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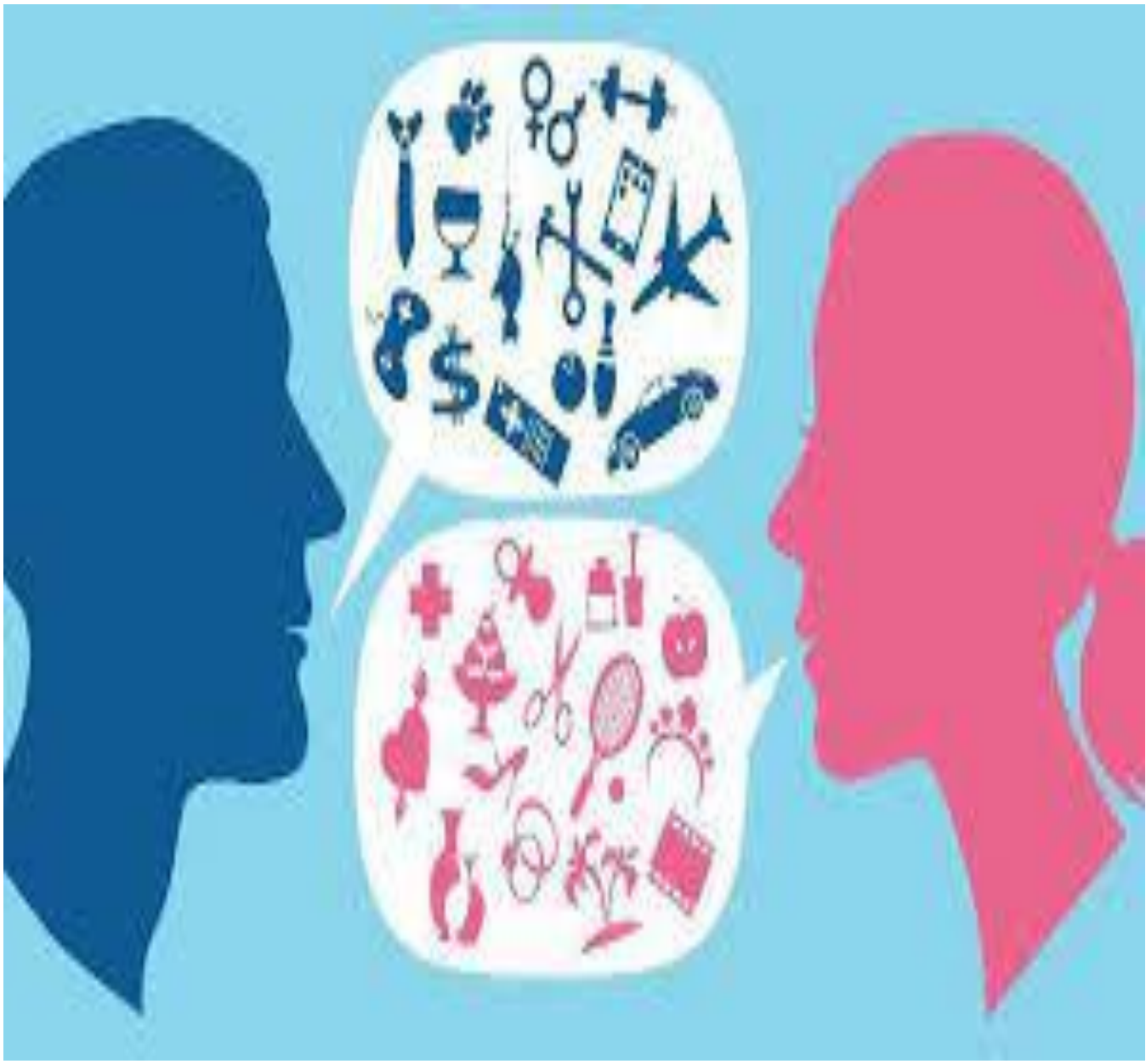

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Indigenous Knowledge, Gender, and Sustainability: Sociological Reflections on Education for Sustainable Development (ESD)

