Integrating Indigenous Knowledge in Science Education:

A Mixed Methods Approach

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Abstract: This mixed-method study was carried out to explore the integration of Indigenous Knowledge (IK) in science education by using an explanatory sequential design. Data were collected through a survey of 110 school science teachers and in-depth interviews with two indigenous science teachers of Newar communities. Results show that IK integration is moderately present in science classrooms, with the most common forms involving Indigenous cultural and agricultural practices. Teachers support IK integration, linking it to enhanced student engagement, attitudes, and understanding. Key challenges include limited training and resource accessibility. It also reveals that culturally relevant IK practices, such as Newar traditions, help bridge scientific concepts and Indigenous perspectives, fostering students' cultural identity. While urban students may initially struggle to connect with IK, adaptive teaching strategies support inclusivity, promoting a more equitable science curriculum that values diverse perspectives.

Keywords: *Indigenous knowledge, science education, mixed-method, classroom practices,* etc.

CONTEXT OF THE STUDY

Indigenous knowledge includes understandings, skills, and philosophies developed by local communities through their long histories and experiences interacting with their natural surroundings (Nesterova, 2020). Indigenous Knowledge (IK) is the growing body of knowledge, practices, and beliefs developed by Indigenous communities through generations of close interaction with their environment. It is holistic, place-based, and transmitted through oral traditions, rituals, and everyday practices (Berkes, 2012). Unlike Western scientific knowledge, which relies on reductionist methodologies and empirical verification, IK integrates observations, spiritual beliefs, and social values to guide sustainable resource management and cultural continuity (Nakata, 2007). Scholars argue that IK is dynamic and adaptive, evolving through experiential learning and cultural exchange while maintaining its core epistemological foundations (Agrawal, 1995). As global sustainability challenges grow, the recognition of Indigenous Knowledge as a complementary system to modern science is gaining importance, particularly in environmental management, health, and education (Bohensky & Maru, 2011).

Similarly, science education is the systematic process of teaching and learning scientific concepts, methods, and reasoning to develop students' understanding of the natural world. It is rooted in empirical inquiry and experimentation; science education aims to cultivate critical thinking, problem-solving, and evidence-based decision-making (Bybee, 2010). Traditional science curricula have often emphasized Western scientific paradigms, sometimes overlooking the value of local and Indigenous knowledge systems (Aikenhead & Michell, 2011). However, contemporary educational frameworks increasingly advocate integrating multiple knowledge systems to enhance student engagement and foster culturally responsive pedagogy (Snively & Corsiglia, 2001). By incorporating Indigenous perspectives, science education can become more inclusive, acknowledging diverse ways of knowing while promoting cross-cultural dialogue and sustainability education (McKinley, 2005).

NCF (2019) focused on curriculum development based on local needs. It has been given priority to address the country's social structure, government structure, and diversity. Similarly, the school science curriculum (2019) also resonates with teaching and learning based on local needs as an essential area of education by adjusting the mother tongue, local knowledge, skills, natural resources, and historical and cultural aspects. The essence of the national curriculum framework (NCF) and the school science curriculum (SSC) stressed integrating indigenous knowledge in teaching learning and curricular practices. The scholars (Timilsena, 2022; Gurung & Shrestha, 2021; Koirala, 2023) argue that there is a need to connect students' daily life experiences, ethnobotanical concepts in cultural aspects, and Vedic and ethno-science concepts into the school science curriculum of Nepal. Other scholars (Madlela, 2023; Johnson, 2024; Rachid et al., 2024) strongly raised the issue of integrating Indigenous knowledge (IK) into the school science curriculum (SSC). Still, other scholars (Devkota & Timilsena, 2023; Ray, 2022; Wendy et al., 2023) focused that the present school science curriculum needs to be revised in line with the possibility of integrating indigenous knowledge systems (IKS).

