


Indigenous cartography and cultural ecology in comparative education: Toward transdisciplinary and practice-oriented methodologies

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DOI: <https://doi.org/10.70830/iejcp.2401.20903>

This paper reconsiders the concept of cultural ecology through a comparative education lens, introducing a novel methodological approach for engaging with Indigenous knowledge systems. Building on the interdisciplinary foundations of cultural ecology, the study employs international and intercultural comparison to examine how Indigenous educational beliefs and practices shape cultural-ecological adaptations and relationships with the environment—including ecosystems and geographical landmarks recognised as legal entities. The methodological innovation of Indigenous Cartography is explored within multiepistemic and holistic worldview frameworks, addressing the challenges of integrating Indigenous perspectives into comparative educational research. Guided by Kemmis' framework of Practice Architectures, the analysis reveals how educational practices and cultural-ecological adaptations are co-constructed through contextual conditions and aspirational transformations. By carefully engaging with Indigenous knowledge systems while safeguarding sacred traditions, the study demonstrates how comparative education can foster cultural ecological stewardship, defend Indigenous cultural rights, and promote sustainable and culturally sensitive futures. Ultimately, the paper advocates for a shift toward ethically grounded, multiepistemic approaches in comparative education research.

Keywords: *cultural ecology; Indigenous knowledges; Mother Earth as legal entity; Indigenous cartography; Indigenous methodologies*

INTRODUCTION: SYNERGY OF EDUCATION AND RESPONSIBILITY

Humanity is perceived as part of a web of life, and the relationship between humans and nature is seen as symbiotic: from the natural environment Indigenous populations get their subsistence and autonomy, at the same time often contributing to its conservation. (Mazzocchi, 2018, p. 22)

This paper begins by examining the dynamic relationship between teacher and student and the synergy that arises from education as a catalyst for imagination and intellectual growth. Regardless of their educational backgrounds, levels of privilege or the fact that neither author originates from the country where they met, studied or worked, what matters most is the serendipitous encounter that sparked an ongoing dialogue about a shared moral imperative. This imperative called on the authors to identify, witness and amplify the voices of Indigenous

communities—widely recognised as vital stewards and custodians of nature—who safeguard the ecosystems that sustain us all, a role increasingly recognised in scholarly literature for its basis in relational knowledge systems that promote long-term ecological stewardship (Berkes, 2012; Whyte, 2017).

Acknowledging the authors' dual roles as observers (outsiders) and participants (insiders) in this research, they recognise that scholarly inquiry is never entirely objective. A scholar's perspectives, positionalities and biases inevitably shape the research process, influencing the questions asked and the interpretations derived and expounded. The co-author was introduced to cultural ecology by Professor Rappaport in the 1980s, a concept he later applied in a 2016 study on cultural ecology and isomorphism. These accumulative engagements have informed the authors' current reconsideration of cultural ecology, tracing its evolving trajectories in contemporary discourse. The first author, drawing on academic experiences from a European higher education institution, integrates an Indigenous perspective from a South American context. This positionality inevitably influences the authors' research, shaping their interpretations and insights.

While both researchers strive for scholarly rigour and methodological precision, they grappled with two central considerations: the significance of developing new methodological approaches in comparative education and the intended audience of scholars and practitioners seeking to engage respectfully with Indigenous knowledge systems. Rather than reporting on empirical research, the authors aim to advance a theoretical and methodological framework—an ontological Indigenous cultural ecology—rooted in Kemmis' (2019) Practice Architectures. Epistemologically, their work is informed by Wenger's (1998) concept of *Communities of Practice*, which positions learning and knowledge as emergent from social participation, shared meaning-making and collective identity. Together, these frameworks provide a systematic lens for understanding how diverse cultures interpret and uphold Mother Earth as a legal entity, a perspective increasingly recognised in both legal and ecological scholarship. The authors purposely chose to be this specific to highlight how diverse or similar Indigenous knowledges may approach such phenomena.

By focusing on a select range of Indigenous voices and contexts, this paper seeks to illuminate the importance of cultural differences, the role of Indigenous communities as environmental stewards and the collective responsibility to ensure that future generations inherit a thriving world. The authors' analysis underscores the value of Indigenous perspectives in shaping cultural-ecological stewardship and rights of nature and highlights the need for methodological innovation in comparative education to better honour and integrate these worldviews

CONTEXTUALIZING CULTURAL ECOLOGY STUDY

Cultural ecology emerged as a significant development within anthropology (Netting, 1986) and has since expanded to intersect with other social sciences due to its focus on human behaviour within environmental contexts. Rappaport's *Pigs for the Ancestors* (Rappaport, 2000) pioneered a distinctive approach to measuring how cultural practices were critical to the ecosystem of Papua New Guinea. He studied the Tsembaga, where pig hunting played a vital role in sustaining the community and the biodiversity of the forest.

Subsequent research has built on these foundational insights, integrating Indigenous knowledge into cultural ecology frameworks. Mazzocchi (2008), Merlan (2009) and Connell (2020) have highlighted the convergence of cultural ecology and indigeneity. Baleé (2013), for example,

examined how the Ka'apor of the Amazon practised sustainable land management by periodically clearing and burning small forest areas for cultivation, allowing for natural regeneration to occur. Hunn (1990) explored the Upper Columbia Plateau Salish communities' intricate ecological relationships through salmon fishing, demonstrating how Indigenous practices contribute to ecological balance.

These studies underscore the need to redefine cultural ecology through an Indigenous Knowledge (IK) lens, moving beyond predominantly Western ecological frameworks toward a more holistic, dynamic and relational understanding of human-environment interactions. As the world grapples with extreme weather conditions, climate action failure, biodiversity loss and environmental degradation (World Economic Forum, 2020), it is increasingly urgent to integrate Indigenous ecological knowledge into global environmental strategies.

