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Traditional ecological knowledge for learning with sustainability in mind

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"What kind of frame of mind could bring about sustainability—and how might we develop it?" is a question that is not usually asked in education. Neither do we appear to consider the role of traditional ecological knowledge (TEK) in developing such a frame of mind, even when we are interested in why and how education might support the goals of sustainability. Significantly, outsiders usually conceptualize TEK, rather than insiders. While TEK tends to be associated with the diversity of knowledge, innovations and practices that indigenous communities hold about the biophysical, socio-economic, and cultural-historical aspects of their local environment, it is also often defined in opposition to (Western) modern, scientific conceptions of knowledge. This, we argue, is important for understanding the ways in which we interpret the interests of outsiders in TEK, like environmental educators, as a concept and as a body of knowledge for developing frames of mind that support goals associated with sustainability. The significance of these goals is that they include (but are not limited to)

lifelong learning, the long-term sustainability of a local environment, poverty eradication, and community-based resource management; themes that are specifically linked to the processes and outcomes of education by the United Nations and environmental NGOs following the UN Conference on Environment and Development in Rio de Janeiro,[1] and that emerge in debates about the effectiveness of the Agenda 21 process over the last decade as with the World Summit on Sustainable Development in 2002.

Traditional ecological knowledge

In Western academic discourse, traditional systems of knowledge are characterised as mixtures of knowledge, practice and belief. At one level, traditional knowledge may be equated to that which is purely empirical in Western science, such as when an aboriginal community describes the migratory patterns of a species of bird, fish, or land animal. At other levels, the knowledge system may invoke religious, spiritual, or cultural values and relationships that are not held by scientists working within a materialist paradigm or who pursue predictability and controllability in their work, features commonly associated with Western science. To return to the previous example, if a traditional system of knowledge suggests that it is ancestor spirits who guide the migratory patterns of a species, the pattern may be acceptable within Western science, the explanation may not.

The ecological dimension to traditional systems of knowledge is usually taken to refer to a people's medicinal, technical, and ritual uses of plants, animals, and rocks; to place names and occupancy of territory; or to the spiritual, cosmological, and relational aspects to the various presences (animate, inanimate, present or past) in an environment (Table 1). Much recent work reported in the Canadian environmental literature focuses on the practices, stories, and legends embodied in the TEK of circumpolar peoples.[2] The TEK of other aboriginal and foraging (i.e. hunter-fisher-gatherer) communities from further afield is also widely represented, [3] as is that of sources and communities made available through anthropology, cultural geography, and development studies, amongst other routes.

Table 1: Definitions and dimensions of traditional ecological knowledge

"… traditional ecological knowledge can be defined as a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, traditional ecological knowledge is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal."[4]

"… the unique, traditional, local knowledge existing within and developed around the specific conditions of men and women indigenous to a particular geographic area."[5]

"… a body of knowledge built by a group of people through generations living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use."[6]

"… there is consensus amongst scientists using various terms that such knowledge: i) is linked to a specific place, culture or society; ii) is dynamic in nature; iii) belongs to groups of people who live in close contact with natural systems; and iv) contrasts with "modern" or "Western formal scientific" knowledge."[7]

"… the local knowledge—knowledge that is unique to a given culture or society. Indigenous knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities."[8]

Having set out some initial terms of reference, it is noted straight away that the terminology of TEK is far from settled. Since its emergence, TEK has been used interchangeably with: indigenous ecological knowledge, local environmental knowledge, first peoples' knowledge, non-Western indigenous knowledge, et cetera, where each qualifier refers to a different aspect of the core referent. Whatever the qualifier though, the use of TEK (or a substitute term) tends to be juxtaposed with that of modern, scientific, or Western scientific knowledge.[9] Table

2 sets out Studley's [10] comparison of modern and indigenous knowledge, a table that is given three qualifications. First, that the generalizations and polar oppositions on the epistemological continua in Table 2 are employed to illustrate the differences in knowledge systems, rather than to fix category types or separate language-games from each other. Second, that elements are not meant to imply exclusivity for either system; and third, that cultural groups are not bound to adopt elements, in their entirety or deterministically, from one knowledge system or another.

