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From Culture to Scientific Literacy: Cultural Integration Beliefs in Science Classroom Teaching

Aizzle Knett R. Rellora[1], Delaine P. Ted[2], Rosalie G. Lustre[3], Aiza A. Bodoque[4], Benedict E. Navarrete[5], Alliah O. Abogado[6], Archie A. Perpetua[7]

[1,2,3,4,5,6]College of Education, Central Bicol State University of Agriculture, Sipocot, Philippines, [7]College of Education, Central Bicol State University of Agriculture, Sipocot, Philippines.

Abstract

In today's multicultural educational landscape, integrating cultural beliefs into science education was recognized as vital for fostering scientific literacy that is both inclusive and meaningful. This study examines the integration of cultural beliefs in science education among Bachelor of Secondary Education major in science students at Central Bicol State University of Agriculture-Sipocot. Using a descriptive survey with a structured questionnaire (N=40), it explores students' cultural beliefs, the extent of cultural integration in instruction, and related challenges. Findings indicate a neutral impact of cultural identity on science perspectives (mean = 3.37), with stronger agreement on the role of upbringing in trust in scientific institutions (mean = 3.66) and linking science learning to cultural identity (mean = 3.56). While students perceive cultural integration positively (mean = 3.76), the representation of non-Western scientific contributions remains limited. Additionally, cultural challenges in science learning are viewed neutrally (mean = 2.94). These results underscore the need for more inclusive science education that acknowledges cultural identity and enhances engagement.

Keywords: Cultural beliefs, Scientific Literacy, Inclusive Teaching, Student Engagement, Cultural Relevance

1. Introduction

In the dynamic landscape of education, the connection of cultural and scientific knowledge has progressed to be an area of exploration, particularly integrating and promoting scientific literacy to students with different backgrounds. Scientific knowledge, while grounded on facts and evidence, is shaped by historical, cultural, and societal influences [1]. This interconnection highlights the value of integrating cultural beliefs into science education to promote more inclusive and contextually relevant learning experiences, aligned with scientific study and knowledge, and cultural background. Recognizing that science is a social endeavor rooted in human experiences allows educators to appreciate how various cultural groups have contributed to scientific development across time, from traditional ecological knowledge to modern innovations [2]. Science, therefore, must not be perceived as a detached or purely objective discipline but as one that reflects values, perspectives, and traditions of different communities.

Science classrooms today are multicultural spaces where students bring in diverse cultural perspectives, values, and worldviews due to the differences in their backgrounds. Incorporating these perspectives into science instruction not only promotes equity but also enhances the engagement of students and their comprehension [3]. Research suggests that culturally relevant pedagogy supports students' academic success by connecting learning content with their cultural values and beliefs [4]. Students' prior experiences are central to how they construct new knowledge [5]. When these experiences are acknowledged and integrated, students are more likely to find science relatable and engaging. Furthermore, studies show that cultural congruence between home and school can improve students' cognitive outcomes, especially in conceptual understanding and inquiry skills [6]. This includes adapting instructional methods, classroom discourse, and science examples to better align with students' identities. However, the integration of cultural studies in science teaching remains limited in practice, as many educators lack the resources to effectively incorporate cultural understanding with scientific content [1]. One major challenge is the dominance of Western scientific paradigms in national curricula, which often position indigenous or local knowledge systems as inferior or unscientific [7]. This contributes to a science culture in schools that alienates students whose ways of knowing and understanding nature differ from mainstream norms. In addition, many science teachers report feeling underprepared to address cultural diversity in their classrooms, often due to a lack of professional development, institutional support, or exposure to multicultural education frameworks [8]. Addressing this requires systemic changes, including reforms in teacher education programs, textbook content, and assessment tools.

This study seeks to examine three key areas: the prevalent cultural beliefs that students bring into science classrooms, the extent of integration of cultural studies in science teaching, and the challenges students face in learning science through a cultural lens. Investigating these dimensions is crucial in developing culturally responsive science instruction that not only respects diversity but also contributes to deeper scientific literacy and knowledge [9]. It is also vital for addressing broader issues such as the underrepresentation of minority groups in STEM fields, which can be traced back to early school experiences that fail to validate their cultural perspectives [10]. By focusing on how cultural beliefs intersect with science learning, this study also contributes to global efforts to decolonize education and promote epistemic justice.

