

Indigenous Knowledge in Science Classroom Practices: An Explorative Study

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Abstract

Indigenous knowledge systems give a unique environmental perspective and can benefit science education by promoting cultural understanding, sustainability, and holistic learning. This study assessed Indigenous Knowledge's practices (IK) in the science classroom, IK of the community regarding science education and the possibility of IK connecting to the science curriculum. In qualitative interviews, FGDs of participants were recorded as the data. Teachers, community members and students are valued. The study also found that limited teacher training, resources, and culturally relevant pedagogy hinder Indigenous knowledge gaining in science classes. The research also showed that educators, Indigenous communities, and curriculum makers must collaborate to include Indigenous knowledge. Classroom practices of science education practices encourage indigenous knowledge through exploration. Science classes that acknowledge Indigenous viewpoints and integrate various knowledge systems are emphasized. This study advises educators, policymakers, and curriculum authors to use Indigenous knowledge to improve cultural diversity, science education, and student equity.

Keywords: Indigenous knowledge, Classroom practices, Explorative study

1. Introduction

Indigenous knowledge is the unique information about people's beliefs, practices, and ways of knowing passed down from generation to generation in indigenous societies (Mekoa, 2018). Indigenous knowledge is based on the wisdom, insights, and information that Indigenous people have about their surroundings, cultural history, social relationships, and spiritual connections. Indigenous knowledge systems deeply understand the natural world and look at it as a whole. They focus on how people, other living things, and the environment are connected (Welden et al., 2021). It is shaped by native languages, oral customs, rituals, ceremonies, and learning by doing. It includes traditional ecological knowledge, ways of making medicines, farming skills, astronomical observations, storytelling, and ways to find your scheme, ways to handle resources, and practices that are good for the environment. It shows indigenous societies' unique cultural, historical, and geographical contexts and their close ties to the land, water, plants, animals, and astronomical bodies (Fuller et al., 2014). Indigenous knowledge is a big part of cultural identity and is generally passed down through oral tradition, stories, and direct teaching within the community. Finding out what indigenous

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knowledge systems are worth and their importance is essential for promoting cultural variety, helping the environment, and making educational systems open to everyone. Indigenous communities are respected and given more power when indigenous knowledge is used in different areas, like science education. It also improves our understanding of the world and encourages different ways of looking at knowledge and wisdom (Newberry & Trujillo, 2018). In recent years, science education has become more aware of how important it is to teach native information (Hu, Suh, and Pedro, 2023). In many places, science education has always been based on what scientists in the West know. It doesn't consider the rich and varied ways of knowing indigenous people. This exclusion hurts indigenous students' traditional identity and self-esteem and doesn't consider the crucial ideas and long-term practices in indigenous knowledge systems. Teachers and experts seek ways to include indigenous knowledge in science classroom tasks. They are doing this because they know they must take a more inclusive and culturally sensitive approach. This exploratory study looks into a new area of research by looking at possible rewards, problems, and ways to teach science using indigenous knowledge.

Indigenous knowledge in Nepal is strongly rooted in the cultural history and traditions of the country's many indigenous communities. Nepal is home to many different indigenous groups, such as the (Tamang et al., 2023). Indigenous knowledge is essential to the daily lives of these people in Nepal. It shows how close they are to the natural world, their traditions, and their spiritual beliefs (Brondzio et al., 2021). Nepal has a lot of traditional ecological knowledge and a deep understanding of its local ecosystems, which include plants, animals, and natural resources. These are well-known examples of places where indigenous knowledge is essential. They have made farming, logging, and managing resources more sustainable by combining what they know with how nature works and how the weather works in their area. Indigenous medicinal practices: Nepal's knowledge systems include many traditional healing techniques that use local herbs, plants, and natural remedies to cure different diseases (Devkota & Timilsena, 2023). Traditional healers, called "Dhami" or "Jhakri," have a lot of information about diagnosing and treating illnesses because it was passed down to them.