Table 2: A comparison between indigenous knowledge and modern knowledge

Indigenous		**Modern**
	Epistemology (knowledge)	
generated through observations and experiments of uses and by identification with the object of knowledge	*Means of knowledge acquisition*	learned in abstract manner, not always linked to application and from the separation of the observer from the object of knowledge
intuitive and subjective	*Basis of cognition*	analytical and objective
usually recorded and transmitted orally, sometimes via sacred texts	*Process of knowledge transmission*	transmitted deductively through written word
holistic, subjective, experiential, embedded, and integrated in the social, cultural, and moral dimension	*Integration with worldview and culture*	reductionist, objective, positivist, disembedded compartmentalized—convergent—homogeneous
	Cosmology (the universe)	
views all matter as having life force, including inanimate forms—Animistic	**View of life forces**	recognizes only plants and animals as having life force—separation between God and people
ecological-based on worldviews which emphasise social and spiritual relations between life forms	*Perception of nature and life forms*	hierarchically organized and vertically compartmentalized—the environment is reduced to conceptually discrete components
spiritual explanations of environmental phenomena, revised and validated over time	*Explanation of environmental phenomena*	explanations derived through testing of hypotheses, using theories and laws of nature
shaped by the ecological system in which it is located	*Basis of relationship with nature*	predicated on people's ability to dominate nature
a finite good	*Nature of knowledge as a "good"*	infinite good
sees all entities in a relational context	*View of universe*	instrumentalism (views everything as sources of gratification)
stresses inter-dependency and equality of all life forms	*Equality between life forms*	sees humans (especially Western men) as superior life form, with an inherent right to control and exploit nature

	Ontology (self)	
predicated on group values or 'holism'	**Basis of self worth**	predicated on individualistic values—nothing but the sum of a biological core and behavioural surfaces—the product of random genetic activity—identity and significance are derived from economic production or consumption
a phenomenon to be rejected or integrated into worldview	*View of technology*	a measure of civilization or backwardness
diachronic-based on a long time series in one locality	*Dealing with change over time (phenomenological)*	synchronic-based on short time series over a large area
time is measured cyclically	*Time measurement*	time is linear
bound by time and space, social contextuality and moral factors	*Contextual validity*	superior on the basis of universal validity
requires a commitment to the local context	*Geographic contextuality*	values mobility and weakens local context
	Accountability	
associated with a system of social accountability (e.g., a Shaman)	Social accountability	not usually associated with a system of social accountability except theoretical physicists in their role as "high priests of science"

(Source: Adapted from Studley [11])

Contesting traditional ecological knowledge

Disputes about the terminology and epistemologies of such categorizations notwithstanding, contestation of the value of differing conceptions of TEK along with the actual substance of what comes to constitute TEK is readily identifiable throughout the literature, whether it be by the holders, collectors, users, or the opponents of the use of TEK (insider or outsider). This is particularly so when local inputs to sustainable resource management—and common property resources especially—are at issue.[12] To begin with, the histories of many indigenous peoples in relation to the West are replete with incidents of land deprivation and marginalization, as typified by the processes of invasion, colonization, and assimilation. According to Mitchie,[13] the problems associated with these processes include those of cultural

demise and dislocation through the pressure of the influences of Western societies and technologies, loss of identity through loss of culture, and clashes between different ways of knowing and valuing, for example, of what might or should be constituted as a resource (e.g., for whom, under what circumstances, and for how long). Two sets of issues may be identified here. First, that resource disputes can indicate a lack of political neutrality in *who* presents *what* and *why* as a resource and the scientific rationale for its management. And second, that resource disputes might also raise questions about the universality and coerciveness of the discourses of scientific, environmental, and sustainable resource management across different ethnic and socio-political contexts; for example, when an impact assessment for a proposed development is projected to affect adversely an aboriginal community and/or the ecosystem, or, when the term "resource" itself is deemed to have exploitative or commodifying connotations.[14]

Reframing these issues in terms of the social construction of ecological knowledge and the contestation (or not) of dominant cultural and scientific values and knowledge has been of particular interest to environmental sociologists, discourse analysts, and environmental educators.[15] Of particular concern are the further challenges and disputes that emerge around the utility of intellectual property rights (IPR) discourse in relation to TEK. While insiders and outsiders have welcomed its application, the collective and collaborative forms of producing knowledge found within some TEK systems may mean that IPR regimes are not necessarily amenable, affordable, or desirable for groups that reject "individualization" of knowledge, "commoditization" of "knowledge products," or the "monetarization" of local communities.[16] As Michie[17] argues, a key challenge is that, between them, many indigenous groups have a lengthy record of receiving little benefit from the appropriation of knowledge by outsiders, while the situation continues to be exacerbated by exploitative practices employed to the primary benefit of others. More recently, these practices have included the pursuit of pharmaceutical, medicinal, and genetic products and patents, the irony of which is that, in and of themselves, the products and patents are often presented as two of the main universal benefits of utilizing TEK in preserving global and local biodiversity and exploring and validating cultural diversity. [18]