However, in the context of schools, classroom teaching and learning have given less priority to integrating indigenous knowledge. School science curriculum (SSC) is also less focused on including indigenous knowledge in classroom practices. On the one hand, the nature of science is based on facts, laws, principles, and theories, as explained in Western scientific philosophy. On the other hand, indigenous knowledge is based on beliefs, culture, religion, traditions, customs, historical practices, and values of local people deeply rooted in society, as in Eastern philosophy. The practices of integrating indigenous knowledge do not connect with Western scientific knowledge in the curricula or the teaching-learning of science at basic and secondary schools in Nepal.

Schools should have the necessary labs and science equipment to teach the learners science skills and behaviour in practical situations. It has also been pronounced that science content and techniques can be linked to the indigenous knowledge of children. However, these ideals are far from being implemented in different schools in Nepal. In the nation's institutional and community schools, science teaching is not in action as expected in the curriculum. On the one hand, the contents and classroom teaching-learning practices are still theoretically driven.

On the other hand, the schools lack the necessary infrastructure and a good social and psychological environment (Timilsena, 2022). Students often experience diverse forms of social and cultural discrimination on the grounds of caste, gender, poverty, disability, and regional background. Whether in the case of curriculum updating, teaching-learning methods applied in the classrooms, teacher expertise, or curriculum implementation in the classrooms, there are serious problems.

Many study reports (NASA, 2015; NASA, 2017; NASA, 2020) show that students' achievement remains below the average. It also resonates with the SEE result (2024) that science is the second subject where students have no grade (NG). It shows that most students are unable to succeed in science. Therefore, 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 exports face challenges in successfully incorporating indigenous knowledge into their teaching-learning due to a lack of resources, training, and institutional support. Therefore, to solve these problems related to secondary science classroom practices, the study entitled "Integrating Indigenous Knowledge in Science Education: A Mixed Methods Approach" is selected as the problem of the study.

MATERIAL AND METHODS

This mixed-method study employed an explanatory sequential mixed-method design to integrate Indigenous knowledge into science learning. The quantitative part used a survey design to gather data from teachers, assessing their perceptions and experiences with Indigenous knowledge in science classrooms (Creswell & Plano Clark, 2017). The survey was administered to 110 science teachers across various schools, providing a broad perspective on the integration process. Quantitative data were analyzed using descriptive and inferential statistics through SPSS, allowing for a comprehensive understanding of general trends and relationships (Field, 2018). In the qualitative part, an interpretative phenomenological approach was used (Smith, Flowers, & Larkin, 2009). Two Indigenous science teachers of Newar background from secondary schools were purposively selected to explore their lived experiences in depth (Creswell & Poth, 2018). The in-depth interviews were conducted with teachers with diverse levels of experience integrating Indigenous knowledge into science education, allowing for a rich exploration of their experiences. Qualitative data were analyzed thematically (Braun & Clarke, 2006), identifying key themes related to challenges, benefits, and practices. The explanatory sequential design enabled quantitative and qualitative data to be analyzed separately before being integrated to offer a different perspective. The study aimed to capture the measurable impacts and contextual factors influencing Indigenous knowledge integration by combining quantitative and qualitative approaches. This mixed-methods approach allowed for a more holistic understanding of the role of Indigenous knowledge in science learning.

RESULTS AND DISCUSSION

The results and discussion are based on quantitative and qualitative data collected through the field. The result and discussion comprise quantitative data analysis, qualitative data analysis, and the blend of quantitative and qualitative information in the discussion phase.

QUANTITATIVE RESPONSES

The data obtained from the respondents were tabulated, analyzed, and interpreted through descriptive and inferential statistics.

Table 1

Analysis of data regarding Sex, Caste, Religion, Ecological belt, and age of the respondents

	Valid	Frequency	Percent
Sex	Female	30	27.3
	Male	79	71.8
	Other	1	.9
	Total	110	100.0
Cate/Ethnicity	Janajati	12	10.9
	Dalit	4	3.6
	Bahun/Chettri	89	80.9
	Others	5	4.5
	Total	110	100.0
Religion	Hindu	108	98.2
	Buddhist	1	.9
	Kirat	1	.9
	Total	110	100.0
Ecological belt	Himal	16	14.5
	Pahad	68	61.8
	Tarai	23	20.9
	Bhitri Madhes	3	2.7
	Total	110	100.0
Age	20 to 30	43	39.1
	31 to 40	52	47.3
	41 to 50	10	9.1
	51 to 60	5	4.5
	Total	**110**	**100.0**

