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Research Article

Development and Validation of Contextualized Blaan Learning Material and Its Effects on Grade 10 Students' Ecology Mastery

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Abstract

Grounded in culturally responsive pedagogy and constructivist learning theory, this study examined the effectiveness of Contextualized Blaan Learning Material in improving ecology mastery among Grade 10 students at Landan National High School. Achievement disparities among Indigenous Blaan learners are frequently linked to the limited integration of culturally relevant knowledge systems in formal science instruction. A quasi-experimental pre-test–post-test control group design was employed with 60 students assigned to experimental and control groups. The intervention incorporated Blaan cultural narratives and indigenous ecological knowledge to scaffold conceptual understanding and promote meaningful learning. Ecology mastery was assessed using validated, curriculum-aligned instruments with established reliability coefficients ($\alpha = []$). Paired-samples *t*-tests revealed a significant within-group increase in post-test scores for the experimental cohort ($t = []$, $p < .05$), while independent-samples *t*-tests indicated significantly higher mean gain scores relative to the control group ($t = []$, $p < .05$), with a moderate-to-large practical effect (Cohen's $d = []$). Participants exposed to the intervention advanced to a “Moving Toward Mastery” proficiency level, whereas the control group-maintained baseline performance. These results demonstrate that culturally contextualized instruction yields statistically and educationally meaningful gains in ecological understanding. The findings contribute empirical support to the theoretical proposition that integrating Indigenous knowledge systems enhances cognitive engagement and conceptual retention. The study underscores the need for systemic curriculum innovation, sustained teacher professional development, and policy-level support to institutionalize culturally responsive science education and advance equity for Indigenous learners.

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1. Introduction

Integrating contextualized Blaan Learning Materials into the educational framework is crucial for meeting the unique cultural and educational needs of Blaan students in the Philippines. This community has faced long-standing marginalization within conventional education systems that often overlook Indigenous perspectives. The development of culturally relevant resources is essential for enhancing student engagement and improving academic outcomes among Indigenous populations. By incorporating Blaan traditions, languages, and worldviews into the curriculum, educators foster a more inclusive learning environment that empowers Blaan students and affirms their identity.

According to Guido (2017), culturally responsive teaching strategies include a range of approaches that focus on empowering students and promoting active learning. This includes active learning strategies that put students at the center of the learning process, experiential learning activities that provide direct, first-hand experience, and project-based learning that involves open-ended curriculum-related questions or challenges.

In the study conducted by Kovach (2021), Indigenous methodologies highlight the necessity of incorporating Contextualized Learning Materials that reflect cultural relevance and community context, significantly enhancing students' learning experiences and outcomes. By engaging with curriculum content tied to their cultural narratives, Indigenous students can foster a deeper connection to the material, promoting academic success and a sense of belonging. This approach is particularly effective in teaching complex concepts like ecosystems, where understanding is enriched by local knowledge.

Student mastery level is a critical indicator of educational effectiveness and directly influences academic achievement. According to Ramdani

et al. (2021), fostering a high level of mastery among students requires the use of targeted instructional strategies and resources that align with their learning needs. Effective educational interventions, particularly those that emphasize contextualized learning, have been shown to significantly enhance students' understanding and retention of key concepts.

At Landan National High School, situated in the municipality of Polomolok with a significant IP population, the absence of IP education in the curriculum has been noted to perpetuate stereotypes and misconceptions about IP cultures. This lack of representation and understanding has been linked to low academic performance and disengagement among IP students.

This study aimed to investigate the effectiveness of contextualized Blaan learning materials to students' mastery of Ecology. Integrating these materials into the curriculum is a crucial step toward fostering an inclusive environment for Indigenous students.

Statement of the Problem

This study aimed to evaluate how Contextualized Blaan Learning materials affect Grade 10 students' understanding of Ecology at Landan National High School.