Evidently, the issues raised above are but sketches of complex sets of arguments. They have parallels with a variety of other environmental and development issues and have been pursued to differing ends and within different geo-political arenas.[19] As to their significance for the practice of resource management, while the actual models for managing resources vary, in relation to TEK the issues can be understood to

crystallise around assumptions regarding the prevalence and appropriateness of: (i) traditional, (ii) centralized [colonial], (iii) community-based, and/or (iv) collaborative management and research strategies.[20] Trends in the role and legitimacy of traditional knowledge systems in management and education can be interpreted as indicating shifts in strategy over the last twenty to thirty years: from TEK having a marginal status to the established science of resource management (traditional and centralized strategies), to instances where it is incorporated into existing scientific knowledge systems, and/or, to being integrated in co-management and participatory research (community-based and collaborative) strategies.[21]

An alternative way of reading these shifts is to consider their role in informing the variation in the degrees of success of TEK-based resource management, and the frameworks for what is seen to count as success, from social, political, ecological, or pedagogic perspectives. A renowned Canadian case is the BHP Diamonds Inc. Mining project in the Northwest Territories (1995), which in turn precipitated considerable debate on the pertinence of including TEK in decision-making processes.[22] Thus, while Howard and Widdowson raise concerns about the value of TEK in environmental assessment, Berkes and Henley [23] maintain that, "seeking practical solutions to environmental and socio-economic impacts with local indigenous people is a matter of fairness and respect." Berkes, in promoting these procedural principles for the use of TEK, tends to maintain this position throughout his work no matter what the outcome of the resource management strategy, a position common to many supporters of TEK initiatives in management and education.[24] In many cases, conservation-through-use is becoming a regular feature of TEK-based resource management across a variety of geographical, environmental, and cultural contexts,[25] although we do note that in this example, despite opposition from local groups, the mining went ahead.

To summarize, the routine contestation of the authority and power of TEK for resource management can be readily identified in the inquiries and disputes documented throughout the literature, and this, we argue, needs to be taken account of by so-called "outsider educators" who use TEK for teaching and learning, in formal, informal, and non-formal educational settings. Found in part at the interface of inclusivist, exclusivist, and pluralist epistemological perspectives,[26] six recurring themes in the contestation of TEK are identified for the purposes of this discussion:

1. opposition and resistance to participatory approaches to resource management, to appeals to tradition or excessive reverence of particular

knowledge systems (insider or outsider), or to expectations of self-governance based on the knowledge outcomes (e.g., indigenous people's management and use of endangered species);

2. the validity, credibility, and compatibility of competing claims to knowledge, the form in which the knowledge is expressed (e.g., objective/subjective, hard/soft, fragmentary/holistic), and the expertise and independence that is attributed to its producers or holders about an environment, in management and pedagogic settings (e.g., when construed as Western science vs. folk wisdom);

3. the reconcilability of differing worldviews and/or opposing knowledge systems (e.g., in educators and learners choosing to translate ideas and concepts from one culture to another, or in being able to pursue touchstones regarding explanation and interpretation of knowledge);

4. where outsiders and insiders as interest groups have competing claims of ownership or use rights over resources and territorial areas, or seek a voice in decision-making that is denied;

5. political and psychological obstacles to the application of TEK within policy-making in management and education; for example, in the structuring of environmental impact assessment and IPR regimes, in prejudice or ignorance, or in misunderstanding, fear or distrust of "the Other" and different ways of knowing in shaping the design of curricula; and

6. when ownership by, benefits for, and/or reciprocity with the local community that creates and sustains the information is undermined, as in property rights violations and compensation claims.

These themes serve to contextualise the discussion of the use of TEK in education that follows, whilst it is also noted that instances of the broader theme of linking TEK and political power in resource management has been explored by Posey[27] as to their expression of, "the latest—and ultimate—neo-colonial form of exploitation of native peoples."