Table 1 shows that the majority of respondents are male (71.8%), followed by female respondents (27.3%), with only one respondent identifying as "Other" (0.9%). Analysis regarding caste/ethnicity indicates that the vast majority of respondents belong to the Bahun/Chettri group (80.9%), while Janajati (10.9%), Dalit (3.6%), and "Others" (4.5%) are represented in much smaller numbers. This heavy representation of Bahun/Chettri indicated that the sample is mainly from this caste/ethnic group, with other groups less represented. The small percentages for Janajati, Dalit, and "Others" highlight the less diversity within the sample regarding caste/ethnicity. Analysis based on religion shows that most respondents identify as Hindu (98.2%), with only one respondent identifying as Buddhist and Kirat, both at 0.9%. This distribution indicates a strong religious homogeneity within the sample, with Hinduism enormously dominant. The minimal representation of Buddhist and Kirat religions suggests limited diversity in religious affiliation among respondents. Analysis of regarding ecological belt reveals that the majority of respondents come from the Pahad ecological belt (61.8%), followed by the Tarai (20.9%) and the Himal (14.5%), with a small percentage from the Bhitri Madhes (2.7%). This distribution indicates a strong representation from the Pahad region, while the Bhitri Madhes are less represented in the sample. It was indicates that most respondents are between the ages of 31 and 40 (47.3%) followed by those aged 20 to 30 (39.1%) making these two age groups the predominant categories in the sample. Fewer respondents are aged 41 to 50 (9.1%) and the smallest group is those aged 51 to 60 (4.5%). This age distribution suggests that the sample largely contains younger to middle-aged individuals, with minimal representation from older age groups.

Table 2

Analysis of data regarding Time allocation, teaching per week, types of Indigenous knowledge, and feeling of Indigenous knowledge integrated.

	Valid	Frequency	Percent
Time allocated for Indigenous knowledge	Never	5	4.5
	Rarely	8	7.3
	Sometime	47	42.7
	Often	36	32.7
	Always	14	12.7
	Total	110	100.0
Teaching Indigenous knowledge per week	1 to 2 pds	57	51.8
	3 to 4 pds	50	45.5
	5 to 6 pds	3	2.7
	Total	110	100.0
Types of Indigenous Knowledge	Traditional ecological practices	18	16.4
	Indigenous cultural practices	46	41.8
	Culinary practices	9	8.2
	Agricultural practices	33	30.0
	Traditional healing practices	4	3.6
	Total	110	100.0
Feeling of indigenous knowledge integrated	Not at all	2	1.8
	To a moderate extent	32	29.1
	To a small extent	46	41.8
	To a large extent	30	27.3
	Total	**110**	**100.0**

Table 2 shows that the majority of respondents report using Indigenous Knowledge in science teaching either "Sometimes" (42.7%) or "Often" (32.7%), indicating moderate to frequent integration. A smaller percentage of respondents report "Always" incorporating Indigenous Knowledge (12.7%), while only 7.3% indicate they "Rarely" use it, and 4.5% report "Never" using it. This distribution suggests a general trend towards at least occasional inclusion of Indigenous Knowledge in science education, though consistent use remains limited. Analysis reveals that the majority of respondents integrate Indigenous Knowledge into science lessons 1 to 2 periods per week (51.8%), followed closely by those who do so for 3 to 4 periods per week (45.5%). Only a small percentage (2.7%) report using Indigenous Knowledge in science teaching for 5 to 6 periods weekly, indicating limited extensive integration. This distribution suggests that while Indigenous Knowledge is regularly incorporated, it is generally limited to a few periods each week. The most commonly integrated types of Indigenous Knowledge in the science curriculum are Indigenous cultural practices (41.8%) and agricultural practices (30%), indicating a strong focus on these areas. Traditional ecological practices are also included but less frequently (16.4%), while culinary practices (8.2%) and traditional healing practices (3.6%) are the least integrated. This suggests a preference for cultural and agricultural knowledge, with more specialized areas like healing and culinary practices being less prioritized. Similarly, most respondents feel Indigenous Knowledge is integrated into the school science curriculum to a small extent (41.8%) or a moderate extent (29.1%). A more minor portion reports that Indigenous Knowledge is integrated to a large extent (27.3%), and only 1.8% feel it is not integrated at all. This indicates that most respondents acknowledge some level of integration, but the perception is that it is limited rather than extensive.