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Education for Sustainable Development (ESD) has gained increasing global relevance in advancing inclusive and equitable learning systems that integrate social, cultural, and environmental values. Yet indigenous knowledge and gendered perspectives are frequently overlooked in mainstream education policies and practices. This study adopts a qualitative sociological approach to investigate how indigenous knowledge, particularly women's ecological contributions, intersects with sustainability and educational justice. Data were collected through semi-structured interviews and focus group discussions with rural community members and educators. Findings show that indigenous women serve as primary custodians of ecological wisdom, transmitting practices related to biodiversity, sustainable farming, and water management to younger generations. However, their knowledge is often undervalued in formal curricula, leading to epistemic marginalisation and gender inequities. The research reveals that integrating indigenous epistemologies into ESD strengthens cultural identity, enhances gender-sensitive pedagogies, and promotes community-based sustainability practices. The analysis highlights structural barriers such as exclusionary language policies, patriarchal norms, and urban-centric curricula. This study calls for a paradigm shift toward knowledge pluralism and participatory educational reform. Re-centring indigenous wisdom is essential for advancing gender justice, ecological resilience, and transformative education.

Keywords: cultural identity, ecological justice, epistemologies, gendered knowledge, participatory education, sustainability practices

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INTRODUCTION

Education for Sustainable Development (ESD) has become a central framework for addressing the interlinked environmental, social, and cultural challenges of the twenty-first century. Grounded in the principles of sustainability, equity, and transformative learning, ESD aims to cultivate the competencies necessary for individuals and communities to engage with complex ecological crises and socio-economic inequalities (UNESCO, 2020). While global policy initiatives recognise the need for inclusive and context-sensitive approaches, mainstream ESD frameworks continue to privilege Western scientific epistemologies, thereby marginalising local and indigenous knowledge systems that have sustained ecological balance for generations (Le Grange, 2016; Smith, 2021). This epistemic asymmetry not only narrows the scope of sustainability education but also reproduces colonial hierarchies within contemporary learning systems.

Indigenous knowledge encompasses culturally grounded understandings of land, biodiversity, climate, and community well-being, developed over centuries of reciprocal interaction with local ecosystems (Berkes, 2012; Kimmerer, 2013). Unlike dominant Eurocentric models, indigenous epistemologies are relational, holistic, and embedded within social practices, spirituality, and community responsibilities (De Sousa Santos, 2014). Their contributions to environmental stewardship, such as sustainable land management, water conservation techniques, medicinal plant knowledge, and biodiversity protection, have long been recognised by scholars but inadequately incorporated into formal education systems (Battiste, 2013; Pretty et al., 2009). Critically, these forms of ecological knowledge are often held, practised, and transmitted by indigenous women, whose roles remain largely invisible within the dominant sustainability discourse (Agarwal, 2010; Kuokkanen, 2010).

Gender plays a significant role in shaping ecological responsibilities and the transmission of knowledge in many indigenous contexts. Women frequently manage seed diversity, herbal medicine, soil fertility, and water systems, yet their expertise is rarely acknowledged within institutional learning spaces or national curricula (Agarwal, 2010; Stromquist, 2015). Feminist scholars argue that this marginalisation constitutes a form of epistemic injustice, wherein certain groups are deemed less credible or legitimate as knowledge-holders (Fricker, 2007; Hooks, 2015). In indigenous communities, this injustice is compounded by patriarchal norms, restricted educational opportunities, and the undervaluation of oral and embodied learning practices traditionally undertaken by women.

Despite policy commitments to equity and cultural inclusion, mainstream ESD continues to operate through frameworks shaped by colonial educational legacies. As Smith (2021) and Mignolo (2018) emphasise, coloniality persists in the ways curricula prioritise Western scientific knowledge, impose national and global language hierarchies, and regulate what counts as valid expertise. Such systems often

detach knowledge from place, community, and lived experience-key elements of indigenous sustainability practices. The resulting educational approaches risk promoting a superficial understanding of sustainability that excludes the very communities whose practices exemplify sustainable living.

This article argues that integrating indigenous knowledge, particularly gendered ecological knowledge, into ESD is critical for three reasons. First, indigenous epistemologies offer alternative frameworks for addressing climate change, biodiversity loss, and environmental degradation, grounded in relational ethics that challenge extractivist paradigms (Kimmerer, 2013). Second, recognising indigenous women's knowledge disrupts gendered inequalities and expands the conceptualisation of sustainability beyond technocratic models. Third, culturally grounded ESD enhances learners' sense of identity, belonging, and community responsibility, contributing to long-term ecological resilience.

