Indigenous Science Teachers' Experience in Integrating Local Knowledge at Classroom Practices

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ABSTRACT. This study explores the lived experiences of Indigenous science teachers, connecting Indigenous knowledge with scientific concepts in science education by employing an interpretative phenomenological research design to understand how teachers bridge cultural practices with scientific inquiry. The experiences of Indigenous science teachers were recorded through in-depth interviews. The interviews were transcribed and coded, and themes were built by grouping similar codes. The study highlights how traditional practices such as the Newar cultural preparation of Aila and yomari are connected to scientific principles like distillation and exothermic reactions. Linking familiar, culturally relevant experiences with scientific content enhances student engagement, fosters critical thinking, and promotes cultural inclusivity. However, challenges arise, particularly for urban students, who may find it difficult to relate to these cultural practices such as dhiki, Jato, plough, aaran and pani ghatta. Despite these challenges, integrating local knowledge enhances science education, encouraging students to view science as a discipline grounded in cultural tradition and modern scientific inquiry. This approach fosters a deeper understanding of scientific concepts and supports a more holistic, inclusive learning environment.

Keywords: *Indigenous knowledge, science education, cultural relevance, and scientific concepts*

INTRODUCTION

Indigenous people refer to the Janajati community in Nepal, such as Magar, Tamang, Gurung, Rai, Newar, Limbu, Tharu, etc (Tamang, 2016). They have various cultural and local knowledge related to formal science education to create culturally responsive learning experiences. Khanal (2017) argues that culturally responsive school policies embrace students' linguistic and cultural diversity that is brought into the school through students. The teachers from indigenous backgrounds may bring unique perspectives from their communities, often incorporating traditional ecological knowledge, local medicinal practices, kitchen practices, agricultural practices, and environmental sustainability principles into science learning.

Indigenous/local knowledge focuses on the traditional knowledge of local communities, including the insight, practices, and experiences developed by Indigenous people (Nja & Obi, 2021). The NCF (2019) emphasized that science curriculum and classroom teaching connect with students' daily life experiences through innovative and interactive teaching methods in the Nepalese context. The curriculum framework seems to suggest including IK in classroom practices. Similarly, De Beer and Mothwa (2013) raised the issue of indigenous knowledge in the science classroom: science, pseudo-science, or a missing link to integrate indigenous knowledge in the science classroom practices in the African context. Indigenous knowledge has been marginalized within mainstream education systems, mainly dominated by Western scientific paradigms (Silvestru, 2023). The lack of focus on indigenous knowledge in science classroom practices led to difficulty in understanding laws, principles, and theories of science concepts. However, there is increasing recognition of the value of indigenous knowledge systems in various fields. Barnhardt & Kawagley (2005) and Whyte (2018) argue that indigenous knowledge offers a contextualized understanding of natural phenomena, which can balance and improve conventional scientific procedures. Integrating indigenous knowledge into science curricula is essential for promoting cultural diversity and inclusivity in education. Identifying and valuing Indigenous views can foster a sense of belonging and respect among Indigenous students, improving their engagement and academic outcomes (Battiste, 2013; Brayboy, 2020).

Similarly, indigenous knowledge systems frequently focus on sustainable and holistic connections with the natural world, providing valuable insights for addressing contemporary environmental challenges (Mazzocchi, 2020; McGregor, 2014). Culturally responsive pedagogy advocates incorporating students' cultural backgrounds in teaching learning to make their knowledge more relevant and effective (Gay, 2018). It emphasizes integrating diverse indigenous knowledge to create a more inclusive and equitable educational environment. Moreover, it relates to the principles of decolonizing education, which helps to challenge and eliminate colonial structures and biases within the academic field.

Integrating Indigenous knowledge into secondary science curricula recognizes the values and understanding of the natural world that tries to connect Indigenous cultures. This approach seeks to create an inclusive and relevant science education for students, fostering a sense of belongingness while enhancing their academic engagement and achievement. Cajete's (1999) focus on indigenous knowledge systems allows for whole perspectives that involve ecological, spiritual, and community-based understandings. It can enrich the diversification of the content and pedagogy of science education (Cajete, 1999). By incorporating these perspectives, teachers can give students a broader understanding of scientific concepts and processes regarding local contexts and practices.

In classroom practices, there is less integration of indigenous knowledge in the Nepalese context. However, it should frequently involve experiential learning, storytelling, and community involvement, aligning with traditional indigenous ways of teaching and learning. For example, field-based learning activities like studying local ecosystems or traditional ecological practices allow students to connect scientific principles with real-world applications and indigenous cultural knowledge (Barnhardt & Kawagley, 2005). These practices enhance students' scientific literacy and promote environmental awareness and a deeper connection to their cultural heritage. Furthermore, engaging with elders and community members as co-educators can provide valuable insights and perspectives, fostering a collaborative learning environment that respects and disappears indigenous knowledge systems (Battiste, 2002).

Research has shown that integrating indigenous knowledge into the science curriculum can significantly improve the educational outcomes of students. McKinley and Gan (2014) found that when students see their cultural knowledge and practices reflected in the curriculum, they will likely feel validated and motivated, leading to increased participation and achievement in science subjects (McKinley & Gan, 2014). Additionally, this approach benefits all students by enlarging their understanding of science as a multicultural and multiple discipline. By recognizing the value of indigenous knowledge in science education, educators can contribute to a more equitable and inclusive educational landscape that respects and celebrates cultural diversity. Modern education systems try to include diverse perspectives and incorporate indigenous knowledge into science education.