Table 3

Analysis of data regarding use, students' engagement, impact on students' engagement, finding resources, and incorporating Indigenous knowledge into the science curriculum.

	Valid	Frequency	Percent
Should IK be used in classroom	Yes	105	95.5
	No	2	1.8
	Not sure	3	2.7
	Total	110	100.0
Students' engagement	Decreases	5	4.5
	No change	1	.9
	Slightly increase	19	17.3
	Moderately Increase	66	60.0
	Greatly increase	19	17.3
	Total	110	100.0
Impact on students' engagement	Negatively	1	.9
	No impact	8	7.3
	Positively	84	76.4
	Very positively	17	15.5
	Total	110	100.0
Students' interest in science learning	Strongly disagree	6	5.5
	Disagree	1	.9
	Neutral	9	8.2
	Agree	73	66.4
	Strongly agree	21	19.1
	Total	110	100.0
Finding resources	Very easy	19	17.3
	Easy	20	18.2
	Neutral	66	60.0
	Difficult	5	4.5
	Total	110	100.0
Incorporating Indigenous knowledge	Lack of export	14	12.7
	Lack of training	53	48.2
	Limited resources	18	16.4
	Less focus on IKS	25	22.7
	Total	**110**	**100.0**

Table 3 shows that a vast majority of respondents (95.5%) believe Indigenous Knowledge should be used in the classroom, while only 2 respondents (1.8%) are opposed to its inclusion, and 3 respondents (2.7%) are unsure. This overwhelming support suggests a strong consensus in favor of incorporating Indigenous Knowledge into educational settings. The very small number of respondents who disagree or are uncertain indicates minimal opposition or ambiguity on the topic. Figure 12 likely visualizes this data, with a dominant portion of the responses indicating strong support ("Yes") for the use of Indigenous Knowledge in the classroom. The majority of respondents believe integrating Indigenous Knowledge moderately increases student engagement in science classes (60%), with 17.3% stating it slightly increases and another 17.3% reporting it greatly increases engagement. Only a small proportion (4.5%) feel it decreases engagement, and an even smaller percentage (0.9%) observe no change in engagement. This suggests that Indigenous Knowledge integration is widely perceived to have a positive impact on student engagement, with a significant number of respondents reporting a moderate to great increase in engagement. The significant majority of respondents (76.4%) believe that integrating Indigenous Knowledge positively impacts students' attitudes toward science, with 15.5% reporting a very positive impact. Only a small percentage (7.3%) perceive no impact, and a minimal 0.9% feel it negatively affects attitudes. This suggests that the integration of Indigenous Knowledge is largely seen as beneficial in shaping students' views of science, fostering more favorable attitudes. The majority of respondents believe integrating Indigenous Knowledge increases students' interest in science learning, with 66.4% agreeing and 19.1% strongly agreeing. A smaller portion of respondents are neutral (8.2%), while only a few disagree (0.9%) or strongly disagree (5.5%). This suggests a strong positive perception of Indigenous Knowledge integration, with most respondents viewing it as enhancing students' interest in science. Similarly, the majority of respondents (60%) feel neutral about the challenges of finding resources to integrate Indigenous Knowledge, suggesting that they neither find it easy nor difficult. A smaller portion finds it very easy (17.3%) or easy (18.2%) to access such resources, while only 4.5% report difficulty in finding resources. This suggests that, while many educators may not encounter significant challenges, there is a notable mixed experience regarding the ease of resource availability. The analysis reveals that the most significant challenge in incorporating Indigenous Knowledge into the science curriculum is the lack of training (48.2%), followed by less focus on Indigenous Knowledge Systems (IKS) (22.7%). A smaller proportion of respondents report challenges related to limited resources (16.4%) and lack of expertise (12.7%). This suggests that the primary obstacle to integration is the need for more training and awareness, rather than resource limitations and expertise gaps.

