# CULTURALLY SUSTAINING PEDAGOGY IN SCIENCE CLASSROOM: A PHENOMENOLOGICAL STUDY OF INDIGENOUS EDUCATION IN BATAAN
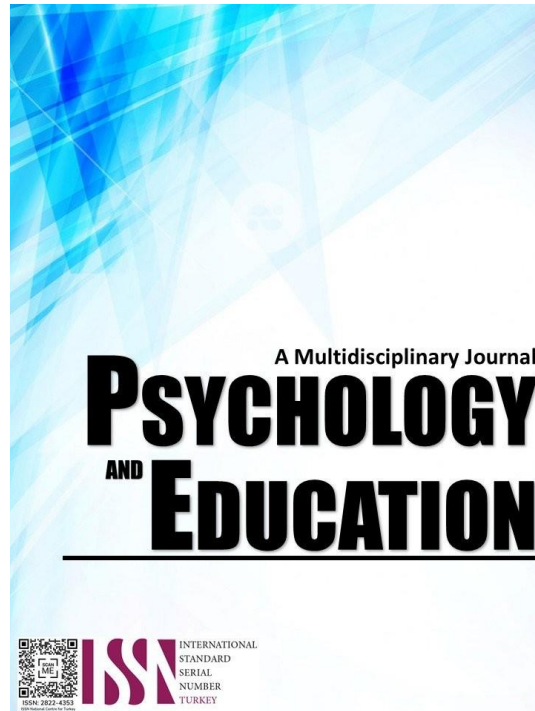
# Culturally Sustaining Pedagogy in Science Classroom: A Phenomenological Study of Indigenous Education in Bataan

Diana Rose M. Gimpaya,* Lucky Sonny A. Ligsanan
For affiliations and correspondence, see the last page.

## Abstract

The increasing enrollment of Indigenous Peoples learners nationwide and in local areas like Dinalupihan reflects a growing trend of IP participation in formal education, underscoring the need for culturally responsive and sustaining teaching practices. This qualitative study explored the lived experiences of science teachers in Bataan, Philippines, who implement culturally sustaining pedagogy (CSP) in classrooms with Indigenous learners. Amid the Department of Education's push for inclusive education, this research addressed the need to contextualize science instruction through cultural relevance and Indigenous knowledge systems. The study aimed to understand how teachers navigate pedagogical practices, cultural integration, and institutional challenges while fostering inclusive and responsive science education. Using a phenomenological approach, the study engaged ten high school science teachers from various Indigenous Peoples Education (IPED) schools in Bataan. Data were collected through semi-structured interviews and document analysis. Participants were purposively selected based on their experience with CSP and involvement in teaching Indigenous learners. Thematic analysis revealed twelve key themes, including integrating Indigenous knowledge into science content, adapting learning materials to cultural contexts, employing constructivist and inquiry-based approaches, using multimedia tools, and leveraging environmental resources. Findings highlighted that culturally sustaining practices foster student engagement, affirm cultural identity, and enhance the relevance of science education. However, teachers also faced notable challenges such as language barriers, limited teaching resources, and insufficient cultural training. The study proposed the I-CARE (Integrating Cultural Awareness and Responsive Education) training plan to support teachers in delivering inclusive and culturally grounded science instruction. This study contributes to the discourse on equity in education by emphasizing the value of embedding cultural knowledge in science pedagogy. It underscores the importance of systemic support, community engagement, and professional development to sustain inclusive practices in diverse classrooms.

**Keywords:** *culturally sustaining pedagogy, indigenous education, science teaching, inclusive education*

## Introduction

As of 2021, the Department of Education (DepEd) serves approximately 2.529 million Indigenous Peoples (IP) learners across 42,176 public schools throughout the Philippines, marking the first decade of the Indigenous Peoples Education (IPEd) Program, as reported by the Indigenous Peoples Education Office (IPsEO). This initiative was institutionalized through DepEd Order No. 62, s. 2011, known as the National Indigenous Peoples Education Policy Framework. Developed in collaboration with IP leaders and elders, the framework adopts a rights-based approach. It mandates implementing an education system responsive to the unique cultural and social contexts of IP learners.

According to the 2015 Census by the Philippine Statistics Authority, the province of Bataan has a population of 760,650, with Tagalog, Kapampangan, and Aeta as its three major ethnolinguistic groups. In the municipality of Dinalupihan, IP students are enrolled in various schools, contributing to the area's rich cultural diversity. Notable figures include 21 IP students at Payangan Integrated School, 15 at Magsaysay National High School, 11 at Sta. Lucia High School, 9 at Tubo-Tubo Integrated School, and 4 at Jose C. Payumo Jr. Memorial High School.

Given the growing number of IP learners and their continued pursuit of formal education, educators need to adopt culturally relevant practices in the classroom. Culturally sustaining pedagogy (CSP) has gained scholarly attention in this context. CSP encourages educators to support learners in maintaining their communities' cultural and linguistic identities while also providing them access to broader cultural competencies (Paris, 2021).

Studies show that integrating CSP into science education enhances student engagement, academic performance, and inclusivity (Smith, Avraamidou, & Adams, 2022; Oatman, 2020). CSP views students' cultural and linguistic backgrounds as assets rather than deficits (Kidwell & Pentón Herrera, 2020). Despite these benefits, applying culturally relevant pedagogies in science classrooms in the Philippines remains underexplored. There is a notable gap in understanding how such approaches can be effectively embedded into the science curriculum to foster a multicultural and inclusive educational framework.