However, including indigenous knowledge is not sufficient in our context. In every society, there are lots of local knowledge experiences related to student's daily life. They have experiences of local knowledge related to science content and curricula. However, they do not feel scientific and experience difficulty in learning science. The school science content is based on Western scientific knowledge, focusing on facts, laws, principles, and theories. This Western and local knowledge may be interrelated, but fewer try to integrate. However, the growing recognition and the value of indigenous knowledge and its integration

into the science curriculum remains limited and insufficient. Mainstream education systems enhance the prioritization of Western scientific paradigms and marginalize indigenous perspectives. This marginalization results in less emphasis on culturally relevant education for Indigenous students. From my experience as a science teacher from secondary to higher education level, there is less focus on integrating the student's daily life experiences and local knowledge into developing science curricula and classroom practices. It may lead to less engagement of students in learning and lower academic performance in science subjects.

Similarly, the NCF (2019) points out that science teaching and learning are based on interactive, innovative, and relating students' daily life experiences with science curricula and classrooms. It shows NCF's focus on integrating indigenous knowledge in science classrooms. Similarly, NASA (2020) shows the achievement of grade ten students remains below average. It also resonates with the SEE result 2024 that science is the second subject where students have no grade (NG). It indicates that more students are failing in science, which seems to be the SEE result. The science curriculum may not focus on indigenous knowledge, student engagement, and innovative and interactive teaching-learning and may not be connected with students' daily life experiences. Furthermore, teachers and experts may face challenges in successfully incorporating indigenous knowledge into their teaching-learning due to a lack of resources, training, and institutional support.

OBJECTIVES

The study has the following objectives:

- To explore the experiences of Indigenous science teachers in integrating local knowledge into science classroom practices
- To assess the challenges of integrating Indigenous knowledge into science learning

RESEARCH METHODOLOGY

This study uses a qualitative research methodology, specifically employing an interpretative phenomenological approach (IPA), compatible with exploring participants' personal experiences and the meanings they assign to them (Smith, Flowers, & Larkin, 2009). IPA focuses on understanding how individuals make sense of their experiences, making it ideal for studying Indigenous science teachers' perspectives on integrating Indigenous knowledge in science education. In-depth interviews are the primary data collection tool, allowing participants to share detailed experiences and personal insights (Creswell & Poth, 2018). Interviews are recorded with two secondary science teachers with more than ten years of experience in science teaching. They are in touch with me from professional relations, frequently connecting with the external and internal supervising of teaching practices of bachelor-level students. Both teachers belong

to Newar communities; one is male, and the other is female. The recorded information was transcribed verbatim to capture the participants' lived experiences, expressions, and perspectives.

Following transcription, a systematic coding process is applied to organize and interpret the data. Initially, open coding is used to identify key ideas and concepts in the participants' responses. The codes are then grouped based on word similarity and thematic relevance, clustering similar items to reveal patterns and relationships within the data. These clusters are reviewed to develop themes that represent the core elements of participants' experiences and views. The thematic analysis involves an in-depth examination of these themes to uncover underlying meanings and connections. Interpretation is based on participants' perspectives, aligning with IPA's emphasis on experiential insights. This process ultimately helps to highlight themes that illustrate Indigenous science teachers' contributions and challenges to incorporate local knowledge within science education.

THEORETICAL FRAMEWORK

The theoretical underpinning of this study is based on bicultural science and culturally responsive pedagogy, both of which emphasize the importance of integrating diverse cultural perspectives within science education. Bicultural science theory advocates for including Indigenous Knowledge alongside Western scientific principles, recognizing that Indigenous communities have developed valuable ecological, environmental, and medicinal knowledge systems over centuries (McKinley, 2005). By approaching science education from a bicultural perspective, educators can help bridge the gap between Indigenous ways of knowing and Western science, fostering a more inclusive learning environment that respects and validates Indigenous contributions.

Culturally responsive pedagogy further supports this approach by focusing on instructional strategies that morality of students' cultural backgrounds, strengths, and experiences (Gay, 2018). In Indigenous science education, culturally responsive teaching involves designing lessons that draw from students' cultural contexts, language, and community practices, making learning more relevant and engaging. This pedagogy emphasizes the need for science teachers to acknowledge and actively integrate Indigenous Knowledge, enabling students to see themselves reflected in the curriculum. By combining bicultural science and culturally responsive pedagogy, this study emphasizes the value of creating a science education framework that respects cultural diversity, promotes equity, and empowers Indigenous knowledge in their learning journeys.

EMPIRICAL LITERATURE ON SUCCESSFUL IK INTEGRATION

Integrating Indigenous Knowledge (IK) into science education has shown promising outcomes in multiple empirical studies. Mehltretter et al. (2024) demonstrate how braiding Indigenous and Western knowledge systems enhance

freshwater ecosystem restoration. Using the EAUX and A-to-A frameworks, their study emphasizes equity, data sovereignty, and relational approaches to learning, providing a structured methodology for educators to integrate IK into scientific research and education. Similarly, research on Traditional Ecological Knowledge (TEK) highlights its successful incorporation into climate change policies and environmental science education. A study published in MDPI (2024) examines how Indigenous fire management techniques and Arctic biodiversity monitoring have been adopted by scientific institutions, showcasing the effectiveness of co-learning models that respect Indigenous wisdom.

