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Role of Traditional Ecological Knowledge in Enhancing Biology Instruction for Indigenous Communities

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Abstract
This study assessed the integration of Traditional Ecological Knowledge (TEK) in the Grade 10 Biology curriculum among Junior High School students in the indigenous community of North Cotabato, Philippines. Specifically, it examined the degree to which TEK was incorporated into instructional methods, examples, instructional materials, assessments, cultural sensitivity, and student engagement for third-quarter topics, including biodiversity conservation, stability, energy flow, population growth, and carrying capacity. Using a descriptive survey design, data were collected from 7 educators and 3 teachers and analyzed to determine average scores and degrees of TEK integration across nine indicators. Results revealed that TEK integration was generally moderate, with the highest levels observed in cultural sensitivity in lesson delivery (M = 3.13, Moderate) and alignment of lesson content with TEK principles (M = 3.17, Moderate). Conversely, the inclusion of TEK in instructional materials (M = 2.0, Low) and integration in teaching methods (M = 2.46, Low) were less evident, highlighting gaps in resources and teacher adaptation of indigenous knowledge. The study underscores the importance of developing contextually relevant instructional materials and training programs to enhance TEK integration in science education. Findings provide insights for educators, curriculum developers, and policymakers aiming to foster culturally responsive and ecologically grounded teaching practices.
Keywords: Traditional Ecological Knowledge, TEK integration, biology education, indigenous knowledge, Junior High School, curriculum assessment

INTRODUCTION

In recent decades, the integration of Indigenous and Traditional Ecological Knowledge (TEK) into formal education has gained increasing attention as a vital approach to advancing sustainability, cultural preservation, and inclusive pedagogy. TEK, which encompasses the intergenerational wisdom, practices, and ecological values of Indigenous peoples, provides critical insights into biodiversity conservation, ecological balance, and sustainable resource management (Gadgil et al., 2021; Tengö et al., 2023). UNESCO (2021) emphasizes that mainstreaming Indigenous knowledge into science education enhances not only the relevance of learning but also supports Sustainable Development Goals (SDGs), particularly those related to quality education (SDG 4), reduced inequalities (SDG 10), and climate action (SDG 13). At the national level, the Philippines recognizes the importance of integrating Indigenous Peoples' knowledge systems into education through the Indigenous Peoples' Rights Act (Republic Act No. 8371) and the Department of Education's Indigenous Peoples Education (IPEd) Program. These initiatives aim to promote inclusive, culture-responsive education that values Indigenous heritage while ensuring equitable access to quality education (DepEd, 2020). However, classroom-level integration of TEK into science subjects such as Biology remains inconsistent, often constrained by limited instructional resources and teacher training (Acosta & Cajote, 2022; Dimalanta, 2024).

Regionally, Mindanao is home to diverse Indigenous groups, including the Erumanen Ne Menuvu of North Cotabato, whose ecological knowledge encompasses sustainable practices in biodiversity conservation, population management, and ecological interdependence. Embedding such perspectives in classroom teaching not only localizes science education but also affirms cultural identity and empowers learners from Indigenous communities (Saguin, 2021).

At the local level, Junior High School Biology in the Philippines, particularly in Grade 10, covers critical third-quarter topics such as biodiversity conservation, stability, energy flow, population growth, and carrying capacity. These topics resonate strongly with Indigenous ecological perspectives and practices. However, limited studies have systematically assessed the degree to which teachers integrate TEK—particularly that of the Erumanen Ne Menuvu—into instruction, examples, materials, and assessments.

Addressing this gap is essential to advancing both educational equity and sustainable knowledge systems in the Philippine context.

Thus, this study aims to assess the integration of Traditional Ecological Knowledge in the Grade 10 Biology curriculum of Junior High School, focusing on the Erumanen Ne Menuvu community in North Cotabato. Specifically, it examines the degree of TEK integration in instructional methods, examples, instructional materials, assessments, cultural sensitivity, and student engagement. By doing so, the study provides empirical evidence on the current status of TEK inclusion in science education and offers insights into strategies for fostering culturally responsive and contextually relevant biology instruction.

