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Role of Indigenous Knowledge Integration on Student Engagement in Science Learning

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ABSTRACT: This study is carried out to examine the role of Indigenous Knowledge (IK) on student engagement in science learning. It employed a quantitative research approach utilizing a survey design to collect data from teachers' perceptions of integrating Indigenous Knowledge in student engagement. A structured survey tool was developed to collect data from teachers. Data collection was facilitated through Google Surveys, allowing participants to respond conveniently online. The investigator sent the link to the survey tool to the respondents via email, WhatsApp, and Messenger. 110 respondents responded to the Google form. The collected data were analyzed by using SPSS software, version 21. Results show strong support for IK inclusion enhancing student engagement. The demographic analysis highlighted the hilly region, and teachers aged 31-40 favoured a balanced integration of IK with Western science. Despite positive perceptions, challenges remain, such as a lack of training and limited IK resources. Most teachers viewed a gap in IK emphasis in curricula hinders student engagement. Chi-Square and Phi tests revealed no significant associations between perceived challenges and demographics. It indicates that training and lack of resources affect all teachers. The study confirms teachers' positive views on integrating IK enhances student engagement. However, emphasizes the need for complete reforms in training, resources, and curriculum support to improve inclusivity in science education.

Keywords: Indigenous knowledge, Student engagement, Science education, etc.

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1. Introduction

De Beer and Mothwa (2013) raised the issue of Indigenous knowledge (IK) in the science classroom: science, pseudo-science, or a missing link to integrate Indigenous knowledge in the science classroom practices in an African context. It also highlights the lack of teachers' content pedagogical knowledge to connect indigenous knowledge with science curricula and classroom teaching. Similarly, the NCF (2019) emphasized that science curriculum and classroom learning connect with students' daily life experiences through innovative and interactive teaching methods in the Nepalese context. However, in the existing classroom situation, there is a lack of indigenous knowledge related to illustrations and science teaching learning activities in the curricula and classroom context.

Integrating indigenous knowledge into science education has increased attention as teachers and policymakers recognize the value of diverse knowledge systems. It may be the result of students having obtained no grade (NG) in the basic level examination (BLE) and school education examination (SEE) outcomes in 2024 in science. These results also resonate with NASA's report of grades 5, 8, and 10 (2015, 2017, and 2020). Indigenous knowledge, which includes the traditional understandings, skills, and philosophies developed by Indigenous peoples, offers unique perspectives that can enhance scientific learning. However, there is limited empirical research literature in the Nepalese context on how this integration affects students' engagement and overall attitudes towards science. To overcome these impacts fill the gap, and add more literature on it. Therefore, this study is essential and relevant for developing inclusive and effective educational practices incorporating indigenous knowledge in science education.

The traditional knowledge systems of indigenous peoples are derived from centuries of accumulated wisdom, deep-rooted expertise, and fundamental cultural beliefs. These knowledge systems offer priceless insights that can enhance the comprehension of scientific concepts. However, within the educational landscape of Nepal, there is a seeming lack of research evidence concerning the impacts of assimilating this indigenous knowledge into students' academic performance, their involvement with the subject matter, and their overall performance towards scientific disciplines. This paper seeks to bridge this gap in existing literature, drive our comprehension forward, and foster the development of complete and impactful teaching methodologies that actively incorporate indigenous knowledge into students' engagement in science education.

Traditional knowledge informs decision-making about fundamental aspects of life, from day-to-day activities to long-term planning. It is deeply embedded in community life, transmitted through generations by oral tradition, and closely tied to spiritual beliefs and cultural practices (Berkes, 2012). The integration of Indigenous knowledge into science education has been advocated as a means to create more culturally responsive curricula, which can engage students from diverse backgrounds more effectively (Aikenhead & Michell, 2011). By acknowledging and valuing the knowledge systems of indigenous peoples, educators can provide a more inclusive educational environment that respects and reflects the lived experiences of all students.