Transforming traditional ecological knowledge in education

Mobilizing traditional knowledge systems for environmental, economic, and ecological gain, or for creating the conditions for

rediversification of traditional languages and cultures in the face of the growing standardization of education and language, represent just some of the ways in which TEK is being transformed for the purposes of pursuing sustainability (understood culturally and environmentally).[28] Davies[29] argues that customary practice and knowledge, the basis of traditional regimes of community-based management of natural resources, were devalued and subverted by state and private sector assumptions of tenure and control of common property resources. It is now being revalued in a search for management regimes that promote protection of remaining components of biodiversity and the unique values of local cultures as well as to enhance local livelihoods through, for example, capacity building environmental-education programs (such as the collaboration between indigenous peoples and Conservation International in the Iwokrama Rainforest Programme in Guyana.)[30] Moreover, as Berkes and Folke[31] suggest, when compared to the rather narrow set of prescriptions of Western scientific resource-management systems—some of which may inadvertently act to reduce ecosystem resilience—indigenous management may be associated with a diversity of property rights regimes, common-property institutions and locally adapted practices which operate within systems of knowledge substantially different from Western knowledge systems (Table 3).

Table 3: Social-ecological practices and mechanisms for resilience and sustainability

1. Management practices based on ecological knowledge
Monitoring change in ecosystems and in resource abundance
Total protection of certain species
Protection of vulnerable stages in the life-history of species
Protection of specific habitats
Temporal restrictions of harvest
Multiple species and integrated management
Resource rotation
Management of succession
Management of landscape patchiness
Watershed management
Managing ecological processes at multiple scales
Responding to and managing pulses and surprises
Nurturing sources of renewal

2. Social mechanisms behind management practices
a) Generation, accumulation, and transmission of ecological knowledge
Re-interpreting signals for learning
Revival of local knowledge

Knowledge carriers/folklore
Integration of knowledge
Intergenerational transmission of knowledge
Geographical transfer of knowledge

b) Structure and dynamics of institutions
Role of stewards/wise people
Community assessments
Cross-scale institutions
Taboos and regulations
Social and cultural sanctions
Coping mechanisms; short-term responses to surprises
Ability to re-organize under changing circumstances
Incipient institutions

c) Mechanisms for cultural internalisation
Rituals, ceremonies, and other traditions
Coding or scripts as a cultural blueprint

d) Worldview and cultural values
Sharing, generosity, reciprocity, redistribution, respect, patience, humility

Source: Folke, Berkes & Colding[32]

While this search for sustainable resource management regimes is not new, it has gained considerable momentum in recent years and has engaged the interests of a range of outsider educators including those working in environmental education programs around the world in a variety of contexts. Further, it has also been observed that the emergence of TEK in Western academic discourse and education systems serves to stabilize and modify a variety of dynamic cultural processes regarding language and education and, thus, TEK.[33] Berkes *et al.*[34] note how momentum for the search often grows when conceptions of ecosystems in traditional societies coincide, at least to some extent, with those of resource managers (often products of a Western education) who favour more recent interpretations of ecosystem concepts. Once associated with linear, equilibrium-centred processes that could be predictable and controllable, alternative scientific models stress that ecosystem processes may be non-linear, stochastic, multi-equilibrial, and full of surprises, threshold effects, and system flips: "Predicability and controllability are not limited by the scientific data available but by the very nature of ecological systems."[35] These alternative views are more compatible with the epistemologies of some systems of TEK, while it is also noted that recent conceptions of chaos

theory, deep ecology, bioregionalism, topophilia, biophilia, ecofeminism, the Gaia hypothesis, and ecological footprints [36] may also be consistent with particular traditional ecological practices, cosmologies, and perspectives, [37] and of course, versions of environmental education. [38]

Table 2 illustrated how TEK epistemologies, like some systemic and holistic epistemologies in environmental education,[39] tend to eschew the reductionism, rationality, and "experimentality" associated with empiricist approaches to ecosystems and science, in favour of holism and interdisciplinary and systemic approaches (and that they may even prefer metaphorical imagery and spiritual expressions.[40]) However, the disparities in what is interpreted as significant to the ecosystem, education, and science serve as warnings against uncritical, demythologized, or Neo-Romantic uses of TEK in environmental education, conservation, and resource management. Hence, it is argued, from both insider and outsider perspectives in the literature,[41] those who use TEK systems, and particularly educators, should be cognizant of:

i. identifying similarities and differences in epistemologies (for example, through competing, co-existing, and/or coalescing worldviews, power structures, and cosmologies);

ii. the relative completeness, compatibility, and complementarity of data sets and knowledge systems, for example, what constitutes baseline data and deviation from normative expectations for an ecosystem; and

iii. the different literacy events and literacy practices (functional, religious, secular, critical, etc.) that a community may use in order to develop understanding and accounts of cultures, ecologies, structures, and interrelationships, for insiders and outsiders.[42]