As education systems progressively aim to prepare students for participation in a global and scientifically informed society, acknowledging and integrating cultural perspectives into science education is both a challenge and a necessity. Bridging the gap between scientific literacy and cultural perspectives can pave the way for a stronger and relatable context, which will make education practices meaningful and relatable. Science educators have a responsibility to prepare teachers who not only possess strong content knowledge and effective pedagogical skills but also demonstrate cultural responsiveness that addresses the diverse needs of today's classrooms. This preparation must integrate content expertise, pedagogy, and social context rather than treat them as separate elements, ensuring teachers are equipped to create inclusive and meaningful learning experiences [11]. Culturally responsive teaching fosters an educational environment where students are empowered to contribute their voices, make connections between school knowledge and real-world challenges, and view science as a tool for community transformation and informed citizenship. This research aims to identify the prevalent cultural beliefs among science students, investigate the extent of integration of cultural studies in Science education, and identify the challenges met by the students in learning Science in the context of cultural studies.

2. Methodology

This study employs a descriptive survey research design to investigate the integration of cultural beliefs in science classroom teaching and its impact on students' scientific literacy. The study aims to gather quantitative data from students to identify prevalent cultural beliefs, measure the extent to which cultural content is integrated into science instruction, and explore the challenges students face in learning science within a cultural context. The target respondents are BSED Science students from 1st to 3rd year of CBSUA Sipocot, chosen through stratified random sampling to ensure balanced representation across grade levels. A structured questionnaire will serve as the main research instrument. The questionnaire includes 10 indicators aligned with the study's objectives and uses a 5-point Likert scale (ranging from "Strongly Disagree" to "Strongly Agree") to capture the students' perceptions and experiences. A Likert scale is utilized to measure the intensity of the participants' views and responses to each indicator and provide balanced scales that accommodate neutral positions. Before data collection, the instrument will undergo expert validation by professionals in education and science pedagogy to ensure reliability and clarity. Data will be collected with the permission of the school administration, and the survey will be administered during regular class hours. Participants will be informed of the study's purpose, and their consent will be obtained. To ensure ethical standards, all responses will remain anonymous and confidential, and students may opt out of the study at any point without any academic consequence. The collected data will be analyzed using descriptive statistical tools, including mean scores, percentages, and frequency counts, to interpret trends and common responses. Additionally, cross-tabulations may be utilized to compare responses across year levels or identify patterns. If open-ended responses are collected, thematic analysis will be applied to categorize and interpret qualitative insights. This methodological approach will provide a comprehensive understanding of how cultural perspectives intersect with science education in the classroom setting.

3. Results

This section outlines the findings of the study conducted among the BSED Science students, concerned about their prevalent cultural beliefs, extent of integration of cultural studies in science teaching, and challenges met by students in learning science in the context of cultural studies.

Table 1. Mean of responses about prevalent cultural beliefs

Indicators	Mean	Interpretation	Rank
1. My cultural values influence how I interpret scientific theories.	3.32	NEUTRAL	6
2. My upbringing shapes my trust in scientific institutions.	3.66	AGREE	1
3. I feel science education often overlooks non-Western knowledge systems.	3.10	NEUTRAL	10
4. My cultural identity impacts my confidence in learning science.	3.37	NEUTRAL	4.5
5. I believe traditional cultural practices align with scientific principles.	3.29	NEUTRAL	7.5
6. My cultural background affects how I engage with science coursework.	3.15	NEUTRAL	9

7. I perceive science as a culturally neutral field.	3.37	NEUTRAL	4.5
8. My community's beliefs shape my attitudes toward science careers.	3.29	NEUTRAL	7.5
9. I connect science learning to my cultural identity.	3.56	AGREE	2
10. My cultural heritage informs how I approach scientific problem-solving.	3.54	AGREE	3
OVERALL MEAN	**3.37**	**NEUTRAL**	

Legend:

1.00 – 1.80	Strongly Disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Neutral
3.41 – 4.20	Agree
4.21 – 5.00	Strongly Agree

The data revealed that cultural identity has a neutral influence on learners' perspectives on science, as indicated by the overall mean score of 3.37. As presented in table 1, the highest-rated statement, "My upbringing shapes my trust in scientific institutions" (WM = 3.66, rank 1), shows that the respondents' societal environments have a positive influence on their attitude toward science, followed by "I connect science learning to my cultural identity" (WM = 3.56), and next is "My cultural heritage informs how I approach scientific problem-solving" (WM = 3.54). These responses show that students are not only aware of their cultural lens, but they also use it productively in learning science. Most of the indicators fall under Neutral, such as "My cultural background affects how I engage with science coursework" (WM = 3.15, rank 9), and "I feel science education often overlooks non-Western knowledge systems" (WM = 3.10, rank 10), showing that students neither strongly agree nor disagree with these experiences, but are clearly not distinguished enough to be classified whether they agree with it or not.

