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Integrating Traditional Ecological Knowledge in Formal Science Curriculum at the Middle Stage for Contextualised Learning

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Abstract

When it comes to understanding our natural world, science and Traditional Ecological Knowledge (TEK) are equally valuable, as both offer distinct yet complementary perspectives. Both should be merged like a mosaic to get a holistic understanding of the natural world. TEK is established on lived experiences, cultural, and spiritual beliefs of Indigenous people, while science heavily relies on methodical, evidence-based approaches. This paper explores the integration of TEK into formal science curricula at the middle stage, which emphasises its relevance in addressing demanding environmental challenges and preserving and disseminating invaluable cultural knowledge. Focusing on Zanskar Valley (a region inhabited predominantly by the indigenous "Boto or Bot" tribe) in Ladakh, India, a region rich in Indigenous knowledge and wisdom but facing rapid modernisation due to massive hard infrastructure development, the study employs an ethnographic approach to document TEK, analyzes it thematically, and proposes its contextual incorporation into middle-school NCERT science curriculum. The study is conducted in three phases: documenting TEK through in-depth ethnographic interviews and participatory observation, thematically analysing obtained data with existing NCERT science curriculum given themes, and demonstrating integration strategies using Fogarty's four-step model. With the theme "Food," this study demonstrates how rich and holistic TEK is in bridging cultural relevance and context with formal science. This study further highlights the need and significance of a contextualised curriculum to reconnect Indigenous learners to their cultural heritage and wisdom for a sustainable future. Future generations can access a holistic knowledge system that supports ecological balance and cultural continuity by embedding TEK within science education.

Keywords: Traditional Ecological Knowledge, Indigenous, Sustainability, Zanskar, Integration, Science, Curriculum.

Introduction

Science is a systematic quest for knowledge that seeks to understand the natural and social world through evidence-based methodologies. It is universal, subject to change, and distinct from other forms of knowledge (Hohenberg, 2017). While a widely accepted definition, stated by Berkes (1999), describes Traditional Ecological Knowledge (TEK) as “a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, and about the relationship of living beings (including humans) with one another and with their environment.”(Berkes, 1999; Hoagland, 2017) Traditional Ecological Knowledge (TEK), also known as folk knowledge, is developed via long-term association with a place and includes beliefs and acquired understanding (Sindhya,2018). TEK is a subjective, organic, complex, and emergent knowledge system that embraces the metaphoric mind and helps localised people preserve and flourish in particular locations. Therefore, in terms of developing innovative and cumulative strategies for surviving within an ecological domain, TEK is both an art and a science (Nelson, 2014).

Although the exact origin of the term "TEK" is unknown, the term "traditional ecological knowledge" is an extension of the term "traditional knowledge," which has often been used to refer to the knowledge and practices of Indigenous populations. The term TEK does not represent the entirety of Indigenous knowledge (IK) and is considered a subset of the broader category of IK. TEK is a form of academic appropriation of Indigenous knowledge. TEK is constructed based on Western interests in creating "science concrete"—factual knowledge about the environment—out of Indigenous knowledge (Kim et al., 2017). Capturing traditional ecological knowledge from indigenous communities is essential for revitalising tribal knowledge and enhancing sustainable environmental management. Numerous indigenous communities have experienced substantial losses of Traditional Ecological Knowledge (TEK), and over time, TEK may vanish entirely (Hoagland, 2017).

Relationship between TEK and Science

Indigenous knowledge and science reflect two distinct takes on the world: Indigenous knowledge provides information about the world holistically, whereas science concentrates on its constituent elements (Sindhya,2018). Integrating TEK (a subset of indigenous knowledge) in formal science education is essential to preserve the invaluable insights that are in danger of being lost in this rapidly changing world. As the severity of today's environmental issues increases, disregard for TEK may result in the loss of critical ecological practices and generation-old cultural knowledge. Future generations may not recognise the importance of successfully managing sustainability concerns if this wealth of information is not incorporated into school curricula (Oando, 2024). Neither TEK nor Science alone will achieve comprehensive environmental protection, and dependence on a single paradigm could worsen the environmental crisis. Simply put, without knowledge, science lacks consciousness

(Hoagland, 2017). Even NEP 2020 focuses on integrating IK into the curriculum, whether it be Indigenous ways of teaching and learning, Indigenous literature and knowledge, or Indigenous sports, in pedagogical practices to help develop skills. This integration highlights how science education has the capacity to empower communities and promote cross-cultural learning, along with bridging knowledge gaps. It fosters cooperation, mutual respect, and shared accountability for sustainable development (Nair, 2024).

