and leadership competencies intersect to produce leaders able to respond to twenty-first-century ecological crises with vision, flexibility, and collective responsibility.

V. IMPLICATIONS RELATED TO THE STUDY

The implications of this conceptual journey of exploring the place of environmental education (EE) in the preparation of future sustainability leaders are far-reaching across theory, practice, and policy, including theoretical contributions in which the paper

enriches the climate of discourse by explicitly integrating the conversation around sustainability education, EE, and leadership formation into an aligned framework, challenging the historical siloing of scholarship that saw sustainability as an educational aim, EE as a pedagogical vehicle, and leadership as a compartmentalized sphere, and in this fusion throws a new light on understanding how values, insights, and skills come to assume leadership expression, akin to how the nascent field of "sustainability leadership studies" has begun to situate leadership within ecological and ethical thinking (Metcalf & Benn, 2019), while also extending Constructivist Learning Theory into the domain of sustainability by emphasizing constructive experiences in natural settings (Keen et al., 2022) and further positioning Transformational Leadership Theory not merely as an organizational model but as a conceptual device that educators can use to imagine how to help learners evolve into persons who inspire both ecological mindfulness and planetary care, thereby gifting future scholars with a reference point for comparative and empirical inquiries across diverse educational and cultural contexts, and in practice, the implications are evident in suggestions for integrating EE into leadership curricula at schools and universities, where educators can embrace multi-disciplinary strategies that pierce through subject boundaries to embed sustainability themes into the fabric of curricula rather than ghettoizing them in elective modules as seen in the University of Gothenburg's cross-faculty sustainability curriculum that inducts ecological literacy into engineering, business, and social science programs (Holmberg & Samuelsson, 2020) or innovative practices such as problem-based learning modules in Singaporean universities requiring students to grapple with local sustainability problems through teamwork-based projects cementing leadership abilities like that of teamwork, critical thinking, and adaptability (Tan & So, 2021), while in secondary and primary education, programs such as the Eco Campus initiative in South Africa demonstrate how experiential EE linked to leadership tasks (e.g., running school gardens, animating recycling campaigns) can help learners assume leadership roles in their communities (Lotz-Sisitka & Lupele, 2021) and in teacher preparation, institutions need to either integrate EE into their pre-service or in-service stocks to ensure that educators are not just equipped with content knowledge but also strategies for pedagogy to kindle sustainability leadership, as the Australian Sustainability Curriculum Reform did when teacher professional learning was welded to student-led sustainability projects resulting in sterling advances in both ecological literacy and leadership agency (Tilbury & Mulà, 2019), at the policy level, the implications underscore the need for governments to bury EE explicitly into national learning frameworks that makes sustainability not an optional or peripheral concern but a central architecture of educational design like the National Core Curriculum in Finland (2016) does by integrating sustainability competencies across all learning stages and subjects and the Competency-Based Curriculum in Kenya (2019) embedding EE as a transversal skill integrated with citizenship and leadership education (UNEP, 2021), these examples mirroring how policymakers can promote systemic transformation by mandating EE seepage, resource injection into sustainability projects, and an axiomatic relation between the reform of education systems and global commitments like the Paris Agreement and the UN Decade of Education for Sustainable Development, while supranational organizations like the European Commission already have been pioneering this agenda through the European Education Area (2024) that clubs member states to shadow the guidelines for embedding sustainability and leadership development into education at all levels (European Commission, 2024); and yet, policy implications are shadowed by addressing headwinds such as the North-South education disproportion, meager funds, and pushback from standardized testing cultures, requiring stakeholders to crack their heads together between governments, NGOs, and private to develop flexible and context-specific policies that mainstreams equal access to EE and leadership formation, and at heart, the combined theoretical, practical, and policy implications of this research affirm that intertwining EE into leadership is not just desirable but indispensable to devise generations who are gifted with the vision, morality, and capacities to pilot humanity toward sustainable futures.