This study explores the lived experiences of science teachers in Bataan who utilize culturally sustaining pedagogy in their instruction. Through in-depth qualitative analysis, the research seeks to illuminate current practices, identify challenges and strengths, and propose a context-sensitive training framework grounded in emerging themes. This work also aligns with DepEd's advocacy for inclusive education and contributes to the broader discourse on improving IP education in the country.

The study is anchored on three theoretical frameworks: Culturally Sustaining Pedagogy (Paris, 2021), Multicultural Education (Banks, 1993), and the Funds of Knowledge Approach (González, Moll, & Amanti, 2005). Paris (2021) underscores the importance of reorienting pedagogical practices to validate and incorporate students' cultural identities, arguing that conventional methods risk marginalizing learners when their cultural knowledge is not recognized in school settings.

Similarly, Banks' (1993) theory of Multicultural Education advocates for a curriculum that reflects the diverse cultural backgrounds of students and promotes equity and social justice. It stresses the need for inclusive content that enhances student engagement and fosters cross-cultural understanding.

The Funds of Knowledge framework further emphasizes the value of students' home and community knowledge in educational contexts. According to González et al. (2005), leveraging this cultural wealth can enhance instructional relevance, deepen comprehension, and empower learners by validating their lived experiences.

This study draws from a range of local and international literature that investigates multicultural and culturally sustaining pedagogies. Hanesworth, Bracken, and Elkington (2020) proposed a typology combining Universal Design for Learning (UDL) with CSP to promote inclusive assessments. Cabrera, Downey, and Smith (2022) critically examined the intersections of Whiteness and CSP, while Wang, Thomas, and Cahill (2022) demonstrated how culturally relevant story time activities in Texas supported community-based learning.

In higher education, Grier-Reed and Williams-Wengerd (2020) advocated for integrating CSP, UDL, and constructivism to support inclusive classrooms. Park and Paulick (2021) explored the use of home visits to create inclusive learning environments rooted in students' cultural realities. Karacabey, Ozdere, and Bozkus (2020) emphasized the importance of teachers' attitudes in implementing multicultural education effectively.

Other studies, such as those by Berté and Martins (2020), Chen, Lord, and Hoople (2021), and Kotluk and Aydin (2021), delve into the challenges educators face when implementing culturally sustaining practices, particularly in diverse and multicultural contexts. These insights reveal practical barriers and advocate for responsive, context-specific pedagogical adjustments.

In the Philippine context, Cornelio and de Castro (2020) critically examined IP education, highlighting systemic challenges and advocating for more inclusive and culturally respectful educational strategies. The ongoing relevance of DepEd Order No. 62, s. 2011 underscores the necessity of aligning science instruction with Indigenous learners' cultural knowledge and perspectives.

Ultimately, this study contributes to a growing body of work advocating for equity in education by emphasizing the role of culturally sustaining pedagogy in science teaching. By documenting the experiences of science educators in Bataan, it aims to offer practical insights and policy-relevant recommendations that can strengthen IP education and foster a more inclusive learning environment in Philippine schools.

**Research Questions**

This study explored integrating culturally sustaining pedagogy (CSP) into science education to develop a training plan that to support teachers' needs and preferences in applying culturally sustaining pedagogy in science classrooms. Specifically, it aimed to address the following:

1. What are the practices of the participants that exhibit culturally supportive pedagogy in their science classrooms?
2. What are the challenges experienced by the participants in integrating culturally sustaining pedagogy in teaching science?
3. What are the contributions of integrating culturally sustaining pedagogy in science education?
4. What training plan can be proposed to support teachers' needs and preferences in applying culturally sustaining pedagogy in science classroom?

# Methodology

### Research Design

This study employed a qualitative, phenomenological research design (Vagle, 2014; Van Manen, 1997) to explore how science teachers understand and implement Culturally Sustaining Pedagogy (CSP) in their classrooms. Phenomenology was chosen for its ability to deeply investigate teachers' personal and subjective experiences, capturing the nuances and complexities of their pedagogical practices and interactions with students and curricula. This approach provides rich, detailed insights into how teachers interpret their roles and construct meaning around culturally responsive teaching. It also allows exploration of emotional and cognitive aspects of teaching, particularly in culturally diverse settings, where teachers' perceptions are shaped by cultural, contextual, and institutional influences (Cridland et al., 2014; Meadan, Stoner & Angel, 2010). Through this lens, the study identified key themes related to the lived experiences of science teachers applying CSP in Indigenous Peoples Education (IPED) settings.

### Participants

The study was conducted in the Schools Division of Bataan and involved 10 high school science teachers. Participants were selected

through purposive sampling, with nominations provided by the Education Program Supervisor for the Indigenous Peoples Education Program (IPED). Eligible participants taught classes that included Indigenous Peoples (IP) students and demonstrated active integration of CSP in their instructional practices.

To ensure suitability, participants underwent a screening interview to confirm their understanding and application of CSP in science education. Participation criteria included teaching in IPED-recognized schools approved by the Department of Education (DepEd), willingness to participate in interviews, and ability to provide teaching materials or documentation that reflect CSP integration. This ensured the inclusion of educators with relevant experience and insight into the phenomenon under study.

Table 1. *Distribution of the Participants of the Study*

| IPED School | District | No. of Participants |
|---|---|---|
| Bangkal Resettlement Elementary School | Abucay | 2 |
| Tubo-Tubo Integrated School | Dinalupihan West | 2 |
| Aeta Integrated School | Mariveles | 2 |
| Kanawan Integrated School | Morong | 2 |
| Pastolan Integrated School | Hermosa | 2 |
| Total | | 10 |

**Research Instrument**

The primary data collection tool was a semi-structured interview guide to explore participants' experiences, challenges, and strategies in implementing CSP in science classrooms. Semi-structured interviews allowed for flexibility while maintaining focus on key research questions (Seidman, 2006).