Interdisciplinary connections: Bringing the insider and outsider perspectives

From an outsider's viewpoint, disciplines such as anthropology, sociology and psychology are often viewed as distinct fields with specialised methodologies. In Rappaport's era, cultural anthropology was expanding rapidly, with scholars such as Levi-Strauss and Margaret Mead studying human cultures and societies through ethnographic methods. However, Trahar (2013) critiqued the dominance of Western theoretical paradigms—such as postmodernism, post-structuralism and social constructionism—which may not always align with Indigenous knowledge systems.

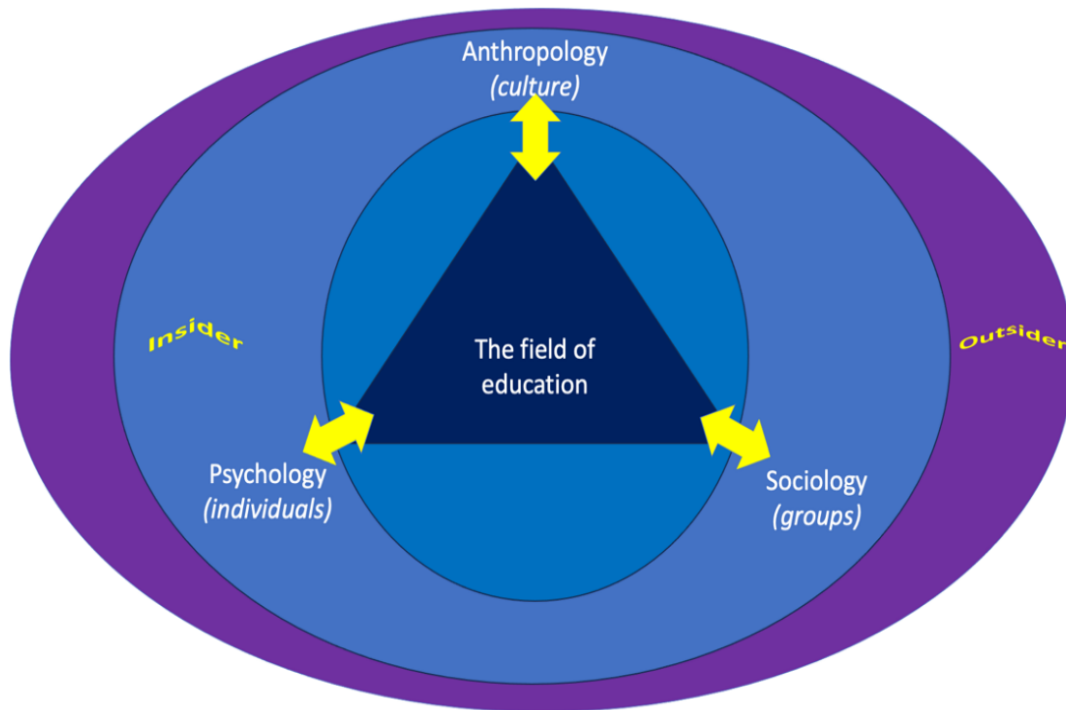
In comparative education research, the role of the outsider is significant, offering a broader vantage point to analyse educational phenomena. This perspective enables cross-cultural analysis, but it also carries the risk of bias or misrepresentation. Historically, Indigenous communities have often perceived outsider viewpoints as discriminatory or uninformed. Hoffman (1991) noted that the issue of authenticity remains central to anthropological self-examination, while Tomaselli et al. (2008) warned against 'paradigmatic fundamentalism', where scholars rigidly adhere to inherited theoretical frameworks, potentially obscuring and denying Indigenous perspectives and approaches.

Conversely, an insider perspective offers an embodied understanding of Indigenous knowledge systems. Insider researchers are often hesitant to impose external theories or methodologies that may not align with the lived realities of their communities. Shawn Wilson, in *Research is Ceremony*, emphasised 'relational accountability', framing research as a ceremony that nurtures a profound connection between the researcher and the cultural environment (Reich et al., 2017). Similarly, Bray et al. (2014) advocated for a research process that is deeply contextualised and personalised, ensuring that Indigenous voices are represented authentically.

The disciplines of anthropology, sociology and psychology each contribute to an understanding of cultural ecology. Yet, their traditional disciplinary boundaries have often led to tensions between positivist approaches and cultural relativism. Anthropology offers a holistic view of human societies within their historical and geographical contexts. Sociology examines social structures, inequalities and community dynamics. Psychology delves into cognition, emotion and individual behaviour. The integration of these disciplines, particularly in education, offers a more comprehensive approach to understanding cultural norms, social interactions and environmental stewardship (Figure 1). The overarching problem is how best to describe Indigenous knowledges as comparative units of analysis without reducing their complexity or imposing external frameworks.

This concern becomes even more pressing in the context of globalisation, which continues to reshape the ways Indigenous knowledge systems are studied and understood. Buchanan and Hellstén (2020) critically examine these global influences, highlighting the tensions between cultural sensitivity and the risk of research biases. Their work highlights the importance of methodological reflexivity, ensuring that research does not merely extract knowledge from Indigenous communities but instead fosters a reciprocal exchange that respects cultural autonomy.

Figure 1: Relationship between the field of education and the social sciences



Source: Denman, B., & James, R. (2016). Cultural ecology and isomorphism applied to educational planning in China's Inner Mongolia: A new rubric. *International Journal of Comparative Education and Development*, 18(1), 40–52

Bridging perspectives for a sustainable future

The tension between insider and outsider perspectives in cultural ecology underscores a need for methodological innovation and ethical research practices. Medina (2017) critiqued the silencing of marginalised voices in academic discourse, while Kingston et al. (2021) and Moore (2023) advocated for research approaches that drive social change and mitigate power imbalances. These perspectives reinforce the necessity for critical reflexivity in navigating complex power dynamics in research.

The relationship between culture and environmental perception has long been recognised in environmental philosophy and geography. Passmore (1974), for instance, was among the early scholars to critique anthropocentric frameworks in Western thought, arguing that environmental ethics are deeply shaped by cultural traditions and lasting ecological responsibility requires rethinking the philosophical foundations of human-nature relationships. His work laid the groundwork for acknowledging that environmental attitudes are not universal but emerge from culturally specific worldviews.