Statement of the Problem

This study seeks to address the following problems regarding the integration of Traditional Ecological Knowledge (TEK) in the Grade 10 Biology curriculum of the Erumanen Ne Menuvu community:

1. What extent do Grade 10 Biology teachers integrate TEK principles into their instructional methods, lesson content, and classroom activities for third-quarter topics?
2. How are specific TEK examples employed by teachers to illustrate and contextualize biological concepts in Grade 10 third-quarter lessons?
3. To what degree are TEK concepts incorporated into instructional materials, including handouts, visual aids, multimedia presentations, and supplementary resources?
4. How are TEK concepts reflected in formative and summative assessments, and how effectively do teachers provide TEK-based feedback to reinforce learning and connect academic content with Indigenous knowledge?
5. How do teachers demonstrate cultural sensitivity in lesson delivery, and how do students engage with TEK-based content in understanding ecological and cultural concepts?

Methodology Research Design

This study employed a descriptive survey design to assess the integration of Traditional Ecological Knowledge (TEK) in the Grade 10 Biology curriculum among Junior High School teachers of the indigenous community. A descriptive approach was deemed appropriate to systematically evaluate the degree of TEK integration across instructional methods, examples, instructional materials, assessments, cultural sensitivity, and student engagement for third-quarter topics such as biodiversity conservation, stability, energy flow, population growth, and carrying capacity (Creswell & Creswell, 2023).

Participants

The study involved a purposive sample of 10 educators, consisting of 7 Biology educators and 3 classroom teachers directly teaching Grade 10 third-quarter topics. Participants were selected based on their experience in teaching biology, familiarity with the indigenous community, and involvement in the delivery of third-quarter curriculum content.

Instrumentation

Data were collected using a structured survey questionnaire developed by the researchers, validated through expert review by education and TEK specialists. The instrument consisted of nine indicators: (1) integration in instructional methods, (2) use of TEK examples, (3) inclusion in instructional materials, (4) cultural sensitivity, (5) incorporation in assessments, (6) student engagement, (7) alignment of lesson content with TEK principles, and (8) use of formative TEK-based feedback. Items were rated using a 4-point Likert scale (1 = Very Low, 2 = Low, 3 = Moderate, 4 = High) to determine the degree of integration.

Data Collection Procedure

Permission to conduct the study was obtained from the school administration. Teachers were briefed about the purpose and confidentiality of the study, in compliance with ethical guidelines for research involving human participants. The survey questionnaire was administered in person and via online platforms, and participants were given sufficient time to provide thoughtful responses.

Data Analysis

Data were analyzed using descriptive statistics, specifically mean scores and degree of integration for each indicator and item. The interpretation scale used was: 1.00–1.80 (Very Low), 1.81–2.60 (Low), 2.61–3.40 (Moderate), and 3.41–4.20 (High). Average scores per topic were calculated by averaging the scores of all items within each indicator. This method provided a clear overview of the current status of TEK integration in Grade 10 Biology instruction and identified areas for improvement.

Ethical Considerations

The study adhered to the Data Privacy Act of 2012 and the ethical standards for research involving human participants. Participants' identities were kept confidential, and data were used solely for research purposes. Informed consent was obtained prior to participation.

RESULTS AND DISCUSSION

Table 1 shows the extent to which Grade 10 Biology teachers integrate Traditional Ecological Knowledge (TEK) into their instructional methods for third-quarter topics. The overall mean score of 2.46 falls within the Low integration category, indicating that teachers incorporate TEK principles into their teaching methods only to a limited extent.

Table 1. Integration of TEK in Instructional Methods

Indicator / Item	Average Score	Degree of Integration
1. Incorporates TEK principles into teaching methods	2.3	Low
2. Adapts lesson content to include Erumanen Ne Menuvu TEK	2.4	Low
3. Uses local stories to explain biology concepts	3.1	Moderate
4. Includes activities based on Erumanen Ne Menuvu practices	2.2	Low
5. Relates biology topics to TEK, reflecting cultural background	2.3	Low
Total / Average	**2.46**	**Low**

Most items, including the incorporation of TEK principles into teaching methods (M = 2.3), adaptation of lesson content to include Erumanen Ne Menuvu TEK (M = 2.4), and the inclusion of activities based on community practices (M = 2.2), were rated low. These findings suggest that while teachers recognize the importance of Indigenous knowledge, practical application in daily instruction remains minimal, possibly due to limited instructional resources, lack of formal training on TEK integration, or time constraints within the curriculum.