Interview questions were informed by existing literature on CSP and science education and aimed to elicit in-depth insights on teaching practices and culturally responsive strategies. A pilot test was conducted with a small group of educators to evaluate the clarity and relevance of the questions. Revisions were made accordingly to ensure alignment with the study's goals.

Interviews were conducted in person at a time and location convenient to the participants. Each session was audio-recorded with consent. To ensure the depth and adequacy of the data, interviews continued until thematic saturation was achieved—that is, when no new themes or insights emerged from subsequent interviews (Guest, Bunce, & Johnson, 2006).

Additionally, participants were asked to provide instructional materials and documents that demonstrated the use of CSP in their science classes. These artifacts were used to triangulate and contextualize interview data.

**Procedure**

The data collection process followed several structured steps to ensure a comprehensive and credible exploration of science teachers' experiences with culturally sustaining pedagogy (CSP). First, the recruitment and selection phase began with the researcher securing formal approval from the Schools Division Office of Bataan. With the assistance of the Education Program Supervisor for Indigenous Peoples Education (IPED), a list of prospective participants was compiled. These teachers underwent initial phone screenings to ensure they met the criteria aligned with the study's objectives. Next, in the consent and orientation stage, participants were provided with informed consent forms outlining the study's purpose, procedures, and their rights as participants. Those who agreed to participate were oriented in person, and interview schedules were arranged according to their availability and convenience.

During the interview phase, semi-structured interviews were conducted on-site to allow for flexibility while clearly focusing on the research questions. With participants' consent, interviews were audio-recorded and centered on their lived experiences with CSP—exploring instructional strategies, challenges faced, and recommendations for improving culturally responsive science education. In addition to interviews, supplementary data was collected by asking participants to share teaching-related documents that reflected CSP practices. These materials, such as lesson plans and activity sheets, were analyzed to provide contextual depth and support the themes emerging from the interviews.

**Data Analysis**

The study utilized thematic analysis to systematically identify recurring patterns and themes within the data, following the six-phase framework outlined by Braun and Clarke (2021). The process began with familiarization, during which interview transcripts were read multiple times to immerse the researcher in the data and develop a holistic understanding of participants' experiences. In the initial coding phase, key concepts and recurring ideas were identified and labeled with codes derived inductively from the data and deductively from the research objectives. These initial codes were then organized during the theme development stage, wherein related codes were clustered into broader themes that reflected shared experiences and insights among participants.

Next, in the theme review phase, each theme was examined for internal coherence and alignment with the entire dataset. This step ensured that the themes were distinct and representative of the participants' narratives. Each theme was clearly articulated and labeled during theme definition and naming to capture its core meaning, accompanied by direct quotations from interviews to illustrate key points. Finally, in the reporting phase, the findings were synthesized, presented in alignment with the research questions, and guided

by the theoretical framework.

To enrich and validate the findings, supplementary teaching materials provided by participants were concurrently analyzed. These documents offered tangible examples of culturally sustaining pedagogy (CSP) in practice, including localized lesson content, indigenous knowledge integration, and culturally relevant teaching methods. The triangulation of interview data and document analysis contributed to a comprehensive understanding of how CSP was applied in science classrooms within the Indigenous Peoples Education (IPED) context. Participants were allowed to review the synthesized results and confirm that their views and experiences had been accurately represented (Lincoln & Guba, 1985).

**Ethical Considerations**

Given the involvement of human participants, the study adhered to strict ethical protocols to safeguard their rights and welfare. Informed consent was obtained from all participants after they were fully briefed on the study's objectives, procedures, and their rights, including the right to withdraw at any point without penalty. Written consent forms were collected before any data gathering began.

All personal information was anonymized to maintain confidentiality, and data were securely stored on a password-protected device. Pseudonyms were used throughout all reports and publications to protect participant identities. The principle of voluntary participation and respect was upheld by ensuring a non-threatening interview environment where participants felt safe and empowered to share their stories.

To ensure data trustworthiness, the researcher employed reflexivity, member checking, and peer debriefing strategies. These measures helped enhance the findings' credibility, dependability, and confirmability. Moreover, rigorous sampling and transparency were observed throughout the selection process. Participants were chosen based on clearly defined inclusion criteria that ensured their capacity to provide meaningful insights relevant to the research focus. Collectively, these ethical considerations reinforced the study's integrity and upheld the dignity and rights of all participants involved.

## Results and Discussion

Multimodal Strategy is used to close the gap between standard teaching approaches and student populations with indigent cultural backgrounds. It involved analyzing participants' activities using culturally supportive pedagogy in their respective science classes. By perceiving the world through the lenses of inclusiveness and respect for cultural diversity, teachers can show their dedication to creating a learning environment where all students feel appreciated and empowered. Making them interact with scientific topics within the context of their own cultural identities.

The main themes of these approaches were the dedication to using technology, including indigenous knowledge systems, and customizing instructional methodologies to learners' cultural backgrounds. Teachers are role models in encouraging a constructivist curriculum, enabling students to create knowledge for themselves actively. These teachers understand the value of placing educational materials in their cultural contexts and use conventional wisdom. By appreciating innovation and honoring students' views, these teaching practices provide examples of how culturally sustaining pedagogy can be successfully used in scientific classrooms to promote inclusive and equitable education for all students. The following themes and subthemes emerged from the responses:

**Key Theme 1. Science Through the Lens of Culture – Exploring how teachers integrate Indigenous knowledge and cultural traditions into science lessons**.