In the same way, communities in Nepal have created methods of farming that work well with the land and weather there. It includes techniques like shared farming, crop rotation, saving seeds, and irrigation that have kept them from going hungry for generations. Nepalese villages have a long history of traditional crafts and art, such as pottery, weaving, metalwork, wood carving, and painting (Jayapriya et al., 2023). These skills are passed down from one generation to the next, showing the artistic and cultural roots of the town. Nepal's native spiritual and cultural practices include many spiritual and cultural practices that are deeply rooted in everyday life. It includes rituals, ceremonies, dance, music, telling stories, and religious views. These things bring people together and help them feel like they belong.

In Nepal, people have tried to recognize and spread Indigenous Knowledge. Indigenous community-based initiatives, non-governmental groups, and the government have all been working to document and preserve Indigenous Knowledge, support traditional practices, and include Indigenous perspectives in policy-making and education. These efforts aim to value and protect indigenous people's cultural heritage and rights while promoting sustainable development and cultural diversity (Labadi et al., 2020). However, problems remain, such as the need for more vital legal recognition and protection of indigenous rights, fair representation and participation of indigenous communities in decision-making processes, and promotion of inclusive education that recognizes and respects indigenous knowledge systems. Nepal is getting better at recognizing and appreciating indigenous knowledge. It has a lot of promise for keeping cultural diversity, promoting sustainable practices, and making society more open and fair.

From what we know, there haven't been many attempts in Nepal to use native information in science classes. But some recent events may be too complicated for me to understand. To get up-to-date knowledge, looking at Nepal's most recent research, educational policies, and projects would be best. Here are some

everyday habits and trends. Through curriculum integration, Nepal has tried to add indigenous knowledge to its science education. The National Curriculum Framework (2019) for school education emphasizes teaching and learning, including indigenous knowledge, local context, and cultural variety. It lays the groundwork for bringing Indigenous Knowledge into science classes. Contextualized teaching materials construct (Zidny et al., 2020) say that teachers and curriculum developers make teaching materials and tools using Indigenous knowledge. These materials use local examples, traditional ways of doing things, and culturally relevant pictures to help students connect science ideas and their lives. Integrating indigenous knowledge into science classes is much easier when communities work with indigenous communities. Sometimes, people from indigenous communities are asked to share their science and environmental knowledge, stories, and experiences. This method helps people learn more about Indigenous Knowledge and how it fits into science education. Field-based learning, which includes field trips and hands-on activities, is being set up to get students interested in the local surroundings and traditional ways of doing things. Through these activities, students can watch and learn from Indigenous community members, study ecological connections, and do hands-on learning about Indigenous Knowledge.

In the same way, teacher professional development includes teacher training and professional development programs that help teachers learn more about Indigenous Knowledge and teach them how to use it in their science classes. These programs aim to help teachers become more culturally aware and give them the skills and knowledge they need to successfully include Indigenous perspectives (Comeaux et al., 2021). Research and teamwork help researchers and educational institutions in Nepal do studies and work together to find out how to use Indigenous Knowledge in science education. These projects aim to find evidence, share the best ways to do things, and help policymakers decide how to include Indigenous knowledge in science classes. It's essential to remember that Nepal's schools, regions, and groups may do these things differently and to different degrees. Work must always be done to deal with problems like limited resources, cultural sensitivity, and the need for ongoing support and cooperation with Indigenous communities. For the most up-to-date information, it is best to look at educational policies, research papers, and projects run by government and non-government groups in Nepal that focus on incorporating Indigenous Knowledge into science education (Moorman et al., 2020) say that using indigenous knowledge in science classrooms can help students learn more and get a better, more complete view of the natural world. When incorporating Indigenous knowledge, working with Indigenous communities respectfully and ensuring they are involved and have feedback is crucial. Indigenous rights, ownership of learning, collaboration, and cultural sensitivity are some of the most important things to remember when integrating indigenous knowledge into science classroom practices. Indigenous knowledge isn't just found in one country or area but in many different Indigenous communities worldwide. Indigenous people have created unique ways of knowing and doing things that have kept their cultures, methods of making a living, and relationships with the environment strong for many generations. International efforts, like the United Nations Declaration on the Rights of Indigenous Peoples and UNESCO's recognition of Indigenous Knowledge as an Intangible Cultural Heritage, show how important Indigenous Knowledge is in international settings. But it's important to remember that protecting and promoting Indigenous Knowledge should be done with respect, cooperation, and the free, prior, and informed consent of Indigenous communities. Indigenous peoples' rights and agency must be recognized, and meaningful relationships must be formed if Indigenous knowledge is used fairly and responsibly worldwide.