The Difficult Position for Indigenous Students in Science Learning

TEK has been passed down traditionally through various events and activities, such as farming, weaving, hunting, and cooking; now, Indigenous children only have the opportunity to receive traditional knowledge from home or festivals that have become uncommon and tourist attractions in recent decades due to school teaching interfering with mainstream culture and children spending much time in school. Hence, they feel less connected to traditional culture and disconnected from traditional knowledge (Chiang & Lee, 2015). To connect these children with Traditional Ecological Knowledge, preservation, and documentation are needed, as well as contextualising the curriculum to disseminate it. The formal science curriculum should be contextualised so that indigenous learners do not feel alienated from science.

Disseminating TEK in the context of Zanskar

India, with over 500 different, colourful Indigenous tribes, has the most incredible collection of acquired Indigenous tribal wisdom. A press release of the 119th meeting of the National Commission for Scheduled Tribes states that with more than 97 percent of the tribal population, the newly created Union Territory of Ladakh is primarily a tribal region, followed by 99.16 percent in Zanskar Valley is predominantly Boto or Bot tribe (NCST Writes to Union Home Minister & Union Tribal Affairs Minister Conveying Its Recommendation to Include Union Territory of Ladakh Under 6th Schedule of Constitution Of India, n.d.). Zanskar, or "Zangskar" (the land of copper), a remote valley in Ladakh now declared a district, is known for its hauntingly beautiful landscapes, rugged terrain, and vibrant cultural heritage, which embeds Indigenous Buddhist tribes with a rich repository of Indigenous knowledge and wisdom. (Hodge, 2013)

For over 2,500 years, human settlements in Zanskar have been well-acknowledged. In such harsh and challenging terrain, where survival was the primary concern, communities developed a unique cultural knowledge system that enabled them to survive. This wisdom was transmitted across generations orally and through hands-on learning (Chatterji, 1992). However, the fast development of hard infrastructure in the modern era puts Zanskar's indigenous wisdom at risk of loss. The remote isolation that once protected this cultural heritage is being replaced by accessibility. The Border Roads Organization (BRO) is set to complete the black-topping of the Nimmo-Padam-Darcha Road by 2025, which connects Leh to the Zanskar Valley, marking a significant development. This road will bring economic potential to the valley, but the influx of tourism and consumerism seriously threatens to undermine the preservation of Zanskar's traditional knowledge system. It emphasises the importance of recording and protecting this indigenous knowledge and wisdom. Lack of documentation, lack of contextualised curriculum, and lack of place-based pedagogy are the main concerns that most researchers highlight. There are many ways it can be done. First, it can be passed on to future generations through education by integrating it into the formal curriculum while maintaining its relevance in the modern era. In Zanskar, most schools follow the NCERT curriculum, while a few follow the Jammu and Kashmir (J&K) board curriculum; neither is contextually framed to pass on Indigenous knowledge to the next generation.

From the start, rote learning is encouraged by the children's inability to connect the concepts in their books with those in their surroundings. They study other world wonders and shout about the Taj Mahal, but learn nothing about the Leh Palace. They chant about how hydrogen and oxygen atoms combine to make molecules, but do not mention how glaciers are the lifeline of irrigation in Ladakh. This has long-term effects on the pupils' lives (Rehman,2013). A contextualised curriculum tailored to the needs and surroundings of indigenous learners will motivate them to pursue science in the future, spark their interest in science, and help them feel more at home in the classroom. Bridging culture in formal science curricula is now widely accepted worldwide. Researchers and policymakers must focus on this to make learning more holistic for native learners. The study supports the notion of making science relevant, accessible, culturally sensitive, and consistent with students' cultures (Pawilen, 2021).