Sociological perspectives provide essential insights into how educational systems reproduce or transform inequalities. Structural inequalities-such as language hierarchies, gender norms, and the centralisation of curriculum development-shape which knowledge is validated in formal education (Dei, 2018; Stromquist, 2015). Indigenous communities often face multiple barriers, including geographic isolation, lack of culturally relevant learning materials, limited participation in policy processes, and educational structures that undervalue local epistemologies (Smith, 2021). By examining these issues through sociological and decolonial lenses, this study situates ESD within broader struggles for cultural and gender justice.

The need for participatory and community-based educational models has been increasingly highlighted in international sustainability discourse. Participatory governance is essential for transforming ESD from a top-down initiative into a community-centred practice that values local voices, especially women's perspectives (De Sousa, 2014). When communities are meaningfully engaged in shaping school policies, curricular content, and teaching practices, education becomes a site of cultural affirmation rather than assimilation (Battiste, 2013).

This study explores how indigenous knowledge, particularly the gendered ecological knowledge of women, interacts with sustainability education in rural contexts. Through semi-structured interviews and focus group discussions, the research examines:

- how indigenous ecological knowledge is understood and transmitted;
- how gender shapes knowledge, responsibilities and recognition;
- the extent to which indigenous epistemologies are incorporated into formal education; and
- What structural barriers hinder the integration of indigenous knowledge into ESD?

By interrogating the dynamics of epistemic marginalisation and exploring pathways for

developing culturally grounded sustainability education, the study contributes to scholarship on decolonising education, gender justice, and ecological knowledge systems. Ultimately, the introduction asserts that achieving meaningful and transformative ESD requires rethinking educational structures through the lenses of knowledge pluralism, gender equity, and community participation.

METHODOLOGY

This study employed a qualitative sociological methodology to examine the intersections of indigenous knowledge, gender, and sustainability within the framework of Education for Sustainable Development (ESD). Qualitative approaches were selected due to their suitability for exploring culturally embedded knowledge systems, community narratives, and the lived experiences of marginalised groups (Creswell & Creswell, 2018). Further, indigenous and feminist scholars emphasise the importance of methodologies that privilege relational, dialogic, and participatory forms of knowledge production when working with indigenous communities (Smith, 2021; Kovach, 2009). This study, therefore, sought to engage participants respectfully and collaboratively, recognising their expertise and agency.

Research Design

The research adopted a multi-method qualitative design combining semi-structured interviews and focus group discussions (FGDs). Semi-structured interviews were used to elicit individual perspectives on ecological knowledge, gender roles, and experiences with formal education. FGDs provided a space for community members, particularly women, to collectively reflect on shared ecological practices and discuss their interactions with local schools. This triangulation increased the depth and credibility of the data by capturing both individual and collective perspectives (Patton, 2015).

The methodological orientation was informed by intersectionality (Crenshaw, 1991) and decolonial theory (Mignolo, 2018). Intersectionality guided the analysis of how gender, indigeneity, language, and socio-economic status intersect to shape participants' experiences in education. Decolonial theory informed the critique of epistemic hierarchies and colonial legacies within ESD frameworks.

Research Sites and Participants

Data were collected in two rural indigenous-majority regions selected for their rich ecological traditions and limited integration of indigenous knowledge into formal schooling. Both regions experience significant gender disparities in educational participation and rely heavily on women's ecological labour.

Participants were recruited through purposive sampling in collaboration with local community leaders, ensuring representation from:

- indigenous women (knowledge holders, farmers, elders),
- male community elders,
- youth,
- local educators,

- school administrators,
- community-based environmental practitioners.

A total of 28 semi-structured interviews and 6 FGDs were conducted. FGDs were held separately for women and mixed groups to create safe spaces for gendered dialogue. Participants ranged in age from 18 to 75 years.

Data Collection

Semi-structured interviews followed a flexible guide with prompts on:

- ecological practices and knowledge transmission,
- gendered responsibilities in land, water, and biodiversity management,
- experiences with formal schooling,
- perceptions of ESD content,
- barriers to integrating indigenous knowledge into curricula.