Specifically, the research sought to address the following questions:

1. Developed and validated a Blaan contextualized learning material to determine its effect on students mastery level in ecology.
2. Determined the content validity of the Blaan contextualized learning material for Grade 10 students in terms of:
 - a. Objectives;
 - b. Concepts;
 - c. Skills;
 - d. Usability;

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- e. Appropriateness; and
 - f. Adequacy
3. What is the mastery level of students in the concept of ecology before the intervention?
 4. What is the mastery level of students in the concept of ecology after the intervention?
 5. Is there a significant difference between the mean scores of the pre- test and post-test mean scores of the control group?
 6. Is there a significant difference between the pre-test and post-test mean scores of the experimental group?
 7. Is there a significant difference between pre-test mean scores of the control group and experimental group?
 8. Is there a significant difference between the post-test mean scores of the control and experimental group?
 9. Is there a significant difference between the mean gain scores of the pre-test and post-test of the control and experimental group?

1.1 Intervention

This action research aimed to enhance the mastery level of Grade 10 students in Ecology through the integration of contextualized Blaan learning materials at Landan National High School. The intervention was designed to address cultural disconnects in traditional science instruction by embedding Blaan ecological narratives, practices, and values into lesson content. By aligning the material with the K to 12 Science Curriculum while incorporating Indigenous knowledge, the contextualized approach sought to increase both comprehension and engagement among students, particularly those from the Blaan community.

The intervention focused on improving student mastery, promoting inclusivity, and validating Indigenous cultural identity through relevant and localized learning experiences. Implemented using a quasi- experimental design, the intervention group demonstrated a significant increase in mean gain scores and mastery level compared to the control group. This outcome underscores the effectiveness of culturally responsive teaching strategies in bridging academic gaps and fostering a more equitable and meaningful science education for Indigenous learners

1.2 Significance of the study

This study aimed to evaluate the effects of contextualized Blaan learning materials in enhancing grade 9 students' mastery of ecological concepts. Its significance is highlighted for the following groups:

To DepEd Policy Makers. This study provides evidence regarding the effectiveness of contextualized learning materials, which can influence curriculum development and instructional strategies. Insights gained can assist policymakers in allocating resources effectively towards innovative teaching materials that enhance student engagement and improve learning outcomes in ecology.

To Teachers. Educators can utilize the findings to increase student interest and motivation in ecology, leading to a deeper understanding and better retention of ecological concepts. This research can serve as a basis for training programs focused on integrating contextualized Blaan materials into lesson plans, fostering teacher creativity and adaptability in their instructional approaches.

To Students. Engaging with contextualized Blaan learning materials can help simplify complex ecological concepts, making them more relatable and easier to understand. This study will promote active engagement, allowing students to connect emotionally and cognitively with the material, which can enhance their

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ecological awareness and sense of responsibility toward the environment.

To Future Researchers. This study can serve as a foundation for further research on the impact of contextualized learning materials in various subjects, particularly in the domain of ecology. It will provide a reference for examining long-term retention of knowledge gained through these materials, contributing to a broader understanding of effective educational strategies in ecological education.

By highlighting these points, the study not only will contribute to immediate educational practices but also establishes a framework for ongoing exploration and improvement in teaching methodologies within the field of ecology.

Review of Related Literature

1.3 Indigenous Pedagogy and Educational Frameworks

The discourse on Indigenous education emphasizes a transformative shift from Western-centric paradigms toward frameworks grounded in sovereignty and cultural reclamation. Gilgen (2016) posits that education serves as a fundamental vehicle for human rights only when teaching methodologies actively dismantle historical injustices by integrating Indigenous knowledge systems. This necessity is echoed by Stavenhagen (2015), who identifies a significant "disconnect" in traditional curricula that neglect Indigenous histories, advocating for inclusive systems that empower communities to preserve their cultural heritage. Central to this transformation is the concept of sovereignty; Brayboy et al. (2015) argue that Indigenous education must be rooted in spiritual and historical contexts to validate student identities effectively. Furthermore, Robles (2016) critiques mainstream practices for failing to recognize Indigenous epistemologies, calling for a "reclaiming" of education through community-driven initiatives. This perspective is reinforced by Bodkin-Andrews, Page, and

Trudgett (2024), who critique assimilationist policies and highlight the importance of actively incorporating Indigenous perspectives to achieve equity. The role of the educator is also pivotal; Vickers (2023) notes that engaging with Indigenous content compels teachers to confront institutional biases, ultimately fostering a more inclusive pedagogical environment. Finally, Hawkins (2022) emphasizes that the adoption of culturally responsive methodologies—such as storytelling and experiential activities—not only improves academic outcomes but also cultivates a critical sense of belonging among marginalized learners.