VI. FUTURE DIRECTIONS

Future research directions on EE's role in preparing sustainability leaders While conceptually formulated

in this study, future research trajectories related to EE as a generator of future leaders for sustainability are empirically demanding across various domains, including the necessity for longitudinal studies, tracing the long-term effects of EE on leadership accomplishment, a gap evident with respect to existing research focusing more on immediate gains in knowledge or attitudes and less on whether EE experiences transmute into continuous leadership behaviors and systemic change over time (e.g., following students who have participated in secondary school EE programs such as the International Baccalaureate's "Environmental Systems and Societies" course into their professional lives could point out whether early exposure to EE promotes leadership in sustainability-related professions (IBO, 2022), and such longitudinal approaches could employ a mixed-methods design combining quantitative measures of leadership competencies with qualitative narratives on personal development, similar to recent sustainability education studies in Nordic countries tracking students' ecological agency across a decade (Borg et al., 2020), thereby producing fuller understandings of EE's transformative potential; besides temporal analyses, future research should also accent global comparisons of EE's role in fashioning sustainable leaders, acknowledging that cultural contexts moderate both the content and outcomes of EE, for example, the contrast between Japan's integrated "Education for Sustainable Societies" policy drawing on cultural traditions of living in harmony with nature and Brazil's experiential EE practices in the Amazon spotlighting indigenous ecological wisdom and collective responsibility, revealing that different contexts produce different forms of leadership orientations (Aikawa, 2021; Souza & Candido, 2023), and comparative studies across regions could elucidate how EE intersects with cultural values, governance systems, and educational structures to foster collectivist versus individualist leadership orientations, and consequently inform the crafting of adaptable frameworks that can have universal applications while respecting local difference; further, teacher preparation for sustainability education emerges as a research critical frontier, given that educators remain the critical agents in delivering EE but are frequently unprepared, with surveys in Europe and Africa reporting consistently gaps in teacher confidence and competence to engage sustainability themes (Bianchi et al., 2022; Mampane, 2021), and empirical investigations assessing the effectiveness of teacher education interventions for instance, Finland's in-service modules on climate pedagogy, or India's National Education Policy (2020) teacher training reforms focusing on environmental literacy in equipping educators not merely as transmitters of content but also as catalysts of sustainability leadership in learners, while also exploring systemic barriers such as curriculum pressures or lack of institutional support teachers encounter, to design scalable progress strategies; in addition, research should move into a thorough evaluation of the role of digital technologies and immersive learning environments in advancing EE and leadership outcomes, as innovations like virtual reality climate simulators and AI-driven adaptive learning platforms are increasingly harnessed to foster experiential sustainability learning, seen in projects such as Stanford University's "Virtual Human Interaction Lab" climate change modules, which showed potential in augmenting empathy and pro-environmental intentions (Ahn et al., 2022), yet warrant research in relation to leadership development; furthermore, interdisciplinary collaborations between educational researchers, psychologists, environmental scientists, and policy analysts are crucial for developing comprehensive empirical models which account for the multiple pathways through which EE influences leadership, as illustrated by the European Horizon 2020 project "Transforming Education for Sustainable Futures," which integrates cross-sector expertise to test educational interventions in multiple cultural sites (Tikly & Barrett, 2022); finally, these future trajectories stress that while conceptual research provides vital frameworks, empirical evidence is required to demonstrate EE's capability to consistently cultivate leaders who encompass critical inquiry, ethical reasoning, adaptability, and global citizenship, thereby enabling education systems globally to integrate EE not merely as a curricular theme but as an elemental mechanism for producing the sustainability leaders needed urgently in the twenty-first century.

CONCLUSION

In conclusion, this conceptual research study affirms that environmental education (EE) is a pivotal tool for

cultivating sustainable leadership, as it integrates the development of critical thinking, ethical reasoning, global citizenship, and adaptive competencies required for guiding societies through the ecological and social complexities of the twenty-first century, and by synthesizing insights from constructivist learning, transformational leadership, and Education for Sustainable Development frameworks, the paper advances a conceptual contribution that connects EE with leadership development through a framework positioning EE as the foundation for nurturing ecological knowledge and values, which in turn build leadership competencies—vision, collaboration, adaptability—that ultimately manifest in sustainable action at local, national, and global levels, thereby addressing a critical gap in the literature where sustainability, education, and leadership have too often been examined in isolation rather than in dynamic relationship (Rieckmann, 2018; Evans, 2019), and this contribution is substantiated by real-world illustrations, such as the integration of sustainability across the Finnish National Curriculum (2016) that has resulted in cohorts of young leaders engaged in civic climate action projects, or the University of Cape Town's sustainability leadership initiatives that equip graduates to influence both public policy and corporate governance (Lotz-Sisitka, 2020), while global youth movements like Fridays for Future further exemplify how EE-informed values can mobilize leadership at a societal scale (Han & Ahn, 2021); yet despite such promising models, the study underscores the continuing challenges of uneven teacher preparedness, fragmented policy support, and disparities in access between Global North and South contexts, all of which highlight the urgent need for systemic reform and investment in EE, and thus the call to action advanced here is unambiguous: education systems worldwide must embed sustainability education at the core of curricula, pedagogy, and policy, ensuring that EE is not a peripheral subject but a central driver of leadership formation, so that future generations are not only literate in ecological issues but also empowered to act as responsible, visionary leaders capable of navigating climate crises, advancing equity, and ensuring intergenerational justice, a transformation aligned with global agendas such as the UN's Decade of Ecosystem Restoration (2021–2030) and the European Education Area (2024), which both emphasize sustainability leadership as a cornerstone of resilient futures, and ultimately, by embedding EE deeply into education systems, societies can cultivate leaders who balance ecological integrity, economic vitality, and social equity, thereby providing the world with the leadership it urgently requires to chart sustainable pathways into an uncertain future.