The framework of science education involves a comprehensive strategy that reflects a dedication to incorporating many cultural views into the learning process results. It involves investigating the issue of cultural integration within the context of science education. Indigenous Knowledge Systems and Practices intentional inclusion acknowledges the importance of abundant sources of knowledge and insights, which is fundamental to this theme.

The development of respect for cultural beliefs emphasizes how crucial it is to establish an inclusive and culturally sensitive environment where all students have a sense of empowerment and affirmation of their identities. Furthermore, using traditions as examples helps close the gap between conventional wisdom and scientific ideas by giving students concrete links to their cultural background in the classroom. These elements of cultural integration work together to create a fundamental framework for advancing diversity, equity, and cultural sustainability in science education.

***Bridging Traditional and Scientific Wisdom.*** In order to create a culturally sustainable pedagogy, examining the integration of indigenous knowledge systems and practices is considered a crucial component of scientific education. The subtheme examines how indigenous ways are acknowledged in the curriculum. This is possible through adopting Indigenous Knowledge Systems and Practices; teachers provide students with viewpoints grounded in old wisdom, enhancing the learning process. By highlighting the significance of respecting and recognizing indigenous scientific contributions, this subtheme promotes a greater awareness of the connections between traditional knowledge and modern scientific research. This combination allows students to grasp science more broadly while appreciating the diversity of other cultural viewpoints.

Teachers can enhance student learning and foster diversity and cultural relevance by incorporating IKSP into science classes. Integrating Indigenous Knowledge Systems and Practices (IKSP) supports culturally sustainable science education. The views shared by the participants highlight how important it is to include indigenous viewpoints in the curriculum because they are priceless sources of knowledge and insight. Indigenous Knowledge System and Practices in science education serves as a catalyst for advancing diversity, equity, and cultural sustainability. Through this integration, students are allowed to investigate scientific ideas from the perspective of their own cultural background. This will strengthen their sense of self while cultivating a sense of pride in it.

In addition, including Indigenous Knowledge Systems and Practices promotes a more comprehensive and rewarding educational experience that enables students to navigate and effectively contribute to their communities and academic endeavors. It is in line with the values of equity and inclusivity.

*Using Cultural Practices as Teaching Tools.* An essential aspect of pedagogy that supports culture in science teaching includes analyzing the subtheme of Using Cultural Practices as Teaching Tools. Teachers provide students with concrete links to their cultural identity in the classrooms by bridging the gap between cultural heritage and scientific notions through traditions. This subtheme explores how cultural customs and traditional behaviors are purposefully incorporated into the curriculum as instructive examples. Teachers establish inclusive and culturally sensitive learning settings where students feel empowered and validated in their cultural identities by using traditions as models. This subtheme emphasizes the importance of respecting and valuing cultural customs, which enhances education and promotes a greater understanding of cultural variety.

Accepting customs as models in the classroom signifies a conscious change in emphasis toward valuing and celebrating the cultural backgrounds of various student bodies. Paris's research emphasizes how important it is to reassess educational positions, terminology, and practices to better match with the principles of CSP, which place a high value on learners' cultural identities being sustained and nurtured. Also, using Traditions as Examples is a robust fit with the conclusions Paris (2021) made in his analysis of Culturally Sustaining Pedagogy (CSP). Teachers can validate students' lived experiences and cultural knowledge while fostering inclusive learning environments that empower students by using traditions as models in their teaching techniques. Per Paris (2021), the intentional incorporation of customs facilitates cultural continuity by allowing students to recognize themselves in their learning environments and encouraging academic achievement based on cultural relevance and authenticity.

*Respecting and Validating Indigenous Beliefs.* Examining the concept of Respecting and Validating Indigenous Beliefs sheds light on a critical component of pedagogy that supports cultural diversity in science education. This theme explores the significance of appreciating, respecting, and recognizing students' many cultural views inside the classroom. Teachers establish inclusive environments where children feel validated in their identities and cultural heritage by valuing respect for cultural ideas. The need to create an atmosphere where cultural diversity is acknowledged and appreciated is emphasized in this opening paragraph. It will set the groundwork for meaningful interaction and educational opportunities that align with students' cultural backgrounds.

The participants' thoughts underscored the importance of respecting cultural ideas when teaching science. Education professionals can foster inclusive learning environments where students feel validated in their identities and cultural heritage by recognizing and appreciating their learners' various cultural views. To teach science effectively, it is imperative that students feel engaged and like they belong. Respecting cultural values also enables teachers to close the gap between scientific ideas and students' real-world experiences, increasing the relevance and accessibility of science for all learners. This method transforms science instruction into a tool for fostering cultural sensitivity, empathy, and educational justice in addition to a way to transfer information. Teachers who respect cultural values enable students to view themselves as engaged contributors to science, able to shape scientific understanding within the framework of their own cultural identities.

**Key Theme 2. Teaching Beyond the Textbook: Adapting Methods for a Multicultural Classroom – Highlighting how educators adjust strategies, materials, and pedagogy to fit the cultural context of Indigenous learners**

The main focus of Cultural Accommodation is the deliberate modification of teaching strategies, resources, and tactics to accommodate the unique requirements and preferences of learners from varied cultural backgrounds. Investigating the theme of Teaching Beyond the Textbook reveals a crucial facet of pedagogy that supports cultural diversity in science education.

