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RESEARCH ARTICLE

Integration of Indigenous Knowledge Systems in Science Instruction: Teachers' Pedagogical Practices and Learners' Conceptual Understanding in Elementary Education

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Abstract

The integration of Indigenous Knowledge Systems (IKS) into science instruction has emerged as an important educational approach in promoting culturally responsive and contextualized learning in elementary education. This qualitative study explored how elementary science teachers integrate Indigenous Knowledge Systems into science instruction and how such pedagogical practices influence learners' conceptual understanding of scientific concepts. Utilizing a phenomenological qualitative research design, the study involved fifteen elementary science teachers from selected public elementary schools implementing contextualized science instruction. Data were gathered through semi-structured interviews, classroom observations, focus group discussions, and document analysis. Thematic analysis following Braun and Clarke's framework was employed in analyzing the collected data. Findings revealed five major themes: (1) Contextualization of Science Concepts Through Indigenous Community Practices; (2) Cultural Relevance and Learner Engagement in Science Learning; (3) Inquiry-Based and Experiential Indigenous Science Pedagogies; (4) Challenges in Integrating Indigenous Knowledge Systems into Formal Science Instruction; and (5) Preservation of Cultural Identity Through Science Education. Participants emphasized that integrating indigenous knowledge enhanced learner participation, conceptual understanding, and appreciation of local culture and environmental practices. However, teachers also encountered challenges related to limited instructional materials, insufficient training, curriculum constraints, and balancing scientific concepts with indigenous perspectives. The study concludes that Indigenous Knowledge Systems serve as valuable pedagogical resources that enrich science instruction and strengthen culturally responsive education in elementary schools. Findings provide implications for curriculum development, science teacher training, and policy initiatives promoting inclusive and culturally grounded science education.

Keywords: Indigenous Knowledge Systems, science instruction, culturally responsive pedagogy, elementary education, contextualized learning, science education, qualitative research

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INTRODUCTION

Science education plays a vital role in developing learners' scientific literacy, critical thinking skills, environmental awareness, and understanding of the natural world. In elementary education, science instruction establishes foundational scientific concepts and promotes inquiry, observation, experimentation, and evidence-based reasoning among learners. However, traditional science instruction often relies heavily on standardized and Western-oriented scientific frameworks that may overlook local cultural realities, indigenous practices, and community-based knowledge systems.

In recent years, there has been growing recognition of the importance of Indigenous Knowledge Systems (IKS) in education. Indigenous knowledge refers to locally developed knowledge, practices, beliefs, and cultural traditions that have evolved within communities through generations of lived experiences and environmental interaction. Indigenous communities possess rich understandings of agriculture, weather patterns, herbal medicine, environmental conservation, astronomy, and ecological sustainability that may complement formal scientific learning.

The integration of Indigenous Knowledge Systems into science education supports culturally responsive pedagogy by connecting scientific concepts to learners' cultural backgrounds, local experiences, and community realities. In elementary classrooms, contextualized instruction rooted in indigenous practices may help learners better understand abstract scientific concepts through familiar and meaningful experiences. Furthermore, integrating indigenous knowledge promotes cultural preservation, learner identity formation, and inclusive educational practices.
In the Philippine educational context, culturally responsive teaching and contextualization have become important educational priorities under the Department of Education's curriculum reforms. Science teachers are encouraged to localize instruction and utilize community-based examples to make learning more relevant and meaningful. However, despite policy support for contextualized learning, the integration of Indigenous Knowledge Systems into formal science instruction remains limited due to curriculum constraints, insufficient teacher preparation, and lack of culturally grounded instructional resources.

Previous studies have explored culturally responsive teaching and contextualized science instruction, yet limited qualitative research has focused specifically on teachers' lived experiences in integrating Indigenous Knowledge Systems into elementary science education. Existing literature often centers on curriculum policy and learner outcomes rather than the pedagogical realities and instructional experiences of teachers implementing indigenous-based science instruction.

Thus, this study explored the integration of Indigenous Knowledge Systems in science instruction by examining teachers' pedagogical practices and learners' conceptual understanding in elementary education. Specifically, the study sought to answer the following questions:
The findings of the study may contribute to science curriculum enhancement, culturally responsive pedagogical practices, teacher professional development, and policy initiatives supporting indigenous and localized education in elementary schools.