Table 4

Crosstab analysis on challenges of incorporating Indigenous knowledge regarding Sex

	Challenges of incorporating Indigenous knowledge				
Sex	Lack of export	Lack of training	Limited resources	Less focus on IKS	Total
Female	4	14	4	8	30
Male	10	38	14	17	79
Other	0	1	0	0	1
Total	14	53	18	25	110

Table 4 presents the crosstab analysis of the challenges of incorporating Indigenous knowledge regarding Sex. It shows 38 mentions for males and 14 for females' regarding lack of training across all groups. Therefore, "Lack of training" is the most frequently mentioned challenge, especially among males, while "Lack of expert" and "Limited resources" are reported less often overall.

Table 5

Chi-Square Tests on Challenges of Incorporating Indigenous knowledge regarding sex

Chi-Square Tests	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.612[a]	6	.952
Likelihood Ratio	1.996	6	.920
Linear-by-Linear Association	.138	1	.711
N of Valid Cases	110		

Table 5 presents that the Chi-Square tests indicate no statistically significant association between sex and the challenges of incorporating Indigenous knowledge, with the Pearson Chi-Square p-value of 0.952. The likelihood ratio and linear-by-linear association tests similarly show high p-values of 0.711 further supporting the lack of a significant relationship.

Table 6

Phi tests on Challenges of Incorporating Indigenous knowledge regarding sex

Nominal by Nominal	Value	Approx. Sig.
Phi	.121	.952
Cramer's V	.086	.952
N of Valid Cases	110	

Table 6 indicated that the Phi and Cramer’s V tests show very weak associations between sex and the challenges of incorporating Indigenous knowledge, with values of 0.121 and 0.086, respectively. Both tests have a high significance level (p = 0.952), indicating no statistically significant relationship between these variables.

Table 7

Crosstab Analysis on types of Indigenous knowledge integration regarding Level of teaching

	Types of Indigenous Knowledge Integration					
Level of teaching	Traditional ecological practices	Indigenous cultural practices	Culinary practices	Agricultural practices	Traditional healing practices	Total
Basic	2	20	2	12	2	38
Secondary	16	26	7	21	2	72
Total	18	46	9	33	4	110

Table 7 shows that crosstab analysis on types of Indigenous knowledge integration regarding the Level of teaching. Across all levels, Indigenous cultural practices are the most commonly integrated in 46 instances, while traditional healing practices are the least integrated in 4 instances.

Table 8

Chi-Square Tests regarding the level and types of Indigenous Knowledge use in the classroom

Pearson Chi-Square	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.070ª	4	.132
used Likelihood Ratio	7.925	4	.094
Linear-by-Linear Association	1.097	1	.295
N of Valid Cases	110		

Table 8 shows the Chi-Square test indicate no statistically significant association between the level of teaching (basic or secondary) and the types of Indigenous Knowledge integrated into the classroom, as evidenced by the Pearson Chi-Square p-value of 0.132, which is above the 0.05 threshold. This suggests that the distribution of Indigenous Knowledge types across teaching levels occurs no association each other.

Table 9

Phi tests regarding the level and types of Indigenous Knowledge used in the classroom

Nominal by Nominal	Value	Approx. Sig.
Phi	.254	.132
Cramer's V	.254	.132
N of Valid Cases	110	

Table 9 reveals the Phi and Cramer's V values of 0.254, with a significance level of 0.132, indicate a small effect size and lack of statistical significance in the association between the level of teaching and types of Indigenous Knowledge used. This implies that, while there is a minor association, it is not strong enough to suggest a meaningful relationship between teaching level and Indigenous Knowledge integration types in the data.