In K-12 education, Indigenous-led land-based learning programs have been particularly effective. A 2023 study in the Journal of Indigenous Studies found that integrating IK into school curricula through experiential learning and ecological stewardship improved student engagement and scientific literacy. Likewise, an analysis of New Zealand's science curriculum revealed that incorporating Māori knowledge, particularly mātauranga Māori, fosters critical thinking and enhances students' appreciation of cultural and scientific ways of knowing (Science Education Research Journal, 2023). Additionally, research from Environmental Education Research (2023) highlights the successful integration of Aboriginal ecological knowledge in climate science education in Australia. By combining Indigenous weather pattern observations with meteorological science, educators developed a culturally relevant approach to teaching climate change, leading to deeper student understanding and engagement. These studies collectively illustrate that integrating Indigenous knowledge into science education strengthens learning outcomes, fosters sustainability, and supports cross-cultural collaboration. The success of these approaches underscores the value of Indigenous perspectives in scientific education and policy development.

CONCEPTUAL FRAMEWORK

The study "Indigenous Science Teachers' Experience in Integrating Local Knowledge at Classroom Practices" focuses on integrating Indigenous Knowledge Systems (IKS) into the science classroom. The framework highlights the potential for including IKS in the science curriculum, creating a more culturally responsive pedagogy, and fostering a more inclusive educational experience. This integration enriches the science curriculum and bridges the gap between community knowledge and formal education in science. The study focuses on bicultural science and culturally responsive pedagogy in education, which integrate diverse cultural perspectives. It uses qualitative research methods to explore how Indigenous knowledge systems (IKS) can be incorporated into classroom practices (Gay, 2018; Ladson-Billings, 2021; Bishop, 2019), gathering insights through in-depth interviews.

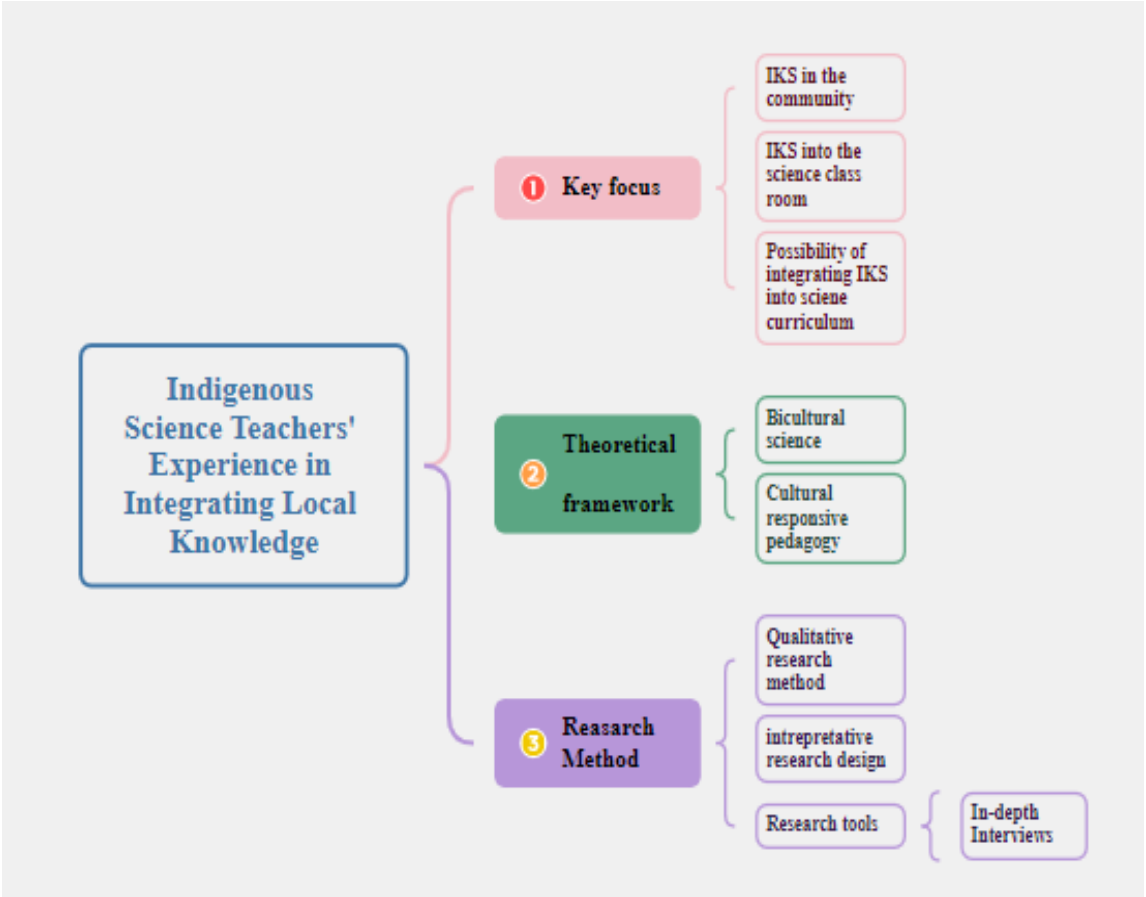

Figure 1. Conceptual framework

RESULT AND DISCUSSION

The result and discussion are based on the theme. These are discussed in terms of cultural knowledge and practices in science learning, integration of local knowledge in science learning, application of daily life context in science learning, teaching and pedagogical practices in science education, and bridging indigenous knowledge with scientific concepts.

