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RESEARCH ARTICLE

Perspectives of Pre-services Teachers on Indigenous Knowledge Practices and Their Integration into the Teaching and Learning of Science

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ABSTRACT

Available research suggests the need to integrate indigenous practices into classroom pedagogy to facilitate learners' understanding of scientific concepts within the context of the local environment. To this end, it is thought having a good knowledge of what learners think about these practices and whether they could be infused into teaching and learning is worth considering. This becomes even more plausible given the pedagogical principle of teaching from the 'known' to the 'unknown'. An assessment of pre-service teachers' perspectives could help ascertain what they already know or must know about indigenous knowledge and its integration into lessons. Using the quantitative descriptive cross-sectional research design, this study assessed pre-service teachers' perspectives on indigenous practices and their infusion into science lessons using a population of 492 third-year pre-service teachers in a College of Education affiliated with the University of Cape Coast. The accessible population comprised 312 third-year pre-service teachers offering primary education. A closed-ended questionnaire was used to collect data, which was analysed using descriptive statistics. The findings showed that the pre-service teachers generally viewed indigenous knowledge as emerging from activities related to everyday life settings. They also agreed that the objective of integrating indigenous knowledge into science lessons is to foster teaching from the 'known' to the 'unknown', to help learners relate school knowledge to everyday experiences, and hence promote a sense of self-belief and self-reliance in solving local problems. In conclusion, the pre-service teachers welcomed the appropriateness of integrating lessons with indigenous practices, which showed how predisposed they were to adopt the practice. It was recommended that, for teachers to effectively integrate indigenous practices, they first assess learners' perspectives on the practices and their relevance to the classroom so that what they already know can be built on.

Keywords: Indigenous knowledge practice, perspectives, pre-service teachers, teaching from 'known' to 'unknown'.

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1. Introduction

As a body of knowledge associated with people who have had an extended history of collaboration with the natural environment, indigenous knowledge has gained prominence in recent times due to growing interest in its practices from researchers. This interest is likely boosted by how indigenous knowledge articulates and accommodates specific worldviews from people. In other words, indigenous knowledge provides different and alternative views on the nature of the world of science vis-à-vis those held by Western science scholars. Indigenous knowledge has been proven to provide a rich, complementary and authentic local context within which science learning can occur (Derbile *et al.*, 2016; Zinyeka *et al.*, 2016). This context is accommodative since it provides room for a reflection on alternative views on the nature of the scientific environment in contemporary science education. This

contributes to developing a more balanced and holistic worldview of scientific phenomena (Zidny *et al*., 2020).

Various researchers have defined Indigenous knowledge to reflect its nature, the environment from which it exudes, its practices as well as its mode of transmission (Kwanya, 2015; Letsekha *et al*., 2013; Onwu & Mosimege, 2004; Oppong, 2017; Rajendran & Parveen, 2005). However, it does appear none of the expressed views has been considered adequate or comprehensive enough and for that reason, several opinions about what indigenous knowledge is continue to be offered. One definition that has, for instance, been proffered is that indigenous knowledge includes local and social knowledge practices of the people (Jacobs, 2015). Indigenous knowledge is a network of knowledge, beliefs, and traditions preserved over time. It is the knowledge that communicates and contextualises indigenous relationships with culture and landscape over time (Bruchac, 2020). Thus, through formal and informal means, it spreads among kin groups of people and communities through social encounters, oral traditions, ritual practices and other activities like planting and harvesting, skills for hunting, understanding of local ecosystems, and the manufacture of specialised tools and concocting medicinal remedies (Bruchac, 2020).

Indigenous knowledge is perceived as a unique and treasured traditional body of knowledge and skills within a given community, culture or society. Characteristically, it is established outside the formal education system and enables the community to live on. It finds expression in folklore that is vertically transmitted from generation to generation and passed on laterally from person to person (Kasanda *et al*., 2005). Onwu and Mosimege (2004), Kasanda *et al*. (2005), and Goma *et al*. (2016) affirm that indigenous knowledge incorporates technologies and practices that native people have used for the continuation of life. It is comprehensive and holistic. Indigenous knowledge contains a complex set of technologies that the indigenous community has improved and sustained (Battiste, 2002). It is a repetition of practices over time that has led to products and processes based on sound scientific principles. After observing that animals did not eat certain plants and conjecturing that it was because these plants were toxic, people within these communities took extracts and tested them for a range of uses. Many of these plant extracts were, and are still used as pesticides in agriculture, as bait to catch fish or to treat maggot infestations in livestock (Rajendran & Parveen, 2005).