1.4 Contextualization as a Nexus for Science Literacy

Contextualization in science education functions as a critical bridge between abstract ecological principles and the lived environmental realities of learners. Sánchez Tapia, Krajcik, and Reiser (2017) provide empirical evidence that scientific comprehension, specifically regarding natural selection and ecology, is significantly enhanced when instructional materials are anchored in a student's specific cultural and environmental milieu. This is corroborated by a meta-analysis by Picardal and Sanchez (2022), which demonstrates that contextually integrated materials in the Philippines markedly improve science literacy and student engagement across diverse settings. Webb (2016) further explores the epistemological implications of this bridge, advocating for collaborative pedagogical practices that facilitate a dialogue between Western science and Indigenous ways of knowing. Complementing this, Zidny et al. (2021) argue that such integration fosters a more holistic understanding of scientific concepts while promoting sustainable development through the valuation of diverse knowledge systems.

The efficacy of these materials, however, is often dependent on systemic support; Gerodias (2023) underscores the necessity of pairing contextualized learning activity sheets with targeted teacher training in Indigenous

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Knowledge Systems and Practices (IKSP). Abrams, Taylor, and Guo (2017) emphasize that these tailored approaches are vital for Indigenous students to relate complex academic content to their cultural identities, preventing the alienation often found in traditional STEM environments. Ultimately, as Kirkness and Barnhardt (2017) suggest, the formation of meaningful partnerships with Indigenous elders and community members allows for the development of a more relevant and relatable science education experience that honors the local context.

1.5 Mastery Learning and Academic Achievement Dynamics

The attainment of student mastery—defined as the comprehensive understanding of foundational concepts—is optimized through structured, culturally resonant instructional strategies. Trocio, Campos, and Yu (2023) highlight that learning materials reflecting local oral lore, such as that of the Blaen, significantly enhance comprehension and support the mastery of educational objectives. This finding is supported by the work of Malong et al. (2018), who demonstrate that project-based learning contextualized to community needs allows students to effectively bridge theoretical knowledge with real-life application, elevating overall mastery levels. From a cognitive perspective, Adeyemo and Babajide (2014) assert that mastery learning approaches ensure high achievement levels by requiring competency before advancing, a process furthered by the use of relatable materials. Zulkarnaen, Supardi, and Jatmiko (2018) link this conceptual mastery to scientific creativity, suggesting that culturally grounded knowledge provides the foundation for innovative scientific inquiry.

Furthermore, Groen et al. (2015) advocate for sequential, structured learning experiences that build problem-solving abilities and conceptual depth. Prayitno et al. (2017) emphasize that targeted contextualized strategies are essential for closing skill gaps among students of varying

achievement levels, fostering an inclusive environment for skill development. Finally, the findings of Ugwu (2016) demonstrate that students exposed to instruction infused with Indigenous knowledge achieve significantly higher academic scores compared to those in conventional classroom settings, validating the efficacy of culturally localized materials in driving academic success.

The current landscape of Indigenous Peoples Education (IPEd) and science pedagogy is well-established regarding the theoretical benefits of culturally responsive teaching. What is known is that the integration of Indigenous knowledge systems significantly enhances student engagement, builds a sense of cultural belonging, and improves general academic achievement across diverse Indigenous groups globally. Within the Philippine context, existing research—including recent meta-analyses—confirms that contextualized learning materials are effective tools for improving science literacy by bridging the gap between abstract scientific principles and the learners' lived experiences. Furthermore, mastery learning approaches have been validated as superior to traditional instructional methods in ensuring that foundational competencies are achieved before students progress to more complex scientific topics.