CULTURAL KNOWLEDGE AND PRACTICES IN SCIENCE LEARNING

The Indigenous teachers belong to the Newar community. Their community is rich in diverse cultural traditions and practices. In my study, one notable aspect of their culture is the preparation of alcohol, particularly Aila, which holds ritual significance and is used as a sagun (auspicious offering) in feasts and festivals. In Kathmandu, this traditional alcohol is known as Aila; in some other regions, it is referred to as tinpane. The process of preparing Aila involves a distillation process in a scientific technique that can be easily integrated into science learning as an example of cultural knowledge. In this study, the indigenous science teachers contextualize the preparation of Aila, to explore the scientific concepts such as evaporation, condensation, and separation, connecting traditional practices with modern scientific inquiry. Regarding cultural knowledge and

practices in science learning, one of the Indigenous science teachers, T1, expressed his views as follows:

> *I belong to the Newar community. The Newar community has a variety of cultures. Like making alcohol, it is commonly used at every feast as a sagun. In Kathmandu, it is called Aila; in some places, it is called Tinpane. I connect the preparation of aila contextualized with the distillation process.*

This Indigenous science teacher's approach to connecting the preparation of Aila (a traditional Newar alcoholic drink) with the scientific concept of distillation is a powerful example of culturally responsive pedagogy in science education. According to Aikenhead and Jegede (1999), bridging Indigenous Knowledge with scientific concepts creates "cultural border crossings" that can reduce the cultural conflict students often feel in conventional science classes, especially when science is presented as separate from or superior to traditional knowledge. In this case, by contextualizing the distillation of a core process in chemistry within the cultural practice of making aila, the teacher validates Newar heritage and enhances students' understanding by embedding the lesson in familiar, everyday practices.

Moreover, Bang and Medin (2010) emphasize that connecting scientific processes to students' lived experiences helps them construct more meaningful, durable understandings of science. For Newar students, understanding distillation through the preparation of aila is likely to promote a more intuitive grasp of the scientific principles involved, as it connects directly to something they may observe in their community and family gatherings. This contextualization aligns with the principles of culturally relevant pedagogy, which encourage teachers to adapt instructional content to reflect students' backgrounds, fostering inclusivity and engagement (Ladson-Billings, 1995). The use of Indigenous Knowledge also serves as an epistemological bridge, as Cajete (1999) suggests, enabling students to view science not as a foreign or imposed discipline but as one that respects and incorporates their culture's longstanding practices and knowledge systems. By presenting distillation within the cultural context of aila preparation, the teacher demonstrates that Indigenous Knowledge can coexist with modern scientific methods. This approach aligns with the work of Kawagley (2006), who advocates for science education that recognizes the validity of Indigenous perspectives, which frequently include empirical, observation-based practices akin to scientific investigation.

This strategy enriches students' conceptual understanding and promotes a sense of pride and identity, showing students that their cultural heritage has inherent scientific value. This example highlights the transformative potential of integrating Indigenous Knowledge into science classrooms, helping students see themselves and their culture as integral to scientific exploration and discovery. Similarly, another Indigenous teacher, T2, adds views on cultural knowledge and practices in science learning as follows:

Newar culture has various feasts and festivals like Gathemangal, Gaijatra, Indrajatra, and Yomari Poornima. On the day of Gathemangal, it is customary to clean water sources, which can be taught in connection with water purification lessons of science. Thus, cultural knowledge can be linked to discourse.

This Indigenous science teacher view effectively links Newar cultural practices, such as the water source cleaning ritual during Gathemangal, to scientific lessons on water purification, illustrating a valuable approach to culturally responsive science education. According to Aikenhead and Jegede (1999), bridging cultural knowledge with scientific discourse allows students to cross "cultural borders" in the classroom, making science more accessible by connecting it to familiar, meaningful practices. By contextualizing scientific concepts within Indigenous rituals, the teacher enriches students' understanding and validates Indigenous Knowledge as a valuable framework within science learning (Bang & Medin, 2010). This method fosters inclusivity by presenting science as interconnected with cultural practices, challenging students to see science through multiple epistemological lenses. Such integration benefits students by encouraging active engagement, as they recognize their cultural heritage within scientific discourse, promoting both learning and cultural pride. In this line, teacher T1 presents the view of settlement and temple concepts connected with environmental sanitation as follows:

Many of our cultures can be copied back to science. For example, a Newar settlement has a temple in the middle of the settlement. In the culture of other castes, it has been seen that the temple is located on a higher hill far away from the settlement. I contextualized it with sanitation.

The teacher here draws a connection between traditional Newar settlement structures and scientific concepts related to sanitation, noting how temple locations may reflect hygiene considerations within cultural practices. By observing that Newar temples are centrally located while others may be on higher ground, the teacher discusses the scientific principles of sanitation, such as accessibility and waste management, as influenced by cultural design. This approach validates Indigenous Knowledge related to environmental science, making sanitation concepts more relevant and grounded in students' everyday experiences. In the context of using local cultural traditions in the classroom, one teacher expressed the following:

Using local cultural traditions and technology in the classroom shows that cultural exchanges and cultures of different castes can relate to science teaching and learning. The assignment is that activities performed on Dashain are interrelated with science. We give the same homework from 6th to 10th grade, like keeping jamara. The lower grade sees it as a seedling, while the higher grade looks at the seedling process and that it is necessary. We should be able to connect our culture with science. I have been given assignments based on the festival. Students are made to do it themselves.

Incorporating local cultural traditions and technologies into the classroom highlights the connections between cultural practices and scientific concepts. For example, when teachers mention community practices or tools unique to different castes, students can see how traditional knowledge aligns with or balances scientific understanding. This approach enriches science teaching and fosters respect for cultural diversity, showing students that scientific inquiry exists within multiple cultural contexts. Such integration encourages students to appreciate cultural exchanges, seeing them as valuable sources of knowledge that enhance scientific discourse. Connecting science to local traditions helps students develop a more inclusive view of science, recognizing it as a field enriched by diverse perspectives and practices. Similarly, teacher T2 expressed the following opinions about refreshments and body protection from Newari jatras and festival foods.

Jatras are held in Newar culture; they provide entertainment and refreshments to the people. It is also called Yomari Purnima, and it falls during the winter season. Yomari is made and eaten on this day by putting a ghee chaku on the rice flour. It is believed that it throws cold or creates heat in our bodies. This can be studied in conjunction with exothermic reactions in science teaching and learning.