Zanskar is one of the last remaining Tibetan cultural settlements and one of Ladakh's least impacted microcosms (Zanskar | District Kargil, Union Territory of Ladakh | India, n.d.). In Zanskar (a remote valley nestled in the UT of Ladakh), people have developed and honed TEK over the years to mindfully interact with their natural resources, minimising waste and pollution. In Zanskar, people possess intimate knowledge of their environment and utilise their resources optimally, considering their technological level, worldview, and priorities (Chatterji, 1992). However, with the flourishing of hard infrastructure development, as consumerism creeps into the valley, the traditional ecological knowledge that they have honed over generations is on the verge of vanishing. To preserve and disseminate this knowledge, a curriculum can be a vital means to pass it on to the next generation.

Research Objective:

1. To document the TEK of the "Boto" tribe in Zanskar Valley and integrate it into the formal science curriculum at the middle stage for contextualised learning.

Methodology

This study employed a qualitative research approach, collecting information through in-depth ethnographic interviews, document analysis, conversation analysis, and participatory observation. As an outsider, to document the Traditional Ecological Knowledge of the indigenous people of Zanskar Valley, the researcher opted for ethnography as the most suitable method to meet the study's requirements. To document TEK, participatory observation and semi-directive interviews are prominent tools while living with the community (Huntington, 2000). The researcher spent 5 months in Zanskar Valley (June to October 2024) to document TEK. To select appropriate informants, snowball sampling or chain referral sampling was employed until a point of saturation was reached (32 in-depth interviews were conducted, recorded, and transcribed). During participatory observation, the researcher immersed herself entirely in the field. Wherever required, help from an interpreter was taken. Additionally, the research examines secondary sources, including documents and documentaries, to supplement primary data. This study can be divided into three phases, as outlined in Table 1.

Table 1: 3 Phases of this study

Phase 1	TEK documentation (primarily primary data via ethnography as a method, which is further supplemented with secondary data)
Phase 2	Data Analysis (Thematic analysis of documented data as per themes provided in middle-stage science curriculum, as well as analysing existing formal science curriculum at middle stage, i.e., NCERT for TEK, to see the scope of integration)
Phase 3	Integrating TEK with formal Science Curriculum using Fogarty's model of integration

There is a total of seven themes in the middle stage NCERT Science curriculum.

i. Food
ii. Materials
iii. The World of the Living
iv. How Things Work
v. Moving Things, People, and Ideas
vi. Natural Phenomena
vii. Natural Resources

Thematic analysis was done according to the above themes.

How can TEK be integrated into the curriculum?

The Four-step model suggested by Fogarty can be used to integrate TEK into science curricula. (Handayani et al., 2018); Fogarty, 1991)

1. **Fragmented/Cellular:** Traditional ecological knowledge and formal science are studied separately in an isolated system. Each is considered a distinct discipline and comprehensive in itself. TEK and formal science are considered independent of each other. The aim of this fragmented step was to preserve the sincerity of each knowledge area.
2. **Connected:** After analysis, the results of each knowledge system are studied in fragmented steps, connected based on themes, concepts, topics, and subject areas. Both knowledge systems begin to overlap and interpenetrate each other. Like osmosis, the knowledge system with greater concentration, i.e., traditional ecological knowledge, begins to permeate formal science. This is done deliberately to correlate indigenous knowledge within a discipline. By connecting within a discipline, one can gain a broader perspective and engage in focused study, allowing for review, reconceptualization, and assimilation of ideas.
3. **Sequenced:** In the next step, alignment is done to examine the relationship between the two knowledge areas in depth and detail, where the universe of traditional ecological knowledge and science classrooms were linked and correlated. This is done to arrange the topics, concepts, themes, and skills that were similar between the two.
4. **Integrated:** This step involves identifying overlapping skills, knowledge, and attitudes when developing a curriculum. The two fields of knowledge become interrelated due to the integrated model, promoting cross-disciplinary understanding. To achieve the desired competency in students, both kinds of knowledge are combined to form a new curriculum.

The researcher has attempted to demonstrate how this integration can be achieved by using one theme, "Food," as a reference. This will integrate the science curriculum's content into learners' everyday experiences and contexts.

Table 2: Illustrating the theme “Food” based on Fogarty’s model of curriculum integration.