The point of convergence of the many definitions and viewpoints about indigenous knowledge is that it is a subject matter that describes a wide range of issues related to culture, tradition, history, and the geographical location of a people in a given community. It encompasses common historical and cultural practices and the processes of these practices associated with people who have lived in a particular place for generations. Knowledge is sustained through continuous interactions with the environment and community interactions (Kozulin *et al*., 2003). Given the reciprocal relationship that appears to exist between knowledge and learning, it has been a plausible view that indigenous knowledge has implications for learning in the formal school system. It is thought that learners would readily conceptualise new scientific ideas, especially those related to chemistry as a discipline if they are introduced to them in the classroom and infused with indigenous knowledge practices.

Simply put, indigenous knowledge systems are essentially locally based knowledge systems unique to a group of people in a given culture or society. These knowledge systems have advanced with the evolution of culture through generations of occupation of particular ecosystems.

Incorporating local community experiences into teaching and learning activities has been a long-standing issue for research. Some studies have seen the issue as having a solid motivational value that holds promise for enhancing learning, retention, and recall of what has been taught (Newton, 1988). Some scholars (Derbile *et al*., 2016; Ogunniyi, 2004; Snively & Corsiglia, 2001; Zinyeka *et al*., 2016) who have researched non-western cultural settings consider indigenous knowledge to have alternative world views that demystify Western science. Hård Af Segerstad and Kasperowski (2015) believed that within any subject area, learners better understand and appreciate concepts when teaching is graduated from the 'known to unknown'. They explain that the immediate environment, observations and shared experiences from parents, friends and others in the community serve as primary sources of knowledge (the known) based on which new concepts (the unknown) can be assimilated. In other words, when integrated into the teaching process, the known or learner's previous knowledge (indigenous practices) helps facilitate understanding and easy concept acquisition. In the particular case of science, it enables students to view the subject as a familiar everyday experience and hence helps diffuse any lingering phobia. Besides, it has been argued that culturally relevant and responsive pedagogy appeals to learners' identities and values in the local context (Byrd, 2016; Nijhuis, 2019). It creates an inclusive classroom climate, with learners valuing and understanding the varying cultures of their peers.

In one study on the integration of indigenous knowledge, for instance, Govender and Mutendera (2020) observed that teachers had rigidly followed the Westernised content in their lesson delivery. The teachers had no regard for what went on in the surrounding communities and, hence, knew very little about indigenous knowledge practices. At the onset of the study, the teachers rejected indigenous knowledge practices, describing them as not scientific, and this attitude negatively affected their teaching and learning outcomes. At the end of the study, however, most of the teachers became enthused and welcomed the idea of learning from the local people's valuable local experiences and skills. The change in the attitude of the teachers following their appreciation of indigenous knowledge was enough to improve teaching and learning outcomes. A related study found that learners felt comfortable relying on scientific knowledge to resolve pertinent issues relating to their ecological, societal, and economic needs (Abonyi *et al*., 2014). Besides, Mudaly (2018) also observed learners to be enthusiastic and motivated as they used indigenous knowledge to learn complex mathematical concepts.

Vygotsky's (1978) concept of the zone of proximal development sees every teacher as a more knowledgeable other (MKO) under whose guidance and support learners can bridge the gap between the 'can do without help' to the 'can do with some support', lends significant support for the integration of indigenous content into formal classroom teaching and learning. His use of the term 'more knowledgeable' connotes the idea that as people who have been trained in curriculum content matter as well as methodology, every teacher knows far more than the learners they handle, relative to any new knowledge or skill that is to be acquired (Evans, 2023).

Given the foregoing, this study was conducted to determine what pre-service teachers think of having indigenous knowledge issues infused into formal teaching pedagogy. Accessing pre-service teachers' perspectives provided a gauge that helped to ascertain what they already knew or needed to know about indigenous knowledge and its integration into classroom learning. The study was used to gauge other existing studies showing that teachers can better promote learners' cognitive development when they are well-informed about their sociocultural background. Abonyi *et al*. (2014) have, for instance, stated that learners' perspectives on indigenous science are important since they can serve as the framework for the development of reality by integrating culture with cutting-edge science. The evaluated perspectives of the pre-service teachers in the study were used to ascertain the implicit viewpoint that any learner of indigenous science can act as a foundation for creating reality by connecting culture to scientific knowledge.

Specifically, the study examined pre-service teachers' perspectives concerning deploying indigenous knowledge practices in teaching and learning chemistry at the College of Education level in Ghana. The research question addressed was as follows:

> *RQ: What are pre-service teachers' perspectives on deploying indigenous knowledge practices in teaching and learning chemistry at the College of Education level in Ghana?*

2. Method

The study examined pre-service teachers' perspectives concerning the deployment of indigenous knowledge practices in the teaching and learning of chemistry. Given the nature and purpose of the study, the quantitative descriptive cross-sectional survey research design was used. This design usually provides an accurate description of the variables studied and is, therefore, an effective approach for gathering data about content knowledge from any population that has been sampled (Creswell & Creswell, 2018).