Cultural accommodation involves changing educational methods to make them more inclusive and culturally appropriate for all students. Teachers establish inclusive learning environment where students feel empowered and validated in their cultural identities these can be attained by prioritizing cultural accommodation. It contrasts cultural integration, incorporating components from different cultures into the curriculum. This emphasizes the significance of appreciating and acknowledging cultural variety while highlighting the necessity of carefully modifying instructional strategies to accommodate students' varied cultural settings.

*Contextualizing Lessons with Real-World Indigenous Applications.* Learning activities, content delivery strategies, and teaching techniques to better suit each student's cultural background and environment. The secondary principle of Contextualizing Lessons with Real- World Indigenous Applications takes on vital importance in the context of scientific education that is culturally supportive.

Teachers may ensure that their methods align with student's experiences and cultural viewpoints, promoting inclusivity and relevance in the classroom. This opening paragraph emphasizes how important it is to modify instructional strategies to accommodate students' varied cultural requirements and preferences to foster learning settings where all students feel respected, valued, and empowered in their cultural identities.

Teachers may promote culturally diverse classrooms where students feel valued and understood, and learning experiences are enhanced through meaningful connections to students' lived realities and cultural identities by adopting the Adaptation to Cultural Context. This arrangement emphasizes how important it is for educators to continually examine their cultural prejudices and participate in ongoing professional development to improve their capacity to successfully modify their teaching methods for various cultural situations.

***Localized Learning Materials: Science from the Community.*** Contextualization and Indigenization of Learning Materials play a significant role in the framework of culturally friendly pedagogy in science education. The deliberate practice of relating educational resources with students' diverse cultural settings and perspectives by incorporating cultural relevance and authenticity into them is also a subtheme. To create learning resources that connect with students' living experiences, customs, and knowledge systems, prioritize contextualization and indigenization. This method promotes inclusivity and increases student's involvement in science classes. Learning materials must be tailored to reflect the cultural differences of students to build environments where all learners feel valued, respected, and empowered in their cultural identities.

Students' motivation will increase, and it will also improve learning outcomes and foster a more comprehensive understanding of the importance of cultural heritage in the search for scientific knowledge. As a result, these methods serve as an important pillar for promoting fairness, diversity, and excellence in science instruction, making sure that every student has equal access to worthwhile and culturally appropriate educational opportunities. Thus, the contextualization and indigenization of learning materials are strongly related to the study of O'Leary et al. (2020), which focuses on creating an inclusive classroom by engaging STEM faculty in culturally responsive teaching workshops. Their research emphasizes how important it is to modify STEM (science, technology, engineering, and mathematics) course materials to suit students' cultural backgrounds and situations better. Teachers can lower cultural barriers and increase the accessibility and relevance of STEM courses for a wide range of student demographics by contextualizing and indigenizing instructional materials. This method improves students' comprehension of the subject matter and heightens their interest in it. They also feel more empowered and a part of the culture. STEM faculty members can acquire knowledge and techniques for incorporating cultural relevance into their teaching practices through culturally responsive teaching workshops. It will help them create inclusive learning environments where all students can succeed.

## Key Theme 3. Empowered Learners: A Student-Centered Approach to Science – Examining how student-led, inquiry- based learning fosters engagement and deeper understanding.

Theme 3 explores the key component of the Pedagogical Approach in the context of culturally inclusive pedagogy in science education. In this subject, inclusiveness and student-centered learning are prioritized through the deliberate selection and implementation of instructional strategies. Educators strongly emphasize the constructivist method and hope to encourage students' critical thinking, active participation, and knowledge creation through practical applications and group projects. It particularly looks at how to apply the constructivist approach and promote inclusive education when teaching science. The promotion of inclusive education highlights the commitment to creating learning environments where all students, regardless of their backgrounds or skill levels, feel appreciated, respected, and empowered to participate actively in the learning process.

***Constructivist Strategies in Indigenous Science Education.*** A crucial component of pedagogical strategy in science education is the application of the Constructivist Approach. This subtheme looks into the deliberate application of constructivist-based teaching strategies prioritizing student knowledge production, critical thinking, and active involvement. Through the constructivist-based method, teachers hope to establish engaging classrooms where learners are inspired to investigate, challenge, and create meaning via practical applications and group projects. This introduction shows the importance of using the constructivist framework in science instructions, which also underscores how it helps students develop lifetime learning abilities and a deeper comprehension of the material.

By constructing new understanding from prior experiences, constructivist method, the constructivist approach encourages students to participate in their education. This strategy entails developing learning opportunities that respect and enhance students' cultural identities and backgrounds while enabling them to connect academic material and their everyday lives and cultural surroundings.

Teachers can encourage greater engagement, critical thinking, and cultural validation in diverse classrooms by empowering students to take ownership of their learning by implementing the constructivist method in culturally relevant teaching.

***Encouraging Inquiry-Based Exploration with Cultural Relevance.*** This subtheme investigates deliberate tactics to establish inclusive learning environments that put importance on accessibility, equity, and diversity for all students. To ensure that every student, regardless of background, ability, or identity, feels valued, respected, and empowered to engage in the learning process fully, educators place a high priority on inclusive education. This first line highlights how important it is to support inclusive education in science instruction.

This theme is consistent with the findings of a research project by Nortvedt et al. (2020), which supported culturally responsive assessments in schools amid a society becoming more interconnected by the day. Their research highlights how important it is to implement evaluation practices that take into account the diverse cultural backgrounds and experiences of pupils. Regardless of linguistic or cultural differences, educators may guarantee that assessment techniques appropriately represent the knowledge and skills of all students by encouraging culturally responsive evaluation. Culturally sensitive assessment methods acknowledge and value the variety of ways in which students exhibit their learning, which helps to create more inclusive and equitable review processes. By implementing culturally sensitive assessment methodologies, teachers can establish learning settings where all students feel motivated to succeed and supported. It will promote a more inclusive educational experience for various student groups.