FGDs explored themes of community sustainability, educational challenges, and collective ecological memory. All interviews and discussions were conducted in local languages with assistance from trained community translators when required.

Data were audio-recorded with consent, transcribed verbatim, and translated into English. Field notes captured contextual details, nonverbal communication, and researcher reflections.

Data Analysis

Data analysis followed a hybrid deductive–inductive thematic approach (Fereday & Muir-Cochrane, 2006). Deductive codes were drawn from intersectionality, decolonial theory, and sustainability literature; inductive codes emerged from participants' narratives. Analysis involved:

- Initial coding of transcripts using NVivo software,
- Grouping codes into thematic clusters,
- Constructing analytic memos to capture emerging interpretations,
- Conducting member checks with community representatives to validate interpretations,
- Triangulating findings across interviews, FGDs, and field notes.

Reflexive journaling helped mitigate researcher bias and maintained transparency in analytic decisions.

Ethical Considerations

Ethical approval was obtained from the relevant institutional review board. The research followed principles of relational accountability, respect, reciprocity, and collective benefit, consistent with indigenous research ethics (Kovach, 2009; Smith, 2021). Participants were informed of the study's objectives, data usage, and their right to withdraw at any time. Consent procedures were adapted to local norms, including oral consent for elders. Pseudonyms were used to ensure confidentiality.

FINDINGS

The findings of this qualitative sociological study reveal a complex interplay between indigenous knowledge systems, gendered ecological responsibilities, and the structuring of sustainable education within

rural indigenous communities. Through analysis of interviews and focus group discussions, five interrelated themes emerged: indigenous women as custodians of ecological knowledge, the marginalisation of local epistemologies within formal schooling, language hierarchies as barriers to sustainability learning, the transformative potential of participatory educational governance, and (e) the pedagogical value of integrating indigenous ecological practices into ESD frameworks. These themes collectively illuminate the structural and cultural factors shaping how ESD is interpreted, practised, and resisted within indigenous-majority contexts.

Indigenous Women as Primary Custodians of Ecological Knowledge

Across both research sites, participants emphasised that indigenous women serve as central actors in maintaining and transmitting ecological knowledge. Women's knowledge contributions include seed preservation, crop diversification, herbal medicine production, water management, composting, and forest foraging activities deeply embedded within communal livelihoods and environmental rhythms. Such knowledge is transmitted through intergenerational pedagogies, including storytelling, apprenticeship, ritual practice, and daily labour.

Many women described their ecological responsibilities as part of a larger cultural identity, aligning with scholarship that frames indigenous epistemologies as relational, place-based, and collectively held (Berkes, 2012; Kimmerer, 2013). Female participants articulated a holistic understanding of sustainability that blends environmental care, community cohesion, cultural continuity, and spiritual responsibility. This resonates with Agarwal's (2010) analysis of gendered environmental labour and the indispensable role women play in ecological conservation.

However, participants also noted that this knowledge is often invisible to external actors, including schools, development organisations, and government officials. Despite their expertise, women are seldom consulted in local curriculum planning, environmental education initiatives, or school–community partnerships. The disconnect between women's ecological roles and their recognition within formal education highlights a form of epistemic injustice (Fricker, 2007), where women's expertise is systematically undervalued and excluded from institutional decision-making.

Epistemic Marginalisation Within Formal Education

Participants consistently reported that formal schooling fails to acknowledge or incorporate indigenous knowledge systems. Teachers noted that national curricula emphasise Western scientific knowledge and urban environmental issues, leaving little room for local ecological practices and community-based sustainability. Textbooks frequently ignore local flora, indigenous farming techniques, and traditional ecological relationships, reinforcing what Smith (2021) describes as the "coloniality of knowledge," in which Western epistemology is positioned as universal and superior.

Several educators described feeling constrained by rigid curriculum requirements and assessment structures that prioritise memorisation of standardised content over locally relevant learning. Students are taught about global warming and pollution in abstract terms, while practical local ecological knowledge, such as forest regeneration practices, community irrigation systems, or traditional weather forecasting, remains unaddressed. This mismatch diminishes the relevance of ESD for indigenous learners and disconnects sustainability education from their lived experiences.