In Nepal, it is essential to learn about Indigenous Knowledge to use it in school. Nepal is home to many indigenous groups with their own ways of knowing and living. Using indigenous information in the classroom helps people learn to appreciate, respect, and include other cultures. It helps students understand and value indigenous communities' contributions and points of view. It makes schools more open and fair for everyone.

Indigenous knowledge is essential to Nepal's indigenous groups' cultural heritage. Using indigenous information in the classroom helps keep this knowledge alive and pass it on to future generations. It understands how important it is to stay active in indigenous communities' cultural traditions, oral histories, ecological knowledge, and traditional ways of doing things (Fernández et al., 2018). Indigenous knowledge gives a complete and localized picture of the natural world, including ecosystems, wildlife, and ways to live in a good way for the environment. By using Indigenous knowledge in Nepali classrooms, students can learn more about the local environment, how it fits into the ecosystem, and how to live healthily and harmoniously with nature.

Indigenous groups in Nepal have lived on their land long and know much about how it works. Indigenous methods for caring for the environment, sustainably managing resources, and adapting to climate change can be better understood by studying Indigenous knowledge in the classroom. This information can help students think and act in ways that help protect the environment and promote sustainable development. Learning becomes more important and meaningful to the students when Indigenous knowledge is used in the classroom. It crosses the gap between what students learn in school and what they know from their lives, putting academic ideas into their cultural context. When Indigenous views are included, students are more likely to be interested, motivated, and in charge of their learning (Morton et al., 2022) say that recognizing and valuing Indigenous knowledge in the classroom aligns with social justice and equality principles. It acknowledges the rights and contributions of Indigenous people, challenges their historical marginalization, and encourages education practices that are open to everyone. It also gives Indigenous students a feeling of empowerment and self-worth, which enables them to take an active role in their education and use their voice. Learning about Indigenous knowledge is essential to being a good global citizen in a world that is becoming more connected and varied. Students in Nepal can learn cross-cultural skills, empathy, and a broader view of knowledge systems by learning about Indigenous knowledge. It helps them learn to respect and work with people from different cultures, traditions, and ways of thinking. Overall, bringing the study of Indigenous Knowledge into Nepali classrooms helps to support cultural diversity, sustainable development, and education for all. It helps raise a generation of students who are proud of their cultural roots, care about the environment, and have a deep knowledge of the world around them.

2. Statement of Problem

Regarding the value and relevance of indigenous knowledge in science education, there is a lack of broad understanding regarding its integration and implementation in the classroom setting (Onwu & Mufundirwa, 2020). Existing research on the topic is limited, typically in the context of relating indigenous knowledge to science education practices. Therefore, there is a need for an explorative study that examines the challenges, benefits, views and perspectives associated with including Indigenous Knowledge in science classroom practices. This study addresses the research issues like existing practices and perspectives of science teachers regarding including Indigenous Knowledge in the classroom, the potential benefits of integrating it into science education, and its impact on students' engagement, cultural understanding, and academic achievement. Similarly, challenges that educators feel when incorporating Indigenous knowledge into science classroom practices can effectively support the integration of Indigenous knowledge in science education, and perceptions and recommendations can be provided for the development of culturally responsive science curricula and instructional materials that incorporate Indigenous Knowledge are the other issues that are relevant for the study-exploring these research issues to contribute to the knowledge base and provide practical insights for educators, curriculum developers, and policymakers on effectively incorporating Indigenous knowledge in science classroom practices. Ultimately, the study promotes culturally responsive and inclusive science education that values and integrates indigenous knowledge systems.