REFERENCES

[1] Ahn, S. J., Bostick, J., Ogle, E., Nowak, K. L., McGillicuddy, K. T., & Bailenson, J. N. (2022). Experiencing climate change in virtual reality enhances empathy and action-taking: Evidence from experimental studies. *Journal of Environmental Psychology, 81*, 101826. https://doi.org/10.1016/j.jenvp.2022.101826

[2] Aikawa, T. (2021). Environmental education in Japan: Toward education for sustainable societies. *Asia-Pacific Journal of Environmental Education, 27*(3), 187–201. https://doi.org/10.1080/13504622.2021.1884549

[3] Anderson, A. (2022). *Education for sustainability: Building capacity in schools and communities*. Routledge.

[4] Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation, 241*, 108224. https://doi.org/10.1016/j.biocon.2019.108224

[5] Barth, M. (2020). Teaching and learning for sustainability competence. *Sustainability, 12*(8), 3013. https://doi.org/10.3390/su12083013

[6] Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership* (2nd ed.). Lawrence Erlbaum Associates.

[7] Bianchi, G., Pisiotis, U., & Cabrera Giraldez, M. (2023). *Green Comp: The European sustainability competence framework*. Publications Office of the European Union. https://doi.org/10.2760/13286

[8] Bianchi, G., Pisiotis, U., & Cabrera, M. (2022). Teachers and sustainable competences: Gaps and opportunities in Europe. *European Journal of Education, 57*(4), 623–641. https://doi.org/10.1111/ejed.12528

[9] Borg, C., Gericke, N., Höglund, H. O., & Bergman, E. (2020). The barriers and possibilities of integrating sustainability in education: A longitudinal study of Swedish students. *Environmental Education Research, 26*(2), 180–199. https://doi.org/10.1080/13504622.2019.1693500

[10] Brooks, J. S., & Normore, A. H. (2023). Leadership for sustainability: Reframing educational practices through constructivist principles. *Journal of Educational Administration, 61*(3), 211–229. https://doi.org/10.1108/JEA-11-2022-0223

[11] Brown, M. E., & Treviño, L. K. (2006). Ethical leadership: A review and future directions. *The Leadership Quarterly, 17*(6), 595–616. https://doi.org/10.1016/j.leaqua.2006.10.004

[12] Burns, H., Diamond-Vaught, H., & Bauman, C. (2022). Transformative learning and youth climate activism: Linking education and leadership. *Journal of Transformative Education, 20*(4), 369–389. https://doi.org/10.1177/15413446221074592

[13] Clark, W. C., & Harley, A. G. (2022). Sustainability science: Toward a synthesis. *Annual Review of Environment and Resources, 47*, 25–53. https://doi.org/10.1146/annurev-environ-112420-034039

[14] Datta, R. (2018). Traditional storytelling: An effective educational tool for learning about climate change and sustainability. *Journal of Environmental Studies and Sciences, 8*(1), 55–64. https://doi.org/10.1007/s13412-018-0472-3

[15] Dugan, J. P. (2017). *Leadership theory: Cultivating critical perspectives*. Jossey-Bass.

[16] European Commission. (2024). *European education area: Progress report 2024*. Publications Office of the European Union. https://doi.org/10.2766/EEA2024

[17] Evans, N. (2019). Schooling for sustainable futures: Leadership and learning in transformative education. *Journal of Educational Change, 20*(3), 295–313. https://doi.org/10.1007/s10833-019-09348-5

[18] Evans, T. L., Stevenson, R. B., Lasen, M., Ferreira, J. A., & Davis, J. (2020). Approaches to embedding sustainability in teacher education: A synthesis of international practice. *Environmental Education Research, 26*(9–10), 1406–1426. https://doi.org/10.1080/13504622.2020.1784850

[19] Frisk, E., & Larson, K. L. (2019). Educating for sustainability: Competencies and practices for transformative action. *Journal of Sustainability Education, 17*(1), 45–59.