Importantly, *hermeneutical* and *multidisciplinary* rather than *reductionist* and *single disciplinary* approaches have a long history of support in environmental education.[43] They are also preferred by those who support TEK-based management strategies,[44] because, as Freeman[45] argues: "Nowhere does the Cartesian model of modern science fail so completely and utterly as in trying to explain the workings of natural ecosystems," and as Dwyer contends, [46] forcing indigenous conservation into the mould of Western conservation is unlikely to work:

> The resource management systems of indigenous people often have outcomes that are analogous to those desired by Western conservationists. They differ, however, in context, motive and conceptual underpinnings. To represent indigenous

management systems as being well-suited to the needs of modern conservation, or as founded in the same ethic, is both facile and wrong.

Such rationales are often complemented by, firstly, a rejection of: (a) the necessity of resolving uncertainty into certainty in knowledge systems, and (b) a belief in total knowledge; and secondly, the acknowledgement of complexity and ambiguity and the limits to knowledge and decision-making. With these issues being raised at both a conceptual and practical level for resource management, what then for environmental educators who employ TEK within learning and teaching?

Education and traditional ecological knowledge

By way of initial observation, we note that despite the apparent pedagogic, economic, and environmental value of TEK in assimilating, applying, and integrating TEK systems within environmental management and education, TEK remains of marginal interest to mainstream Western education systems (e.g., national curricula, assessment frameworks, educational policies, etc.). More broadly, until the emergence and acceptance of Rapid Rural Appraisal and Participatory Rural Appraisal techniques, it was largely disregarded in development planning, it has played only a minor role in biodiversity management, and its contributions to Western society in general (and formal education in particular) continue to go ignored.[47] The World Wildlife Fund[48] argues that TEK, and the language communities that support it, are being lost under the impact of modernization and ongoing globalization processes. We also note that UNESCO[49] proposes that for environmental educators, knowledge is indispensable for understanding and promoting environmental, technological, economic, and social change in societies. This leads us to ask, what options do educators have in the light of these challenges?

A starting point is to recognize that UNESCO, in pursuing the agenda set by UNCED [50] in Agenda 21, has positioned scientific and technological knowledge as the basis of development, both in the North and in the South, and as a factor of production as important as labour and capital. However, such an emphasis on scientific and technological knowledge is not considered to be in conflict with TEK-based resource management strategies. This is a key theme within Chapter 36 of Agenda 21 on education, public awareness, and training, where the documentation promotes incorporating TEK into formal, non-formal, and informal modes of teaching and learning, within schools, the family

and community, and so on. Thus, in order to: (a) promote better understanding and use of traditional knowledge systems; (b) foster partnerships between the natural and social sciences and indigenous knowledge; and (c) sustain the societies that are the guardians of these systems of knowledge, UNESCO[51] has more recently reasoned that there is a need to protect and further develop the knowledge generated and perpetuated by local communities through a range of initiatives, including awareness-raising, training programs, international property rights arrangements, and validation procedures. A major aspect to this is using (environmental) education to investigate the relationship between knowledge systems, including whether: knowledge in one system is explainable in the other (now, or is likely but not yet available), that a link can be made but the underlying principles are different, or, that the knowledge from one cannot be explained in that of the other's terms. These considerations, alongside those of knowledge access, ownership, and use, are argued to be important preliminary issues for evaluating responses to TEK in education.

Second, Hobson [52] reminds us that what has been frequently overlooked or remains unknown in Western formal education systems is that the survival of aboriginal peoples can often be attributed to their knowledge, their special relationship with environments over time, and their ways of organizing themselves and their values. This is in opposition to both the assumptions underpinning the explanatory frameworks and the frameworks themselves that shape teaching and learning in many Western schools.[53] Traditional knowledge, in being passed on from one generation to the next, forms a key part of the educational process in these communities, while as Hobson[54] argues:

> Today, aboriginal peoples are aware that they must integrate traditional knowledge into the institutions that serve them; it is essential to their survival as a distinct people, and it is the key to reversing the cycle of dependency which has come to distinguish aboriginal communities.