However, despite these broad pedagogical advancements, specific applications remain underexplored, particularly concerning the development and empirical validation of ecology-specific instructional materials for the Blaen community. While general science contextualization exists, there is a distinct lack of validated learning modules that integrate the unique ecological knowledge and oral lore of the Blaen people at Landan National High School. This study uniquely contributes to the field by moving beyond general advocacy for IPEd to provide a rigorous, data-driven validation of a localized learning material specifically designed for Grade 10 Ecology. By documenting the direct effect of these Blaen-centric materials on

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student mastery levels, this research offers a replicable framework for educators seeking to

harmonize academic rigor with Indigenous cultural integrity in the STEM curriculum.

1.6 Conceptual Framework

The conceptual framework of this study is centered on investigating the relationship between the independent variable—the efficacy of contextualized Blaan learning materials—and the dependent variable, which is the students' level of mastery in ecology concepts. In this study, the mastery level was evaluated through a pre-test and a post-test, allowing for a comparative analysis of student understanding before and after exposure to the learning materials. The objective was to assess how effectively the contextualized Blaan learning materials enhance the understanding of ecology concepts among students. The study's design incorporated a control group to provide a benchmark for assessing the impact of the new teaching strategy; students in this group will be instructed using traditional teaching methods.

In the framework, the experimental group consisted of students who are exposed to the contextualized Blaan learning materials, which are designed to resonate with their cultural context and enhance engagement. This approach is anticipated to foster a deeper understanding of ecological concepts through relatable and

meaningful content. By juxtaposing the experimental group against the control group, which utilized conventional teaching methods, the study aimed to identify significant differences in mastery levels. Ultimately, the findings provided insights into the effectiveness of culturally relevant educational strategies in improving students' academic performance in ecology and contributed to a broader understanding of how context-aware learning materials can enhance educational outcomes.

This study's conceptual framework, structured around the Input- Process-Output (IPO) model, posited that the "Contextualized Blaan Learning Materials and Traditional Teaching Materials serve as the Input. The Process involved the teaching and learning activities utilizing these materials, followed by a comparative analysis of the mean scores between the groups. Ultimately, the Output is defined by the "Students' Mastery Level in Ecology Concepts," as measured through pre-test and post-test results, mean gain scores, and the statistical significance of differences observed between the control and experimental groups.