More recently, Casinader (2021) revisited these themes within the context of sustainability education, contending that concepts such as sustainability are themselves culturally mediated and cannot be treated as monolithic. He emphasised that transformative environmental and sustainability education must recognise and include diverse epistemologies—particularly those grounded in Indigenous and local traditions—if they are to support genuine ecological and social change. This view aligns with the authors' call for Indigenous Cartography as a framework that foregrounds epistemic plurality and place-based understandings of sustainability.

Within this discourse, education—as an inherently interdisciplinary field—serves as a crucial bridge, facilitating connections and dialogues that might not otherwise emerge across disciplinary boundaries. Anthropological studies may draw on psychological theories to understand cultural behaviours, while sociological research can integrate insights into identity and group dynamics. Yet, these disciplines often remain constrained by methodological silos. In contrast, comparative and international education opens space for more integrative frameworks, particularly at the intersection of cultural ecology and Indigenous knowledge, where a balance between local specificity and global applicability is essential.

Indigenous knowledge systems are grounded in holistic worldviews, emphasising interconnectedness, sustainability and long-term ecological balance. As Tuhiwai Smith (2012) asserted, Indigenous epistemologies should not be subordinated to Western academic frameworks but rather embraced as integral to knowledge production. Diversity of knowledge can thus be equated to eco-diversity. Turner (2003) equated this with a fraternal coexistence and care for our common home, Mother Earth. He stated, '[t]hese communities maintain that their way of understanding the world is valuable for survival and a sustainable future, expressed not as a voice of arrogance but of empirical affirmation (p. 237). By aligning cultural ecology with Indigenous knowledge in comparative education, this study proposes a new methodology through Indigenous Cartography. It may not necessarily address scholarly concerns about ecological threats that affect the planet discussed by Ytterstad (2020) or the justice-oriented frameworks aimed at reducing power imbalances and safeguarding marginalised voices as articulated by Kingston et al. (2021), but it seeks to advocate for a broader, more global and inclusive understanding of cultural ecology.

Reconsidering cultural ecology from both insider and outsider perspectives contributes to a more equitable and sustainable approach to environmental stewardship. The introduction of this methodological and comparative tool could systematically identify and analyse Indigenous approaches to Mother Earth, understood not merely as a resource but also as a legal and relational entity. This work underscores the imperative to respect Indigenous knowledge systems, acknowledge historical injustices and foster collaborative international research that honours the voices of those who have long safeguarded the planet's ecosystems.

DIFFERENTIATION IN RESEARCH EPISTEMOLOGIES

Indigenous knowledge systems

IK systems embody rich and dynamic traditions that are deeply rooted in the cultural, social, and ecological contexts of Indigenous communities. Far from being static or antiquated, this knowledge is living, evolving and intimately tied to the values of communal living, biocentrism and responsibility toward the natural world (LaDuke, n.d.; Melgarejo & Vivar, 2022; Smithers, 2019; Windchief & Ryan, 2019). It encompasses traditional ecological knowledge, healing practices, agricultural methods, storytelling, spirituality and governance structures, reflecting sophisticated ways of knowing and sustaining life.

A defining feature of IK is not only *what* is known but also *how* knowledge is analysed, stored, transmitted, and protected. Knowledge is often passed orally through stories, legends, ceremonies and lived practice (Cajete, 2000; Melgarejo & Vivar, 2022), but access to it is highly contextual. Some knowledge is gendered, age-restricted, family-specific or reserved for ceremonial leadership. In many communities, sacred knowledge is accessible only through specific initiations or responsibilities, remaining private to protect its spiritual and cultural integrity. Consequently, the IK available to external researchers typically represents only a small, public-facing portion of a much broader and more complex epistemological world.

Understanding IK, therefore, requires a multi-epistemic orientation (Garroute, 1999, cited in Andreotti, 2011), one that recognises diverse ways of knowing, respects boundaries around sacred knowledge and acknowledges Indigenous authority over what is shared. Indigenous peoples, often referred to as ‘Guardians of the Earth’ (Moore & Nesterova, 2020), sustain environmental stewardship practices embedded within these knowledge systems, governed by ethical frameworks that prioritise intergenerational responsibility and relationality with the natural world.

Historically, IK has been marginalised within Western scientific paradigms, often due to epistemological biases and extractive research practices (Hunn, 2020). However, scholars such as Linda Tuhiwai Smith (2012), Margaret Kovach (2009) and Graham Hingangaroa Smith (2000) have challenged these dynamics, advocating for research methodologies that are decolonised, relational and guided by Indigenous protocols and priorities.

Conventional research methods

Creswell (2012) and Bryman (2021) emphasised that qualitative research seeks to accurately represent participants’ narratives, a crucial responsibility given the complexity of human consciousness and experience. Ethnographic research exemplifies qualitative inquiry, allowing researchers to immerse themselves in real-world experiences (Bryman, 2021). Blevins (2017) noted that this approach provides a comprehensive understanding of participants’ interactions, settings and unfolding events. Rivas and Gibson-Light (2016) further highlighted the use of interviews to explore attitudes, emotions, motives and judgments.

Quantitative research, however, focuses on generalisability and standardisation (Patten, 2017). It employs structured surveys, experiments, and questionnaires to collect, analyse and interpret data. Grounded in the positivist tradition, quantitative methods seek to identify patterns, relationships, correlations and causality within specific populations, viewing social reality as an external and objective phenomenon (Clark et al., 2021).

Contrast and common ground

Research methodologies that align with Indigenous ontologies and epistemologies must move beyond cultural or geographical distinctions to accurately represent Indigenous experiences, practices and voices. While qualitative and quantitative approaches are mostly Western-centric and offer valuable insights, their differing goals and perspectives often limit the full integration of Indigenous worldviews.