Fragmented		Connected	Sequenced (embedded in content) Linking traditional practices with scientific principles	Integrated (Via activity)
Formal Science	TEK			
Sources of Food (Plant parts and animal products as sources of food)	Edible native plants (Classification of plants based on their edible parts: roots, stems, leaves, flowers, fruits, seeds), animal products consumed like butter, milk, meat, curd. Livestock management and	Native plant and animal products are sources of food, the interdependency of humans on the ecosystem, and livestock in Zanskar	1. Classification of plants based on edible parts (roots, stems, leaves, etc.) 2. Prominent plants consisting of the valley’s ecosystem, like Sea buckthorn, Willow, Poplar, Juniper, Barley, and black pea, along with	1. Draw a classification chart of hybrids of native livestock 2. Write all the dishes and their composition you see during *nyopta* (a community event during

	classification of their hybrid species		some fodder plants. 3. Livestock management principles used by indigenous people of the valley over time, and hybrid identification of yak and cow to learn genetic inheritance and crossbreeding. 4. Animal products as a source of food. 5. Concepts of interdependence, ecological balance, and sustainable animal husbandry.	marriage) 3. Construct a food web including local edible plants and animal products. 4. Make a table illustrating the difference between the dietary habits of your grandparents and those of you. 5. Map the seasonal migration of the herders of your village and write a report on their daily routine. Highlight the concern over abandoned *doksa*.
Components Of food (balanced diet)	Traditional diet components of Zanskar- *Tsampa*, *Paba*, *Kholak*, *Khambir*, *Skyur*, *Paktuk*, *Tangtur*, *chhutagi*, *Thukpa*, *Stri*, *Tara*, *Maar*, *Dabo*, *Churrpey*, Milk, butter, *Thuth*, *Gyuma*, curd, Yak Meat (*shapchen*), Leafy vegetables, Berries, Butter Tea, Local Fruits, *Chhang* (local beverage), *Arak, Siri, gur gur cha,* i.e., butter tea	Rich sources of necessary nutrition, catered to their living circumstances, are the main elements of the cuisine of indigenous people of Zanskar. These elements call for carbohydrates, proteins, vitamins, minerals, fats, fiber, and water. "Four pillars of life": *tsampa (*barley flour), meat, salt, and tea."	1. Carbohydrates- staple food *barley* i.e. *neh* consumed in various forms is a rich source of carbohydrate. 2. Proteins- Meat and dairy products like milk, curd, and cheese. 3. Vitamins- Sea buckthorn is a source of vitamin C, leafy vegetables, and berries are a source of vitamins. 4. Minerals- Salt from *Changthang*, Wholegrains, Milk products 5. Fat- Yak butter, cheese, and curd are sources of fat 6. Fiber- Wholegrains, vegetables. 7. Hydration –Butter tea is not only hydrating but also aids in replenishing electrolytes, promoting digestion, and protecting against the harsh climate by moisturizing skin and lips.	1. Create table featuring food combinations where Tsampa is a core ingredient. 2. Document the ceremonial roles of Tsampa in rituals like *Gustor* and *Saka*. 3. Research and record the preparation process for butter tea. 4. Collect oral histories about *Changthang* traders and goiter-related folktales involving salt exchange 5. Analyze the evolution of meat consumption patterns over generations, exploring changes in accessibility and preferences within the valley.