In Newar culture, Jatras such as Yomari Purnima provide an opportunity to explore cultural practices with scientific principles. On this day, people prepare yomari, a rice flour dumpling filled with ghee chaku (a mixture of clarified butter and molasses), which is believed to generate warmth in the body during winter. The traditional belief that yomari creates heat in the body can be linked to the scientific concept of exothermic reactions, where heat is released during certain processes. By examining this cultural practice, students understand how traditional knowledge aligns with scientific explanations. This approach enriches science education by connecting cultural traditions with scientific inquiry, making learning relevant and culturally responsive. In the integration of local knowledge in the science classroom, teacher T1 proposed the following views:

> *It has been 10 years since I started teaching. I have tried to combine local knowledge skills with science. It is based on according to the text. Some students who grew up in the city find it difficult to understand when using local knowledge skills.*

This teacher’s decade-long effort to integrate local knowledge and skills into science teaching reflects an approach rooted in culturally responsive pedagogy. As Aikenhead and Jegede (1999) suggest, students often face "cultural border crossings" in science education, especially when lessons draw from unfamiliar Indigenous Knowledge systems. For students raised in urban environments, these traditional concepts can feel disconnected from their experiences, making comprehension more challenging. Bang and Medin (2010) emphasize that cultural relevance in teaching requires sensitivity to students' backgrounds to facilitate understanding across diverse experiences. The teacher's approach aims

to bridge these gaps by valuing local knowledge in science. However, they recognize that urban-raised students may need additional support to connect with this culturally grounded material.

In summary, Integrating Indigenous Knowledge and practices into science learning provides students with culturally relevant, engaging, and meaningful ways to connect scientific concepts to their lived experiences. For example, Newar teachers link traditional practices, like the making of Aila and yomari in cultural festivals, with science concepts such as distillation and exothermic reactions, bridging students' heritage and scientific inquiry (Aikenhead & Jegede, 1999; Bang & Medin, 2010). This culturally responsive pedagogy respects Indigenous perspectives, promoting inclusivity and enhancing students' understanding of science as a diverse, cross-cultural field. Challenges remain, especially for urban students who may struggle to connect with these cultural practices. Still, teachers are working to support all students in recognizing the scientific value within their cultural heritage. This approach fosters cultural pride and encourages students to appreciate diverse knowledge systems, broadening their view of science as a discipline enriched by various perspectives.

INTEGRATION OF LOCAL KNOWLEDGE IN SCIENCE LEARNING

Integrating local knowledge into science learning may enhance students' engagement and cultural appreciation while fostering critical thinking skills. Integrating local wisdom in science learning provides contextually relevant learning experiences to students that connect scientific concepts to their cultural heritage. In my study, Indigenous science teachers used local knowledge and skills in the classroom to make science learning more meaningful and relevant. Observing the cleanliness maintained around temples in Newar settlements, they encourage students to apply similar practices to their homes and surroundings. The Indigenous science teachers contextualized this traditional emphasis on hygiene and community care in science lessons related to environmental conservation and sanitation. By integrating this local knowledge, students can better understand the scientific principles of waste management and hygiene in their everyday lives. Indigenous science teacher T1 expressed the following insight regarding integrating local knowledge in science learning.

I have used local knowledge skills in the classroom. Seeing the temple's cleanliness near Newar's settlement, they can teach the same cleanliness needed at the home. This knowledge can be contextualized in science to the environment and sanitation around us.

Using local knowledge in the classroom allows students to learn science in a way they feel is relevant to their daily lives. For example, teaching about the cleanliness observed in the nearby Newar temple helps students recognize the importance of hygiene and environmental sanitation at home. This local practice of maintaining cleanliness can be contextualized with science lessons on

environmental health and sanitation, emphasizing pollution, waste management, and personal responsibility. By applying knowledge from their cultural surroundings, students learn scientific principles and develop a sense of pride and ownership over their community's practices. Integrating local knowledge into science creates a more holistic and impactful learning experience that connects scientific concepts with the students' cultural values. Similarly, in support of teacher T1, teacher T2 gives the views as follows:

> *Most of the things seen and experienced are not connected with scientific knowledge. As the circular motion is taught, it is not associated with the circular motion of Jato in the house. I have incorporated this local knowledge into the classroom while teaching.*

Many classroom experiences are disconnected from local knowledge and the scientific knowledge embedded in students' daily lives. For example, while students learn about circular motion, they often don't relate it to the circular motion they see in everyday tools, like the "jato" (traditional grinding stone) used at home. By incorporating this familiar tool into lessons, I help students make connections between scientific concepts and local knowledge. This approach enhances their understanding of science and validates its values and the cultural knowledge they bring to the classroom. Bridging these experiences fosters a more relevant and engaging learning environment, showing students the science within their cultural practices. Likewise, the science teacher connected the Newari food types in science teaching as follows:

> *The Newari dishes and foods cooked in them contain adequate protein. These food recipes can be taught with the science food pyramid lesson.*

Newari dishes are rich in protein and can be enhanced as practical examples when teaching nutrition and the food pyramid in science class. Using these traditional recipes helps students connect local cooking to nutritional science, reinforcing concepts about balanced diets and nutrient sources. This approach makes the food pyramid lesson more engaging and culturally relevant, allowing students to appreciate the nutritional value of their traditional foods. Regarding local medicinal values, the Indigenous science teacher T2 expressed his thoughts as follows:

> *Similarly, aila has been used as an aphrodisiac since ancient times. When allopathic medicines did not come, a small amount was used as a pain reliever, taken on the painful part. In science, it can be taught in conjunction with alcohol and drug lessons.*

Aila or tinpane, a traditional Newari alcoholic drink, has historically been used as an aphrodisiac and a mild pain reliever when applied in small amounts to painful areas. Before modern medicine, it served as a common household remedy, offering medicinal and cultural value. In science lessons, Aila can be used to introduce discussions about the effects of alcohol on the body, tying into broader topics like traditional medicine and drug awareness. This connection provides a

culturally relevant way to discuss the potential impacts and conventional uses of alcohol, helping students appreciate the local knowledge surrounding its use. Integrating these examples makes the lesson more engaging and allows students to connect scientific concepts with familiar cultural practices. Strengthening the local medicinal concept of teacher T2, teacher T1 presents the following views:

> *I teach the students that if you look at the use of guava leaves and oak leaves, they can be combined with plant teaching. In case of stomachache, mango and peepal leaves are eaten. Our stomach also contains hydrochloric acid. Turmeric hot water can also reduce such problems. It can be connected with local medicinal knowledge.*

In the above views, indigenous teachers expressed that they teach students about the medicinal uses of local plants, such as guava and oak leaves, which can enhance lessons on plant biology. For example, when someone has a stomachache, leaves from mango or peepal trees are traditionally used for relief. It connects with scientific knowledge by explaining that our stomach contains hydrochloric acid, which these natural remedies can help relax. Additionally, drinking warm turmeric water is another local remedy for digestive issues. Integrating these examples allows students to relate plant biology to local medicinal practices, showing the practical application of plants in health. Similarly, another teacher, T1, expressed the following views on connecting local technology with science learning.

Nowadays, it is taught modern technology. It is said that tractors are needed for farming with modern technology. I taught the student by asking why we did not think how to update the plow pulled by the ox and Rago to plow the field from side to side fine.

The above views of indigenous teachers claim that today, there is a strong emphasis on teaching students about modern technology in agriculture, such as using tractors for farming. However, I encouraged my students to think critically about traditional methods, like the ox-pulled plow, and consider ways to innovate and improve it. Instead of entirely replacing traditional tools, we discussed how adapting they could still be valuable for farming, especially in regions where modern machinery may not be accessible. This exercise helped students appreciate the benefits of traditional and contemporary approaches to agriculture. By encouraging creative problem-solving, students learned that innovation can come from enhancing existing tools, not only adopting new technology.

In summary, integrating local knowledge into science lessons enhances student engagement and fosters cultural appreciation. For instance, teachers in Indonesia have found that teaching science concepts through familiar, culturally relevant experiences, such as traditional measurements and ecological knowledge, aids student understanding (Suciati, 2023). Using local knowledge in lessons allows students to connect scientific ideas with their cultural heritage, improving comprehension and appreciation (Kasi et al., 2020). For example, one teacher used temple cleanliness practices to emphasize sanitation, linking it to lessons on

environmental health and pollution (Suciati, 2023). Another teacher introduced the circular motion of traditional tools, like the "jato," to illustrate physics concepts, making learning more relatable and grounded in students' daily lives.

Additionally, connecting food and nutrition lessons with local diets, such as protein-rich Newari dishes, offers a practical application of nutrition science and allows students to see the value in their traditional foods (Meiraini & Retnawati, 2020). For stomach relief, local medicinal practices, such as mango and peepal leaves, are included in plant biology lessons to help students understand medicinal plant properties and digestive health. By drawing these connections, students see the relevance of traditional remedies within modern scientific frameworks (Glasson et al., 2010). Similarly, agricultural science lessons encourage students to innovate with traditional tools, like the ox-pulled plough, inspiring them to blend modern and traditional methods creatively. This holistic approach promotes critical thinking and validates cultural knowledge within science education.

Application of Daily Life Contexts in Science Learning

The application of daily life contexts in science learning helps students see the relevance of science in their everyday experiences, fostering engagement and deeper understanding. When teaching about mixtures, the indigenous science teachers asked their students why different pulses are mixed and cooked together, inspiring them to think about the changes that occur during the process. They explored how these mixtures transform through cooking and could connect everyday practices to scientific concepts. In my study, they also suggested to colleague science teachers that simple experiments, using eggshells and lemon juice to produce carbon dioxide gas, can effectively utilize local resources. The natural environment often serves as a science lab that enhances the value of integrating daily life context into learning. It emphasizes making science more accessible and engaging for students. Regarding the application of daily life contexts in science learning, the Indigenous science teacher T1 expresses the following views:

> *When teaching the mixture, I asked the students why different pulses had been mixed and cooked. How was it before, and what happened after? I suggest to other science teachers that science experiments can be done using local resources, such as egg shells and lemon juice, to make carbon dioxide gas. In our culture, local resources are more important, like 'nature as the science labs.*

Using daily life contexts in science teaching, like discussing the cooking of mixed pulses, helps students relate science concepts to their own experiences, enhancing understanding. By asking questions about the changes before and after cooking, students connect theory with real-world observations, which makes learning more engaging. I encourage science teachers to use local resources, such

as eggshells and lemon juice, to demonstrate concepts like carbon dioxide production, as these materials are accessible and culturally relevant. This approach makes science more practical and aligns with sustainability, reducing dependence on imported lab materials. Incorporating everyday resources in the classroom turns the local environment into a living science lab, enriching students' learning experiences. Similarly, about daily life experience, another teacher, T2, expressed as follows:

> *Similarly, when I teach acid, base, and salt, I add lemon, junar, bhogate, soap, sempoo, ash, rice, mango leaf, bark, and table salt as examples. When teaching the indicator, I show the colour change by showing the turmeric and tea.*