Table 2. Mean of responses about the extent of integration of cultural studies in science teaching

Indicators	Mean	Interpretation	Rank
1. My science courses include examples from non-Western scientists.	3.39	NEUTRAL	10
2. Instructors use culturally relevant analogies to explain concepts.	3.71	AGREE	8
3. The curriculum acknowledges indigenous contributions to science.	3.76	AGREE	6.5
4. Textbooks reflect diverse cultural perspectives.	3.80	AGREE	5
5. Science projects encourage exploration of cultural contexts.	3.88	AGREE	3
6. Cultural diversity is discussed in relation to ethical issues in science.	3.90	AGREE	2

7. Guest speakers from diverse backgrounds are invited to science classes.	3.54	AGREE	9
8. Assignments allow me to connect science to my cultural experiences.	3.76	AGREE	6.5
9. Case studies include culturally diverse applications of science.	4.05	AGREE	1
10. Instructors address cultural biases in scientific research methods.	3.85	AGREE	4
OVERALL MEAN	**3.76**	**AGREE**	

Legend:

1.00 – 1.80	Strongly Disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Neutral
3.41 – 4.20	Agree
4.21 – 5.00	Strongly Agree

Meanwhile, the results of the second objective indicate a generally positive perception of cultural inclusivity in science education among the respondents, as reflected by an overall mean score of 3.76 in Table 2. This suggests that most indicators were rated as "Agree," with only one indicator receiving a "Neutral" rating. The statement “Case studies include culturally diverse applications of science” ranked the highest (WM = 4.05), demonstrating strong agreement that science education incorporates real-world examples from diverse cultural backgrounds. Meanwhile, “My science courses include examples from non-Western scientists” received the lowest mean score (WM = 3.39), which falls into the Neutral interpretation, pointing out that while cultural diversity is generally addressed, there is a significant gap in representation of non-Western scientific contributions.

Table 3. Mean of responses about the challenges met by students in learning science in the context of cultural studies

Indicators	Mean	Interpretation	Rank
I struggle with science terminology that conflicts with my native language.	3.12	NEUTRAL	4
My cultural values sometimes clash with scientific ethics discussions.	3.37	NEUTRAL	2
I find it hard to relate to science examples from unfamiliar cultures.	3.20	NEUTRAL	3
Teaching styles in science courses don’t align with my cultural learning preferences.	2.61	NEUTRAL	8
I avoid participating in class due to cultural differences in communication norms.	2.27	DISAGREE	10

Science assessments overlook culturally diverse problem-solving approaches.	3.05	NEUTRAL	5
I feel excluded when science topics ignore my cultural heritage.	2.56	DISAGREE	9
Lab group dynamics sometimes reflect cultural misunderstandings.	2.85	NEUTRAL	6
I wish instructors addressed cultural stereotypes in science history.	3.56	AGREE	1
My cultural background limits my access to science mentorship opportunities.	2.83	NEUTRAL	7
OVERALL MEAN	**2.94**	**NEUTRAL**	

Legend:

1.00 – 1.80	Strongly Disagree
1.81 – 2.60	Disagree
2.61 – 3.40	Neutral
3.41 – 4.20	Agree
4.21 – 5.00	Strongly Agree

The findings reflect learners' perceptions of how cultural challenges impact their science learning experiences, with an overall mean of 2.94. This score falls within the "Neutral" interpretation range, indicating a balanced viewpoint. Most indicators were rated as "Neutral," while two were classified under "Disagree" and one under "Agree," suggesting varied responses but an overall moderate perception of cultural challenges in science learning. The indicator rated highest was "I wish instructors addressed cultural stereotypes in science history" with a weighted mean of 3.56, indicates a desire for more culturally responsive teaching and acknowledgement of stereotypes in the historical development of science, followed by "My cultural values sometimes clash with scientific ethics discussions" with a weighted mean of 3.37. However, the indicator "I avoid participating in class due to cultural differences in communication norms" rated the lowest, with a weighted mean of 2.27, which is indicated as "Disagree", showing the innate motivation to participate in class discussions that students have regardless of their diverse cultural background. The results reveal that deeper cultural integration is still needed in science instruction.

4. Discussion

This study examined how cultural identity, cultural integration and inclusivity, and perceived challenges affect BSED Science students' engagement with science education. The results reveal both the strengths and gaps in how students experience science learning through a cultural lens.