**Key Theme 4. Unlocking the Power of Learning: Harnessing the Immersive Potential of Passive Multimedia**

The subject of the fourth theme discovers how educators can use technology to improve science instruction. Its main goal is to increase learning outcomes through integrating digital technologies and resources to improve student engagement and expand comprehension of scientific ideas.

In the contemporary digital age, educators increasingly utilize modern technologies like simulations, interactive software, and online resources to create dynamic and engaging learning environments. The topic emphasizes how crucial it is for educators to take on the role of facilitators, carefully choosing and implementing technology to meet the needs of each student, accommodate a variety of learning styles, and improve the standard of science education as a whole. Teachers get essential insights into technology's revolutionary potential in influencing scientific education going forward by investigating how educators strategically integrate it into their pedagogical methods.

The theme of Technology Utilization interacts with Ladson-Billings' (2021) examination of culturally relevant, responsive, and enduring pedagogy. Because it captures the changing nature of education in the digital age. Moreover, the study emphasizes how technology may support culturally responsive pedagogy by increasing access to educational resources and opening doors for creative teaching approaches. One of the functions of technology is to help us create learning settings that are culturally sensitive and use digital resources to engage students from different backgrounds. Teachers can tailor learning experiences, integrate different cultural viewpoints into curricular materials, and create collaborative learning communities that cut across geographic borders utilizing culturally appropriate technological tools. Advanced equity and cultural validity in education can also be attained through technology. Technology provides opportunities for students to speak up and share their cultural experiences and expertise with larger audiences through various platforms.

**Key Theme 5: Use of Immediate Environment and Available Materials to Promote Experiential Learning**

The fifth theme reveals the vital practice of resourcefulness in science education, a fundamental tactic educators use to overcome obstacles brought on by the lack of supplies and infrastructure in schools. To optimize the learning possibilities available to students with their means and understand the limitations provided by scarce resources, teachers have always relied on innovation and inventiveness. Thus, this theme shows teachers' ability to get around resource limits, showcasing their ability to innovate and adapt while providing high- quality science instruction.

Teachers can effectively bridge cultural divides and encourage equal access to STEM (science, technology, engineering, and mathematics) fields for all students by adopting resourcefulness in science instruction. This methodology entails utilizing culturally appropriate illustrations, integrating practical applications of scientific concepts, and cultivating cooperative learning settings that respect students' varied viewpoints and life experiences. Teachers may create inclusive science classrooms where all students feel respected, encouraged, and empowered to explore and thrive in their scientific endeavors.

Consequently, the experiences of participants navigate the difficulties of incorporating inclusivity and cultural relevance into their teaching practices. This analysis involves a wide range of real-life narratives, insights, and goals as teachers work to create classrooms that respect and appreciate the differentiated cultural backgrounds of their learners. To ensure progress in scientific education via the lens of cultural responsiveness, participants commenced on a voyage of discovery that included wrestling with cultural awareness and compression challenges, embracing the richness of students' cultural history.

**Key Theme 6. Language as a Bridge and a Barrier – Addressing the linguistic challenges of balancing Indigenous languages and scientific terminology.**

The sixth theme addresses the universal problem of linguistic barriers teachers face when teaching science. Due to cultural and linguistic differences, teachers struggle to explain scientific ideas successfully in classrooms where learners may not speak the language of instruction well.

This theme underscores the substantial effects of language obstacles on students' participation, comprehension, and access to science education by illuminating the complex interactions between language, culture, and pedagogy. With these obstacles, educators set out on a path of creativity, adaptation, and cultural sensitivity to overcome language barriers and provide inclusive learning environments where every student can succeed.

***Navigating Between Mother Tongue and Scientific Vocabulary.*** Students' insufficient fluency in their mother tongue is included in the more significant problem of the language barrier, which teachers constantly battle with. This part of the language barrier creates a complicated dynamic for educators working to support science instruction in classrooms where students can find it difficult to understand scientific topics because of language barriers fully.

In addition, teachers are urged to use multilingual techniques, such as translanguaging practices, where students are encouraged to use their linguistic repertoires to generate sense and participate in learning activities as part of culturally responsive teaching. Teachers can establish inclusive learning environments where students feel encouraged to express themselves verbally and academically, building a sense of belonging and improving academic achievement by adopting a culturally relevant approach to teaching. Educators must implement solutions that support students' different language demands while recognizing their cultural identities when they are not proficient in their home tongue.

***Overcoming Language Gaps in Resource Materials.*** The complexities of scientific language pose significant obstacles in translating science resource materials, particularly when technical terms are involve. Scientific vocabulary is often precise and nuanced, making it difficult to translate accurately. To address these challenges, this subtheme explored the educators' perspectives, tactics, and pedagogical techniques to overcome language proficiency nuances and guarantee that every student has fair access to science instruction. It also examined the strategies, viewpoints, and pedagogical approaches used by educators to get over the language competency barriers and ensure that all students have equitable access to science education. By means of their narratives, educators can gain a perceptive understanding of the intricate facets of science teaching in the English language, shedding light on the challenges, opportunities, and creative approaches that shape the educational landscape.