Third, in a dictionary sense, traditional often refers to cultural continuity transmitted in the form of social attitudes, beliefs, principles, and conventions of behaviour and practice derived from historical experience. Positive connotations of TEK include that it refers to time-tested knowledge and wisdom of (usually) others than ourselves or our communities. For the holders of TEK, some may consider their knowledge to be important in the modern world, and their role as one not merely of informants but that of participants in ongoing dialogue about ecosystems and resource management. However, we do note that this does not usually involve debate about the terms of reference, thinking, and assumptions for conducting such dialogue, that is, Western frameworks for management and education tend to be

reinscribed, and both can be accompanied by paternalistic connotations.[55]

By way of illustration, within the discourse on TEK, the socio-economic aspects of the environmental and conservation dividend often come to the fore in outsiders' value-through-utility arguments. Through the production, preservation and circulation of TEK, the dividend is seen to provide employment, resources, income and prestige; while the valuing of TEK by others outside of the community serves to maintain and reinforce the validity of traditional practices, reviving and sustaining their integrity within and beyond a community through educational initiatives[56] (e.g., the Darwin Initiative "Coral Reef Biodiversity in the Caribbean: a schools education project," which has involved local communities, NGOs in six Caribbean countries, the Ministries of Education in those countries, and external participants).[57] This form of empowerment—for individuals, as members of a learning community, and in terms of the politics of difference and identity within and across pedagogic regimes[58]—is considered to be particularly important in situations where the transformation of educational practices, and hence enculturation processes, continues:

> Today many young people in the developing world receive their education in schools with Western-style curricula, rather than at the feet of their elders as in the past. Because most such curricula tend to ignore local knowledge, they tacitly imply that it is not worth learning. Where this perception prevails, valuable stocks of such knowledge will continue to disappear as the old people who possess it die; while their descendants, along with many [outsiders], ignore it. [59]

A second example concerns educational processes within multicultural and pluralist contexts. Ruddle,[60] for instance, argues for the importance of developing resource centres for indigenous knowledge as national resources. Centres serve as vehicles to introduce indigenous ("insider") knowledge into the formal ("outsider") curricula from primary school through to university level and in vocational and training institutions. Such action, it is argued, helps arrest the declining capacity of traditional means of transmission of TEK and that associated with competing agendas—even those associated with universal access to basic education and primary education in newly or quasi-independent nations or people groups, through formal schooling or non-formal education.[61] In relation to Agenda 21, resource centres are seen to strengthen scientific education and training, thus enabling citizens to meet their environmental and development objectives, and facilitating the transfer and assimilation of new environmentally sound, socially acceptable, and appropriate technology and know-how (Agenda 21, Article 36.2c/36.13). They also help affirm the rights of indigenous

peoples to use their experience and understanding of sustainable development and to play a part in education and training (Article 36.5n).

Rather than regarding traditional and modern education as antagonistic though, Kasten[62] has argued that such situations are well-suited to securing the merits of a bicultural education, maintaining, as opposed to denuding, TEK. Kasten contends that non-involvement is avoided in bicultural approaches to formal education, as is assimilation. The goal is self-determination, through retaining and reviving culture and language through teaching and learning in formal educational settings, even as local and broader contexts and circumstances change. So, while:

> Native content is needed to provide young people with important traditional knowledge and values for their survival in natural and social environments specific to their people, modern knowledge prepares them to utilise more academic or international knowledge as well, and to secure and enhance their future lives, such as the efficient management of territorial resources under world market conditions, and the organisation of their destinies as independent people. [63]

As a broader form of environmental education, geared to local needs and developed by and with local communities, Kasten[64] argues that bicultural curricula give students, "a variety of options that will later allow them to decide, according to their own individual talents and inclinations, the direction and cultural orientation of their lives, particularly if based on well-established ethnic or local identities and on maintaining links to the cultural past of the respective peoples." The curriculum may be developed so that it is: indigenous; a restructured version of a Western curriculum; or as resource materials, based on a Western curriculum (which tends to be the main approach). This too might be read as supportive of Agenda 21 initiatives to increase co-operation with indigenous people in the management, planning, and development of their local environment, and those of the promotion and the dissemination of traditional and socially learned knowledge through means of local customs (Article 36.10 I), but it is not to say that each and every approach addresses the paternalism that can be implicit therein. Rather, as Michie [65] maintains, whatever the model, educational initiatives do well to be informed by values education, peace education, and environmental education *in their socially-critical forms*, so that the education is explicitly aligned to the pursuit of diversity and equality for all members and groups in a territory, however problematic this may (in fact or theory) be. Or, as exemplified by Payne's interest in promoting identity-seeking and identity-development processes in

environmental education,[66] a critical ecological ontology forms a generative framework for interrogating subjectivities and detraditionalization of place, space, and time, within and outside the processes and products of an educational system. Warren,[67] for example, in warning against approaches to TEK in education and resource management that universalize particular educational frameworks and knowledge systems, comments:

> Development activities that work with and through indigenous knowledge and organizational structures have several important advantages over projects that operate outside them. Indigenous knowledge provides the basis for grassroots decision-making, much of which takes place at the community level through indigenous organizations and associations where problems are identified and solutions to them are determined. Solution-seeking behaviour is based on indigenous creativity leading to experimentation and innovations as well as the appraisal of knowledge and technologies introduced from other societies.