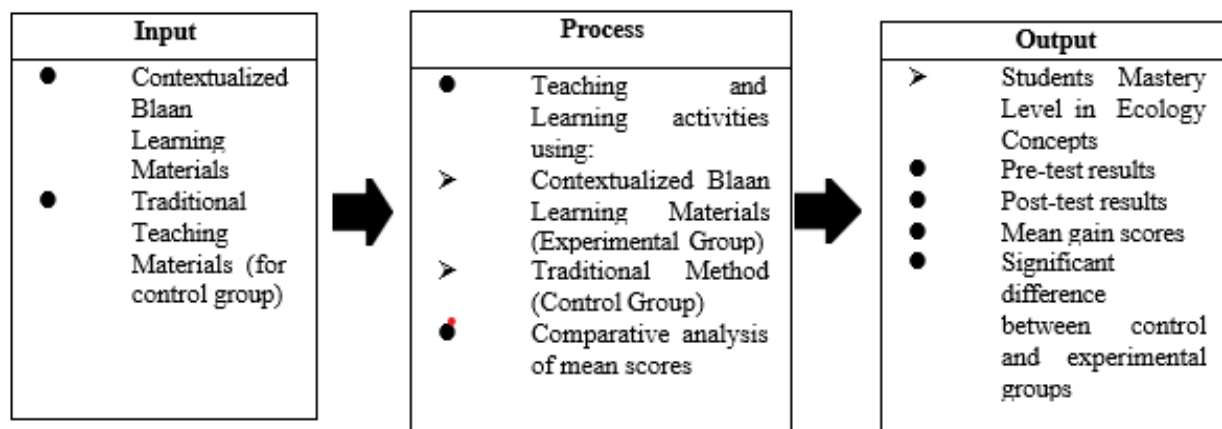


Figure 1: IPO Model

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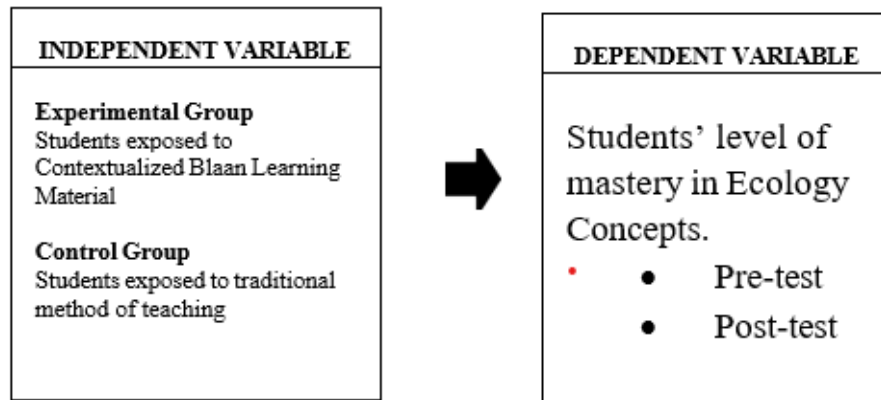


Figure 2: Conceptual Framework

2. Materials and Methods

2.1 Research Design and Locale

The study utilized a quasi-experimental, non-equivalent control group design. This design was selected because random assignment of individual students was not feasible due to administrative constraints at Landan National High School; the researchers were required to utilize existing, intact classroom structures to minimize disruption to the school's academic schedule.

A total of 60 Grade 10 students were selected through purposive sampling. This method was justified by the need to involve participants who identify as members of the B'laan community, ensuring that the culturally specific content of the Contextualized B'laan Learning Material (CBLM) aligned with the learners' lived experiences.

To ensure group equivalence, the two groups were selected based on their similar academic profiles and comparable mean scores from the previous grading period. Furthermore, statistical analysis of pre-test results confirmed no significant difference in baseline mastery levels between the control and experimental groups ($p > .05$), effectively mitigating selection bias and internal validity threats.

2.2 Intervention Protocol and Instructional Fidelity

The intervention was conducted over a period of four weeks, covering specific modules in Grade 10 Ecology as outlined in the K to 12 Science Curriculum. The control group received instruction through conventional teaching modalities, whereas the experimental group utilized the CBLM, which integrated B'laan cultural narratives and Indigenous ecological practices.

To ensure instructional fidelity, both groups were taught by the same instructor following a standardized lesson plan format. The researchers monitored consistency through a fidelity checklist, ensuring that the duration of exposure, the delivery of content, and the classroom activities remained uniform across both cohorts, with the only varying factor being the instructional material used.

2.3 Ethical Considerations

The study adhered to strict ethical protocols to protect the rights and well-being of the participants. Prior to data collection, formal permission was secured from the Office of the Schools Division Superintendent and the Principal of Landan National High School.

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2.4 Voluntary Participation and Confidentiality

Participation was entirely voluntary, and students were informed of their right to withdraw at any time without academic penalty. To ensure confidentiality, all data were anonymized using alphanumeric codes, and

results were reported in aggregate form to prevent the identification of individual students. All physical and digital records were stored in a secure location accessible only to the research team.

2.5 Data Analysis

Following the intervention phase, both cohorts were administered a validated post-test. The resulting data were subjected to paired-sample t-tests to measure intra-group progress and independent-sample t-tests to determine inter-group variance. This comparative

framework provided the empirical evidence required to evaluate the impact of culturally localized instruction on student mastery levels. The scale below, adapted from DepEd's 7 Levels of Mastery, was employed to describe the mastery level of students in concepts of ecology.