Table 10

Crosstab analysis on the feeling of Indigenous knowledge integration regarding Cast/Ethnicity

	To what extent do you feel indigenous knowledge is integrated into the school science curriculum?				
Cast/Ethnicity	Not at all	To a moderate extent	To a small extent	To a large extent	Total
Janajati	1	2	4	5	12
Dalit	0	3	0	1	4
Bahun/Chettri	1	26	39	23	89
Others	0	1	3	1	5
Total	2	32	46	30	110

Table 10 indicated that the crosstab analysis that shows the majority of respondents who feel Indigenous Knowledge is integrated to some extent in the science curriculum belongs to the Bahun/Chettri group (88 out of 110 total responses), with the highest number perceiving integration to a small extent (39). In contrast, the Dalit and "Others" groups report fewer instances of

Indigenous Knowledge integration, suggesting a perception difference across caste/ethnic groups.

Table 11

Chi-Square tests on the feeling of integration of Indigenous knowledge regarding cast ethnicity

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.321ᵃ	9	.325
Likelihood Ratio	9.972	9	.353
Linear-by-Linear Association	.022	1	.883
N of Valid Cases	110		

Table 11 reveals that the Chi-Square test shows no statistically significant relationship between caste/ethnicity and feelings about Indigenous Knowledge integration, with a Pearson Chi-Square p-value of 0.325. This suggests that perceptions of Indigenous Knowledge integration are not meaningfully associated with caste/ethnicity in the data analysis.

Table 12

Phi Tests the feeling of integration of Indigenous knowledge regarding cast ethnicity

Nominal by Nominal	Value	Approx. Sig.
Phi	.306	.325
Cramer's V	.177	.325
N of Valid Cases	110	

Table 12 indicated that the Phi and Cramer's V values of 0.306 and 0.177, with a significance level of 0.325, suggest a weak association between caste/ethnicity and feelings of Indigenous Knowledge integration in the curriculum. This weak and statistically insignificant association implies that perceptions of Indigenous Knowledge integration do not strongly vary by caste or ethnicity in this sample.

Table 13

Crosstab analysis on Indigenous knowledge used in the classroom regarding sex

	In your opinion, should indigenous knowledge be used in the classroom?			
Sex	Yes	No	Not sure	Total
Female	30	0	0	30
Male	74	2	3	79
Other	1	0	0	1
Total	105	2	3	110

Table 13 shows that the crosstab analysis reveals that the majority of both male and female respondents support the use of Indigenous Knowledge in the classroom, with all female respondents (100%) and nearly all male respondents (94%) answering "Yes." Very few respondents (2 males) are opposed and neutral (3 males), indicating strong support for Indigenous Knowledge integration across genders.

Table 14

Chi-Square Tests on Indigenous knowledge used in the classroom regarding sex

Pearson Chi-Square	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.055[a]	4	.726
Likelihood Ratio	3.403	4	.493
Linear-by-Linear Association	1.547	1	.214
N of Valid Cases	110		

Table 14 shows the Chi-Square test, which indicates no statistically significant association between sex and opinions on using Indigenous Knowledge in the classroom, as shown by the Pearson Chi-Square p-value of 0.726. This suggests that support for Indigenous Knowledge integration does not significantly differ across gender groups in this sample.

Table 15

Phi Tests on Indigenous knowledge used in the classroom regarding sex

Nominal by Nominal	Value	Approx. Sig.
Phi	.137	.726
Cramer's V	.097	.726
N of Valid Cases	110	

Table 15 represents the Phi and Cramer's V values of 0.137 and 0.097 with a significance level of 0.726, indicating a weak and statistically insignificant association between sex and opinions on Indigenous Knowledge use in the classroom. This suggests that opinions on integrating Indigenous Knowledge are consistent across genders and have no meaningful variation in support based on sex in this study.