Table 1 outlines the epistemological contrasts between IK systems, positivist approaches and naturalistic approaches across four dimensions: epistemological beliefs and purpose, types of knowledge and ways of knowing, sources of knowledge and evidence, and justification of knowledge. IK emphasises relational, community-centred, and experiential ways of knowing,

often transmitted through oral traditions and lived practice. In contrast, positivist approaches prioritise empirical and objective evidence gathered through detached observation. Naturalistic approaches, although more flexible, maintain a Western-centred focus on interpretation and individual researcher reflexivity. The comparison of approaches highlights that Indigenous epistemologies cannot simply be adapted into existing Western paradigms but require distinct recognition and frameworks that honour their unique ontological grounding.

Table 1: Epistemologies of Indigenous knowledges, positivist & naturalistic approaches

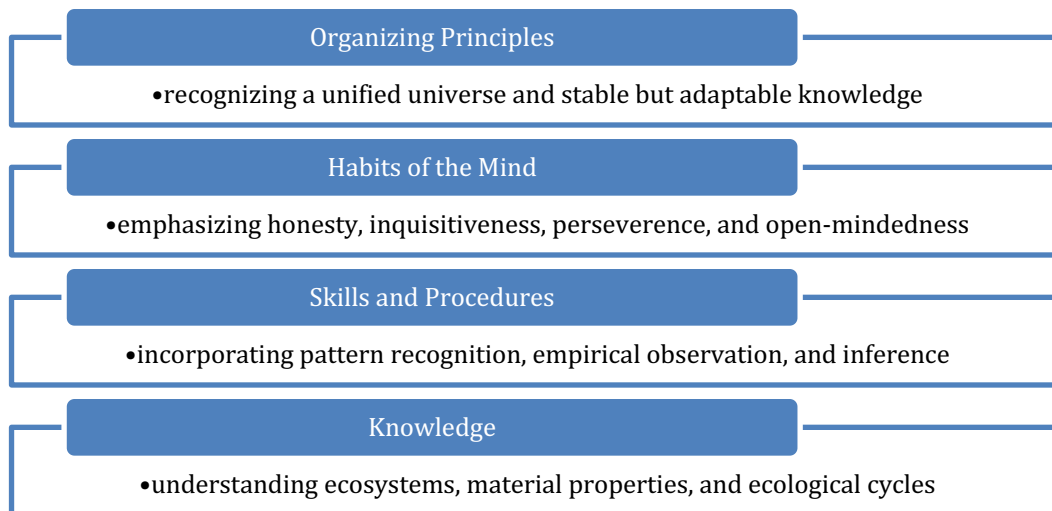
Epistemology	Indigenous knowledges*	Positivist (quantitative) approaches**	Naturalistic (qualitative) approaches***
Epistemological beliefs and purpose	Holistic; to include the physical and metaphysical worlds, which are linked to moral codes	Incremental; to produce a data-driven, interpretable description of the process by which humans form and adapt their beliefs and understanding of the world	Differentiated; The <i>sine qua non</i> is a commitment to seeing the social world from the point of view of the actor; attributed to phenomenology, <i>Verstehen</i> and symbolic interactionism
Types of knowledge and ways of knowing	Knowledge as narrative, interpretative, and critical; knowledge is inherent to object and represents values that may be shared or individually held	Knowledge as mechanistic; believed to be objective and replicable. Knowledge is acquired via the scientific method (inclusive) or identification of falsehoods (deductive)	Knowledge as contingent and complex; knowledge seeks causality; relies on behaviour, variability, context and socially held norms
Sources of knowledge and evidence	Concrete examples of products or artefacts that acknowledge or privilege Indigenous ways of knowing and being	Research evidence and evidence-based practice based mostly on theory	Objective sources of data and information based on suppositions, including documentation, archival records, interviews, direct observation, participant observation and physical artefacts
Justification of knowledge, knowing	Seeks to preserve knowledge and to guard against misappropriation or misuse of Indigenous knowledges; a demarcation of useful and useless knowledge	Seeks to generate knowledge and create an understanding of and about the social world; to observe situations or events that affect people	Seeks to rationalize what can be extracted from reality; assumes some particular external world truths, and appeals to the nature of what is known rather than the nature of knowledge itself

Sources: * Althaus, 2019; Agrawal, 2020; Chapin, Cochran, Huntington, & Ray, 2013; Miller et al., 2008. ** Miller et al., 2008; van der Schaar, 2013. *** Bryman, 1984, pp. 77–78; Dahlberg, 2018; Miller et al., 2008; Stanford Encyclopedia of Philosophy, 2021.

In comparative and international education research, this contrast reflects the need for methodologies that respect Indigenous ontologies and epistemologies. These methodologies should acknowledge complexity, facilitate intercultural dialogue and adopt a transdisciplinary

perspective (Crossley & Tikly, 2004). They must also encourage ongoing reflection throughout the research process (Iphofen & Tolich, 2018) to prevent distortion and misappropriation (Creswell, 2012) (Figure 2).

Figure 2: Commonalities between Indigenous, positivist (quantitative), and naturalistic (qualitative) research methodologies



At the heart of both Indigenous and Western scientific traditions lie foundational dimensions that offer opportunities for meaningful dialogue and integration. Both knowledge systems are guided by organising principles that recognise a unified universe and value knowledge that is stable yet adaptable to new contexts. They emphasise habits of mind, such as honesty, inquisitiveness, perseverance and open-mindedness-qualities that foster learning and respect for diverse perspectives. Additionally, both traditions rely on skills and procedures, such as pattern recognition, empirical observation and inference, to interpret the world. Ultimately, the pursuit of knowledge in each context involves understanding ecosystems, material properties and ecological cycles, though the epistemological lenses may differ.

Recognising these shared dimensions does not diminish the profound differences between Indigenous and Western paradigms, particularly in terms of power dynamics and cultural identity (Tuhiwai Smith, 2012). Instead, it highlights the potential for methodologies that honour both the uniqueness and the common ground of these traditions, supporting ethical, respectful and contextually relevant research.

Exploring outsider and insider perspectives is crucial to bridging Indigenous and conventional knowledge systems. However, as Tuhiwai Smith (2012) argued, IKs are deeply intertwined with power dynamics, cultural identity and sociocultural contexts. This complexity necessitates a more nuanced approach to integrating Indigenous and Western epistemologies.