Table 1. Levels of Mastery

Score Range	Mean Percentage Score	Description
48-50	96-100%	Mastered
43-47	86-95%	Closely Approximating Mastery
33-42	66-85%	Moving towards Mastery
18-32	35-65%	Average
8-17	15-34%	Low
3-7	5-14%	Very Low
0-2	0-4%	Absolutely no Mastery

3. Results and Discussions

Table 2. Validity level of Instructional Material in terms of objectives

Item	Mean
1. Clearly stated and specific	4.33
2. Measurable	4.33
3. Attainable	4.67
4. Realistic	4.33
Mean of Objectives	4.42

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The content validity of the objectives of the Contextualized Blaan Learning Material was assessed by the validators, yielding a mean score of 4.42.

According to the scale provided, this indicates a High Extent of content validity for the objectives. This suggests that the expert evaluators generally perceived the learning objectives to be clearly stated and specific, measurable, attainable, and realistic, aligning with the intended learning outcomes of the module.

The high extent of content validity observed for the learning material's objectives underscores the

foundational principle that clearly defined objectives are crucial for effective instructional design.

As emphasized by Anderson (2017), well-formulated objectives serve as the bedrock for aligning content, teaching strategies, and assessment, thereby ensuring that the learning material effectively targets the intended educational outcomes.

The positive evaluation by the validators suggests that the objectives of the Contextualized Blaan Learning Material for Grade 10 Science are robust in guiding the learning process

Table 3. Validity level of Instructional Material in terms of concepts

Item	Mean
1. Based on learning competencies of Grade 10 Science	4.33
2. Within the curriculum of Grade 10 Science	4.67
3. Systematically and sequentially arranged	4.00
4. Vocabulary used in the Module is simple	5.00
5. Concepts are related to Grade 10 Prescriptions	4.33
Mean of Concepts	4.47

The evaluation of the concepts presented within the learning material resulted in a mean score of 4.47, which also corresponds to a High Extent of content validity.

This finding implies that the validators considered the fundamental concepts to be appropriately based on the Grade 10 Science learning competencies and curriculum, presented in a logically sequenced manner, utilizing suitable vocabulary, and relevant to the prescribed content.

The determined high extent of content validity for the concepts within the learning material

aligns with contemporary perspectives on science education, which stress the importance of accurate and contextually relevant conceptual frameworks.

According to Krajcik and Reiser (2019), effective science instruction hinges on presenting core concepts in a manner that is both scientifically sound and accessible to learners.

The validators' assessment indicates that the Blaan learning material adeptly presents fundamental science concepts relevant to the Grade 10 curriculum.

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Table 4. Validity level of Instructional Material in terms of skills

Item	Mean
1. Congruent to the objective	4.67
2. Varied and fundamental	4.67
3. Higher order thinking skills are balanced	4.67
4. Promotes experiences for individual assessment in Grade 10 Science	4.67
5. Skill-based, challenging and interesting	4.33
Mean of Skill	4.60

The extent to which the learning material effectively develops the intended skills was assessed, resulting in a mean score of 4.60. This score falls within the Very High Extent category.

This indicates a strong agreement among the validators that the learning activities are well-designed to foster skills that are congruent with the learning objectives, encompass a variety of fundamental aspects, promote balanced higher-order thinking, facilitate individual assessment of learning, and are engaging, challenging, and skill-focused.

The very high extent of content validity in the skills dimension resonates with current educational trends that prioritize the development of competencies necessary for the 21st century. Research by Care, Griffin, and McGaw (2018) highlights the significance of embedding opportunities for skill development within learning materials to foster deeper learning and the ability to apply knowledge in meaningful contexts. The validators' high rating suggests that the Blaan learning material effectively integrates activities that promote essential science skills among Grade 10 learners.