The study population comprised 492 third-year pre-service teachers in a College of Education affiliated with the University of Cape Coast. The accessible population was 312 third-year pre-service teachers offering primary education in that College of Education. These pre-service teachers offered General Chemistry as a course. Third-year pre-service teachers in the college were purposively selected to participate in the study because they had already been taken through curriculum studies in basic school science and acquired basic competencies and methods in the teaching of science in basic schools.

The research instrument used to gather data was a closed-ended questionnaire. Since a questionnaire provides an objective means of gathering data and concepts from people, it was most appropriate to prepare and administer it to the pre-service teachers in order to capture their authentic perspectives about the integration of indigenous knowledge practices. Fig. 1 presents the dimensions of the pre-service teachers' perspectives that the questionnaire captured.

In designing the questionnaire, a 4-Likert scale was used for data on three dimensions, namely, nature, knowledge, and objectives. Justification for the use of this scale anchored on the fact that it allowed the inclusion of four extreme options without a neutral choice. To ensure that everyone expressed an opinion, ratings were used on the scale, which comprised 'Strongly Agree', 'Agree', 'Disagree', and 'Strongly Disagree'. The scale thus had no midpoint, which helped to eliminate the possibility of respondents taking advantage of the midpoint to provide neutral responses. Questionnaires on the fourth dimension (the application of indigenous knowledge) were designed based on a 2-point Likert scale. The rated options for selection that were scored on this scale were 'Applicable' and 'Not Applicable'.

The validity of the questionnaire was safeguarded by allowing supervisors from the Department of Teacher Education, Kwame Nkrumah University of Science and Technology, to go through the items to check for face and content validity. To further check for face and content validity, the questionnaire was pre-tested in a college of education that was affiliated with the University of Cape Coast and where primary education students offered General Chemistry. The rationale for the pre-test was fourfold: namely, to establish whether the instructions on the questionnaire were clear to the respondents, to forestall ambiguity between questions and corresponding response options, to determine how long it took to complete the questionnaire as well, as to use the results to fine-tune the instrument.

To determine the reliability, data from the pre-test were analysed using the Cronbach alpha coefficient as an index of internal consistency or a measure of scale reliability (Cohen *et al*., 2018). The Cronbach's Alpha reliability figures for the nature of indigenous knowledge practices, knowledge of indigenous knowledge practices, objectives of integrating indigenous knowledge, and practical application of integrating indigenous knowledge practices into the teaching of specific topics in General Chemistry were 0.711, 0.763, 0.808 and 0.937, respectively. Responses from the questionnaire for the actual study were analysed using descriptive statistics, which included frequency counts, percentages, means, standard deviations and mean of means.

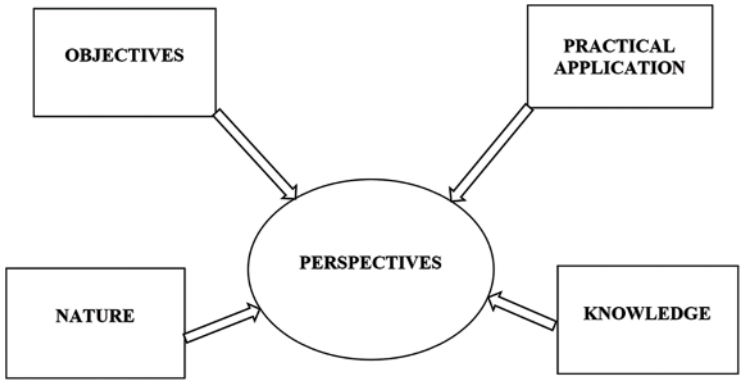

Fig. 1. Dimensions of pre-service teachers' perspectives assessed.

3. Results

3.1. Pre-service Teachers' Perspectives on the Deployment of Indigenous Knowledge Practices in the Teaching and Learning of Chemistry

The data gathered from the questionnaire administered to the respondents vis-à-vis their perspectives on the deployment of indigenous knowledge practices were organised into four sections: (1) Nature of indigenous knowledge practices, (2) knowledge of indigenous knowledge practices integration, (3) objectives of integrating indigenous knowledge, and (4) practical application of integrating indigenous knowledge practices.

3.2. Pre-service Teachers' Perspectives on the Nature of Indigenous Knowledge Practices

The perspectives of pre-service teachers on the nature of indigenous knowledge practices were assessed. They were asked to best describe their level of agreement or disagreement with the statements about the nature of indigenous knowledge on a questionnaire designed for the purpose. The results were captured in Tables I and II.

Table II illustrates the overall mean of means and standard deviations of responses obtained from pre-service teachers.

From the results, the majority (more than 200) of the respondents positively agreed with most of the statements, with ticks on the 'agree' and 'strongly agree' options. For instance, out of the 312 respondents, more than 200 (above 50%) with means and standard deviations (Table I) above or almost the same as the mean of means scores and standard deviation (3.0873 ± 0.3789) of nine of the statement went for each of these two options. The average (mean of means) score on the nature of indigenous knowledge practices index is 3.0873, with a standard deviation ±0.3789. This reflects a slightly more favourable opinion about the nature of indigenous knowledge practice than the four 'disagree' responses on the thirteen statements making up the index. This implied that most of the pre-service teachers had ideas on the nature of indigenous knowledge practices. They indicated a strong level of agreement that indigenous knowledge was applicable and functional in practical application to addressing needs and is the consequence of activities connected to everyday life in the natural environment of any group of people.