While Hobson,[68] writing in the context of research in the Canadian north and south, asks (in preference to viewing this as a uni-directional response):

> "Why is it not part of the education process of the southern scientist to become familiar with traditional knowledge? How can science as undertaken by southerners be explained and demystified for northerners? How can southerners be encouraged to use traditional knowledge? Must we forever regulate the participation of northerners in southern-inspired projects?"

Conclusion: reflections on a frame of mind

In discussing contemporary frameworks for ecological knowledge, interpretation, and understanding in education, we have sought to develop a commentary for investigating the use of traditional ecological knowledge in education, and suggested a variety of issues about the shaping and structuring of knowledge systems and the cultural themes that are read through them in pedagogical situations. For Bowers,[69] this has included how the concept of an eco-justice pedagogy relies on valuing and reflecting on traditional ecological knowledge and ensuring that it does not become overlooked in education, including sustainable development education and environmental education. As representative of a worldview, traditional ecological knowledge, like other knowledge systems, tends to be accumulated over generations, but a key difference is that with traditional ecological knowledge, it may be passed on by word of mouth and by direct experience, features of a dialogic pedagogy that are often omitted in Western education but remain important to many environmental educators. [70] Both Studley and

Michie,[71] in advocating the use of traditional ecological knowledge in education, have argued that the concept of worldview is very closely related to definitions of culture and cognitive map. However, what we have argued is that this should not be at the expense of recognizing that a worldview, in consisting of the principles we acquire to make sense of the world around us, scientifically-based or otherwise, always remains limited, incomplete and imperfect in terms of its own and others' epistemologies, ontologies, and methodologies.

Transforming traditional ecological knowledge and the worldviews associated with it for and by educators is not unproblematic then, but then neither has this been argued to be inherently problematic. Presupposed by bicultural education, for example, is a familiarity with culture and historical patterns of resource use, as a prerequisite for dialogue. A lack of sensitivity to the cultural frames for (and limits of) knowledge generation and regeneration, the time frames for resource use and abstinence, and other ecological factors and socio-cultural factors, militates against the commodification and reapplication of such knowledge. On the one hand, critics of traditional ecological knowledge may point to its anecdotal and unscientific nature or to its lack of verifiability, as when traditional opinion, belief, and authority are more prominent than independently verifiable, systematic, positive knowledge in environmental discourse. On the other, there remains an important concern about its corruption and fracturing, when traditional ecological knowledge is divorced from its original context or is incorporated into other systems of knowledge, thus undermining the broader conception of traditional, holistic knowledge and wisdom.[72]

These final issues return us to the origins for the discussion, namely, questions of frames of mind and the role of traditional ecological knowledge. We have suggested that in seeking a frame of mind that could bring about sustainability we should not shy away from matters of epistemological confusion and questions about the methods by which we know what we claim to know or cannot know, or the standards and criteria that are employed by insiders and outsiders alike in making and evaluating claims to what can be known. What is being preferred here are frames of mind that eschew bracketing out the compatibility, certainty, and truth status of ecological knowledge systems by adopting an agnostic approach in terms of methodology, as in relying on purely phenomenological approaches to traditional ecological knowledge. Claims to impartiality and disinterest are limited, they may hide other intentions and help to construct and justify the power of one group over another, such as that of the powerful, uninvolved, observer (often the outsider viz. traditional ecological knowledge) versus the powerless, passive subject (often the insider). Since traditional ecological

knowledge relies on a community's insider knowledge, through their histories, contexts, values, and worldviews, a final consideration for environmental educators is thus offered, namely, that of what Said[73] calls the "imperialist dynamic"—the constant impulse to objectify, simply, and decontextualize people in the service of political and economic power. In response, it is argued, educators might start from the position that traditional ecological knowledge does not provide its own explanation, nor is it self-evidently meaningful and important to the insider or the outsider. Such a position reflects a theme implicit throughout the discussion, that traditional ecological knowledge itself can be regarded as an insider category of the outsider, rather than a shared category for insiders and outsiders. Put in the language of the source for this discussion then, it raises a fundamental query for deliberations on a sustainable frame of mind, and one that might be asked in and of any frame of mind. That is, do we—and perhaps, more importantly, *why* and *where* do we—inquire what lies behind our terminologies, thinking, and assumptions about ecological knowledge and sustainability in environmental education?