Research has shown that incorporating Indigenous knowledge into science curricula can improve academic performance. Students are more likely to understand and retain scientific concepts when these are taught through contexts that are familiar and relevant to their own lives (Battiste, 2002). For example, the use of local examples and traditional ecological knowledge can make abstract scientific principles more concrete and relatable. In a study conducted in Canada, Aikenhead and Huntley (1999) found that Indigenous students who were taught science through a curriculum that included indigenous knowledge performed better academically than those who were taught through a conventional science curriculum. This suggests that the integration of Indigenous knowledge can help to bridge the gap between students' everyday experiences and the abstract concepts of science, leading to improved academic outcomes.

Engagement in science education is crucial for fostering a lifelong interest in the subject. Indigenous knowledge can be a powerful tool for increasing student engagement, as it provides a context for learning that is meaningful and relevant to students' lives (Barnhardt & Kawagley, 2005). By connecting scientific concepts to traditional practices and local environments, educators can create a more engaging and motivating learning experience. A study by Snively and Corsiglia (2001) demonstrated that students who were taught science using a curriculum that integrated indigenous knowledge were more engaged and motivated to learn. The use of storytelling, hands-on activities, and community involvement helped to create a learning environment that was dynamic and interactive, fostering a deeper connection to the subject matter.

Attitudes towards science play a significant role in students' willingness to pursue further studies and careers in the field. Integrating Indigenous knowledge into science education can help to foster more positive attitudes by demonstrating the relevance and value of science in everyday life (McKinley, 2005). When students see their own cultures and knowledge systems reflected in the curriculum, they are more likely to develop a positive feeling towards science and feel that it is a field in which they can succeed. In a study conducted in New Zealand, McKinley (2005) found that Maori students who were taught science using a curriculum that included Indigenous knowledge had more positive attitudes towards science than those who were taught through a conventional curriculum. The integration of Maori knowledge and perspectives helped to create a more inclusive and affirming learning environment, leading to increased interest and engagement in the subject.

Despite the potential benefits, there are several challenges and barriers to integrating Indigenous knowledge into science education. One of the main challenges is the lack of teacher training and resources.

Many teachers may not be familiar with Indigenous knowledge systems or how to effectively incorporate them into their teaching (Aikenhead, 1996). Additionally, there may be a lack of culturally relevant teaching materials and resources that can be used to support this integration. Another challenge is the potential for cultural misappropriation and misrepresentation. Indigenous knowledge must be integrated into science education in a way that respects and honors the source of that knowledge (Battiste, 2002). This requires collaboration and partnership with Indigenous communities, as well as a commitment to ethical and respectful practices.

In the context of Nepal, there is a significant gap in the research on the impact of integrating Indigenous knowledge into science education. Nepal is home to a rich diversity of Indigenous cultures and knowledge systems, yet these are often overlooked or marginalized in the formal education system (Thapa, 2012). Research is needed to explore the potential benefits and challenges of integrating Indigenous knowledge into science education in Nepal and to develop effective strategies for doing so. A study by Maharjan and Maharjan (2017) highlighted the importance of incorporating Indigenous knowledge into the Nepali education system to promote cultural preservation and enhance learning outcomes. However, there is still a lack of empirical research on the specific impacts of this integration on students' academic performance, engagement, and attitudes towards science. This research is crucial for developing evidence-based teaching methodologies that can improve science education in Nepal and create a more inclusive and culturally responsive curriculum. The integration of indigenous knowledge into science education holds the potential to enhance students' academic performance, increase their engagement with the subject matter, and foster more positive attitudes towards science. However, there is a significant gap in the research on this topic, particularly in the context of Nepal. Bridging this gap is essential for developing comprehensive and impactful teaching methodologies that actively incorporate Indigenous knowledge into science education. By doing so, we can create a more inclusive and culturally responsive education system that respects and values the knowledge systems of all students.

In every society, there are lots of local knowledge experiences related to student's daily life experiences. They have experiences of local knowledge that are related to science contents and curricula. However, they do not feel scientific and are less engaged in science learning. The school science content is based on Western scientific knowledge that focuses on facts, laws, principles, and theories. These Western and local knowledge may interrelated, but less try to integrate each other. 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. In my experience as a science teacher from secondary to higher education level, there is less focus on integrating the students' daily life experiences and local knowledge into the development of science curricula, and classroom practices. It may lead to less engagement of students in science subjects.