The cultural beliefs, reveal that while students may not be fully immersed in culturally influenced scientific thinking, they are aware of their cultural lens and use it constructively in their learning. This aligns with the claim that cultural identity serves as a central factor in promoting the persistence of indigenous and marginalized students in science fields [12]. Their study illustrated how students who feel their identities are validated in educational spaces are more likely to remain engaged and confident in science learning. In contrast, neutral responses may also indicate a lack of explicit cultural integration in the science curriculum, which limits students' ability to fully recognize the impact of their backgrounds, suggesting

that while students may be conscious of cultural dynamics, these are not consistently strong enough to shape or challenge their learning experiences. This supports the claim that cultural contexts shape students' understanding of science, but does not assert that culture either positively or negatively affects science learning [13]. These neutral responses may also indicate a lack of explicit cultural integration in the science curriculum, which limits students' ability to fully recognize the impact of their backgrounds.

In terms of students' perception of cultural inclusivity in science education, the results showed a generally positive outlook—students positively perceive science education as incorporating real-world examples from a variety of cultural contexts, supporting the position of advocating for culturally relevant and sustaining pedagogies in science [14]. Their study found that when science instruction reflects students' cultural backgrounds and real-life experiences, it increases engagement and establishes a stronger sense of belonging in the classroom. However, the inclusion of examples from non non-Western scientists is low, reflecting a persisting gap in representation. This concern is addressed by calling for a more integrative teaching approach in science, where contributions from non-Western scientists and knowledge systems are actively incorporated into the curriculum [11]. Such practices can correct the imbalance in scientific narratives that often privilege Western perspectives and help students see science as a more inclusive and global endeavor.

As for the perceived cultural challenges in science learning, which also received an overall neutral mean, students showed varying levels of agreement, with most indicators falling in the neutral range, suggesting a balanced but not strongly felt impact. The students' wish to address cultural stereotypes in science history reflects a desire for more culturally responsive science instruction. This need is echoed by Marosi et al. (2021), who argued that science education often reinforces dominant cultural narratives and overlooks diverse worldviews, thus marginalizing students whose cultural identities do not align with the mainstream [15]. When these stereotypes go unaddressed, students may feel disconnected from scientific histories and discourses. Similarly, the statement the students' perspective about their cultural beliefs sometimes clashing with scientific ethics discussions indicates that while not widespread, some students experience tension between cultural beliefs and scientific norms. Nevertheless, the lowest-rated item—"I avoid participating in class due to cultural differences in communication norms"—suggests that cultural barriers do not significantly deter students from engaging in classroom discussions. This aligns with the claim that culturally responsive teaching practices can mitigate communication-based cultural challenges and help foster more inclusive and active participation in science classes [16].

Overall, these findings suggest that while students are becoming more aware of the cultural dimensions of science education, there remains a need to fully embed cultural responsiveness in instruction. Cultural identity moderately shapes students' science engagement, and students appreciate culturally inclusive examples in their curriculum. However, they also recognize the absence of representation from non-Western scientists and express a desire for teaching practices that address stereotypes and validate diverse perspectives.

5. Conclusion

Students expressed varied perspectives on the influence of culture in their science learning experiences. While there is a general consensus that cultural backgrounds contribute positively to their engagement with scientific concepts, there remains a significant need for more inclusive educational practices. Specifically, curriculum design, instructional approaches, and assessment methods should be further adapted to effectively accommodate cultural diversity within science education.

While learners demonstrate an awareness of their cultural identity and its relevance to science, the integration of culture into science learning remains moderate. The neutral mean scores from the first and third sets of data suggest that students recognize cultural influences in their engagement with science but do not experience them deeply or consistently enough to classify them as strong or decisive. However, the second table reveals a more positive outlook toward cultural inclusivity in science education, especially in the presence of diverse case studies and real-world applications, although the underrepresentation of non-Western scientists still marks a significant gap. These results highlight a nuanced relationship between culture and science learning: students neither fully embrace nor reject the influence of their cultural backgrounds, suggesting a balanced but underutilized potential for culturally responsive teaching. The data aligns with recent studies [17, 18] emphasize that science education becomes more engaging and meaningful when students' cultural contexts are acknowledged and integrated into the curriculum. Therefore, it is recommended that science educators incorporate culturally relevant pedagogical approaches and diversify the representation of scientific contributors to bridge the disconnect between learners' cultural identities and academic content. Doing so may not only improve engagement but also foster critical thinking, inclusivity, and a more comprehensive understanding of science. Future research could further explore how specific cultural elements—such as language, belief systems, and traditional knowledge—interact with science instruction, ideally contributing to more equitable and culturally responsive educational practices.

Based on the results, improving inclusivity in science education by integrating diverse perspectives, employing culturally relevant teaching, and refining assessments will be some of the ways to bridge the gap between cultural beliefs and science learning. This involves recognizing non-Western contributions, using appropriate examples, and designing assignments that reflect students' backgrounds. Instructors should address biases, create an inclusive environment, expand mentorship opportunities, and adjust assessments to support diverse problem-solving approaches, ensuring a more equitable learning experience.

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