When teaching about acids, bases, and salts, they use everyday items like lemon, junar (citron), bhogate (pomelo), soap, sempoo, ash, rice, mango leaf, bark, and common salt to make the concepts relatable. These local examples help students recognize familiar substances with acidic, basic, or salty properties. They demonstrate colour changes using turmeric and tea, which visibly respond to acids and bases for teaching indicators. This hands-on approach allows students to observe and understand chemical reactions in materials they encounter in daily life experiences. Such practical examples make science more engaging and relevant to students' learning. To strengthen the daily life concept integrated with Western science, the next science teacher, T1, presents the following views:

> *When teaching distillation, it can be connected with the context of making local alcohol at home; it comes in the form of distilled water, so it can be taught that water can also be distilled.*

An Indigenous science teacher might connect the concept of distillation with traditional practices, such as making local alcohol, to enhance students' understanding. By relating distillation to a familiar process, students can grasp how distilled water is produced, seeing parallels in both scientific and cultural contexts. This approach respects and utilizes Indigenous knowledge, showing students that scientific principles are embedded in their everyday lives. Demonstrating that water, like alcohol, can be distilled bridges cultural practices with scientific concepts, making learning more meaningful. Teaching science in integrating daily life experiences strengthens students' knowledge and preserves local cultural heritage.

In summary, integrating daily life contexts in science learning helps students see the relevance of science in familiar experiences, making the learning process more engaging and accessible. When teachers use real-world examples, students can relate abstract science concepts to things they encounter every day, which improves understanding and retention (Krajcik & Czerniak, 2018). This contextualized approach fosters critical thinking as students apply their knowledge beyond the classroom. Research shows that using relatable, culturally relevant contexts is especially beneficial for students who struggle with traditional instruction, as it supports diverse learning needs (Basu & Barton,

2007). For example, one Indigenous teacher uses common items like mixed pulses, eggshells, and lemon juice in science experiments, helping students connect their cultural knowledge with scientific concepts. Another teacher illustrates acids, bases, and salts using locally available items such as lemon, pomelo, soap, and turmeric as pH indicators, making chemical reactions more perceptible and relatable. By incorporating local materials, teachers make science more sustainable and culturally inclusive, aligning with environmental and community values (Lee & Buxton, 2013). Teachers who connect scientific ideas with cultural practices, such as distilling alcohol, to teach distillation, bridge Indigenous and scientific knowledge, and strengthen student engagement. These methods respect cultural heritage and demonstrate that scientific principles are rooted in daily life. Overall, this approach fosters lifelong learning and prepares students with skills to make informed decisions.

TEACHING AND PEDAGOGICAL PRACTICES IN SCIENCE EDUCATION

Teaching and pedagogical practices in science education aim to make science concepts understandable, relevant, and engaging for students. Effective science teaching often integrates hands-on experiments, demonstrations, and inquiry-based learning, allowing students to explore and question natural phenomena. In my study, indigenous science teachers have been teaching science in schools for the past 12 years. It has been 9 years since he was permanent. They asked students, what would have happened if no water had been added to the rice while cooking. Indigenous science teachers integrate these concepts with chemical reactions such as hydrolysis. Regarding pedagogy and practices in science education, one of the Indigenous teachers, T1, shares the following views:

> *I have been teaching science in schools for the past 12 years. It has been 9 years since I was permanent. I asked them what would have happened if no water had been added to the rice while cooking. These concepts can also be connected with chemical reactions such as hydrolysis.*

An Indigenous science teacher with 12 years of experience shares insights on incorporating practical, culturally relevant examples in science teaching. By posing questions like, "What would happen if no water was added to the rice while cooking?" the teacher encourages students to think critically and connect science with everyday practices. This example allows students to explore scientific concepts like chemical reactions and hydrolysis in familiar, culturally relevant contexts. Such approaches make science relatable and demonstrate its presence in daily life, strengthening student engagement. The teacher emphasizes that posing relatable questions helps students understand the scientific processes essential to traditional practices. Integrating cultural practices, the teacher promotes inclusivity, making science accessible to students from various backgrounds. This method also respects Indigenous knowledge, blending it with scientific principles to improve students' learning. The teachers' long experience

emphasizes the value of this pedagogical approach in creating meaningful science education. Encouraging students to explore science through their own experiences fosters critical thinking and connects them to the content on a deeper level. This culturally integrated teaching develops scientific understanding while honouring and preserving cultural heritage. Similarly, other teachers express their views based on challenges to the integration of local pedagogy and practices in science.

Students have shown more interest when local resources are connected to the classroom. Some students who grew up in the city find it difficult to understand when using local knowledge skills. Parents in school administration have mixed reactions to linking local knowledge in assignments.

Teachers' views indicate that students become more engaged in science when local resources and knowledge are integrated into lessons. However, some city-raised students struggle to grasp these concepts, as they may not be as familiar with traditional practices. Parents involved in the school administration have varied opinions about including local knowledge in assignments. Some were supportive, and others were uncertain. Despite these differences, incorporating local knowledge fosters a unique learning experience that connects science to students' lives. Overall, using local resources in teaching highlights cultural relevance but also reveals gaps in familiarity among students from diverse backgrounds.

In summary, Teaching practices in science education aim to make concepts clear, relevant, and engaging, often incorporating hands-on experiments, real-world contexts, and collaborative learning to enhance students understanding. Teachers emphasize culturally responsive practices, such as integrating Indigenous knowledge, to make science accessible and inclusive for students from various backgrounds (Ali & De Jager, 2020; Guberina, 2023). For example, an Indigenous teacher uses culturally familiar questions, like the importance of adding water when cooking rice, to help students connect scientific concepts like hydrolysis with daily life. However, challenges arise as some urban students may find it difficult to relate to traditional practices, and parents have mixed opinions about including local knowledge in assignments. Despite these challenges, using local resources in science classes strengthens student engagement, bridges cultural gaps, and honours diverse backgrounds, creating a peaceful learning experience.