Less than 100 respondents expressed a lack of ideas on indigenous knowledge practices' nature. Those who opted for 'disagree' and 'strongly disagree' were less than 100 for each item (less than 50%) with means and standard deviations (Table I) less than the mean of means scores and standard deviation (3.0873 ± 0.3789) of four of the statements went for each of the two options. Thus, the average (means of mean) score on the nature of indigenous knowledge practice index is 3.0873 and a standard deviation ±0.3789. This reflects a slightly less favourable perception of the nature of indigenous knowledge practice than nine 'agree' responses of the thirteen statements making up the index. Most of the pre-service teachers' responses to the statements were not intensely (strongly) emphasised, as most disagreed with them (Table II). The results, therefore, gave a positive indication that the pre-service teachers were not completely ignorant about the nature of indigenous knowledge practices. However, their level of agreement with the statements was not intensely (strongly) emphasised as most of them agreed to the statement.

3.3. Pre-service Teachers' Knowledge of Indigenous Knowledge Practices and Their Integration into Classroom Learning

The pre-service teachers' knowledge of indigenous knowledge practices and their integration into classroom learning was assessed. The respondents were asked to indicate their agreement or disagreement with statements by selecting options that best described their perspectives on the subject matter. The results are shown in Tables III and IV.

Table IV illustrates the overall mean of means and standard deviations of responses obtained from pre-service teachers.

The results indicated that the pre-service teachers had a good knowledge of indigenous knowledge practices and their integration into classroom learning. Collectively, more than half of them selected the 'strongly agree' and 'agreed' options of the statements. This depicted their strong conviction that indigenous knowledge practices can be integrated into lessons and can meaningfully contribute to knowledge if used to teach in the classroom. More than 200 (more than 50%) out of the 312 respondents had responses for both 'strongly agree' and 'agree', with means and standard deviations (Table III) above or almost the same as the mean of means scores and standard deviation (3.1368 ± 0.3809) of ten of the statements went for each

TABLE I: Perceived Nature of Indigenous Knowledge Practices

Statements	Strongly agree (N/%)	Agree (N/%)	Disagree (N/%)	Strongly disagree (N/%)	Mean	Std. dev.
Indigenous knowledge comprises the beliefs, values, customs, traditions, family, culture and norms shared by members of a community or society.	138 (44.2%)	170 (54.2%)	2 (0.6%)	2 (0.6%)	3.423	0.544
Experience is acquired from indigenous knowledge practices as people grow up in all cultures.	111 (35.6%)	157 (50.3%)	41 (13.1%)	3 (1.0%)	3.205	0.696
Indigenous knowledge is situated in cultural tradition and within a certain politico-historical context.	74 (23.7%)	166 (53.2%)	55 (17.6%)	17 (5.4%)	2.952	0.794
Indigenous knowledge is the consequence of activities connected to everyday life in the natural environment of a group of people.	120 (38.5%)	152 (48.5%)	28 (9.0%)	12 (3.8%)	3.218	0.763
Indigenous knowledge is concerned with what and why things happen in nature, but also with what ought to happen.	107 (34.3%)	132 (42.3%)	61 (19.6%)	12 (3.8%)	3.070	0.830
Indigenous knowledge has withstood the test of time but is constantly changing as tradition changes.	104 (33.3%)	133 (42.2%)	62 (19.9%)	13 (4.2%)	3.051	0.836
Indigenous knowledge is a conglomeration of knowledge systems, including science, religion, psychology and other fields.	94 (30.1%)	160 (51.3%)	42 (13.1%)	16 (5.1%)	3.064	0.799
Indigenous knowledge is applicable and functional in practical application to addressing needs.	103 (33.0%)	137 (43.9%)	57 (18.3%)	15 (4.8%)	3.051	0.839
Indigenous knowledge is both resilient and tentative.	79 (25.3%)	149 (47.8%)	73 (23.4%)	11 (3.5%)	2.949	0.792
Indigenous knowledge is both empirical and metaphysical. It can be observed and tested.	87 (27.9%)	134 (42.9%)	66 (21.2%)	25 (8.0%)	2.907	0.897
Indigenous knowledge is intergenerational and differs from culture to culture.	142 (45.5%)	116 (37.2%)	39 (12.5%)	15 (4.8%)	3.234	0.848
Indigenous knowledge is transmitted vertically through generations and laterally among the people.	97 (31.1%)	144 (46.2%)	52 (16.7%)	19 (6.1%)	3.022	0.850
Indigenous knowledge can always be relied on to solve social problems.	89 (28.5%)	153 (49.0%)	47 (15.1%)	23 (7.4%)	2.987	0.856