3. Literature Review

Using Indigenous knowledge in science classrooms is supported by a number of theories and points of view. Culturally responsive pedagogy is a well-known framework that focuses on recognizing and valuing students' ethnic identities and experiences in the classroom. Ladson-Billings (1995) says that culturally responsive pedagogy helps students do well in school and be interested in learning by recognizing their cultural backgrounds and including culturally relevant material in the curriculum. Culturally responsive teaching makes it easier to include Indigenous knowledge in science education. This helps students see how their culture and scientific ideas are related. Another theory that applies to this study is "two-way science education" or "bicultural science." This approach understands that Indigenous knowledge systems and Western scientific knowledge are both important, which helps people talk to each other and learn from each other. Scholars like (Aikenhead, 2001) support the idea of bicultural science and say that incorporating Indigenous Knowledge can improve science education by giving students different points of view, pushing them to think critically, and helping them understand other cultures.

Considerable empirical literature supports the idea that integrating Indigenous knowledge into science classroom methods could be helpful. They are Cajete (1999), Corsiglia (2001), Kawagley (2006), Cajete (1999), Snively and Corsiglia (2001), oehrig and Luft (2004), Australian Curriculum (2019), Whyte (2018), (Zidny Sjöström & Eilks 2020), Kim & Layman (2022), and Dentzau (2019). These studies show how Indigenous knowledge can help kids learn science better, be more interested in it, and understand other cultures. But they also shed light on the problems educators face, such as limited resources, different ways of knowing, and how important it is to build relationships with Indigenous communities. These results help explain why it makes sense to do an exploratory study on "Relating Indigenous Knowledge in Science Classroom Practices" and guide the planning of the research and analysis of the data to learn more about the topic.

4. Conceptual Framework

The conceptual, theoretical, and analytical framework is given in the following Fig.1

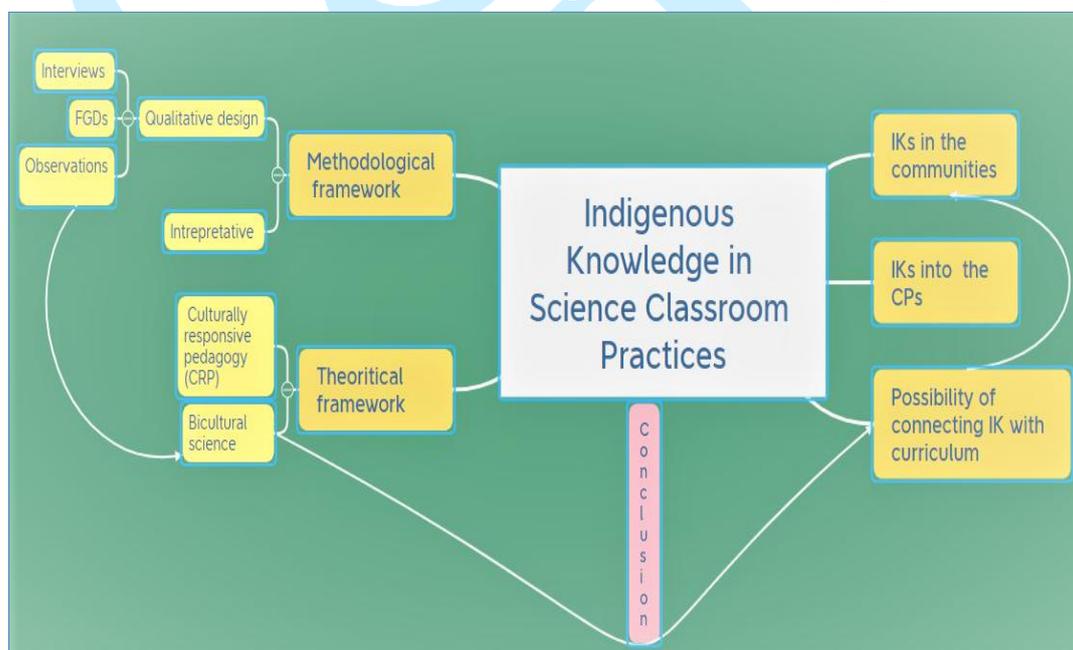


Fig. 1 Conceptual/ Theoretical Framework

5. Methodology

The methodology comprises research design, tools, and data collection and analysis. This explorative study employed a qualitative research design to gather comprehensive data. Teachers, students, and local community members of Palungtaar municipality of Gorkha district were the population of the study. Five

teachers, five students and six community members were selected from the purposive sampling method. The study will involve in-depth interviews and FGDs with science teachers, students, and Indigenous community members to gain insights into their perspectives and experiences in integrating Indigenous knowledge into science education. The validation procedures are crucial for ensuring the accuracy and reliability of data collected using qualitative research tools.