Similarly, the NCF (2019) points out that science teaching and learning are based on interactive, innovative, and relate students' daily life experiences with science curricula and classrooms. It shows NCF's focus on integrating indigenous knowledge and students' attitudes in the science classroom. Similarly, NASA (2020) shows that 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). This indicates that more students are failing in science, which seems to be the SEE result. The science curriculum may not focus on Indigenous knowledge or student engagement, students' attitudes may not be positive towards science learning, and innovative and interactive teaching-learning may not be connected with students' daily life experiences. There is a lack of empirical evidence on the role of Indigenous knowledge in student engagement in science learning. This gap in the literature indicates the development of effective educational strategies that can influence the benefits of indigenous knowledge to enhance science learning. However, the lack of understanding of indigenous knowledge integration with science curricula and classroom context affects students, teachers, and policymakers. They may face problems in implementing IK in science classroom practices. The IK may promote academic success, student engagement in science, and the inclusion of cultural aspects. Therefore, the study entitled Role of Integrating Indigenous Knowledge on Student Engagement in Science Learning is selected as the problem of the study.

2. Theoretical Overview of the Main Concepts

Integrating Indigenous knowledge (IK) in science education fosters student engagement by making learning culturally relevant and contextually meaningful (Aikenhead & Michell, 2011). Research suggests that incorporating IK helps bridge the gap between students' lived experiences and formal scientific concepts, increasing their interest and participation (Snively & Williams, 2016). This approach supports a holistic understanding of science by including diverse ways of knowing, thus enriching students' cognitive and affective engagement (Battiste, 2002). IK integration fosters a sense of identity and belonging among Indigenous students, leading to increased motivation and confidence in science learning (McKinley, 2005). Moreover, it promotes inquiry-based learning by encouraging students to explore environmental and ecological knowledge systems grounded in local traditions (Barnhardt & Kawagley, 2005). Studies indicate that such integration enhances students' ability to critically analyze and apply scientific knowledge in real-world contexts (Jegede & Aikenhead, 1999). By valuing Indigenous epistemologies, educators can challenge the Eurocentric dominance in science education and create more inclusive learning environments (Cajete, 1999). Engaging with IK encourages collaborative learning as students interact with community elders and knowledge holders, fostering intergenerational knowledge transmission (Kimmerer, 2013). Additionally, it nurtures a more profound ethical and ecological responsibility by connecting science education with sustainability and environmental development (Berkes, 2012). Integrating Indigenous knowledge in science curricula enhances student engagement by fostering cultural relevance, critical thinking, and meaningful connections to scientific inquiry.

3. Methodology

The study employed a quantitative research approach utilizing a survey design to gather data on teachers' perspectives regarding the integration of Indigenous Knowledge in science classrooms. A structured survey tool was developed to capture insights from teachers across various demographics. Data collection was facilitated through Google Surveys, allowing participants to respond conveniently online. The survey targeted 384 teachers from diverse backgrounds of population beyond the researcher, representing the three ecological belts, and covering a range of caste, ethnicity, and religious groups. The total number of science teachers in Nepalese schools was unknown population to the investigator. Therefore 384 samples are statistically needed for the study. The investigator sent the link to the survey tool to the respondents via email, WhatsApp, and Messenger which were available for the researchers' link. However, there were only 110 respondents responded to the Google form. The data of 110 teachers were used for the manuscript writing. This diverse sampling aimed to capture a holistic view of perspectives across different sociocultural contexts, enhancing the study's generalizability (Creswell & Creswell, 2018). The collected data were analyzed using SPSS software, version 21 to ensure precise statistical handling and interpretation. Descriptive and inferential statistics were employed to draw meaningful insights from the data set (Field, 2013). To enhance precision, results were further interpreted manually, allowing deep analysis of specific trends and patterns. Overall, this approach ensured the data analysis and accessible presentation of results.