TABLE II: Overall Mean of Means and Standard deviations of Respondents Perceived Nature of indigenous Knowledge Practices

	N	Mean	Std. deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. error	Statistic	Std. error
Overall mean	312	3.0873	0.3789	0.040	0.138	−0.369	0.275
Valid N (listwise)	312						

of the two options. The average (mean of means) score on the knowledge of indigenous knowledge practice index is 3.1368 with a standard deviation ±0.3809. This reflects a slightly more favourable opinion about the knowledge of indigenous knowledge practice than three 'disagree' responses of the thirteen statements making up the index. Collectively, more than 100 responses (less than 50%) with means and standard deviations (Table III) less than the mean of means scores and standard deviation (3.1368 ± 0.3809) of three of the statements went for each of the two

TABLE III: Perceived Knowledge of Indigenous Knowledge Practices

Statements	Strongly agree (N/%)	Agree (N/%)	Disagree (N/%)	Strongly disagree (N/%)	Mean	Std. dev.
Learners should be educated about their environment right from elementary school.	231 (74.0%)	74 (23.7%)	2 (0.6%)	5 (1.6%)	3.702	0.565
It is possible to integrate indigenous knowledge practices into the teaching and learning process.	125 (40.1%)	155 (49.7%)	29 (9.3%)	3 (1.0%)	3.288	0.671
Indigenous artefacts are resources that can be accessed from the community and used to teach in the classroom.	105 (33.7%)	162 (51.9%)	40 (12.8%)	5 (1.6%)	3.176	0.707
Indigenous knowledge practices can make a meaningful contribution to knowledge if used to teach in the classroom.	119 (38.1%)	145 (46.5%)	33 (10.6%)	15 (4.8%)	3.179	0.806
There are various methods to integrate indigenous knowledge practices into the teaching and learning process.	91 (29.2%)	177 (56.7%)	37 (11.9%)	7 (2.2%)	3.128	0.696
As a pre-service teacher, I can integrate indigenous knowledge practices into my teaching and learning activities.	106 (34.0%)	159 (51.0%)	42 (13.4%)	5 (1.6%)	3.173	0.714
It is easy for every pre-service teacher to recognise activities that are indigenous knowledge-based.	81 (26.0%)	154 (49.4%)	71 (22.8%)	6 (1.9%)	2.994	0.752
Integrating indigenous knowledge practices into the teaching and learning process can provide solutions to environmental problems.	112 (35.9%)	149 (47.8%)	39 (12.5%)	12 (3.8%)	3.157	0.784
Integration of indigenous practices into the teaching process must be done by only teachers with knowledge in that field.	85 (27.2%)	100 (32.1%)	88 (28.2%)	39 (12.5%)	2.740	0.995
Every pre-service teacher can mention at least three ways indigenous knowledge is used in local industry in their communities.	96 (30.8%)	166 (53.2%)	44 (14.1%)	6 (1.9%)	3.128	0.715
Akpeteshie distillation and *pito* brewing exemplify productive uses of indigenous knowledge.	93 (29.8%)	152 (48.7%)	44 (19.2%)	23 (7.4%)	3.010	0.858
People from the West look down on indigenous knowledge as savage knowledge.	86 (27.6%)	146 (46.8%)	60 (19.2%)	20 (6.4%)	2.955	0.851
Pre-service teachers require special training to be able to integrate indigenous knowledge practices into the teaching process.	113 (36.2%)	149 (47.8%)	33 (10.6%)	17 (5.4%)	3.147	0.816

TABLE IV: Overall Mean of Means and Standard Deviations of Respondents Perceived Knowledge of Indigenous Knowledge Practices

	N	Mean	Std. deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. error	Statistic	Std. error
Overall mean	312	3.1368	0.3809	−0.098	0.138	0.066	0.275
Valid N (listwise)	312						

options (disagree or strongly disagree). Thus, the average (mean of means) score on the knowledge of indigenous knowledge practice index is 3.1368 and the standard deviation of ±0.3809. This reflects a slightly less favourable perception of knowledge of indigenous knowledge practice than ten 'agree' responses of the thirteen statements making up the index. This indicated disagreement that only teachers must integrate indigenous practices with knowledge in that field into the teaching process. The pre-service teachers' responses to the statements were not intensely (strongly) emphasised, as most disagreed with them. Generally, most pre-service teachers indicated knowledge of indigenous knowledge practices and their integration into classroom learning. Nevertheless, the level of pre-service teachers' agreement with the statements was not intensely

(strongly) emphasised as most of them agreed to the statement.

3.4. Pre-service Teachers' Perspectives on the Objectives of Integrating Indigenous Knowledge into Science Lessons

The pre-service teachers' perspectives on the objectives of integrating indigenous knowledge into science lessons were explored. Respondents were asked to indicate their agreement or disagreement with relevant statements. Results were displayed in Tables V and VI.