Cleaning food (Threshing, winnowing, hand picking, sedimentation, filtration.)	Yaks and *dzhos* are used to separate grain from husks. Natural wind currents are used to separate lighter chaff from heavier grains. Flowing water is used in *Kuhls* to clean grains. *Chhang* is filtered using handmade sieves and vaporized to make *arak.*	Separating grain from husks is threshing. Winnowing is separating lighter chaff from heavier Sedimentation is being done via flowing water to clean the grains *Chhang* is filtered, and condensation produces *arak*.	1. Threshing (Using yaks and dzhos)- Mechanical separation using kinetic energy. 2. Winnowing (Using wind currents)- Aerodynamics and density difference 3. Sedimentation (Using *Kuhls* for grain washing)- Gravity-induced separation 4. Filtration (Handmade sieves for *chhang*)- Physical separation (porosity) 5. Condensation (Distilling *chhang* into *arak*)- Phase change (evaporation & condensation)	1. Create a small-scale model of a traditional threshing setup using craft materials. 2. Learn a folk song sung to yaks while threshing 3. Engage students in cleaning and maintaining *Kuhls*; include discussions on glacier dependence and community water-sharing methods. 4. Prepare a chart to show the process of distillation while preparing *arak*.
Crop production (Soil preparation, selection of seeds, sowing, applying fertilizers, irrigation, weeding, harvesting, and storage; nitrogen fixation, nitrogen cycle)	*Saka* festival marks the ceremonial opening of the farmland. Selecting seeds based on color, size, and viability. Time of sowing based on the local calendar, *lotho*. Use of nightsoil for soil enrichment. Distributing water through *Kuhls*. Manual removal of weeds. Crop rotation with legumes. Different harvesting techniques are used for barley, wheat, and peas. Storing food in *panga*, *laptong*, *churches*, *checho ng*, *pitzey*, *dzama*, and by dehydration.	*Saka* festival embarks ploughing journey; seeds are selected for better yield. Organic manure from dry toilets is used as fertilizer, maintaining water gradients via *kulhs* for irrigation. Harvesting peas using a sickle to leave roots behind for nitrogen fixation. Traditional food storage and preservation methods.	1. Soil preparation-With *Saka* ploughing, compacted soil is disrupted, improving water infiltration and root penetration. 2. Selection of seeds- seeds chosen maximize germination rates and promote traits for better yield. 3. Sowing- *Lotho* determines favorable climatic conditions for sowing. 4. Applying fertilizers- nightsoil enriches the soil sustainably, recycling nutrients. 5. Irrigation- Kuhls distributes water efficiently using gravity, showing the immense significance of glaciers in the region. 6. Weeding- Eliminates unwanted growth, enhancing nutrient availability for crops while using it for fodder. 7. Harvesting-Barley and wheat are uprooted while peas are harvested using a sickle so that legumes fix nitrogen in the soil. 8. Nitrogen Cycle: Legume roots host nitrogen-fixing bacteria, converting atmospheric nitrogen into usable forms. Nightsoil enhances organic matter recycling, completing the nitrogen cycle	1. Provide students with samples of different seeds and have them observe traditional criteria for selection alongside scientific traits. 2. To learn determining sowing times using *lotho* and have students map climatic conditions having any impact on sowing schedules due to climate change. 3. Have students design visual models depicting the nitrogen cycle, incorporating legume cropping and nightsoil application in Zanskar farming. 4. Students build replicas of structures like *panga* and *laptong*, and study their effectiveness in preserving food compared to refrigeration.

			loop 9. Storage- Structures like *panga, laptong, churches, checho ng, pitzey, dzama,* and dehydration methods preserve food naturally by controlling temperature and moisture.	
Microorganisms	Fermented food and beverages like *chhang*, *khambiri*, *tara*, *maar*, etc.	Traditional foods like *chhang*, *khambir*, *tara*, and *maar* rely on microbial fermentation. Microorganisms trigger fermentation, producing beneficial compounds like probiotics. Microorganisms produce natural acids that prevent food spoilage, preserving food traditionally.	1. Microorganisms like yeast and lactobacillus break down starches and sugars, leading to fermentation. 2. Scientific principle: Anaerobic Respiration – microbes convert sugars into alcohol and acids in the absence of oxygen. 3. Biochemical Preservation – Lactic acid bacteria prevent harmful bacterial growth, extending shelf life. 10. Microbial Action in Digestion – Fermented foods regulate gut microbiota and improve nutrient absorption.	1. Collect fermented food samples, i.e., chhang, and observe microorganisms under a microscope. 2. Explore how fermented beverages like *chhang* play a role in festivals and ceremonies. 3. Students write the process of making *khambiri*.

