

1.Introduction

Indigenous peoples globally have maintained unique perspectives, grounded in cultural experiences, that govern interactions among human, non-human, and other-than-human entities within particular ecosystems. These comprehensions and relationships form Indigenous knowledge, alternatively, traditional or Aboriginal knowledge. People sometimes use the words "knowledge," "belief," and "tradition" to characterize Indigenous ways of knowing vaguely and interchangeably. Indigenous knowledge is transmitted formally and informally among kin groups and communities through social interactions, oral traditions, ritual practices, and various activities (Bruchac, 2014). National Curriculum Framework for School Education (NCF-SE) 2023 defines indigenous knowledge as the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment.

One of the most important things on the national and global agenda is protecting biodiversity for future generations while striving to learn about and record how indigenous people manage resources. Because indigenous knowledge has allowed its bearers to live in "harmony" with nature, which has allowed them to use it in a way that is good for the environment, it is considered very important to talk about how to use resources in a way that is good for the environment. (Farooquee et al., 2004).

In this fast-paced world, where we are working hard to keep up with the speed of scientific progress and modernism, we need to protect the indigenous knowledge, but a lot of it is not used or shown enough. It is essential to contemplate the methods and mechanisms for preserving and transmitting indigenous knowledge throughout generations. School curriculum is the most effective way to shape young minds with varied worldviews; hence, it can be important to teach indigenous knowledge elements in schools. Science, as a field that studies the connections between the natural, physical, and social worlds, provides a broad framework for examining the knowledge and practices of indigenous communities and reflecting on them to develop various viewpoints and interpretations. (Welden et al., 2021).

A. Ladakh- A living repository of Indigenous Knowledge

Indigenous knowledge has been passed down through generations in the Himalayas, home to various ethnic tribes, which has helped people survive and adapt to such a harsh environment. Due to isolation, local customs, oral histories, and environmental knowledge were protected in the past, but things have evolved quickly in recent decades. These communities are increasingly affected by modernization. New lifestyles, technologies, and outside influences often clash with local values. For instance, road construction and tourism in the Zaskar Valley have made communication easier. This has generated economic opportunities, but researchers warn that traditions and indigenous practices risk extinction due to changing lifestyles. Thus, preserving Indigenous knowledge in these areas is crucial for cultural identity and sustainable development. Conservation and educational initiatives, such as participatory documentation and curricular integration, are becoming more vital to stop loss and pass on knowledge.

Ladakh has five valleys: Indus, Nubra, Changthang, Suru, and Zaskar. This study examines documentation of indigenous knowledge in the Zaskar Valley. The valley, located north of the Himalayas west of Leh at elevations between 11,000 and 14,000 feet, is the most beautiful in Ladakh. The poorly vegetated Indian trans-Himalayan region covers 186,000 km² above the natural tree line. The Zaskar valley is surrounded by towering mountains and the Zaskar River, isolating it from the rest of Ladakh (Jishtu et al., 2025).

2. Objectives

This study focuses on two main objectives-

1. To identify the indigenous knowledge of the Bot or Bodo tribe of Zankar Valley for integrating into Ladakh's secondary stage science curriculum.
2. To validate the indigenous knowledge as legitimate science via a truth-based epistemological framework and propose a systematic plan for integration.

3. Rational

Indigenous knowledge, in many ways, is complementary to science rather than contradictory, as it is built on intense, continuous observation by generations over time, and observation is a well-accepted tool in science (Agrawal, 1995). Research indicates conflicts between formal science and indigenous knowledge. Science, deemed universal, differs from indigenous knowledge, which is rooted in distinct cultures and experiences. While Western science is frequently considered the standard, indigenous wisdom offers a holistic view of the world, while science focuses on its pieces. Most tribal students in India struggle to comprehend class courses, according to existing research. The fundamental reason is its lack of relevance to their daily lives (Wright et al., 2019; Tigga & Krishnan, 2024).

4. Methodology

For objective 1, the researcher used a qualitative research approach to conduct the study. Rooted in ethnographic methods to collect data, participant observation, semi-directed ethnographic interviews, immersive field visits, and living with the community for around six months (July- October 2024, April- May 2025), helped researchers gain in-depth insight into Indigenous knowledge of the tribe. Researchers participated in the Zaskar cultural festival 2024, including two weddings and other events and rituals, to understand and observe the imbibed indigenous knowledge.