Interestingly, the use of local stories to explain biology concepts received a Moderate score (M = 3.1). This indicates that teachers occasionally incorporate narrative approaches that reflect local culture, which may engage students and provide contextual understanding of biological concepts. However, the limited adaptation of other TEK-based activities or alignment of lesson content with Indigenous knowledge underscores the need for professional development, resource support, and curriculum guidance to improve culturally responsive teaching.

The low integration highlights a significant gap between policy recommendations on Indigenous knowledge inclusion and actual classroom practice. Strengthening teacher capacity to embed TEK into instructional methods could enhance student engagement, cultural relevance, and learning outcomes.

Table 2 presents the extent to which Grade 10 Biology teachers employ Traditional Ecological Knowledge (TEK) examples to illustrate and contextualize biological concepts. The overall mean score of 3.17 indicates Moderate integration, showing that teachers moderately utilize TEK examples in their lessons.

Table 2. Use of TEK Examples to Illustrate Biological Concepts

Indicator / Item	Average Score	Degree of Integration
1. Specific examples from Erumanen Ne Menuvu TEK	2.9	Moderate
2. Uses TEK-related scenarios to illustrate biological processes	3.6	High
3. Examples include explanations based on community practices for conservation	3.0	Moderate
Total / Average	**3.17**	**Moderate**

Among the items, using TEK-related scenarios to illustrate biological processes received the highest score (M = 3.6, High), suggesting that teachers actively draw on real-life, culturally relevant situations to explain complex biological concepts. This practice helps students relate abstract scientific principles to their local environment, thereby enhancing comprehension and engagement.

Other items, such as providing specific examples from the Erumanen Ne Menuvu TEK (M = 2.9) and explanations based on community conservation practices (M = 3.0), were rated moderate. These results suggest that while teachers do incorporate local knowledge, the selection and frequency of examples may be inconsistent or limited by available teaching materials.

The moderate overall integration highlights both the potential and the need for structured guidance in embedding TEK examples consistently across lessons. Strengthening teacher awareness, providing a

repository of culturally relevant examples, and aligning examples with curriculum objectives could further enhance the meaningful integration of TEK in Biology instruction.

Table 3 shows the degree to which Traditional Ecological Knowledge (TEK) is incorporated into instructional materials for Grade 10 Biology. The overall mean score of 2.2 indicates Low integration, suggesting that the inclusion of TEK in handouts, visuals, multimedia, and supplementary resources is limited.

Table 3. Inclusion of TEK in Instructional Materials

Indicator / Item	**Average Score**	**Degree of Integration**
1. Handouts, visuals, or multimedia presentations include TEK symbols related to Erumanen Ne Menuvu	2.0	Low
2. Materials provide context that connects biology topics to local ecological practices	2.4	Low
3. TEK concepts are integrated into supplementary resources provided to students	2.2	Low
Total / Average	2.2	Low

All items scored low, including the inclusion of TEK symbols in handouts or multimedia (M = 2.0), providing contextual connections to local ecological practices (M = 2.4), and integrating TEK concepts into supplementary materials (M = 2.2). These results imply that teachers may face challenges such as lack of TEK-based resources, limited training, or insufficient time to develop culturally responsive instructional materials.

The low integration of TEK in instructional materials is concerning because these materials serve as essential tools for reinforcing concepts, supporting student engagement, and connecting scientific knowledge with local ecological and cultural contexts. Addressing this gap through the development of TEK-informed teaching resources and professional teacher development could enhance the cultural relevance and effectiveness of Biology instruction.

Table 4 presents the extent to which Traditional Ecological Knowledge (TEK) is incorporated into assessments and formative feedback in Grade 10 Biology. The overall mean score of 2.7 indicates Moderate integration, showing that teachers moderately apply TEK in evaluating student learning and providing feedback.