The exclusion of indigenous women's knowledge is particularly pronounced. Teachers acknowledged that the curriculum does not reflect the ecological expertise held by women, nor does it critically address gendered inequalities in environmental participation. This aligns with findings by Stromquist (2015), who observes that gendered knowledge is frequently sidelined within mainstream education. Consequently, girls and women in indigenous communities encounter limited institutional recognition of their ecological contributions.

Participants described this omission as discouraging for students who do not see their communities represented in the formal learning environment. Elders expressed concern that the lack of indigenous content in schools contributes to cultural erosion, weakening intergenerational bonds and diminishing the transmission of ecological wisdom. The absence of indigenous perspectives in ESD thus not only limits sustainability learning but also reinforces historical patterns of cultural marginalisation (Dei, 2018).

Language Hierarchies Reproduce Educational Inequities

Language emerged as a critical factor shaping access to and participation in sustainability learning. Both research sites rely heavily on indigenous languages for everyday ecological knowledge. Key environmental concepts-such as soil types, medicinal plants, or land rituals-are often embedded in local vocabularies that carry cultural and spiritual significance.

Participants explained that when instruction occurs in national or colonial languages, learners struggle to connect ecological concepts taught in school with their lived practices. Female participants particularly emphasised the reliance on the indigenous language for transmitting ecological knowledge to children. The disconnect created by linguistic hierarchies leads to a form of epistemic marginalisation that disproportionately affects women's knowledges, which are often orally transmitted and regionally specific (Kovach, 2009).

Teachers also reported facing challenges when translating indigenous ecological terms into national languages, as direct equivalents sometimes do not exist. This reinforces research arguing that language policy plays a decisive role in shaping whose knowledge is legitimised in education (De Sousa, 2014; Le Grange, 2016). Where indigenous languages are not recognised as legitimate mediums of instruction, the cultural and ecological

worlds of learners are obscured within formal education.

The findings suggest that linguistic exclusion contributes to educational inequity by reducing learner engagement, diminishing cultural pride, and narrowing the range of knowledge integrated into ESD. Teachers expressed a desire for bilingual or multilingual pedagogies that validate indigenous languages as vital components of sustainability learning.

Participatory Education Strengthens Gendered Ecological Knowledge

Contrary to schools where decision-making was centralised and curriculum remained rigid, the few schools with participatory governance exhibited more culturally grounded and gender-inclusive approaches to sustainability education. In these contexts, school committees included indigenous elders, women farmers, youth representatives, and community-based environmental practitioners. These committees met regularly to co-develop learning activities, adapt curriculum content to local needs, and organise community-based environmental workshops.

Participants reported that such participatory structures fostered a stronger sense of ownership and relevance in educational processes. Women described increased opportunities to share ecological knowledge through school gardening projects, medicinal plant demonstrations, and cultural festivals. These inclusive practices align with scholarship emphasising the importance of community participation in decolonising education (Battiste, 2013; Dei, 2018).

Students exposed to participatory and community-integrated ESD expressed greater interest in local ecosystems and a deeper appreciation of their cultural heritage. Teachers observed improvements in attendance, engagement, and comprehension, attributing these changes to the integration of familiar ecological contexts into learning content.

These findings underscore the potential of participatory models to challenge hierarchical structures and redistribute epistemic authority within education. By centring women's knowledge and enabling communities to shape educational content, participatory ESD fosters gender-sensitive learning environments that strengthen ecological resilience.

Integrating Indigenous Knowledge Enhances Sustainability Learning

Across interviews and FGDs, participants expressed strong support for integrating indigenous ecological practices into formal ESD. Teachers reported that students responded positively when lessons incorporated local examples such as crop rotation rituals, community forest management, and traditional weather indicators. These practices enhanced comprehension by grounding abstract sustainability concepts in familiar cultural and ecological experiences.

Furthermore, integrating indigenous epistemologies supported students' cultural identity development, reinforcing feelings of pride, belonging, and responsibility toward

their communities. This affirms the argument that culturally responsive education strengthens learner engagement and promotes sustainable community development (Kimmerer, 2013; Pretty et al., 2009).

Participants also noted that bridging indigenous and scientific knowledge can generate hybrid pedagogical models that enrich ESD. Teachers described using both local ecological observations and scientific explanations to discuss seasonal changes, water cycles, and biodiversity. This dual approach aligns with decolonial perspectives that argue for "epistemic pluralism," wherein multiple knowledge systems coexist and complement each other (Mignolo, 2018; De Sousa, 2014).