For in-depth ethnographic interviews, participants were selected through chain referral based on their expertise in indigenous knowledge, until saturation of informants. With a diverse age group and gender, 32 participants were interviewed based on snowball sampling to ensure rich and relevant data would be collected firsthand for the first objective. Multiple times, local interpreters were used to overcome language barriers, though many could speak good Hindi.

During the field work, most of the time locals questioned me about the purpose of my research and the benefit to the community of this work. Though most of the informants were older, perhaps they understood my research work and supported it with great warmth

because they were genuinely concerned about the loss of indigenous wisdom due to the influence of modernity on their future generation. The community was welcoming enough for me once I was introduced by the gatekeepers, whose trust I had to win initially by explaining my purpose and intentions behind choosing them.

For objective 2, the researcher completely relied on the literature review to explore truth-based epistemological framework and integration strategies.

5. Findings / Discussion

A. Two Eyed Seeing Approach –

Two-Eyed Seeing focuses on the importance of seeing the world through both the eyes together to benefit all, one eye using the strengths of Indigenous worldviews and the other eye using the strengths of Western worldviews (Wright et al., 2019).

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

1. Food
2. Materials
3. The World of the Living
4. How Things Work
5. Moving Things, People, and Ideas
6. Natural Phenomena
7. Natural Resources

B. Epistemological justification

Epistemology is the branch of philosophy that examines knowledge, focusing on the concepts of truth, belief, and perception. Knowledge constitutes justified true belief, while epistemology examines the foundations for endorsing such views (e.g., statements, sentences, propositions, etc.) (Bernecker & Pritchard, 2011; Zinyeka et al., 2016). The correspondence, pragmatic, and coherence theories of truth constitute the foundation for the examination and acceptance of knowledge claims in numerous contexts (Audi, 1995; Zinyeka et al., 2016).

The correspondence theory states that a knowledge assertion or belief is true if it has an observable and empirical basis that matches it. However, it does not account for moral and mathematical ideas, hence it cannot be considered a universal theory of truth. The pragmatic theory defines truth as practical problem-solving. The coherence theory asserts that a belief is considered true when it is part of a cohesive and harmonious system of accepted beliefs and knowledge. Beliefs are recognized as true when they fit into existing systems. The coherence theory of truth can enable the integration of 'mysterious' IKS characteristics in science education (Zinyeka et al., 2016).

This study's conceptual framework included the above truth theories.

Table 1: Illustrates major scientific concepts from the 7 themes provided by NCERT, backed by the scope of integration with epistemological justification.

	<p>temperatures.</p> <p>Cow dung is used for combustion.</p> <p>Using an edelweiss flower called <i>Tsa</i> and a white colored stone called <i>chado</i> to ignite fire.</p> <p>Gunpowder used to be made locally, sourced from local ingredients for hunting purposes.</p>	
River	Zanskar is dominated by three main rivers: the Stot River, the Zanskar (formed by the confluence of the Stot and Luknak Rivers), and the Luknak River.	Observable and factual data (correspondence); Determines daily life and occupation (pragmatic)
Mountain ranges	The region is surrounded by the Northern face of the Great Himalayan Range and the Zanskar Range.	
Glaciers	Zanskar hosts several glaciers, including the large Drung Drang Glacier (source of the Stot River) and Shingo La Glacier.	
Lakes	Sani Lake is very sacred in the region.	
Soil	Soils in Zanskar are largely sandy loam with low organic matter and poor water retention.	
Climate	Zanskar experiences extreme cold winters (down to -40°C), mild summers (up to 25°C), and very dry conditions with low rainfall but heavy snowfall. Winds are strong and dusty in summer.	
Flora and Fauna	The Zanskar Valley's harsh, cold desert environment supports hardy flora such as sea-buckthorn, alpine meadows with edelweiss, medicinal plants, and cultivated crops like barley, potatoes, and lentils at lower elevations. The fauna includes domestic animals like yak and dzo, alongside wild species such as the snow leopard, Himalayan blue sheep (bharal), ibex, marmots, and various birds like ravens and redstarts.	
Animal Adaptation and Domestication/ Crossbreeding	Some of the domesticated animals are ponies, asses, horses, sheep, goats, yaks, and dogs. The yak is a prominent animal in Zanskar. It is also called the "ship of snow." The herders relied on highland pastoralism and set up temporary villages called doksa. They raise yaks, cows, <i>zhomo</i> , and	