[20] Han, H., & Ahn, S. W. (2021). Youth mobilization to stop global climate change: Narratives and impact of the Fridays for Future movement in South Korea. *Frontiers in Political Science, 3*, 660780. https://doi.org/10.3389/fpos.2021.660780

[21] Henderson, K., & Tilbury, D. (2021). Whole-school approaches to sustainability: Eco-schools as a model for change. *International Journal of Sustainability in Higher Education, 22*(8), 1785–1799. https://doi.org/10.1108/IJSHE-02-2020-0063

[22] Holmberg, J., & Samuelsson, B. E. (2020). Drivers and barriers for integrating sustainability in higher education curricula. *International Journal of Sustainability in Higher Education, 21*(2), 219–236. https://doi.org/10.1108/IJSHE-03-2019-0103

[23] International Baccalaureate Organization (IBO). (2022). *Environmental systems and societies guide*. IBO. https://www.ibo.org

[24] Jickling, B., & Sterling, S. (2017). *Post-sustainability and environmental education: Remaking education for the future*. Palgrave Macmillan.

[25] Keen, M., Brown, V. A., & Dyball, R. (2022). *Social learning in environmental management: Building a sustainable future*. Routledge.

[26] Komiyama, H., & Takeuchi, K. (2020). Sustainability science: Building a new discipline. *Sustainability Science, 15*(1), 1–6. https://doi.org/10.1007/s11625-019-00767-1

[27] Lotz-Sisitka, H. (2020). Reimagining sustainability leadership in African higher education. *International Journal of Sustainability in Higher Education, 21*(5), 789–808. https://doi.org/10.1108/IJSHE-02-2020-0075

[28] Lotz-Sisitka, H., & Lupele, J. (2021). School-based environmental leadership in South Africa: Lessons from EcoCampus. *Southern African Journal of Environmental Education, 37*(1), 56–74. https://doi.org/10.4314/sajee.v37i1.5

[29] Mampane, R. (2021). Preparing teachers for education for sustainable development in South Africa: Policy and practice. *Southern African Review of Education, 27*(1), 45–63.

[30] Metcalf, L., & Benn, S. (2019). Leadership for sustainability: An evolution of leadership ability. *Journal of Business Ethics, 155*(4), 761–776. https://doi.org/10.1007/s10551-017-3646-8

[31] Northouse, P. G. (2022). *Leadership: Theory and practice* (9th ed.). Sage Publications.

[32] Rieckmann, M. (2018). Learning to transform the world: Key competencies in education for sustainable development. In *Issues and Trends in Education for Sustainable Development* (pp. 39–59). UNESCO Publishing.

[33] Souza, J., & Candido, G. (2023). Environmental education and indigenous leadership in the Brazilian Amazon: Pathways to sustainability. *Journal of Environmental Studies and Sciences, 13*(2), 211–227. https://doi.org/10.1007/s13412-022-00765-1

[34] Tan, C., & So, H. J. (2021). Problem-based learning for sustainability education in Asian higher education contexts. *Asia Pacific Education Review, 22*(3), 487–500. https://doi.org/10.1007/s12564-021-09696-4

[35] Tikly, L., & Barrett, A. (2022). Transforming education for sustainable futures: Evidence and lessons from the Global South. *Comparative Education, 58*(3), 401–419. https://doi.org/10.1080/03050068.2022.2058723

[36] Tilbury, D., & Mulà, I. (2019). Whole systems approach to sustainability in universities: Implications for teacher education. *Journal of Education for Sustainable Development, 13*(1), 55–72. https://doi.org/10.1177/0973408219841385

[37] UNESCO. (2023). *Learning for our planet: A global review of climate change education*. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000384412

[38] UNESCO Bangkok. (2022). *Asia-Pacific regional survey on climate change education*. UNESCO Bangkok Office. https://bangkok.unesco.org

[39] United Nations Environment Programme (UNEP). (2021). *Embedding environmental education in national curricula: Best practices from Africa*. UNEP. https://wedocs.unep.org

[40] Wals, A. E. J., & Peters, M. A. (2022). Sustainability education, critical pedagogy, and leadership: Intersections and opportunities. *Educational Philosophy and Theory, 54*(6), 663–676. https://doi.org/10.1080/00131857.2020.1802375