Table VI illustrates the overall mean of means and standard deviations of responses obtained from pre-service teachers.

The results indicated that respondents had adequate knowledge of the objectives of integrating indigenous knowledge into science lessons. As illustrated in Table V, the responses of more than 200 (more than 50%) out of the 312 respondents with means and standard deviations (Table III) above or almost the same as the mean of means scores and standard deviation (3.2322 ± 0.3791) of fourteen of the statements went for each of the two options (agree and strongly agree). The average (mean of means) score on the objective of integrating the indigenous practice index is 3.2322, and the standard deviation is ±0.3791. This reflects a marginally more favourable perception of the objective of integrating indigenous knowledge practices than the two 'disagree' responses to the sixteen statements making up the index. The pre-service teachers indicated a high level of agreement, demonstrating that many in-home science activities could prepare learners for innovative local industrialisation. Total responses for 'strongly agree' and 'agree' recorded percentages above 50%, indicating a positive level of agreement.

On the other hand, less than 100 respondents expressed disagreement with the statement that the objective of integrating indigenous knowledge is to reinforce the fear of science in learners. Less than 50% of the responses, with means and standard deviations (Table V) less than the mean of means scores and standard deviation (3.2322 ± 0.3791) of two of the statements went for each of the two options (strongly disagree and disagree). Thus, the average (mean of means) score on the objectives of integrating indigenous knowledge practices index is 3.2322, and the standard deviation is ±0.3791. This reflects a marginally less favourable perception of the objectives of integrating indigenous knowledge practices than fourteen 'agree' responses to the 16 statements making up the index. The pre-service teachers' responses to the statements were not intensely (strongly) emphasised, as most disagreed with them. Generally, therefore, the pre-service teachers indicated that they had some knowledge of the objectives of integrating indigenous knowledge into science lessons. Nonetheless, the level of their agreement with the statements was not intensely (strongly) emphasised as most of them agreed with the statement.

3.5. Pre-service Teachers' Perspectives on the Practical Application of Integrating Indigenous Knowledge Practices into Teaching Specific Topics in General Chemistry

Pre-service teachers' perspectives on the practical application of integrating indigenous knowledge practices into teaching specific topics in General Chemistry were explored. They were asked to indicate whether or not it was applicable to use indigenous knowledge to teach topics in the General Chemistry curriculum of those colleges of education offering primary education. The results are shown in Tables VII and VIII.

Table VIII illustrates the overall mean of means and standard deviations of responses obtained from pre-service teachers.

The results show that the responses of more than 50% of the respondents, with means and standard deviations (Table VII) above or almost the same as the mean of means scores and standard deviation (1.5151 ± 0.2523) of seventeen of the topics went for the option 'applicable'. The average (mean of means) score on the topics index is 1.5151, and the standard deviation is ±0.2523. This reflects a marginally more favourable opinion about the practical application of integrating indigenous knowledge practices than the eleven 'non-applicable' responses of the twenty-eighty topics making up the index. As indicated, it was practically applicable to integrate indigenous knowledge practices into the teaching of topics in the General Chemistry curriculum. The other responses, which constituted less than 50%, indicated that it was practically impossible to integrate indigenous knowledge practices into teaching topics in the General Chemistry curriculum. Responses from the respondents, with means and standard deviations (Table VII) less than the mean of means scores and standard deviation (1.5151 ± 0.2523) of eleven topics, went for the second option, 'non-applicable'. Thus, the average (mean of means) score on the topics index is 1.5151 and the standard deviations ±0.2523. This reflects a marginally less favourable perception of the practical application of integrating indigenous knowledge practices than the seventeen 'applicable' responses of the twenty-eighty topics making up the index.

4. Discussion and Conclusion

Integrating indigenous knowledge into lessons is effective when learners' perspectives on the nature and concept of the subject matter are assessed. Learners' everyday experiences and ideas shared in class serve as a source of motivation that impacts the improvement of academic performance. It was, therefore, important to know what learners knew or needed to know about indigenous knowledge and its incorporation into classroom learning before formally introducing them to the topic. Thus, the perspectives of the pre-service teachers had to be assessed first. The assessment also confirmed (Abonyi *et al*., 2014) stance that the perspectives of learners on indigenous science are crucial since they can provide the framework for creating reality by fusing culture with cutting-edge research.