Discussion

According to the United Nations Declaration on the Rights of Indigenous Peoples (U.N. Assembly, 2007), Indigenous peoples have the right to education that is culturally relevant. Indigenous Peoples have the right to an education that is in line with their own teaching and learning methodologies, according to Article 14 of the Declaration, and their education should take into account the diversity of their cultures, customs, histories, and goals, according to Article 15 (Sánchez Tapia et al., 2018). With the inclusion of TEK in the formal science curriculum at the middle stage, learning will be more culturally relevant and contextually relevant for Indigenous learners. It will increase their engagement and motivate them to pursue their rich cultural heritage. They would be able to connect their surroundings to the classroom. (Nair, 2024) discovered that a case study conducted in a rural village in Tamil Nadu, India, demonstrated that incorporating Indigenous Knowledge Systems (IKS), including traditional water harvesting methods and sustainable agricultural practices, into the science curriculum enhanced student learning outcomes and fostered an appreciation for cultural heritage. He further supports the success of this integration in bridging the learning gap by providing various examples within the Indian context. Two notable instances he has evaluated as successful accounts of Indigenous Knowledge Systems (IKS) integration in science education are the

TERRA (Traditional Ecological Resource Research and Utilization) Project in India, initiated in the 1990s, which sought to incorporate local forest management knowledge into school curricula, thereby enhancing student engagement, environ-mental awareness, and community empowerment, and the Traditional Ecological Knowledge (TEK) initiative within Alaska Native Science Programs. Numerous school districts in Alaska have integrated Traditional Ecological Knowledge (TEK) into their science curricula, wherein elders instruct students on animal tracking, traditional hunting methodologies, and indigenous astronomy. This approach enhances students' understanding of their cultural heritage, environment, ecosystems, and sustainable practices, while fostering respect for diverse knowledge systems and scientific inquiry (Nair, 2024). In the above cases, we can assert that TEK holds the key to sustainability in modern times, including practical knowledge about various sustainable practices, such as crop rotation, water conservation, and the use of native plants, thereby fostering a greater commitment to a sustainable future. Teaching such practices can provide students with actionable strategies for sustainability that they can apply in their lives and communities. It can foster a generation of students who are knowledgeable about eco-logical principles and equipped to support and implement sustainable practices in their communities (Oando, 2024). Preserving and reviving indigenous knowledge systems is essential, as is the need to popularize them among the youth to prevent their gradual loss over time (Rai, 2007). In addition to preserving and honouring these traditional systems, the integration of Indigenous Knowledge Systems (IKS) into contemporary science education and environmental practices enhances students' educational experiences and helps them to more fully value both scientific paradigm and cultural heritage (Phirke, 2025).

Conclusion

Indigenous learners gain firsthand knowledge from the community in their context, including livestock management, agriculture, health, healing, religious aspects, Indigenous crafts, and language. When they bring it to the table in the classroom, some of the information can be discarded by not labelling it as science, but rather as a community value. Although formal science may reject such knowledge, socio-cultural factors in science learning are now widely accepted worldwide (Aikenhead & Michell, 2011). It will make learners appreciate their own culture rather than feeling backward. It will significantly contribute to cultural inheritance and connect learners to their community (Chiang & Lee, 2015). To connect the gaps and build meaningful learning experiences for Indigenous learners, TEK in the science curriculum holds the potential to ensure that native learners do not feel separated from their environment

(Handayani et al., 2018). To properly recognize this knowledge, NEP 2020 also supports its inclusion in the curriculum. Concluding with a quote by Gitga'at elder Tina Robinson, "We might go back to this, the way the world is going" (Hoagland, 2017; Turner & Spalding, 2013).

References

Aikenhead, G., & Michell, H. J. (2011). *Bridging Cultures: Scientific and Indigenous and ways of knowing nature*. Pearson Prentice Hall.

Anamuah-Mensah, J., & Asabere-Ameyaw, A. (2004). The fusion of modern and indigenous science and technology: How should it be done? *African Journal of Educational Studies in Mathematics and Sciences,* 2(1), Article 1. https://doi.org/10.4314/ajesms.v2i1.38587

Berkes, F. (1999). *Sacred Ecology: Traditional Ecological Knowledge and Resource Management.* Taylor & Francis.

Chatterji, S. (1992). The Indigenous Culture of Zanskar. *India International Centre Quarterly, 19*(1/2), 233–240.