4. Discussion

The data obtained from the Google survey as the views of respondents were an entry in the SPSS software for analysis. The univariate and bivariate analyses were performed in it. The tabulated data were interpreted as follows:

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 the 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 indicated 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, the majority of respondents feel Indigenous Knowledge is integrated into the school science curriculum *to a small extent* (41.8%) or *to a moderate extent* (29.1%). A smaller 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

Sex	Challenges of incorporating Indigenous knowledge				Total
	Lack of export	Lack of training	Limited resources	Less focus on IKS	
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 that 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	7.070[a]	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	10.321[a]	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 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 are opposed (2 males) neutral (3 males), indicating strong overall 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 whose results indicate 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 very 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.

5. Synopsis of the Main Research Outcomes

The findings indicate a strong application for integrating Indigenous Knowledge in science classrooms, as evidenced by the large proportion of respondents supporting its inclusion. This aligns with literature emphasizing the cultural relevance of Indigenous Knowledge for enhancing student engagement (Aikenhead & Jegede, 1999). The positive impact on student engagement and interest also reflects existing research on culturally responsive education, which suggests that Indigenous Knowledge can make science more relatable and increase participation (Barnhardt & Kawagley, 2005). Additionally, the perception of a favourable impact on students' engagement in science emphasizes the value of Indigenous Knowledge in developing students' appreciation and positive feelings toward science subjects (Demmert, 2001).

The sample demographics reveal the distribution in three ecological belts. The male respondents and individuals from specific regions, such as the Pahad belt, led the study's concept. This disparity suggests potential cultural or geographic factors influencing perceptions of Indigenous Knowledge integration, which could be further investigated to understand regional or gender-based differences in educational attitudes. Most respondents, particularly those aged 31 to 40, advocate for moderate use of Indigenous Knowledge, pointing to a preference for balanced integration rather than full replacement of traditional scientific frameworks. Challenges remain, particularly regarding the lack of training and limited focus on Indigenous Knowledge, consistent with findings by Meyer (2001), who highlights the need for teacher support and resource availability for successful Indigenous Knowledge integration. While Indigenous cultural and agricultural practices are more commonly incorporated, traditional healing and culinary practices are less represented, indicating selective integration based on perceived relevance to science topics.

This analysis highlights the perceived neutrality in resource accessibility for Indigenous Knowledge integration in classrooms and the significant barriers presented by limited training and focus on Indigenous Knowledge Systems (IKS). Most educators surveyed show a neutral stance of 60% on the easiness of accessing resources for Indigenous Knowledge, suggesting a mixed experience that may vary based on individual schools and regions. While some teachers, 17.3% and 18.2%, find it "very easy" or "easy" to access these resources, a small proportion, 4.5%, experience difficulties. This neutral position might imply that resources for integrating Indigenous Knowledge exist but are either inconsistently available or lack centralized access (Aikenhead, 2001). Research indicates that the variability in Indigenous Knowledge resource availability is often a result of institutional differences and limited support at the policy level (Barnhardt & Kawagley, 2005). These findings reveal that the lack of teacher training 48.2% represents the most significant barrier to incorporating Indigenous Knowledge into science curricula. This finding aligns with Kanu's (2011) assertion that teachers are ill-prepared to integrate Indigenous Knowledge without dedicated training effectively. Furthermore, the limited emphasis on Indigenous Knowledge in educational frameworks 22.7% suggests a gap in curriculum design that deprioritizes culturally relevant perspectives in science. This has been shown to impact students' engagement, as curriculum frameworks that integrate culturally relevant knowledge can make science more appropriate and accessible to diverse learners (Bang & Medin, 2010).