Findings from the perspectives assessment of the pre-service teachers in the study showed a high level of agreement in their responses on the Likert scale. The trend of the responses pointed to a general agreement that indigenous knowledge emerges from activities related to everyday life in the natural environment of any group of people. The findings also showed that the pre-service teachers were generally convinced about the relevance of

TABLE V: Perceived Objectives of Integrating Indigenous Knowledge Practices

Objective	Strongly agree (N/%)	Agree (N/%)	Disagree (N/%)	Strongly disagree (N/%)	Mean	Std. dev.
To enable teachers to teach from the 'known' to the 'unknown'.	227 (72.8%)	76 (24.4%)	5 (1.6%)	4 (1.3%)	3.686	0.570
To serve as the previous knowledge of learners.	150 (48.1%)	145 (46.5%)	15 (4.8%)	2 (0.6%)	3.420	0.616
To promote cultural and ecological sustainability.	143 (45.8%)	146 (46.8%)	17 (5.4%)	6 (1.9&)	3.365	0.676
To promote the practical use of knowledge in everyday life.	147 (47.1%)	133 (42.6%)	21 (6.7%)	11 (3.5%)	3.333	0.755
To promote the integration of critical thinking and cultural values into decision-making.	138 (44.2%)	153 (49.0%)	19 (6.1%)	2 (0.6%)	3.369	0.628
To help link what is learnt in school to everyday experience.	154 (49.4)	125 (40.1%)	17 (5.4%)	16 (5.1%)	3.336	0.801
To reinforce the fear of science in learners.	83 (26.6%)	120 (38.5%)	82 (26.3%)	27 (8.7%)	2.830	0.921
To create environmental awareness in teachers and learners.	131 (42.0%)	147 (47.1%)	30 (9.6%)	4 (1.3%)	3.298	0.693
To encourage improvisation and under-dependence on exotic laboratory equipment	93 (29.8%)	135 (43.3%)	67 (21.5%)	17 (5.4%)	2.974	0.856
To make learners more intelligent	115 (36.9%)	134 (42.9%)	49 (15.7%)	14 (4.5%)	3.122	0.832
To support the fact that everything we do in life has a scientific explanation	135 (43.3%)	139 (44.6%)	33 (10.6%)	5 (1.6%)	3.295	0.719
To prepare learners for innovative local industrialisation in the future.	119 (38.1%)	141 (45.2%)	36 (11.5%)	16 (5.1%)	3.163	0.823
To discourage overdependence on Western ways of learning	105 (33.7%)	127 (40.7%)	63 (20.2%)	17 (5.4%)	3.026	0.871
To demonstrate that there is a lot of science in the activities we engage in at home.	116 (37.2%)	158 (50.6%)	31 (9.9%)	7 (2.2%)	3.228	0.715
To show the inter-relationship between Western science and indigenous science	105 (33.7%)	148 (47.4%)	51 (16.3%)	8 (2.6%)	3.122	0.768
To promote a sense of self-belief in, hence self-reliance in indigenous ways of solving social problems	113 (36.2%)	149 (47.8%)	33 (10.6%)	17 (5.4%)	3.147	0.816

TABLE VI: Overall Mean of Means and Standard Deviations of Respondents' Perceived Objectives of Integrating Indigenous Knowledge Practices

	N	Mean	Std. deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. error	Statistic	Std. error
Overall mean	312	3.2322	0.3791	−0.245	0.138	0.076	0.275
Valid N (listwise)	312						

indigenous knowledge practices and the possibility of integrating them into pedagogy to meaningfully contribute to effective teaching and learning, particularly in General Chemistry lessons. They also suggested that indigenous knowledge could be relied on to provide practical solutions to problems. Results from the assessed perspectives of the pre-service teachers thus corroborated Goma *et al.*'s (2016) report on how indigenous knowledge systems were relied on for the treatment of hypertension, a health problem in Lusaka, Zambia.

According to Kozulin *et al.* (2003), a learner's development is contingent on the interaction between their maturation and the system of symbolic tools and activities they engage in within their sociocultural environment. In other words, the learner's learning and development are mediated indirectly by their environment. Results from the perspective assessment suggest that the pre-service teachers were convinced that indigenous knowledge practices could boost learners' confidence and assertiveness to relate more with what goes on in their environment if well integrated into classroom teaching and learning. The pre-service teachers also thought that it could enhance teachers' ability to address learners' diverse experiences by

TABLE VII: Perceived Practical Application of Integrating Indigenous Knowledge Practices