QUALITATIVE RESPONSES

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

Cultural knowledge and practices can enrich science learning by contextualizing scientific concepts within students' lived experiences, making learning more relevant and engaging (Aikenhead & Ogawa, 2007). In classrooms integrating Indigenous knowledge, students often exhibit increased motivation and improved understanding of scientific concepts, as they can see connections between their cultural heritage and scientific inquiry (Kawagley, 2006). Cultural practices in science education can also develop students' problem-solving skills, as traditional knowledge systems are often grounded in empirical observations and adaptive strategies (Berkes, 2012). Additionally, studies suggest that blending cultural knowledge with science fosters inclusivity, validating diverse worldviews and promoting educational equity (Bang & Medin, 2010). This approach benefits Indigenous students and broadens all students' understanding of science as a diverse, cross-cultural field (Cajete, 1999). 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 classroom learning.

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.

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 views 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 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 specific 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 a 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.

INTEGRATION OF LOCAL KNOWLEDGE IN SCIENCE LEARNING

Integrating local knowledge into science learning enhances students' engagement and cultural appreciation while fostering critical thinking skills. For instance, integrating local knowledge in science education provides students contextually relevant learning experiences, connecting scientific concepts to their cultural heritage in Indonesia (Suciati, 2023). This method also helps students better understand complex scientific ideas by linking them to familiar, everyday practices, such as traditional measurement techniques and ecological knowledge, thus improving conceptual understanding (Kasi et al., 2020). Teachers face challenges, such as adapting lesson plans to incorporate these cultural elements, but the benefits for cultural preservation and student motivation are significant. By collaborating with community elders, educators can bridge traditional and scientific knowledge, creating a curriculum that is both educational and culturally inclusive. 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 want to 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. This 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 plough pulled by the ox and Rago to plough 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 plough, and consider ways to innovate and improve it. Instead of fully replacing traditional tools, we discussed how adapting them 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 modern approaches to agriculture. By encouraging creative problem-solving, students learned that innovation can come from enhancing existing tools, not only adopting new technology.

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 science concepts are contextualized within real-world situations, students can relate abstract ideas to familiar situations, making learning more meaningful (Krajcik & Czerniak, 2018). This approach not only aids in knowledge retention but also encourages critical thinking as students analyze and apply concepts beyond the classroom. Research suggests that contextualized science education supports better academic outcomes, particularly for students who may struggle with traditional methods of instruction (Basu & Barton, 2007). By connecting science topics to daily life, teachers can address diverse learning needs and promote inclusivity, as students from different cultural and socio-economic backgrounds may see themselves represented in the curriculum (Lee & Buxton, 2013).

Moreover, integrating daily life contexts into science lessons has improved motivation, as students often find practical applications of science more attractive than purely theoretical approaches. For example, understanding chemical reactions through cooking and learning about physics by studying sports can make learning more perceptible. Integrating real-life contexts can also encourage collaborative learning, as students work together to solve relatable problems. Teachers are critical in selecting contexts that resonate with their students' experiences, making science learning accessible and culturally relevant (Moje et al., 2001). Incorporating everyday life into science education promotes lifelong learning as students develop skills that empower them to make informed decisions in their future careers. 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 for nature than 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 by strengthening the concepts of daily life integrated with Western science. The following 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.

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. Using real-world contexts and daily life examples can enhance students' understanding by connecting science to their personal experiences (Ali & De Jager, 2020). Teachers emphasising collaborative learning encourage students to work in groups, fostering problem-solving skills and critical thinking. Differentiated instruction is also essential as it modifies lessons to diverse learning needs and backgrounds, making science more accessible to all students. Integrating technology, like simulations and virtual labs, has become common, offering dynamic and interactive ways for students to visualize complex concepts. Assessment in science education has also evolved to include formative assessments that provide continuous feedback, helping students improve incrementally. Culturally responsive teaching practices, integrating Indigenous knowledge, can bridge scientific ideas with students' cultural backgrounds, fostering inclusivity (Guberina, 2023). Teachers' role as facilitators of learning emphasizes guiding students to discover answers rather than simply delivering information. Finally, these pedagogical practices aim to cultivate scientific literacy, curiosity, and a lifelong interest in science among students. 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. By 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 teacher's 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 are supportive, and others are 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.