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Notes

[1] UNCED. 1992.

[2] For example, that associated with the Canadian Arctic Resources Committee, CARC, and reported in their journal, *Northern Perspectives*.

[3] Berkes and Folke 1998; Freeman 1992; Johnson 1992; Studley 1998; World Wildlife Fund. 2000.

[4] Berkes 1993, 1–10.

[5] Grenier 1998.

[6] Johnson 1992.

[7] Studley 1998.

[8] Warren, 1991.

[9]Berkes et al. 1998; Johnson. 1992; Studley. 1998.

[10] Studley. 1998.

[11] Studley. 1998.

[12] Benton and Short 1999.

[13] Michie 1999.

[14] Grenier. 1998; Johnson. 1992. We note that similar challenges have been raised about the political neutrality of environmental education, its universality and coerciveness.

[15] Hannigan 1995; Harre, Brockmeir and Mühlhäusler 1999; Robottom and Hart 1993.

[16] Gregoire and Lebner 2001.

[17] Mitchie. 1999.

[18] Studley. 1998.

[19] Benton and Short. 1999.

[20] Gadgil and Berkes 1991; Christie and White 1997.

[21] There are parallels here with reading across the dimensions to the epistemological frameworks for learning and teaching in education *about, in* and *for* the environment, as set out in Robottom and Hart, op cit. This raises the issue of which knowledge systems submerge others in environmental education, or put differently, which and whose forms of knowledge are privileged in environmental education?

[22] Howard and Widdowson 1996; Howard and Widdowson 1997; Berkes and Henley. 1997a; Berkes and Henley 1997b; Stevenson 1997.

[23] Berkes and Henley. 1997b, 55.

[24] Berkes and Folke. 1998.

[25] Roe et al. 2000; Berkes and Folke. 1998.

[26] See Reid 2000.

[27] Posey 1990.

[28] Kasten 1998.

[29] Davies 2001.

[30] DFID 2001; Gough 2002.

[31] Berkes and Folke. 1998.

[32] Folke, Berkes and Colding 1998, 418.

[33] Kasten. 1992.

[34] Berkes *et al.* 1998.

[35] Ibid., 413.

[36] Ibid., 412–4; Studley. 1998.

[37] Golley. 1993.

[38] Sterling. 2001.

[39] Ibid.

[40] Freeman. 1992.

[41] Berkes and Folke. 1998.

[42] Street. 2001.

[43] Sterling. 2001.

[44] UNESCO. 1999.

[45] Freeman. 1992, 3.

[46] Dwyer. 1994. Cited in Berkes *et al.* 1998, 413.

[47] Johnson. 1992; WWF. 2000.

[48] WWF. 2000.

[49] UNESCO. 1999.

[50] UNCED. 1992.

[51] UNESCO. 1999.

[52] Hobson. 1992, 2.

[53] Bowers. 2001.

[54] Hobson. 1992, 2.

[55] Bowers. 2001.

[56] Studley. 1998.

[57] Gough. 2002.

[58] Usher, Bryant and Johnston. 1997.

[59] Johannes, Freeman and Hamilton. 2000.

[60] Ruddle. 1991.

[61] For example, as linked to the Framework for Action at the World Conference on Education for All: Meeting Basic Learning Needs, Jomtien, Thailand (1990), and sponsored by the UNDP, UNESCO, UNICEF, and World Bank. Chapter 36 of

Agenda 21, it is noted, stresses the importance of a non-competitive approach to educational provision, regarding basic education and primary education as a prerequisite to making environmental and development education universally accessible, and recognising its links to the social education of all age groups.

[62] Kasten. 1998.

[63] Ibid., 1–2.

[64] Ibid., 2.

[65] Michie. 1999.

[66] Payne. 2001.

[67] Warren. 1992, 3.

[68] Hobson. 1992.

[69] Bowers. 2001.

[70] UNCED. 1992.

[71] Studley. 1998; Michie. 1999.

[72] "The Native worldview holds that all things are connected and equal. Calling "traditional knowledge" TEK denigrates the balance of our worldview and limits the vision of our traditional knowledge and ways of knowing." (Cochran, P.A.L. 1997. *Traditional Knowledge Systems in the Arctic.* Bering Sea Ecosystem Workshop, Anchorage, Alaska.)

[73] Said. 1978.