Hyter and Salas-Provance's (2021) investigation of culturally responsive practices in speech, language, and hearing sciences intersects with the difficulties of using English as a Medium of Instruction, emphasizing the necessity of addressing linguistic diversity and cultural competence in educational settings. With more academic environments using English as the primary teaching language, students from various linguistic and cultural backgrounds may find it difficult to access and participate in the curriculum. Hyter and Salas-Provance (2021) support using culturally sensitive teaching methods that help students achieve academic success while acknowledging and validating their language and cultural identities. In speech, language, and hearing sciences, culturally responsive techniques include a variety of tactics, such as accepting students in their native tongues, offering language assistance, and including culturally appropriate material in lessons.

**Key Theme 7. A Classroom Without Walls: Navigating Limited Resources – Discussing how teachers innovate despite a lack of teaching aids, laboratories, and infrastructure.**

The seventh theme explores the widespread issue of teachers in scientific education facing a shortage of classroom and science laboratory facilities. This theme emphasizes the most common problems that both teachers and learners encounter in science education: insufficient facilities and supplies for carrying out scientific investigations and hands-on training experiences.

The teacher testimonies highlight the pressing need for dedicated scientific lab facilities in educational institutions. Because of these regions' deficiency, performing experiments and practical demonstrations—which are essential for fully understanding scientific concepts— become more complex. Despite limitations, teachers' creative use of the spaces available to them shows that they are committed to providing high-quality science instruction. However, the breadth and depth of science instruction provided to children are compromised by subpar laboratory facilities. As a result, these stories emphasize how urgent it is to fund science labs in order to ensure equitable access to opportunities for experiential learning and foster an environment that supports scientific inquiry and discovery in the classroom.

**Key Theme 8. Breaking Barriers: Challenging Misconceptions About Indigenous Knowledge – Confronting biases that diminish the value of traditional knowledge in science.**

The eight theme investigates narratives such as insensitivity to cultural differences in the classroom. It turns out that teachers not knowing their students' cultural origins and circumstances play a crucial factor. The experiences and insights of teachers who struggle to manage cultural differences and close the gap between their cultural viewpoints and those of their learners are examined in this section. One factor that creates significant barriers to developing inclusive and culturally sensitive learning settings involves ignorance about other people's cultures, which results in lowering educational standards and decreasing student involvement.

The teacher narratives highlight how important it is for students to know and comprehend people from different cultural backgrounds in school environments. Ignorance frequently breeds misunderstandings and stereotypes, making it challenging to teach learners from different cultural backgrounds in an effective manner. Teachers emphasized that it is critical to acknowledge and accept cultural differences to establish inclusive learning settings where all children feel valued and understood. Schools can encourage empathy, respect, and cooperation across different contexts by raising cultural understanding among teachers and students. It emphasizes how important it is to keep working to improve cultural sensitivity and knowledge in the classroom so that all students have fair opportunities to achieve.

## Key Theme 9. Relearning Culture: Teachers as Cultural Mediators – Exploring the difficulties teachers face in learning and adapting Indigenous traditions into their teaching.

The ninth theme explores the difficulties teachers face in understanding and comprehending their students' cultures, particularly those from marginalized or indigenous groups. This study investigates teachers' experiences struggling to understand the complexities of their learners' cultural origins. These teachers find it difficult to close the gap between their cultural viewpoints and those of their students as they negotiate the complexity of strange cultural customs, traditions, and belief systems. The challenge of understanding the cultures of their learners, establishing inclusive learning environments, and building meaningful connections significantly hampered science instruction.

Teachers can acquire the knowledge and skills necessary to tackle the challenges of integrating students' cultures into their instruction through ongoing professional development and training programs. By collaborating, educators, schools, and communities may foster inclusive classroom environments where kids feel valued and respected, as well as cross-cultural discourse and understanding. Including culturally relevant resources in the curriculum, such as literature, art, and music, can also increase student involvement and foster deeper connections. By taking proactive steps and making cultural competency a top priority in education, teachers may successfully navigate the complexities of many cultural contexts, improving the teaching and learning process for all.

The integration of culturally sustaining pedagogy into science education is presented in Part III as a crucial and significant practice. Hence, by bringing cultural components to science lessons, teachers help preserve and celebrate their students' rich cultural legacy.

## Key Theme 10. Science as a Cultural Heirloom: Reviving Indigenous Knowledge – Understanding how CSP helps preserve Indigenous traditions and values.

Theme 10 emphasizes how educators and learners can actively preserve and celebrate cultural heritage in their science classes. In integrating cultural components in the class, teachers play as the facilitator, this is to make sure that the diversity of their students' origin is recognized and appreciated. Teachers empower students to engage with scientific concepts while discovering and appreciating their cultural identities. Preservation of culture involves educators actively conserving and honoring multiple cultural identities within educational contexts. Howe and Lisi (2023) urge multicultural educators to actively include culturally relevant practices, content, and viewpoints in their teaching methods and cultivate an understanding of cultural variety.

When teachers know how to appreciate the importance of cultural preservation, inclusive classrooms can be built. It highlights the diversity of students' cultural backgrounds and celebrates the richness of cultural history. Additionally, teachers may permit students to unravel and express their cultural identities by incorporating culturally responsive teaching, which will help them feel confident and like they belong.

## Key Theme 11. Roots and Wings: Strengthening Cultural Identity Through Science – Exploring how students develop a sense of pride and belonging through culturally relevant education.

In addition to imparting knowledge, teachers are vital in ensuring that science education affirms and celebrates the different cultural backgrounds of learners. Teachers in science education do not only focus on imparting knowledge; they also ensure that the learner's backgrounds are being affirmed and celebrated.