The validation of qualitative tools involves ensuring credibility (researcher's credibility, triangulation, and member checking), transferability (making findings applicable to different settings), dependability (maintaining an audit trail and peer debriefing), and conformability (reducing bias and reflexivity). Thematic analysis or other systematic approaches were used to analyze qualitative data. The set of validation procedures was designed for the research objectives. They must be appropriate for the specific study design and methodology to enhance the quality and trustworthiness of the research outcomes. The collected data will be analyzed using thematic analysis to identify key themes, patterns, and connections. The findings will be presented descriptively and supported by direct quotations, contributing to a rich understanding of the research topic. The collected data were analyzed manually and using N-vivo software by making a qualitative theme in the study.

6. Location Map of Research Site

The location map of the research site, like the Palungtar municipality of Gorkha districts, is constructed by the geographical information system (GIS), which is given as follows:

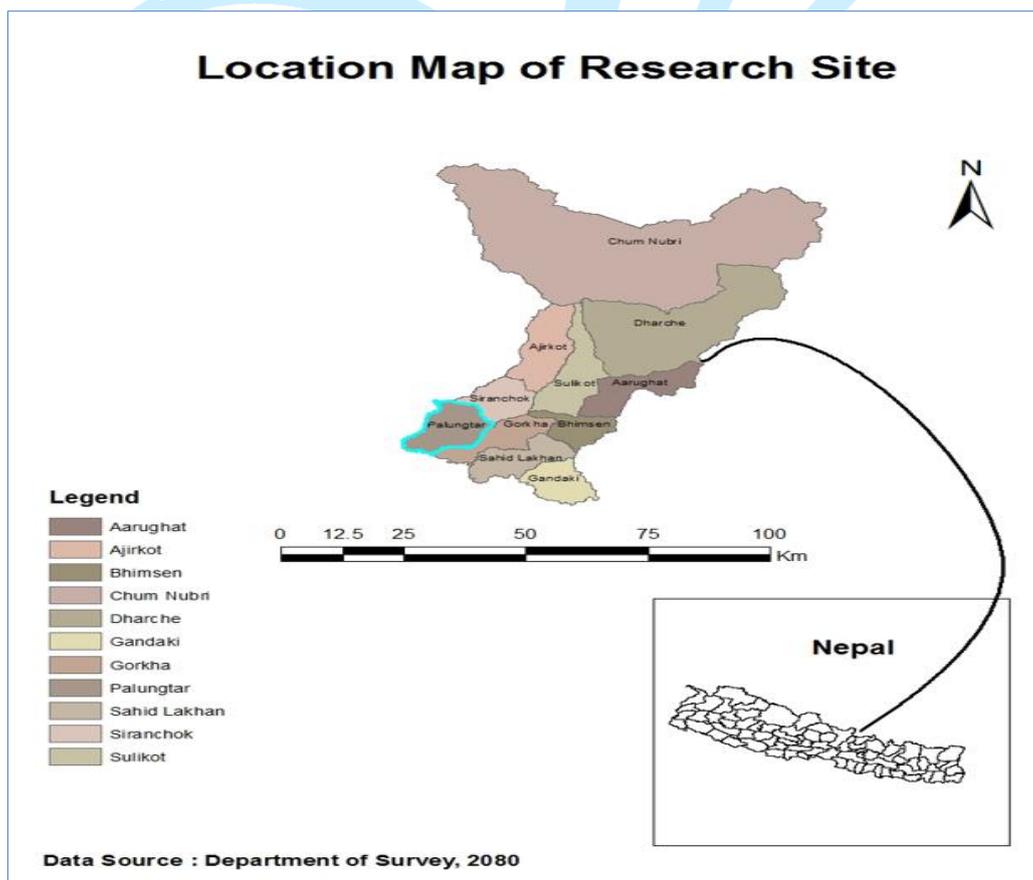


Fig. 2 Location map of research site

7. Result and Discussion

The information obtained from the interviews and FGDs of teachers, students and members of local communities were coded and built of theme to analyze and interpret. The result and discussion are based on the classroom practices of IK in science learning, indigenous knowledge of communities regarding science, and the possibility of IK connected to the science curriculum as the discussion of themes in interpretative ways.