Finally, the findings indicate that integrating indigenous knowledge into ESD requires institutional support, including teacher training, curriculum adaptation, and policy-level recognition. Teachers stressed the need for professional development that equips them to engage respectfully and accurately with indigenous knowledge systems. Community members emphasised that sustainable educational reform demands structural commitment rather than surface-level inclusion.

DISCUSSION

The purpose of this study was to examine how indigenous ecological knowledge, particularly the gendered expertise of indigenous women, intersects with sustainability learning and the broader objectives of Education for Sustainable Development (ESD). Through interviews and focus group discussions conducted in two rural indigenous-majority regions, the research revealed systemic patterns of epistemic marginalisation, linguistic exclusion, and gendered inequities embedded within formal schooling. Simultaneously, the findings illuminated the transformative potential of participatory educational governance and the integration of locally grounded knowledge systems into formal ESD frameworks. The discussion below situates the findings within broader scholarly debates on decolonisation, gender justice, epistemic pluralism, and sociological theories of education. Five central arguments are developed: indigenous women's ecological knowledge challenges dominant paradigms of sustainability,

- formal educational systems continue to reproduce epistemic hierarchies rooted in coloniality,
- linguistic inequities undermine access to sustainability learning,
- participatory and community-driven ESD provides pathways toward structural transformation, and
- Knowledge pluralism must become a foundational principle of ESD reform.

Indigenous Women's Ecological Knowledge and the Reframing of Sustainability

The findings highlight that indigenous women serve as primary custodians of ecological knowledge in their communities, transmitting intergenerational wisdom on sustainable agriculture, biodiversity protection, water conservation,

and medicinal plant use. This aligns with extensive scholarly work documenting women's centrality in environmental stewardship across diverse indigenous contexts (Agarwal, 2010; Kimmerer, 2013). The knowledge practices described by participants-seed saving, crop rotation rituals, riverbank management, and herbal medicine-reflect holistic and relational understandings of sustainability that integrate ecological responsibility with social cohesion and cultural continuity.

From a sociological standpoint, the gendered distribution of ecological knowledge challenges mainstream ESD frameworks that prioritise technical or scientific conceptions of sustainability, divorced from local cultural experiences. Indigenous women's ecological knowledge is situated, meaning it arises from lived labour, relational engagement with ecosystems, and embodied experience-qualities often dismissed as "informal" or "traditional" within Western epistemological hierarchies (Battiste, 2013; Dei, 2018). This dismissal is not merely misrecognition, but a form of epistemic injustice, in which gendered and racialised knowledge-holders are systematically devalued (Fricker, 2007).

The findings, therefore, challenge policymakers, educators, and sustainability scholars to reconsider who counts as an expert within ESD. Indigenous women's knowledge does not merely supplement scientific sustainability frameworks-it expands and complicates them. It reframes sustainability as a relational ethic grounded in reciprocity, community responsibility, and ecological care. This challenges the anthropocentric, developmentalist models of sustainability that dominate global discourse (De Sousa, 2014; Le Grange, 2016). In doing so, it supports calls for gender-transformative ESD that acknowledges women as active contributors rather than passive beneficiaries (Stromquist, 2015).

Colonial Legacies and the Reproduction of Epistemic Hierarchies in ESD

A central theme emerging from the data is the persistence of epistemic hierarchies in formal education. National curricula and textbook content overwhelmingly privilege Western scientific knowledge, universalised environmental models, and urban-centric examples. This mirrors the academic critiques articulated by Smith (2021) and Mignolo (2018), who argue that coloniality, defined as the enduring patterns of power, knowledge, and being formed through colonial histories, continues to structure educational institutions.

Participants' observations that formal curricula marginalise indigenous ecological knowledge confirm the continued dominance of a "single story" of knowledge within ESD. Western epistemologies are valorised as objective and universal, while indigenous knowledge systems are treated as anecdotal, localised, or insufficiently rigorous. This hierarchy has material consequences. It shapes the design of assessment systems, teacher professional development, and classroom practices, producing a curriculum that is simultaneously alienating for indigenous learners and unrepresentative of their lived realities.