Chiang, C.-L., & Lee, H. (2015). Crossing the Gap between Indigenous Worldview and Western Science: Millet Festival as a Bridge in the Teaching Module. *Journal of Education and Training Studies, 3(6),* Article 6. https://doi.org/10.11114/jets.v3i6.1002

Fogarty, R. (n.d.). *Ten Ways to Integrate Curriculum.*

Handayani, R. D., Wilujeng, I., & Prasetyo, Z. K. (2018). Elaborating Indigenous Knowledge in the Science Curriculum for the Cultural Sustainability. *Journal of Teacher Education for Sustainability, 20*(2), 74–88. https://doi.org/10.2478/jtes-2018-0016

Hoagland, S. J. (2017). Integrating Traditional Ecological Knowledge with Western Science for Optimal Natural Resource Management. *Published in IK: Other Ways of Knowing, 3,* no. 1. https://doi.org/10.18113/P8IK359744

Hohenberg, P. C. (2017). *What is Science?* (No. arXiv:1704.01614). arXiv. https://doi.org/10.48550/arXiv.1704.01614

Huntington, H. P. (2000). Using Traditional Ecological Knowledge in Science: Methods and Applications. *Ecological Applications, 10*(5), 1270–1274. https://doi.org/10.1890/1051-0761(2000)010[1270:UTEKIS]2.0.CO;2

Kim, E.-J. A., Asghar, A., & Jordan, S. (2017). A Critical Review of Traditional Ecological Knowledge (TEK) in Science Education. *Canadian Journal of Science, Mathematics and Technology Education, 17*(4), 258–270. https://doi.org/10.1080/14926156.2017.1380866

Nair, H. B. (2024). Science Education as a Catalyst for Integrating Indian Knowledge Systems in Rural Communities with Urban Modernism. *Journal of Scientific Temper (JST), 12*(1), Article 1. https://doi.org/10.56042/jst.v12i1.8719

NCST Writes to Union Home Minister & Union Tribal Affairs Minister Conveying Its recommendation to Include Union Territory of Ladakh Under 6th Schedule of Constitution Of India. (n.d.). Retrieved 1 May 2025, from https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=1584746

Nelson, M. K. (2014). Indigenous science and traditional ecological knowledge: Persistence in place. In *The World of Indigenous North America* (pp. 188–214). Taylor and Francis. https://doi.org/10.4324/9780203122280-21

Norberg-Hodge, H. (1993). Learning from Ladakh. *The Trumpeter, 10*(4).

Oando, O. C. (2024). Incorporating traditional ecological knowledge into science education, a case study of Mbita sub-county. *Regional Journal of Information and Knowledge Management, 9*(2), Article 2. https://doi.org/10.70759/3xecwv02

Pawilen, G. T. (2021). Integrating indigenous knowledge in the Philippine elementary science curriculum: Integrating indigenous knowledge. *International Journal of Curriculum and Instruction, 13*(2), Article 2.

Phirke, P. (2025). *Reviving Ancient Knowledge: Integrating Indigenous Knowledge Systems in Biological Education.*

Rai, S. C. (2007). Traditional ecological knowledge and community-based natural resource management in northeast India. *Journal of Mountain Science, 4*(3), 248–258. https://doi.org/10.1007/s11629-007-0248-4

Rehman, S. (2013). Contemporary Ladakh Evolving Indigenous & Quality Education. SINDHYA, V. & Department of Education, University of Kerala, India. (2018). INTEGRATING INDIGENOUS KNOWLEDGE INTO SCIENCE TEACHING IN SECONDARY SCHOOLS. In Indian J.Sci.Res. (Vol. 20, Issue 1, pp. 71–75). https://www.ijsr.in/upload/1605939570 Chapter_14.pdf

Sánchez Tapia, I., Krajcik, J., & Reiser, B. (2018). “We do not know what is the real story anymore”: Curricular contextualization principles that support indigenous students in understanding natural selection. *Journal of Research in Science Teaching, 55*(3), 348–376. https://doi.org/10.1002/tea.21422

Turner, N., & Spalding, P. R. (2013). ‘We Might Go Back to This’; Drawing on the Past to Meet the Future in Northwestern North American Indigenous Communities. *Ecology and Society, 18*(4), art29. https://doi.org/10.5751/ES-05981-180429

Zanskar | District Kargil, Union Territory of Ladakh | India. (n.d.). Retrieved 30 April 2025, from https://kargil.nic.in/tourist-place/zanskar/