7.1 Practices of Indigenous Knowledge (IK) in the Science Classroom

Integrating Indigenous Knowledge practices into science learning is a transformative method that respects cultural diversity, promotes environmental-friendliness, and encourages a more complete knowledge of science. Using IK, teachers can give their students a more comprehensive and well-rounded education that trains them to deal with complex problems with empathy, ethical awareness, and a deep connection to the natural world. Integration of IK practices shows how important different ways of knowing and learning are as we continue to live in a global world that is becoming more and more connected. In the line of indigenous knowledge practices in the science classroom, one of the teachers, T₁, says:

When I teach the science lesson, acid, base and salt, I use several indigenous materials belonging to kitchen practices like tea, turmeric, and red cabbage juice as the indicators. Lemon, tomato, and vinegar are used as the acid; ash, soap, and shampoo are used as the base; rock salt and common salt are used as the salt. Similarly, I used egg cells and lemon juice to prepare carbon dioxide gas, a chemical reaction illustrated by cooking rice as hydrolysis. I teach mixture, solution, and colloids by demonstrating tea, lemonade, milk, etc., from kitchen practices related to students' daily life experiences (Interview Recorded, August 2022).

The above information shows that science classroom practices are based on students' daily experiences. The experience of the prospective teacher is discussed in the classroom, which are the sustainable culinary practices of IK. Similarly, on the support of teacher T₁, student S₅ says as follows:

I am engaged in many activities like gas preparation, litmus paper preparation, soap preparation, and participation in discussions related to culinary practices, ethno-botany, agricultural and traditional daily live practices like dhiki, jato, coal, jach as the learning simple machine topics through the science teacher educator. I benefited from the learning resources that were acquired from the teacher (Interview Recorded, August 2022).

The above narrative of the students also shows that the classroom teaching of science is based on the IK practices. All these practices, like student daily life experiences, ethno-science procedures, and culinary traditions, belong to the IK practices in the science classroom.

7.2 Community Indigenous Knowledge (CIK) and Science Learning (SL)

Indigenous knowledge, also called "traditional ecological knowledge," is a collection of observations, practices, and ideas passed down through generations by Indigenous peoples living close to their surroundings. This knowledge shows how closely people are connected to nature, how well they understand ecosystems, and how to live harmoniously with them. Adding Indigenous knowledge to science lessons makes the lessons more exciting and shows how vital this knowledge is culturally. To explore the indigenous knowledge of communities regarding science learning, focus group discussions and interviews with community members were conducted. Concerning the IK of CRS, the community member CM₁ perspective is as follows:

I am engaged in many traditional activities as daily live practices like dhiki for husk rice, grinding and powdering of maize and other grains, jato for making flour of maize, wheat, malt, barley, junelo, and grindings of many bowls of cereal. Similarly, coal is used for crushing mustard, sunflower, soybean, and ukhu to produce oil and juice. The jach is used as the crushing junar, lemon, and ukhu to make juice. However, I do not know about the scientific connection behind them, what it to be connected to the learning science of our child and how it can be related to the science curriculum (Focus Group Discussion, September 2022).

The community members' narrative shows their many daily activities based on the IK practices. But they do not know the science behind these practices and have no idea how to connect it with the science classroom practices. Similarly, in support of the CM₁ view, another community member says that as follows:

I am also involved in many activities like powdering wheat maize from pani ghatta, making weapons and utensils from aaran, ploughing fields from halo, and many practices like mixing ash to stored seeds. I don't know, though, what the science behind them is, how it relates to our child's learning of science, or how it fits into the science curriculum (Focus Group Discussion, September 2022).