The exclusion of women's ecological knowledge further amplifies gendered forms of epistemic injustice. Although indigenous women are the primary environmental practitioners in their communities, their expertise is absent in ESD. This remains consistent with feminist analyses showing that gendered labour, particularly care work, environmental stewardship, and community maintenance routinely devalued within formal institutions (Hooks, 2015; Agarwal, 2010). This invisibility reinforces patriarchal norms and limits opportunities for girls to see themselves represented as knowledge-holders within environmental learning.

The findings, therefore, reflect a broader sociological critique: formal education remains a site where colonial epistemologies are reproduced rather than challenged. The structures of schooling-curriculum design, language policy, assessment, and teacher training continue to privilege Western scientific knowledge in ways that systematically marginalise indigenous epistemologies. Without addressing these structural conditions, ESD will inevitably reproduce inequalities rather than dismantle them.

Language Hierarchies as Barriers to Sustainability Learning

Language emerged as one of the most significant barriers to integrating indigenous ecological knowledge into ESD. Participants repeatedly noted that local ecological vocabulary-names of medicinal plants, soil types, water cycles, and farming rituals-is embedded in indigenous languages. When the medium of instruction is a national or colonial language, this knowledge is rendered invisible or untranslatable.

Sociological research on language and education argues that linguistic hierarchies are a fundamental mechanism for reproducing inequalities (De Sousa, 2014). When the language of schooling does not align with the linguistic practices of students or communities, learners experience alienation, reduced participation, and lower academic attainment. The findings of this study extend this argument to ESD: linguistic exclusion not only impedes comprehension but also erases ecological knowledge systems grounded in indigenous languages.

Teachers reported difficulties translating indigenous ecological concepts into the national language, noting that many environmental terms have no direct equivalents. For example, certain words for soil fertility, rainfall patterns, or plant properties carry spiritual or cultural connotations that English or national languages fail to capture. This aligns with Kovach's (2009) argument that indigenous epistemologies are deeply embedded in linguistic practices, making linguistic assimilation a form of epistemic erasure.

In addition, gender intersects with linguistic hierarchies. Women, who are often less fluent in national or colonial languages due to historical educational inequities, face greater barriers in participating in school–community dialogues. As a result, the epistemic authority of indigenous women is doubly undermined, first by patriarchal norms and second by language policy. This reveals that sustainable education cannot be achieved through monolingual models of

schooling. Instead, multilingual pedagogies that legitimise indigenous languages as mediums of ecological knowledge are necessary for equitable and culturally relevant ESD.

Participatory Governance as a Pathway to Transformative ESD

One of the most promising findings of this research was the transformative potential of schools that adopted participatory governance structures. In settings where curriculum and decision-making processes included indigenous elders, women farmers, youth representatives, and community environmental practitioners, ESD became more culturally grounded, gender-inclusive, and locally relevant.

These results support the work of scholars who argue that community participation is essential for decolonising educational structures (Battiste, 2013; Dei, 2018). Participatory governance redistributes power within education by granting communities external policymakers the authority to shape learning content and practices. This stands in contrast to top-down ESD approaches that impose standardised content without regard for local knowledge systems. The data showed that participatory ESD had several benefits:

- Enhanced student engagement, as learners recognised their lived experiences reflected in the curriculum.
- Greater representation of women's ecological knowledge, as women were invited to share expertise in medicinal plants, sustainable agriculture, and resource management.
- Strengthened school–community relationships, resulting in collaborative sustainability projects.
- Increased cultural pride and identity, supporting holistic well-being and learning.

From a sociological perspective, participatory governance represents a shift from schooling as a site of cultural assimilation to schooling as a site of cultural affirmation. It challenges the hierarchical relation between "expert" knowledge produced by formal institutions and "local" knowledge produced by communities. When communities are decision-makers rather than passive recipients, education can become a tool for cultural revitalisation and ecological resilience.

Toward Knowledge Pluralism in ESD

The findings collectively point to a central argument: ESD must adopt a knowledge-pluralist approach to sustainability. Knowledge pluralism refers to the recognition that multiple ways of knowing-scientific, indigenous, experiential, relational, and spiritual- are valid and necessary for addressing complex global sustainability challenges (De Sousa, 2014; Mignolo, 2018).