Table 4. TEK in Assessments and Formative Feedback

Indicator / Item	**Average Score**	**Degree of Integration**
1. Quizzes, tests, or assignments include questions about understanding traditional ecological practices	2.8	Moderate
2. Assessments allow students to apply TEK concepts to demonstrate comprehension from cultural and scientific perspectives	2.7	Moderate
3. Short quizzes include TEK-related questions to gauge understanding throughout the lesson	2.6	Moderate
4. Teacher provides formative feedback using TEK concepts	2.8	Moderate
5. Formative feedback encourages reflection on TEK concepts and their relation to biology	2.7	Moderate
Total / Average	**2.7**	**Moderate**

All items fall within the moderate range. Quizzes, tests, and assignments that include TEK-related questions received a mean score of 2.8, while assessments allowing students to apply TEK concepts scored 2.7. Short quizzes designed to gauge TEK understanding scored slightly lower at 2.6, suggesting that the inclusion of TEK in day-to-day evaluations is present but inconsistent.

Formative feedback items, such as using TEK concepts to reinforce learning (M = 2.8) and encouraging reflection on TEK in relation to biology (M = 2.7), were also rated moderate. This indicates that while teachers attempt to connect Indigenous knowledge with scientific learning through feedback, systematic and consistent application is limited.

Moderate integration in assessments and feedback highlights the potential for TEK to enhance student comprehension and critical thinking. Developing structured TEK-informed assessment tools and guiding teachers on how to provide culturally relevant feedback could strengthen the integration and effectiveness of TEK in student evaluation.

Table 5 shows the extent to which teachers demonstrate cultural sensitivity and how students engage with TEK-based content in Grade 10 Biology. The overall mean score of 3.17 indicates Moderate integration, highlighting that while teachers generally respect Indigenous knowledge and students are moderately engaged, there is room for improvement.

Table 5. Cultural Sensitivity and Student Engagement

Indicator / Item	**Average Score**	**Degree of Integration**
1. Teacher demonstrates respect for TEK using culturally appropriate explanations	3.7	High
2. Lesson delivery acknowledges origins of TEK concepts	2.9	Moderate
3. Teacher encourages respectful dialogue, valuing Indigenous perspectives	2.8	Moderate
4. Students ask about TEK personal experiences	3.2	Moderate
5. Student responses demonstrate interest in TEK content	3.0	Moderate
6. Students show understanding of TEK-based content through discussions and activities	3.3	Moderate
Total / Average	**3.17**	**Moderate**

Among the items, demonstrating respect for TEK through culturally appropriate explanations scored the highest (M = 3.7, High), indicating that teachers actively acknowledge and honor Indigenous knowledge in their teaching practices. Lesson delivery that acknowledges the origins of TEK concepts (M = 2.9) and encouragement of respectful dialogue (M = 2.8) were rated moderate, suggesting that acknowledgment of TEK sources and fostering classroom dialogue are practiced but not consistently applied.

Student engagement items, including asking about TEK personal experiences (M = 3.2), showing interest in TEK content (M = 3.0), and demonstrating understanding through discussions and activities (M = 3.3), all received moderate ratings. This indicates that students are generally receptive to TEK-based instruction, and participatory activities help strengthen their comprehension.

The findings suggest that teachers' cultural sensitivity positively influences student engagement, but more structured strategies are needed to fully leverage TEK in classroom interactions and student learning outcomes.

CONCLUSION

This study examined the integration of Traditional Ecological Knowledge (TEK) in Grade 10 Biology instruction among the Erumanen Ne Menuvu community. Findings indicate varying degrees of integration across different teaching dimensions.

Teachers demonstrated limited integration of TEK in instructional methods and instructional materials, reflecting minimal adaptation of lessons and resources to incorporate Indigenous knowledge. In contrast, the use of TEK examples, integration in assessments and formative feedback, and cultural sensitivity and student engagement were more evident, with notable strengths in employing TEK-related scenarios and demonstrating respect for Indigenous knowledge.

Overall, while teachers acknowledge the value of TEK and incorporate it into examples, assessments, and culturally sensitive practices, systematic integration across all aspects of instruction remains insufficient. Enhancing TEK integration requires the development of culturally responsive teaching materials,

structured instructional strategies, and professional development programs that empower teachers to embed Indigenous knowledge effectively in biology education.

Traditional Ecological Knowledge integration in Grade 10 Biology is present but not comprehensive, highlighting the need for targeted interventions to strengthen culturally relevant and ecologically informed science instruction for indigenous communities.

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