The stories of the community members show how they use IK practices in their daily lives. However, they don't understand the science behind these practices or know how to connect them to what they do in the science classroom.

7.3 Possibility of Connecting IK with Science Curriculum (SC)

The results of this study show how important it could be to include Indigenous Knowledge in science classes. IK-based classroom practices not only help students learn more but also show respect for different cultures and encourage a more complete knowledge of science. Even though people in the community know a lot about their culture, they want this information to be connected to formal science education. So, trying to bridge the gap between IK practices and scientific thinking could help make a science curriculum that is more inclusive and sensitive to different cultures. By recognizing the importance of both IK and traditional science education, teachers can ensure that all students learn in a more connected and exciting way.

From the interviews and FGDs of teachers, students and community members, the possibility of connecting indigenous knowledge with science curriculum is given as in Table 1:

Table 1 Possibility of connecting IK to the science curriculum

SN.	Indigenous knowledge	Possibility of connecting to the scope of the science curriculum	Remarks
1	Dhiki, jato, halo, koal, Jaach	Simple machine, etc.	Can be connected
2	Paani ghatta	Potential and kinetic energy, Electricity and magnetism, Electromagnetic induction, Motor effect, Centripetal and centrifugal force, Rotational dynamics, etc.	Can be connected
3	Aaran	Metals and non-metals, Properties of metal and non-metals, Roasting and Purification of metals.	Can be connected
4	Lemon, ash, rock salt	Acid, base, and salts	Can be connected
5	Tea, turmeric, red cabbage	Indicators	Can be connected
6	Cooking rice	Hydrolysis reaction, carbohydrates	Can be connected
7	Making pickle	Preservation of foods	Can be connected
8	Mixing ash, camphor, with seeds	Preservation of seeds	
9	lime, egg cell, chalk	calcium carbonate	Can be connected
10	Ukhu	Sucrose	Can be connected

Source: Field study, 2022

Table 1 gives an overview of how different Indigenous Knowledge (IK) practices and ideas might relate to each other in the context of the science curriculum. The table shows specific native practices, the scientific topics that could be connected to them, and an assessment of how likely it is that these connections can be made. The table is also a good way to see how native ways of doing things can be used to help people understand complex science ideas. Based on how likely it is that these connections can be made, it looks like a lot of these traditional practices fit well with the science curriculum. Integrating IK practices in this way can help people understand science ideas better while still respecting their culture.

8. Conclusion

In conclusion, the article emphasizes the significance of incorporating Indigenous Knowledge practices into educational settings that involve in science learning. It emphasizes that such integration can lead to a more holistic and culturally sensitive approach to learning, while also boosting one's grasp of scientific topics. This

can be accomplished by integrating different aspects of learning. A curriculum that recognizes the value of cultural variety and encourages students to have a closer relationship with the natural world can be developed by bridging the gap between traditional indigenous practices and conventional scientific education.

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Declaration of Conflict

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contribution

Both authors, *Krishna Maya Devkota* and, *Narayan Prasad Timilsena* have contributed equally to this paper.