Integrating indigenous knowledge does not entail romanticising traditional practices or rejecting scientific knowledge. Rather, it involves recognising the epistemic integrity of indigenous worldviews and fostering dialogue across knowledge systems. Participants in this study offered

numerous examples of how integrating scientific explanations with local ecological practices created richer and more meaningful sustainability learning. Teachers described using both indigenous weather forecasting and scientific climate models to teach about seasonal change, demonstrating that hybrid pedagogies can promote conceptual understanding and critical thinking.

Knowledge pluralism also requires expanding the epistemic boundaries of what counts as "curriculum." Indigenous ecological knowledge often takes place outside classrooms, fields, forests, rivers, and communal gatherings. Recognising these spaces as legitimate sites of learning challenges the physical and conceptual limitations of formal education.

Finally, knowledge pluralism is inseparable from gender justice. A truly inclusive ESD must foreground the voices, experiences, and ecological expertise of indigenous women, who hold critical knowledge not captured by mainstream sustainability frameworks. This requires not only curricular reform but structural transformation of power relations within educational systems.

Implications for Policy, Practice, and Research

The findings offer important implications for educational policy, school practice, and future research. National ESD policies should explicitly mandate the inclusion of indigenous ecological knowledge and multilingual learning practices. Educational ministries must collaborate with indigenous communities, particularly women's groups, when developing sustainability curriculum. Teacher training institutions should incorporate indigenous epistemologies and gender-sensitive pedagogy into professional development programmes. Governments must address structural barriers-such as colonial language policies and centralised curriculum frameworks-that undermine equitable ESD. Schools should adopt participatory governance systems that include women knowledge-holders as core contributors. Teachers should use place-based and experiential pedagogies that reflect local ecological practices. Curriculum materials should be co-developed with community members to ensure cultural relevance. Multilingual approaches should be integrated into classroom instruction to support conceptual understanding and cultural continuity.

Future Research

Further studies could explore comparative analysis across different indigenous communities to identify diverse models of gendered ecological knowledge. Longitudinal studies could examine the long-term impact of culturally grounded ESD on student outcomes, community resilience, and ecological practices. Quantitative or mixed-methods research could assess how participatory governance influences educational equity metrics.

This discussion demonstrates that indigenous ecological knowledge, particularly the gendered knowledge held by women, is indispensable to the pursuit of truly transformative ESD. Yet structural, curricular, and linguistic barriers continue to

marginalise these knowledge systems. The findings argue for a paradigm shift toward knowledge pluralism, participatory governance, and gender-inclusive pedagogies that honour the wisdom embedded in indigenous ecological practices. Only through such a shift can ESD move beyond its colonial and technocratic legacies and become a genuinely transformative framework capable of advancing cultural, ecological, and gender justice.

CONCLUSION

This study demonstrates that indigenous women's ecological knowledge is indispensable to sustainable community life, yet remains systematically undervalued within formal educational structures. Education for Sustainable Development (ESD) must therefore incorporate indigenous epistemologies not as supplementary content but as central components of sustainability pedagogy. Findings reveal that when indigenous knowledge, particularly women's ecological expertise excluded from curricula, educational systems reproduce colonial hierarchies, epistemic injustice, and gendered exclusions. Conversely, integrating these local knowledge systems enriches students' understanding of sustainability, strengthens community identity, and enhances ecological resilience.

Structural barriers such as exclusionary language policies, patriarchal norms, and urban-centric curricula continue to limit the recognition and transmission of indigenous knowledge. Addressing these inequities requires a shift toward participatory educational governance in which communities, especially women, are active partners in shaping school policies and curriculum design. By positioning indigenous women as knowledge leaders, ESD can adopt more culturally grounded, gender-just, and environmentally responsive practices.

This research argues that knowledge pluralism-the recognition of multiple, culturally situated ways of knowing-is essential for transformative ESD. Sustainable futures cannot be achieved through singular, Western-driven frameworks; instead, they demand dialogic, relational, and context-specific approaches informed by indigenous wisdom. Ultimately, re-centring indigenous epistemologies within ESD advances not only ecological sustainability but also gender equity, cultural revitalisation, and educational justice. This paradigm shift is crucial for realising the broader aims of the 2030 Agenda and ensuring that ESD contributes meaningfully to social transformation.

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Conflicts of Interest

The author declares no conflicts of interest.

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