Finding commonalities in Indigenous peoples and knowledges

Globally, Indigenous peoples number approximately 476 million and encompass more than 5,000 unique cultures. Their ancestral lands represent at least 28% of the planet's landmass, possess unique ecologies, and provide biodiversity essential to preserving the ecological balance of the planet (Buchholz, 2022; Planet Anomaly, 2023). Their knowledge is not passive but actively shapes cultural and environmental sustainability (Connell, 2020; Jonuscheit, 2015).

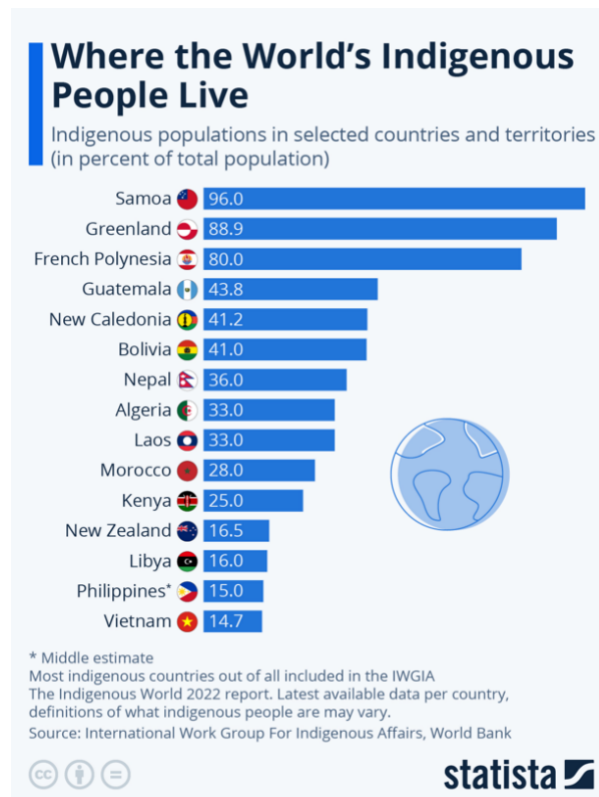
For Indigenous communities, ‘community’ extends beyond human relationships to include all life forms, emphasising harmony with Mother Earth (Settee, 2011). This connection, often perceived as mystical, is deeply relational and manifests as a lived experience rather than a set of guidelines (Moore & Nesterova, 2020; Shinkfield, 2024).

Methodologies that engage with IK must recognise the significance of place, language and narrative (Richardson, 2015; Sanga et al., 2024). Moving beyond conventional methods allows researchers to embrace reciprocity, cultural humility and respect for life itself. However, the privileging of a single disciplinary or epistemological perspective constrains the diversity of scientific and local knowledge systems (Miller et al., 2008). The historical dominance of Western epistemology, particularly in Aboriginal and Torres Strait Islander communities, has stifled Indigenous ways of knowing and being (Althaus, 2020).

To counteract this, research must embrace epistemological pluralism and transdisciplinarity (Miller et al., 2008). This approach fosters inclusion, navigates complexity and promotes social justice (Khoo et al., 2019). Rather than applying a reductionist framework, it enhances multidimensional analysis while encouraging scholars to engage critically with diverse epistemologies (Aguilar, 2018).

A critical component of this framework is recognising a core principle of IK systems: a deep reverence for Mother Earth, recognised as a legal entity with intrinsic rights. Concepts such as *Sumak Kawsay* (Good Living) in South America (Avendaño, 2010), *Pachamama* in Andean and Amazonian cultures, *Dadirri* in Aboriginal Australian traditions (Ungunmerr-Baumann et al., 2022), and *Turtle Island* in Native American worldviews illustrate how Indigenous communities steward cultural ecology. Recognising the Earth as a living entity necessitates a shift towards environmental harmony and sustainability (Figure 3).

Figure 3: Percentages of the largest 15 Indigenous Populations in the World



Source: Buchholz, K. (2022). Where the world's Indigenous people live. *Statista*.

<https://www.statista.com/chart/18981/countries-with-the-largest-share-of-Indigenous-people/>

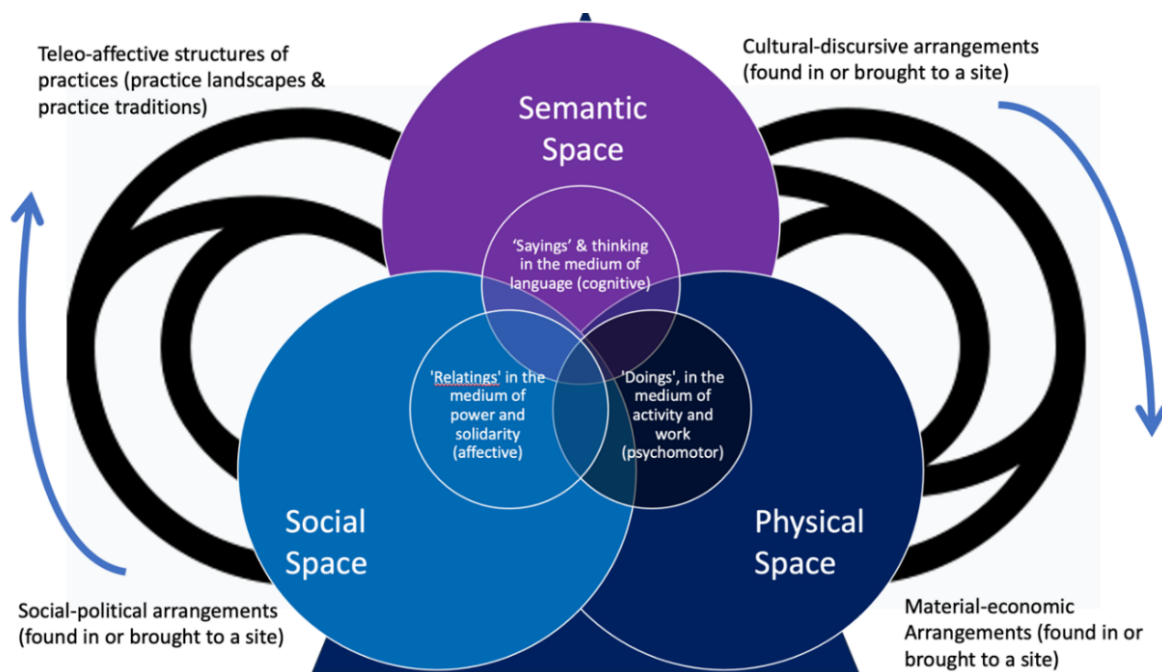
THEORETICAL FOUNDATIONS ON KEMMIS'S PRACTICE ARCHITECTURES AND WENGER'S COMMUNITIES OF PRACTICE