Teachers must preserve cultural identity within the context of multicultural education, according to Jayadi et al. (2022), in order to acknowledge the diversity of the country's people and the richness of its cultural heritage and customs. By fostering cultural identification, multicultural education programs can help people embrace their unique cultural backgrounds and foster a sense of unity and national identity. Furthermore, by including culturally relevant content and opinions in the curriculum, multicultural education promotes social cohesiveness, understanding, and respect among Indonesia's numerous communities.

## Key Theme 12. A Future Where Science and Culture Coexist – Envisioning how CSP can redefine science education in Indigenous communities.

The dynamic interaction between science education and real-world settings and the importance of connecting scientific ideas to real-world situations are all emphasized in Theme 12. Educators hope to improve students' understanding and admiration of science while providing them with the tools necessary to navigate and make contributions to the world around them by establishing links between theoretical ideas and practical applications.

### I-CARE (Integrating Cultural Awareness and Responsive Education)

The I-CARE (Integrating Cultural Awareness and Responsive Education) training plan was crafted as an answer to the diverse needs and preferences of teachers while implementing culturally sustaining pedagogy. Multicultural Education entails teachers' need to acknowledge and value the cultural origins of their learners to establish welcoming and productive learning spaces.

The I-CARE training plan seeks to build a learning environment where all students feel valued and empowered in their educational journey by supporting pedagogical approaches that resonate with students' cultural identities, improving teachers' understanding of cultural integration, and assisting with language barriers. Furthermore, the plan offers teachers the necessary skills in inventiveness

and urges the use of technology to improve the delivery of instruction, thereby addressing issues like limited facilities and resources. The I-CARE training plan aims to ensure fair opportunities for all students by promoting cultural awareness, responsiveness, and inclusivity in science education. The I-CARE training plan acknowledges the significance of recognizing and integrating indigenous knowledge systems, customs, and cultural heritage into the educational system and is under DepEd Order 62, s. 2011 (National Indigenous Peoples Education Policy Framework). The training plan supports indigenous peoples' rights, welfare, and sustainable development by prioritizing maintaining cultural identity, establishing relationships, and applying knowledge to practical settings. In addition, the strategy addresses obstacles like linguistic hurdles and limited facilities to underscore the importance of inclusivity and equity in education, as stated in both the DepEd order and the policy framework. The I-CARE training plan equips teachers with the skills necessary to successfully use culturally sustaining pedagogy, support cultural diversity and appreciation in the classroom, and aid indigenous students' development and academic achievement.

## Conclusion

This research aimed to support the Department of Education's ongoing efforts to promote inclusive education by examining the lived experiences of science teachers in Bataan who implement culturally sustaining pedagogy (CSP) in their classrooms. The findings revealed that participating educators consistently demonstrated culturally responsive practices, including the integration of Indigenous Knowledge Systems and Practices (IKSP), the use of cultural traditions as instructional tools, and the respectful validation of students' cultural beliefs. These practices were complemented by differentiated strategies such as cultural accommodation, contextual adaptation, and the indigenization of learning materials. Pedagogical approaches grounded in constructivism and inclusive education further reinforced these efforts, with teachers also employing creative use of technology to bridge resource gaps and enhance lesson delivery.

Despite these positive practices, several challenges emerged that hinder the full implementation of CSP in science education. Participants identified language barriers, limited facilities and instructional materials, a lack of cultural awareness, and difficulties in acquiring sufficient cultural knowledge as persistent obstacles. These challenges underscore the need for holistic and systemic approaches to address linguistic, institutional, and cultural competency gaps in order to ensure equitable and meaningful learning experiences for all students.

The integration of CSP into science education offers numerous advantages, including the preservation of cultural heritage, improved relevance of learning to real-life contexts, and the promotion of students' cultural identities. When educators embrace cultural diversity within their teaching frameworks, they foster inclusive, empowering environments that encourage deeper engagement and academic achievement among Indigenous learners.

In response to the challenges identified, this study recommends the implementation of the I-CARE (Integrating Cultural Awareness and Responsive Education) training plan. This proposed program is designed to equip teachers with the necessary knowledge, skills, and tools to effectively integrate cultural elements into science instruction through culturally responsive, inclusive, and learner-centered pedagogies.

Furthermore, several actionable recommendations are proposed. First, educational institutions should develop and expand programs like I-CARE that honor cultural values, integrate Indigenous knowledge systems, and align with regional customs. Instructional materials and activities must be contextually and culturally relevant to the learners' backgrounds. Second, language support programs should be established to enhance both teachers' and students' proficiency in English, including the provision of bilingual resources and translation services to improve classroom communication. Third, the government and school divisions should invest in science equipment, Indigenous learning materials, and infrastructure to support culturally appropriate and high-quality science instruction.

Regular training and capacity-building initiatives—such as workshops and seminars on inclusive strategies, cultural sensitivity, and effective teaching—are also essential. Additionally, partnerships should be fostered with local communities, Indigenous leaders, and cultural experts to develop culturally informed curricula and enrich the educational experience. To measure the effectiveness of such efforts, a robust monitoring and evaluation framework should be established, incorporating feedback from teachers, students, and community stakeholders to ensure continual improvement and inclusivity in science education practices.

Finally, future researchers are encouraged to conduct longitudinal studies to assess the long-term impacts of culturally sustaining pedagogy. By tracking academic performance, cultural identity development, and learner engagement over time, these studies can provide deeper insights into the sustainability and transformative potential of culturally responsive science education in Indigenous communities.

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## Affiliations and Corresponding Information

**Diana Rose M. Gimpaya**
Jose C. Payumo Jr. Memorial High School
Department of Education – Philippines

**Lucky Sonny A. Ligsanan**
Bataan Peninsula State University – Philippines