Sub-unit	Applicable	Not applicable	Mean	Std. dev.
1. Features of the atom	211 (67.6)	101 (32.4)	1.676	0.469
2. Arrangement of electrons in the main energy levels	160 (51.3)	152 (48.7)	1.487	0.501
3. Atomic number, mass number, isotopes and atomic mass	178 (57.1)	134 (42.9)	1.570	0.496
4. Ionic bonds	178 (57.1)	134 (42.9)	1.570	0.496
5. Covalent bonds	172 (55.1)	140 (44.9)	1.551	0.498
6. Molecular and formula mass	146 (46.8)	166 (53.2)	1.468	0.500
7. The Avogadro constant	137 (43.7	175 (56.1)	1.439	0.497
8. The mole	147 (47.1)	165 (52.9)	1.471	0.500
9. Moles in solution	162 (51.9)	150 (48.1)	1.519	0.500
10. Percentage composition of substances	162 (51.9)	150 (48.1)	1.519	0.500
11. Empirical formula	136 (43.6)	176 (56.4)	1.436	0.497
12. Determination of the formulae for hydrates	146 (46.8)	166 (53.2)	1.468	0.500
13. Chemical symbols and formula	164 (52.6)	148 (47.4)	1.526	0.500
14. Cations, anions, radicals, valency	149 (47.8)	163 (53.2)	1.478	0.500
15. Writing chemical formula	149 (47.8)	163 (53.2)	1.478	0.500
16. Chemical equation 17. Balancing equations 18. Chemical reactions	169 (54.2)	143 (54.8)	1.542	0.499
19. Pure and impure substances	166 (53.2)	146 (46.8)	1.532	0.500
20. Methods of purification of impure substances	166 (53.2)	146 (46.8)	1.532	0.500
21. Importance of purification of impure substances	188 (60.3)	124 (39.7)	1.603	0.490
22. Definition of acids and bases	172 (55.1)	140 (44.9)	1.551	0.498
23. Physical and chemical properties of acids and bases	161(51.6)	151 (48.4)	1.516	0.501
24. Acids, bases and salts as electrolytes	162 (51.9)	150 (48.1)	1.519	0.500
25. P^h scale	152 (48.7)	160 (51.3)	1.487	0.501
26. Weak acids and weak bases	157 (50.3)	155 (49.7)	1.503	0.501
27. Classification and nomenclature of alkanes, alkenes, and alkynes	146 (46.8)	166 (53.2)	1.468	0.500
28. Sources/preparation of alkanes, alkenes, and alkynes	164 (52.6)	148 (47.4)	1.526	0.500
29. Isomerism	146 (46.8)	166 (53.2)	1.468	0.500
30. Alkanols and alkanoic acids	162 (51.9)	150 (48.1)	1.519	0.500

TABLE VIII: Overall Mean of Means and Standard Deviations of Respondents Perceived Practical Application of Integrating Indigenous Knowledge Practices

	N	Mean	Std. deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. error	Statistic	Std. error
Overall mean	312	1.5151	0.2523	0.183	0.138	−0.380	0.275
Valid N (listwise)	312						

relating curriculum content to what is happening in the environment.

The most important part of teaching and learning is the setting of objectives that are measurable and achievable. The objectives of every lesson must have a bearing on the content to be taught. Byrd (2016) has argued that for pedagogy to be culturally relevant and responsive, it must appeal to learners' identities and values within the local contexts to create a respectful and inclusive classroom climate. One key objective of integrating indigenous knowledge into science lessons is to enable teachers to teach from the 'known' to the 'unknown'. It also helps link what is learnt in school to everyday experiences, promoting a sense of self-belief and self-reliance in indigenous ways of solving social problems. Indigenous knowledge practices and traditions can enhance science teaching and learning by using examples pertinent to the learners. The pre-service teachers agreed there were a lot of in-home science activities that could prepare learners for innovative local industrialisation in the future. Appropriate objectives need to be set to promote the integration of critical thinking and cultural values into decision-making. The teacher must set objectives that allow learners to expand on their existing knowledge and skills, and they should gradually withdraw support as learners become more adept at performing the activity.

Overall, the results from the assessment of the pre-service teachers' perspectives seemed conclusive about how important indigenous knowledge practices are in support of the daily lives of people of different cultures. The results appear to have made an advocative statement for the proper integration of indigenous knowledge practices into the curriculum to make the practices relevant in modern society and motivate learners to apply indigenous ways of thinking to solve societal problems. This corroborates well with the views expressed by Govender and Mutendera (2020), Mudaly (2018), and Abonyi *et al*. (2014).

Most of the pre-service teachers believed that indigenous knowledge emerges from activities related to everyday life in the natural environment of any group of people. They were also conscious of and affirmed the relevance of indigenous knowledge practices and the possibility of integrating them into pedagogy to meaningfully contribute to effective teaching and learning, particularly in General Chemistry lessons. The majority of the pre-service teachers agreed that one key objective of integrating indigenous knowledge into science lessons is that it enables teachers to teach from the 'known' to the 'unknown'. Doing so especially helps to relate what is learnt in school to everyday experiences. It promotes a sense of self-belief and self-reliance in indigenous ways of solving social problems.

Conclusively, the pre-service teachers largely registered their approval about the appropriateness of integrating indigenous knowledge practices into lessons to impact lesson delivery meaningfully. This approval also meant the pre-service teachers had indicated their commitment to integrating indigenous knowledge practices into their lessons. For such integration processes to be effective or productive, it is recommended that science teachers should always precede their lessons by assessing learners' perspectives on indigenous knowledge practices on particular topics to ascertain what they already know or ought to know about the topics before proceeding to conduct lessons on them. This will enable the teachers to build on what the learners already know.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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