REVIEW OF RELATED LITERATURE

Indigenous Knowledge Systems and Education
Indigenous Knowledge Systems refer to the accumulated body of knowledge, cultural beliefs, practices, and environmental understandings developed by indigenous and local communities through generations of experience. According to UNESCO (2021), indigenous knowledge

represents a dynamic system of understanding that contributes significantly to sustainable development, environmental conservation, and cultural identity preservation.
In educational contexts, integrating indigenous knowledge into classroom instruction supports culturally responsive teaching by validating learners' cultural experiences and community-based knowledge. Indigenous pedagogies emphasize experiential learning, storytelling, observation, collaboration, and intergenerational knowledge transmission.

Culturally Responsive Science Instruction
Culturally responsive pedagogy recognizes the importance of incorporating learners' cultural backgrounds, traditions, and experiences into instructional practices. According to Geneva Gay, culturally responsive teaching enhances learner engagement, motivation, and academic achievement by making instruction more relevant and meaningful.

In science education, contextualizing scientific concepts through indigenous practices and local environmental experiences enables learners to connect abstract scientific principles to familiar realities. Learners become more engaged when scientific ideas are linked to agricultural practices, weather observations, herbal medicine, ecological conservation, and local technologies within their communities.

Constructivist and Experiential Learning in Science Education
Constructivist learning theory posits that learners actively construct knowledge through interaction, collaboration, and meaningful experiences. According to Lev Vygotsky, learning occurs through social interaction and culturally mediated experiences. Indigenous knowledge integration aligns with constructivist principles by allowing learners to connect scientific learning with cultural practices and community experiences.

Kolb's Experiential Learning Theory further emphasizes the role of concrete experiences and reflective observation in knowledge construction (Kolb, 1984). Science instruction integrating Indigenous Knowledge Systems often involves observation, experimentation, storytelling, environmental interaction, and practical demonstrations that strengthen conceptual understanding.

Challenges in Integrating Indigenous Knowledge into Science Instruction
Despite the benefits of indigenous knowledge integration, teachers often encounter challenges related to curriculum rigidity, limited culturally relevant instructional materials, insufficient teacher preparation, and tensions between indigenous beliefs and standardized scientific frameworks. According to Aikenhead and Michell (2019), science teachers may struggle to balance formal scientific concepts with culturally grounded perspectives within classroom instruction.

Additionally, the absence of institutional support and professional training limits teachers' confidence and preparedness in implementing culturally responsive science pedagogies.

Theoretical Framework
This study was anchored on Constructivist Learning Theory proposed by Lev Vygotsky, which emphasizes that learners actively construct knowledge through social interaction, culture, and meaningful experiences. The study also utilized Culturally Responsive Pedagogy Theory developed by Geneva Gay, highlighting the importance of integrating learners' cultural backgrounds and lived experiences into educational practices.
These theories guided the interpretation of teachers' pedagogical practices, learner engagement, and conceptual understanding in the integration of Indigenous Knowledge Systems into science instruction.

METHODOLOGY

This study utilized a qualitative phenomenological research design to explore the lived experiences, pedagogical practices, and instructional challenges of elementary science teachers integrating Indigenous Knowledge Systems into science instruction. Phenomenology was appropriate because it enabled the researcher to gain in-depth understanding of teachers' experiences, perspectives, and reflections regarding culturally grounded science teaching within actual classroom contexts.

The study was conducted in selected public elementary schools implementing contextualized science instruction within culturally diverse communities in the Philippines. These schools were selected because of their exposure to indigenous community practices, local environmental knowledge, and contextualized educational initiatives.

The participants consisted of fifteen elementary science teachers selected through purposive sampling. Participants met the following criteria: currently teaching elementary science subjects, actively integrating local or indigenous knowledge into instruction, possessing at least three years of teaching experience, and willing to participate in interviews and classroom observations.

Data were gathered through semi-structured interviews, classroom observations, focus group discussions, and document analysis of lesson plans and instructional materials. The interview guide focused on teachers' pedagogical experiences, instructional strategies, learner engagement, conceptual understanding, and challenges related to Indigenous Knowledge Systems integration in science education.

Ethical considerations including informed consent, confidentiality, anonymity, voluntary participation, and respect for participants' cultural perspectives were strictly observed throughout the research process.

Data were analyzed using thematic analysis following Braun and Clarke's (2006) framework. Interview transcripts, observation notes, and instructional documents were coded, categorized, and interpreted to identify recurring themes and patterns. Trustworthiness was ensured through triangulation, member checking, prolonged engagement, and peer debriefing.

RESULTS

Theme 1: Contextualization of Science Concepts Through Indigenous Community Practices

Participants emphasized that integrating indigenous practices into science instruction made scientific concepts more understandable and relatable for learners. Teachers utilized examples from farming, fishing, herbal medicine, weather prediction, and environmental conservation practices observed within local communities.