Research methodologies that seek to align with Indigenous worldviews must respect diverse ways of knowing and provide a systematic framework that acknowledges the interconnections between knowledge, practice and community. To this end, this study draws on Kemmis's Practice Architectures and Wenger's communities of practice to conceptualise Indigenous practices of preserving Mother Earth.

An attempt has been made to employ Kemmis's Practice Architectures, recognising that the act of practice in celebrating Mother Earth offers: (1) an acknowledgment of Indigenous practices in preserving Mother Earth in their respective ways, and (2) a systematic research framework that celebrates cultural diversity and embraces sustainability of and for the planet (Figure 4).

Kemmis's framework conceptualises practice through three interrelated spaces: the Semantic Space, the Social Space and the Physical Space. The Semantic Space involves 'sayings'—the shared language, narratives and cultural-discursive arrangements that shape how knowledge and meaning are constructed within communities. The Social Space encompasses 'relatings'—the affective and power-laden relationships that organise social solidarity and governance. The Physical Space refers to 'doings'—the material-economic arrangements and embodied activities through which practices are enacted. These spaces overlap and interact dynamically, shaped by broader practice landscapes and traditions, illustrating how language, power and materiality collectively enable or constrain Indigenous environmental practices.

Figure 4: Modified version of Kemmis's Practice Architectures



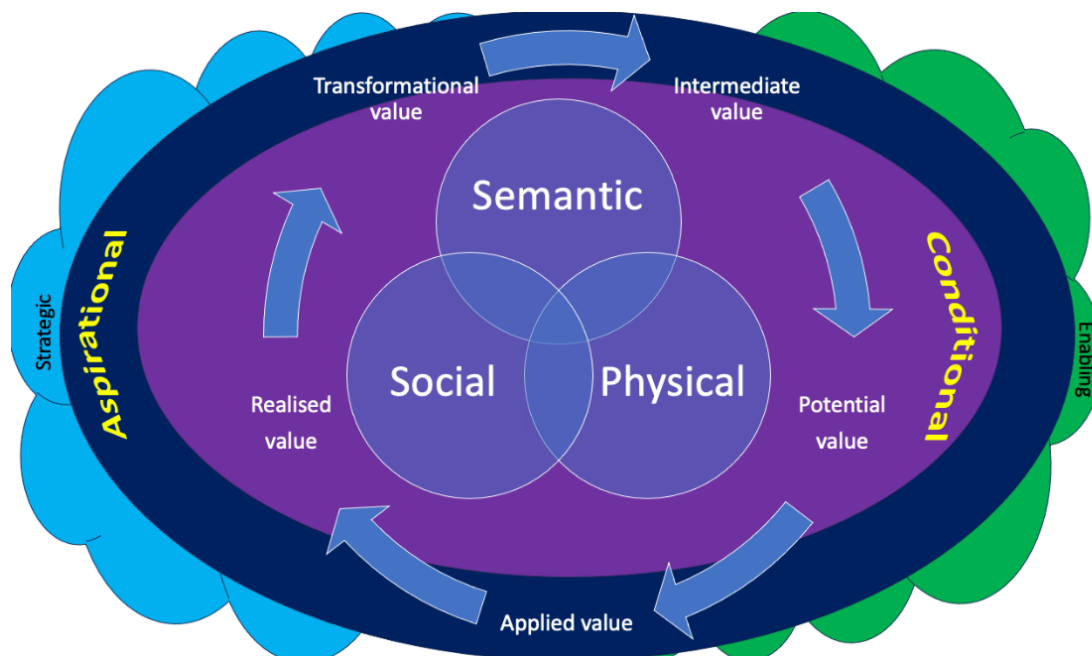
Source: Adapted from Kemmis, S., & Grootenboer, P. (2008). Situating praxis in practice: Practice architectures and the cultural, social and material conditions for practice. In *Enabling praxis* (pp. 37–62). Brill Sense.

As previously indicated, attempting to subsume all IKs into a single entity is fraught with contestation and divisiveness due to issues of identity, place, space and context. By focusing on select IKs and how they frame, celebrate and engage with Mother Earth, Kemmis's Practice Architectures allow for the systematic codification of 'sayings', 'doings', and 'relatings'. This provides units of comparison and helps articulate a collective voice that celebrates diversity, particularly in comparative educational research aligned with scholars' theoretical and epistemological perspectives (Rios & Patel, 2023).

Complementing this ontological perspective, Wenger's Communities of Practice framework (Figure 5) emphasises the social and epistemic dimensions of learning and identity formation within Indigenous communities. Wenger's model highlights how knowledge is co-constructed through mutual engagement, joint enterprise and shared repertoire, underscoring the centrality of identity, place and aspiration in shaping Indigenous ways of knowing. This framework recognises that learning and practice are deeply embedded in social relationships and communal participation, reflecting the lived realities of Indigenous peoples.

What is particularly interesting about Wenger's model is its capacity to support a nuanced analysis of community dynamics through several key aspects, including *conditional aspects*, which refer to the social, cultural, historical and environmental contexts shaping community life; *aspirational aspects*, reflecting the visions and values that guide collective goals; *enabling aspects*, encompassing the practices and conditions that support learning and identity; and *strategic aspects*, highlighting the actions and strategies communities employ to pursue their aspirations.