Bridging Indigenous Knowledge with Scientific Concepts

Bridging Indigenous knowledge with scientific concepts enhances science education by incorporating culturally relevant knowledge and practices. Teachers emphasize addressing culturally relevant pedagogy that bridges Indigenous practices and scientific principles. In my study, the indigenous science teachers have connected the indigenous knowledge of Newar culture with science according to the context. They connect the preparation of local alcohol with the separation and evaporation process in science classroom practices. Concerning

this theme of bridging Indigenous knowledge with scientific ideas, one of the teachers, T2, shares the following views:

> *I have connected the indigenous knowledge of Newar culture with science according to the context. The preparation of tinpane can be connected with the distillation process of science.*

An Indigenous science teacher integrates Newar cultural knowledge with science by connecting traditional practices to scientific concepts. For example, preparing tinpane (a traditional distilled alcohol in Newar culture) explains the distillation process. By linking this familiar practice to scientific principles, students gain a deeper understanding of distillation in a way that resonates with their cultural background. This approach validates Indigenous knowledge within the science curriculum, making learning more inclusive and relevant. Such connections help students see the value of their cultural heritage while learning scientific concepts, fostering engagement and respect for diverse knowledge systems. Similarly, on bridging Indigenous knowledge with scientific ideas, another teacher expressed their thought as follows:

> *I have tried to combine local knowledge skills with science. Dhiki with leaver, Jato with circular motion, Ghatta with motor effect, cooking rice with chemical reaction, tea; turmeric; red cabbage with indicator, common salt; sidhe noon; rock salt; bire noon with salt, kagati; junar; bhogate; with acid, kharani; ritho' sempoo; sabun with base, ghiu, chaku with exothermic reaction, halo represent the tractor. It is an updated form of plough, etc. These all can be connected as per Western scientific concepts.*

An Indigenous science teacher creatively bridges local knowledge with scientific concepts using familiar cultural tools and practices. For example, they relate the dhiki, a traditional lever used for grinding, to the scientific idea of levers. Similarly, they connect the Jato, a hand-operated grinding tool, to circular motion and the ghatta, a water mill, to the motor effect, illustrating the practical applications of these physics principles. Cooking rice explains chemical reactions, while substances like tea, turmeric, and red cabbage serve as pH indicators to demonstrate acidity and basicity. Local salts, such as sidhe noon and bire noon, are connected to common salts, helping students recognize chemical properties in familiar materials. The teacher uses citrus fruits like kagati (lemon), junar, and bhogate to demonstrate acids, ash, ritho, and soap for bases. Familiar reactions make chemistry concepts tangible, like heating ghiu (clarified butter) and chaku (molasses) for exothermic reactions.

Additionally, they use the traditional plough (halo) as an analogy for the modern tractor, showing technological evolution. By linking Indigenous practices to scientific ideas, the teacher enhances understanding and highlights the value of cultural heritage in learning science. This method promotes a culturally inclusive curriculum that resonates with students' everyday experiences, making science relevant and accessible.

In summary, Bridging Indigenous knowledge with scientific concepts in science education fosters inclusivity and helps students connect scientific ideas to their cultural practices, enhancing engagement and understanding (Aikenhead & Ogawa, 2007). Indigenous knowledge, often centred on sustainability and interconnectedness, provides valuable context for topics like environmental science, making complex ideas more relatable (Cajete, 1999). Students develop a deeper grasp of these concepts by connecting familiar cultural practices, such as the Newar tradition of distilling tinpane, to scientific processes like distillation. Teachers further enrich learning by using everyday tools, such as the dhiki for levers or turmeric for pH indicators, bridging students' daily experiences with scientific concepts. This approach supports cultural pride and critical thinking and promotes respect for diverse knowledge systems, making science more relevant and comprehensive.

CONCLUSION

Integrating Indigenous knowledge with scientific concepts in education offers a dynamic and culturally responsive approach to teaching science, fostering inclusivity and engagement. By linking traditional practices with scientific principles, such as using the Newar distillation method to explain distillation in science, students can connect their cultural knowledge with modern scientific ideas, creating a deeper, more meaningful understanding of the concepts. This approach enhances learning and promotes cultural respect for diverse knowledge systems, encouraging students to view science as a global, interconnected field. Despite challenges, particularly for urban students less familiar with local practices, the benefits of integrating local knowledge into science education are essential as it fosters critical thinking and bridges cultural gaps. Moreover, this approach aligns scientific learning with real-world contexts, making it more relevant and relatable to students' lives, improving comprehension and retention. Teachers are essential in selecting and adapting culturally appropriate materials to make science accessible and engaging, ensuring that all students can relate to and appreciate scientific concepts. Incorporating local knowledge into lessons strengthens the subject's relevance, enabling students to see science as an academic pursuit and a part of their lived experience. This connection to daily life also encourages students to explore sustainable practices and traditional ecological knowledge, which enriches their understanding of environmental science. Finally, by blending Indigenous knowledge with scientific learning, teachers create an inclusive, culturally rich curriculum that respects students' backgrounds while preparing them to navigate the broader world of scientific inquiry. Through this fusion of local knowledge with scientific perspectives, science education becomes more holistic and inclusive, schooling students with the skills to engage with modern scientific challenges and traditional knowledge systems.

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