One participant shared:
"Mas naiintindihan ng mga bata ang science kapag ginagamit ang mga halimbawa mula sa kanilang komunidad."
Another participant explained:
"Kapag iniuugnay namin ang science lesson sa local farming practices, mas mabilis nilang naiintindihan ang concepts."

Teachers explained that contextualized instruction enabled learners to connect scientific concepts with their lived experiences and local realities. These findings support culturally responsive pedagogy emphasizing meaningful and culturally relevant instruction.

Theme 2: Cultural Relevance and Learner Engagement in Science Learning
Participants observed that learners became more engaged and participative when indigenous knowledge and local practices were incorporated into classroom discussions and activities.

One participant stated:
"Nagiging mas interesado sila kapag nakikita nilang bahagi ng kultura nila ang lesson."
Another participant remarked:
"Kapag familiar sa kanila ang examples, mas active sila sa class participation."

Classroom observations revealed increased learner interaction, curiosity, and collaborative discussions during culturally grounded science lessons. Learners demonstrated stronger interest in lessons involving local environmental practices and indigenous technologies.
These findings align with constructivist principles suggesting that culturally meaningful learning experiences enhance learner engagement and conceptual understanding.

Theme 3: Inquiry-Based and Experiential Indigenous Science Pedagogies
Teachers highlighted the use of storytelling, observation, environmental exploration, practical demonstrations, and collaborative inquiry in integrating indigenous knowledge into science instruction.

One participant shared:
"Ginagamit namin ang storytelling at actual observation para mas maintindihan nila ang science concepts."
Another participant explained:
"Mas effective kapag experiential ang learning at may direct interaction sa environment."

Participants emphasized that indigenous science pedagogies encourage inquiry, observation, and reflective learning. Learners actively explored local ecosystems, weather patterns, and traditional community practices to deepen scientific understanding.

These findings support Kolb's Experiential Learning Theory emphasizing concrete experiences and reflective observation in knowledge construction.

Theme 4: Challenges in Integrating Indigenous Knowledge Systems into Formal Science Instruction
Despite positive instructional experiences, participants encountered challenges related to limited instructional resources, lack of formal training, curriculum constraints, and balancing scientific explanations with indigenous beliefs.

One participant stated:
"Minsan nahihirapan kaming maghanap ng materials tungkol sa indigenous knowledge."
Another participant remarked:
"May mga concepts na mahirap i-balance between science explanations at traditional beliefs."

Teachers explained that insufficient institutional support and lack of culturally grounded instructional materials limited the consistent integration of Indigenous Knowledge Systems into classroom instruction.

These findings reflect the need for professional development programs and culturally responsive science curriculum resources.

Theme 5: Preservation of Cultural Identity Through Science Education
Participants emphasized that integrating indigenous knowledge into science instruction contributes to cultural preservation and strengthens learners' appreciation of local traditions and community practices.

One participant shared:
"Hindi lang science ang natututuhan nila kundi pati pagpapahalaga sa kultura nila."
Another participant explained:
"Nakakatulong ito para mapanatili ang indigenous knowledge ng komunidad."

Teachers believed that culturally grounded science instruction promotes learner identity, cultural pride, and environmental awareness while preserving valuable indigenous practices and knowledge systems.

CONCLUSION

The study revealed that integrating Indigenous Knowledge Systems into elementary science instruction strengthens culturally responsive pedagogy, learner engagement, and conceptual understanding of scientific concepts. Teachers utilized contextualized, inquiry-based, and experiential instructional practices to connect scientific learning with indigenous community experiences and local environmental realities.

The findings further showed that Indigenous Knowledge Systems integration promotes cultural preservation, learner identity formation, and meaningful science learning experiences. However, teachers also encountered challenges related to insufficient instructional resources, lack of training, curriculum limitations, and balancing indigenous beliefs with formal scientific frameworks.

Despite these challenges, teachers demonstrated commitment and instructional innovation in implementing culturally grounded science education. The study highlights the importance of integrating indigenous perspectives into formal science instruction to promote inclusive, contextualized, and culturally relevant education.

IMPLICATIONS OF THE STUDY

The findings imply the need for curriculum enhancement that supports Indigenous Knowledge Systems integration within elementary science education. Teacher professional development programs may strengthen culturally responsive pedagogies, contextualized science instruction, and indigenous knowledge integration practices.

Educational institutions and policymakers may also develop culturally grounded instructional materials and provide institutional support for indigenous-based science education initiatives. Furthermore, schools may strengthen partnerships with indigenous communities to preserve local knowledge systems and promote culturally inclusive learning environments.

Future studies may further explore learners' perspectives, comparative indigenous science practices, and the long-term impact of culturally grounded science instruction on learner achievement and cultural identity development.

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