BRIDGING INDIGENOUS KNOWLEDGE WITH SCIENTIFIC CONCEPTS

Bridging Indigenous knowledge with scientific concepts enhances science education by incorporating culturally relevant knowledge and practices. This integration fosters a holistic understanding of science as students learn to see scientific principles reflected in their cultural practices (Aikenhead & Ogawa, 2007). Indigenous knowledge, which often emphasizes interconnectedness and sustainability, can complement scientific perspectives by providing context for environmental and ecological studies. For example, traditional soil conservation and water management methods can be connected with modern ecological and environmental science, enhancing students' understanding of sustainable practices (Cajete, 1999). By validating Indigenous knowledge in the classroom, educators promote cultural advantage and inclusivity, helping students from Indigenous backgrounds feel represented in the curriculum. This approach supports diversity in science education and encourages all students to respect and value different ways of meaning. Bridging these knowledge systems also teaches students critical thinking as they compare, contrast, and find common ground between Indigenous and scientific worldviews. Such integration allows students to see science as an academic subject and part of a broader, interconnected worldview. Teachers are crucial in selecting culturally relevant examples highlighting parallels between Indigenous practices and scientific principles. Bridging knowledge systems cultivates a more complete understanding of science, preparing students to apply these concepts in diverse, real-world situations. Concerning this theme of bridging Indigenous knowledge with scientific concepts, 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 concepts, 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.

DISCUSSION

The contribution of this mixed methods research lies in its ability to provide a comprehensive understanding of how Indigenous knowledge can be effectively integrated into science education. The study uniquely bridges cultural and scientific paradigms by combining qualitative insights from Indigenous educators and community members with quantitative data on student learning outcomes. It offers an evidence-based framework for curriculum design that honours Indigenous epistemology while enhancing scientific literacy. The mixed methods approach ensures a holistic exploration, capturing both the lived experiences of science teachers and measurable impacts on teaching practices and student engagement. Finally, this research contributes to inclusive education models that foster cultural sustainability and scientific innovation.

The integration of Indigenous Knowledge (IK) into science lessons is reflected in moderate frequency, with teachers predominantly incorporating it "Sometimes" and "Often and most allocate 1-2 periods per week. Key IK types include Indigenous cultural and agricultural practices, while traditional healing and culinary knowledge are less commonly used. Although most teachers believe IK is integrated to a limited and moderate extent in the science curriculum, there is broad support for its use, with many noting that IK improves student engagement and attitudes toward science. However, access to IK resources is neutral, indicating challenges in availability, and training gaps present significant barriers. Qualitative insights reveal that IK makes science more relatable as teachers use cultural practices like the Newar distillation of Aila or exothermic yomari preparation to explain scientific processes, fostering cultural significance. Integrating IK enables "cultural border crossings," reducing cultural conflict and making science more inclusive for students from diverse backgrounds. Challenges arise when urban-raised students struggle to connect with traditional knowledge, underscoring the need for adaptable teaching approaches, linking IK with scientific concepts that benefit all students, validating cultural heritage as an appropriate context for science learning, building pride, and promoting equity. This inclusive approach makes science accessible with practical examples, such as hygiene linked to temple cleanliness, which enhance engagement and deepen understanding by embedding science in everyday life.

CONCLUSION

In conclusion, while integrating Indigenous Knowledge (IK) in science education remains moderate and faces challenges such as limited training, its impact on student engagement, attitude, and comprehension is significant. Teachers widely support the inclusion of IK, recognizing its ability to make scientific concepts more culturally relevant and accessible, enriching learning for students from diverse backgrounds and integrating cultural practices, such as Newar traditions, bridging scientific and Indigenous knowledge, fostering a sense of identity and pride in students by validating their heritage. Although urban students may initially find it challenging to connect with traditional knowledge, adaptive teaching strategies help make these connections. Ultimately, integrating IK in science curricula enhances students' understanding of science as part of everyday life and promotes inclusivity, supporting a more equitable educational environment that respects and values multiple cultural perspectives.

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