Figure 5: Proposed Kemmis and Wenger Model (an ontological and epistemological framework for the study of Indigenous knowledges)



Together, these frameworks provide a comprehensive ontological and epistemological lens for studying IKs and practices. Kemmis's Practice Architectures elucidate the structural conditions—language, power and materiality—that shape practice, while Wenger's Communities of Practice foreground the dynamic processes of social learning, identity

formation and communal aspiration. This dual approach supports a nuanced understanding of Indigenous environmental stewardship as both situated and relational.

Reflecting on these frameworks encourages deeper engagement with IK systems beyond rigid paradigms. As Meyer (2008) suggested, this reconceptualisation views knowledge as a dynamic and interconnected tapestry where each element plays a vital role in understanding the complexities of human and environmental relationships (Hoffman, 1999; Sobe, 2013).

In response to these theoretical insights, the present study introduces the concept of *Indigenous Cartography* (Table 2), a methodological tool designed to capture the fluidity, complexity and relationality of IK systems. This approach emphasises a holistic representation that challenges traditional Western paradigms of knowledge organisation and transmission. This cartography is constructed through the integration of Kemmis's Practice Architectures and Wenger's Communities of Practice, and it unfolds across nine dimensions that reflect the diverse aspects of IK.

Table 2: Celebrating commonalities 'Indigenous Cartography'

Epistemology and Ontology	Semantic Space*	Physical Space-Time Space**	Social Space***
Doings	<i>Cultural expression:</i> From words to action; beliefs and values embodied in concrete practices.	<i>Rituals:</i> ceremonial rituals and collective wisdom: seasonal harvesting	<i>Collaborative efforts:</i> Social movements in solidarity; community initiatives. (Law – treaty)
Sayings	<i>Oral Tradition:</i> songs; oral stories; lyrics; poems; thinking; traditional proverbs; storytelling as an educational tool that inspires ecological action.	Environmental preservation; interpretation of ecological calendars	<i>Art and Symbolism:</i> Hymns and chants during ceremonies; mythological narratives.
Relating	<i>Cultural revitalization:</i> cultural discourses; promotion of culture; Indigenous language revival; environmental education programs; Indigenous curricula in schools.	<i>Land Management:</i> Identity preservation; holistic ways of thinking/knowing; land management; community elders passing down knowledge (intergenerational learning).	<i>Community engagement:</i> Relationships between people; beginners to advanced; real-world/spiritual world; knowledge sharing networks; traditional ecological knowledge exchanges, community councils for ecological stewardship.

Source: * Meyer (2008); Rose (2004); Tuhiwai Smith (2012). ** Battiste (2013); Cajete (1993); Wilson (2020). *** Meyer (2008); Mignolo (2000); Tuhiwai Smith (2012).

DISCUSSION

In the authors' transformative journey, their research focused on the teacher-student dynamic as a lens through which to explore a mutually recognised issue that demands greater consideration, specifically, the role of cultural ecology in framing Mother Earth as a legal entity. The authors have approached this inquiry from a dual perspective, as both external observers and internal participants, navigating the intricate landscapes of cultural ecology. Their collective understanding reaffirms that IK systems are often approached in fundamentally different ways from conventional research methodologies—quantitative or qualitative—due to their emphasis on relational and experiential knowledge, collective memory and oral traditions (Battiste, 2013; Wilson, 2020), which contrast with the more individualistic and empirical methodologies prevalent in Western research.

Crucially, these systems are grounded in practice and foundational ways of thinking—referred to as Organising Principles, Habits of the Mind, Skills and Procedures, and Knowledge. While there are shared values, such as the pursuit of understanding ecosystems, the importance of honesty and open-mindedness and the use of empirical observation, IK systems uniquely embed these within a relational worldview. For Indigenous communities, knowledge is stable and adaptable, rooted in the interconnectedness of humans, land, non-human beings and cyclical ecological processes. As illustrated in Table 1, these dimensions reveal key commonalities and divergences across Indigenous, positivist (quantitative) and naturalistic (qualitative) research methodologies. Each reflects a distinct epistemological orientation that shapes how knowledge is generated, validated, and sustained within its respective paradigm.

Building on the foundational work of Rappaport and other scholars, this paper illustrates how Indigenous communities sustain their lives within the frameworks of their unique cultures, spaces and belief systems while highlighting the connections between cultural ecology and various academic disciplines. These interdisciplinary linkages provide deeper insight into human behaviour within complex environmental contexts. Through this exploration, the authors seek to align their proposal with the dynamic systems of Indigenous communities, uncovering methodologies that engage with comprehensive frameworks while respecting the deep-rooted connection these communities maintain with Mother Earth, viewing nature as a legal entity.

To understand how such knowledge is enacted, Kemmis's Practice Architectures framework provides a valuable ontological lens (see Figure 4). This model identifies three interrelated spaces: the Semantic Space, where 'sayings' and collective meanings are articulated through language and narrative; the Physical Space, where 'doings' such as rituals, seasonal harvesting, and land stewardship embody knowledge in practice; and the Social Space, where 'relatings' encompass kinship, governance and community solidarity that sustain cultural continuity. These spaces are shaped by cultural-discursive, social-political and material-economic arrangements, which can either enable or constrain Indigenous practices depending on historical and contemporary contexts.

Wenger's Communities of Practice framework complements this by highlighting the conditional, aspirational, enabling and strategic aspects of IK systems (see Figure 5). For instance, *conditional* aspects include the social and environmental contexts, such as land relationships and colonial histories that shape community life. *Aspirational* aspects reflect community visions for cultural revitalisation and environmental stewardship. *Enabling* aspects involve practices that support learning and identity, such as intergenerational teaching and ceremonies, while *strategic* aspects focus on organised actions like political activism and

Indigenous-led education. These aspects illuminate how Indigenous communities dynamically negotiate and sustain their knowledge systems within and beyond their immediate contexts.