Additional analyses reveal no significant gender-based association with the challenges of Indigenous Knowledge incorporation. This implies that both male and female teachers face similar hurdles, with "lack of training" referred to most frequently by both groups, especially among male respondents. The Chi-Square and Phi tests support this lack of association with high p-values indicating that challenges are experienced independently of the teacher's gender. This uniformity underscores that these challenges are widespread and not limited to particular demographics, suggesting a systemic issue within the educational system that affects all educators equally. Similarly, the analysis of Indigenous Knowledge integration by teaching level indicates no significant difference between basic and secondary levels. Indigenous cultural practices remain the most integrated, while traditional healing practices are the least integrated. This could suggest a tendency to prioritize Indigenous Knowledge that aligns closely with common scientific themes, leaving out areas such as traditional healing, which could provide valuable interdisciplinary insights into biology and chemistry (Snively & Corsiglia, 2001). The lack of significant association here, as indicated by the Chi-Square and Phi tests suggests that the type of Indigenous Knowledge integrated in curriculum constraints than by the level of education.

Perceptions of Indigenous Knowledge integration across caste/ethnicity groups show that the Bahun/Chettri group reports higher perceived integration, especially to a "small extent" 39 responses. However, these perceptions do not significantly vary by caste/ethnicity, as confirmed by the Chi-Square and Phi tests. This suggests that while there are minor differences in perception, they are not substantial enough to indicate cultural or ethnic biases in Indigenous Knowledge inclusion within the curriculum. This finding aligns with Snively and Corsiglia's (2001) observation that Indigenous Knowledge can provide a universally valuable perspective, but its integration often depends on individual educator initiatives rather than systemic support. Lastly, the analysis demonstrates strong support for Indigenous Knowledge use in classrooms across genders, with all female and nearly all male respondents expressing supportive agreement. This agreement strengthens the idea that educators recognize the value of culturally relevant pedagogy, as research shows that Indigenous Knowledge can enhance science education by making it more inclusive and relatable (Aikenhead & Ogawa, 2007). However, the lack of significant gender-based association in the Chi-Square tests indicates that this support is uniformly distributed across genders, emphasizing a collective acknowledgement of Indigenous Knowledge's potential to enrich science curricula.

6. Conclusions

The results indicate an overall positive perception of integrating Indigenous Knowledge into science education, suggesting it can enhance student engagement in science learning. However, the limited diversity among respondents and ongoing challenges in integration point out the areas that need further development, particularly in teacher training and resource support. This study shows that Indigenous Knowledge can significantly enhance science education by achieving widespread and effective integration that requires addressing existing structural and resource-related problems. Although teachers largely support the integration of Indigenous Knowledge, several structural barriers hinder its implementation, mainly due to inadequate training and less emphasis on IKS in the curriculum. The study declares that integrating Indigenous Knowledge in science education is valuable and complex, requiring systemic changes. These changes should include improved training, resource access, and curriculum modifications to enable a more consistent and effective integration. Such efforts are essential to create a learning environment where Indigenous Knowledge can effectively combine with scientific inquiry, making science education more inclusive and representative of diverse cultural perspectives.

7. Limitations, Implications, and Further Directions of Research

Regardless of its benefits, integrating Indigenous knowledge (IK) into science education faces several limitations, including teacher training, limited curricular resources, and tensions between Indigenous and Western epistemologies (Aikenhead & Michell, 2011). There is also a risk of misrepresenting or oversimplifying IK when adapted to fit standardized curricula (Snively & Williams, 2016). However, the implications of IK integration are significant, as it promotes culturally responsive pedagogy, enhances student engagement, and fosters ecological stewardship (Kimmerer, 2013).

This approach encourages collaborative learning between schools and Indigenous communities, strengthening intergenerational knowledge transmission (Barnhardt & Kawagley, 2005). Further research should explore how IK integration impacts different student demographics, including non-Indigenous learners, and investigate effective pedagogical strategies for harmonizing Indigenous and scientific knowledge (Jegede & Aikenhead, 1999). Longitudinal studies are needed to assess the long-term effects of IK integration on students' scientific literacy and career choices. Additionally, more research should focus on policy frameworks that support sustainable IK inclusion in science curricula (Battiste, 2002).

Investigating the role of digital technologies in preserving and disseminating IK could also enhance accessibility and engagement. Future studies should emphasize participatory research methodologies involving Indigenous educators and knowledge holders in curriculum development. Ultimately, advancing research in this field will contribute to a more inclusive and holistic science education system.

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