References

1. Aikenhead, G. (2001). Integrating Western and Aboriginal Sciences: Cross-cultural science teaching. *Research in Science Education* 31, 337–355.
2. Australian Curriculum. (2019). Australian Curriculum: Science Aboriginal and Torres Strait Islander Histories and Cultures cross-curriculum priority. *Acara*, (July).
3. Basnet, R., Rai, N., Tamang, R., Awasthi, N. P., Pradhan, I., Parajuli, P., & Thangaraj, K. (2023). The matrilineal ancestry of Nepali populations. *Human Genetics*, 142(2), 167-180.
4. Brondízio, E. S., Aumeeruddy-Thomas, Y., Bates, P., Carino, J., Fernández-Llamazares, Á. Ferrari, M. F., & Shrestha, U. B. (2021). Locally based, regionally manifested, and globally relevant: Indigenous and local knowledge, values, and practices for nature. *Annual Review of Environment and Resources*, 46, 481-509.
5. Cajete, G. A. (1999). *Igniting the Sparkle: An Indigenous Science Education Model*. Kivaki Press, PO Box 1053, Skyland, NC 28776.
6. Comeaux, E., Grummert, S. E., & Mireles, D. C. (2021). A critical review of the literature on cultural competency in student affairs: Toward transformative cultural responsiveness. *Journal of Diversity in Higher Education*.
7. Dentzau, M.W. (2019). The tensions between indigenous knowledge and western science. *Cult Study of Sci. Educ*, 14, 1031–1036 <https://doi.org/10.1007/s11422-018-9903-z>
8. Devkota, K. M. & Timilsena, N. P. (2023). Indigenous medicinal practices in rural communities of Nepal : a religious perspective, 1091–1099. <https://doi.org/10.17605/osf.io/dr4xb>
9. Fernández-Llamazares, A. & Cabeza, M. (2018). Rediscovering the potential of indigenous storytelling for conservation practice. *Conservation Letters*, 11(3), e12398.
10. Fuller, R. S., Norris, R. P., & Trudgett, M. (2014). The astronomy of the Kamilaroi and Euahlayi peoples and their neighbors. *Australian Aboriginal Studies*, (2), 3-27.
11. Hu, M., Suh, J., & Pedro, C. (2023). An Integrated Framework for Preservation of Hawaii Indigenous Culture: Learning from Vernacular Knowledge. *Buildings*, 13(5), 1190.
12. Jayapriya, S., Anisha, C., & Jaisri, J. (2023). Indian Traditional Paintings a Journey through time.
13. Kawagley, A. O. (2006). *A Yupiaq Worldview: A Pathway to Ecology and Spirit*. Second Edition. Illinois: Waveland Press, Inc.
14. Kim, E. J. A., & Layman, E. W. (2022). Unsettling the urban–rural dichotomy for Indigenous education and education for reconciliation. *Diaspora, Indigenous, and Minority Education*, 16(1), 57-70.
15. Labadi, S., Giliberto, F., Rosetti, I., Shetabi, L., & Yildirim, E. (2021). Heritage and the sustainable development goals: Policy guidance for heritage and development actors. *International Journal of Heritage Studies*.
16. Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American educational research journal*, 32(3), 465-491.
17. Mekoa, I. (2018). Essentializing African indigenous knowledge systems in the midst of globalization and modernity. *African Renaissance*, 11-28.

18. Moorman, L., Evanovitch, J., & Muliaina, T. (2021). Envisioning indigenized geography: a two-eyed seeing approach. *Journal of Geography in Higher Education*, 45(2), 201-220.
19. Morton, M., Thomson, L., & Varghese, J. (2022). The Value of Critical Community-Engaged Teaching and Learning is in the Values: Advancing Students' Learning Outcomes. *International Journal for Research on Service-Learning & Community Engagement*, 10(1).
20. NCF. (2019). *Report on a national curriculum framework*. Ministry of science and technology. Curriculum development center, sanothimi.
21. Newberry, T., & Trujillo, O. V. (2018). Decolonizing education through transdisciplinary approaches to climate change education. In *Indigenous and decolonizing studies in education* (pp. 204-214). Routledge.
22. Onwu, G. O., & Mufundirwa, C. (2020). A two-eyed seeing context-based approach for incorporating indigenous knowledge into school science teaching. *African Journal of Research in Mathematics, Science and Technology Education*, 24(2), 229-240.
23. Roehrig, G. H., & Luft, J. A. (2004). Constraints experienced by beginning secondary science teachers in implementing scientific inquiry lessons. *International Journal of Science Education*. Retrieved from <https://doi.org/10.1111/j.1468-0262.2005.00584.x>
24. Snively, G., & Corsiglia, J. (2001). Discovering indigenous science: Implications for science education. *Science education*, 85(1), 6-34.
25. 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.
26. Whyte, K. (2018). Critical investigations of resilience: a brief introduction to indigenous environmental studies & sciences. *Daedalus*, 147(2), 136-147.
27. Zidny, R., Sjöström, J., & Eilks, I. (2020). A multi-perspective reflection on how indigenous knowledge and related ideas can improve science education for sustainability. *Science & Education*, 29(1), 145-185.