By synthesising Indigenous ontological and epistemological standpoints, the proposed conceptual matrix of Indigenous Cartography offers a relational framework through which knowledge is not merely represented but enacted, embodied, and sustained. This 3x3 model, structured by the axes of Doings, Sayings, and Relatings across Semantic, Physical-Time and Social Spaces, provides a tool to trace how IK lives through practice, language, and relationships. Each intersection of the matrix functions as a knowledge event, embedding worldview, ethics, memory, and pedagogy within spatial and social realities.

Doings: From action to accountability

In the *Physical-Time Space*, Doings such as seasonal harvesting, hunting rituals and land-based ceremonies exemplify embodied ecological knowledge rooted in pattern recognition, generational learning and attunement to natural cycles.

In the *Semantic Space*, Doings take the form of cultural expression, where stories, beliefs and spiritual insights are materialised in art, regalia and dance. These expressions do not merely reflect identity but also serve as performative acts of epistemic sovereignty, encoding community values into visible and repeatable forms.

In the *Social Space*, Doings, such as treaty-making and collaborative stewardship projects, illustrate political agency and solidarity. These practices are not only about preserving rights but also about reaffirming intergenerational obligations, communal responsibility and the reassertion of Indigenous legal orders.

Sayings: Language as knowledge carrier

Sayings in the *Semantic Space*, including oral stories, proverbs and cosmological narratives, represent cognitive architectures of knowledge—structures through which moral reasoning, environmental ethics, and historical memory are sustained. These are not symbolic or metaphorical devices but methodologies of thought.

In the *Physical-Time Space*, Sayings function as temporal guides—ecological calendars, seasonal chants and place names—that instruct when to plant, harvest or migrate. These expressions synchronise memory and environment, bridging cognition and ecosystem cycles.

In the *Social Space*, ceremonial speech, mythic narratives and performative chants establish shared meaning and cultural cohesion. These sayings operate as relational technologies that transmit knowledge and responsibility across generations, ensuring continuity within community networks.

Relatings: The ethics of connection

In the *Semantic Space*, Relatings appear in language revitalisation, curriculum design and cultural discourse. These initiatives do more than preserve identity; they challenge epistemic erasure and reclaim narrative authority.

In the *Physical-Time Space*, relational practices, such as elder-guided land management, exemplify knowledge embedded in intergenerational responsibility. Here, land is not a resource but a sentient participant in knowledge-making.

In the *Social Space*, relationality is enacted through community councils, kinship-based governance and ecological stewardship networks. These modes of relating demonstrate a politics of care, positioning knowledge not as an individual asset but as a collective inheritance.

By unpacking the Indigenous Cartography matrix, this study moves beyond abstraction and symbolism to offer a nuanced analytic framework that honours the situated, lived nature of Indigenous epistemologies. The model supports comparative inquiry while remaining attentive to cultural specificity, enabling researchers to work with rather than on IK systems. It does so by revealing how foundational dimensions of knowledge are continually enacted and transformed through engagements with land, language and law.

Rather than viewing IK as static or essentialised, Indigenous Cartography illustrates how knowledge practices are dynamically sustained within overlapping semantic, physical and social spaces. Each intersection in the matrix offers insight into the relational and contextual character of knowing knowledge as performance, ethical responsibility and intergenerational continuity. This orientation provides a basis for research that is both methodologically rigorous and accountable to the values and protocols of Indigenous communities.

Moreover, Indigenous Cartography offers a platform for ethical dialogue, where researchers and communities can co-produce knowledge in ways that are transparent, reciprocal and respectful. By disrupting normative assumptions and inviting plural epistemologies, it contributes to the reconfiguration of academic practice toward inclusivity and responsiveness. As de Oliveira Andreotti et al. (2016) emphasised, methodologies that challenge epistemic dominance must be grounded in reflexivity, humility and openness to other modes of relating and reasoning.

In this light, Indigenous Cartography is not only a conceptual tool but also a methodological invitation. It calls for ongoing reflection, relationship-building and dialogic engagement across knowledge systems. As a living framework, it has the potential to inform the decolonisation of research, curriculum and practice—not by prescribing fixed pathways but by enabling context-sensitive, community-led approaches that foreground justice, care and relational accountability.

CONCLUSION: TOWARD A TRANSFORMATIVE RESEARCH APPROACH

The proposed Indigenous Cartography framework serves as a comparative education tool that enables researchers to explore cultural perspectives, constructively fostering mutual respect while emphasising the dynamic and spatial dimensions of IK systems. Emphasising the diversity within epistemological environments, this framework recognises them as interconnected and evolving rather than static (Ytterstad, 2020).

Paulston (1996) advocated using social mapping to construct comprehensive representations of cultural phenomena, for which the Indigenous Cartography represents his work on visualising social data. By leveraging this approach, Indigenous researchers can facilitate an emancipatory dialogue that minimises cultural hegemony. As de Oliveira Andreotti et al. (2016) asserted, social mapping challenges perceived certainties rather than imposing normative orientations. Through this lens, researchers can foster mutual respect, develop a more nuanced understanding and contribute to a holistic perspective of knowledge creation.

At a time when Indigenous wisdom converges with contemporary scientific discourse, education must serve as a catalyst for transformation while honouring deeply rooted traditions (Freire, 1976). The pursuit of knowledge is evolving into an inclusive exploration that integrates diverse epistemologies (Denman, 2017; Kolawole, 2022). This shift calls for embracing

multiple perspectives to reimagine education and research in a way that fosters sustainability and balance.

Ultimately, this research affirms the resilience of IK systems and their indispensable role in shaping a more inclusive and equitable future. How can researchers and global citizens meaningfully integrate IK to foster collaborative solutions for pressing global challenges? This question remains central to shaping a world where cultural ecology and Indigenous epistemologies are fully recognised and respected.

ACKNOWLEDGEMENT

The first author received the 2024 OCIES Scholarship, which supported her participation in the OCIES conference held in Melbourne.

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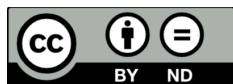
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