with more concentration, i.e., traditional ecological knowledge, starts to penetrate formal science. This is done deliberately to correlate indigenous knowledge within a discipline. By connecting within a discipline, one will perceive the big picture and a focused study, allowing one to review, reconceptualize, and assimilate 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 and promote cross-disciplinary understanding. To achieve the desired competency in students, both kinds of knowledge are combined to form a new curriculum.

5. Conclusion & Implications

According to the United Nations Declaration on the Rights of Indigenous Peoples (U.N. Assembly, 2007), Indigenous peoples have the right to culturally relevant education. 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 this inclusion of indigenous knowledge in the formal science curriculum at the middle stage, learning will be more culturally relevant and contextual 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.

Indigenous learners gain firsthand knowledge from the community in their context, like livestock management, agriculture, health, healing, religious aspects, Indigenous crafts, language, etc. When they bring it to the table in the classroom, some of the information can be discarded by not stating it as science, but the community values it. Though formal science might reject such knowledge, socio-cultural factors in science learning are now 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 for Indigenous learners, indigenous knowledge in the science curriculum holds the potential so 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.

6. References

- Agrawal, A. (1995). Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change*, 26(3), 413–439. <https://doi.org/10.1111/j.1467-7660.1995.tb00560.x>

- Aikenhead, G., & Michell, H. J. (2011). *Bridging Cultures: Scientific and indigenous and ways of knowing nature*. Pearson Prentice Hall.
- Audi, R. (1995). (Ed.). *The Cambridge dictionary of philosophy*. Cambridge: Cambridge University Press.
- Bernecker, S., & Pritchard, D. (2011). *The Routledge companion to epistemology*. New York: Routledge.
- Bruchac, M. M. (2014). *Indigenous Knowledge and Traditional Knowledge*.
- 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>
- Farooquee, N. A., Majila, B. S., & Kala, C. P. (2004). Indigenous Knowledge Systems and Sustainable Management of Natural Resources in a High Altitude Society in Kumaun Himalaya, India. *Journal of Human Ecology*, 16(1), 33–42. <https://doi.org/10.1080/09709274.2004.11905713>
- 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>
- Jishtu, V., Moran, A., Ibrahim, M., & Ahmad, Z. (2025). Quantitative study of the indian ethnobotanical medicinal plant resources in the remote Zanskar Valley of Ladakh. *Ethnobotany Research and Applications*, 31. <https://doi.org/10.32859/era.31.12.1-28>
- 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>
- Tigga, A., & Krishnan, D. (2024). Exploring The Scope of Integration of Indigenous Knowledge of Tribal Communities of Jharkhand in Science Curriculum at Elementary Stage. *School Science a Quarterly Journal of Science Education*, Vol. 62.
- Welden, E. A., Chausson, A., & Melanidis, M. S. (2021). Leveraging Nature-based Solutions for transformation: Reconnecting people and nature. *People and Nature*, 3(5), 966–977. <https://doi.org/10.1002/pan3.10212>
- Wright, A. L., Gabel, C., Ballantyne, M., Jack, S. M., & Wahoush, O. (2019). Using Two-Eyed Seeing in Research with Indigenous People: An Integrative Review. *International Journal of Qualitative Methods*, 18, 1609406919869695. <https://doi.org/10.1177/1609406919869695>
- Zinyeka, G., Onwu, G. O. M., & Braun, M. (2016). A Truth-Based Epistemological Framework for Supporting Teachers in Integrating Indigenous Knowledge into Science Teaching. *African Journal of Research in Mathematics, Science and Technology Education*, 20(3), 256–266. <https://doi.org/10.1080/18117295.2016.1239963>