Table 5. Validity level of Instructional Material in terms of usability

Item	Mean
1. Logically presented from simple to complex ones	4.33
2. Instructions are clear and easy to follow	4.67
3. Character is presented in vivid letters	4.00
4. Some exercises are fitted for individual and group work	4.33
5. Exercise can be adopted in other Grade 10 Science book	5.00
Mean of Usability	4.47

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The usability of the Contextualized Blaan Learning Material was evaluated, and the mean score obtained was 4.47, indicating a High Extent. This suggests that the validators generally found the material to be logically organized, progressing from simpler to more complex elements, with instructions that are clear and easy to understand.

Furthermore, the presentation, including character depictions, was deemed appropriate, and the material was considered adaptable for various learning contexts within Grade 10 Science.

The high extent of usability observed in the learning material is consistent with principles of effective educational resource design.

As noted by Lowenthal (2015), the ease with which learners can navigate and interact with instructional materials significantly impacts their learning experience.

Clear organization, straightforward instructions, and appropriate presentation contribute to the overall usability, which the validators found to be a strength of the Blaan learning material.

Table 6. Validity level of Instructional Material in terms of appropriateness

Item	Mean
1. Contents are congruent and correlative with learning competencies	4.67
2. Module measures the study	5.00
3. Provides different exercises for different learner capabilities	4.67
4. Exercises are varied and suited to the objectives of the lesson	4.00
5. Exercises enhance the student's science skill	4.67
Mean of Appropriateness	4.60

The appropriateness of the learning content was rated with a mean score of 4.60, which signifies a Very High Extent. This finding reflects a strong consensus among the validators that the content is well-aligned and correlative with the specified learning competencies, effectively serves the purpose of the study, offers varied exercises catering to different learner capabilities, is suitable for the objectives of the lessons, and contributes to the enhancement of students' science skills. The very high extent of

appropriateness aligns with the growing body of research on culturally responsive teaching and the importance of contextualizing learning. Gay (2018) argues that culturally relevant pedagogy not only respects students' cultural backgrounds but also uses them as a bridge to learning.

The validators' assessment suggests that the Blaan learning material is highly suitable and relevant to the cultural context of the Grade 10 learners, enhancing its effectiveness.

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Table 7. Validity level of Instructional Material in terms of adequacy

Item	Mean
1. Adequate and comprehensive to ensure understanding of concepts and mastery of skills	4.33
2. Objectives are sufficient to fully cover the learning competency objectives	4.00
3. Set of exercises is sufficient to fully develop concepts and skills among learners	4.67
4. Set of exercises is sufficient in quantity and varying level of difficulty	5.00
5. Exercises are presented in scientific and analytic forms	4.67
Mean of Adequacy	4.53

The adequacy of the learning material was assessed, and the mean score was 4.53, denoting a Very High Extent. This suggests that the validators perceived the material to be sufficiently comprehensive for facilitating the understanding of concepts and the mastery of skills. It also implies that the learning material has an adequate number of objectives and exercises, offers a range of difficulty, and is presented in a manner consistent with scientific and analytic principles.

The determined very high extent of adequacy reflects the importance of comprehensive and

sufficient learning experiences in educational materials.

As posited by Wiggins and McTighe (2014) in their work on Understanding by Design, effective learning requires a curriculum and resources that provide adequate depth and breadth to enable students to achieve the desired understandings and skills.

The validators' rating indicates that the Blaan learning material offers a sufficient scope and quality of content and activities for Grade 10 Science learners.

Table 8. Summary of Content Validity of Contextualized Blaan Learning Material

Dimension	Mean Score	Extent
Objectives	4.42	High Extent
Concepts	4.47	High Extent
Skills	4.60	Very High Extent
Usability	4.47	High Extent
Appropriateness	4.60	Very High Extent
Adequacy	4.53	Very High Extent
Total Mean	4.515	Very High Extent

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The content validity of the Contextualized Blaan Learning Material for Grade 10 Science was evaluated across six dimensions by expert validators. The mean scores for each dimension were consistently high, ranging from 4.42 (High Extent) to 4.60 (Very High Extent). Calculating the overall mean across all dimensions yields 4.515, which falls into the "Very High Extent" category based on the provided scale. This indicates that the expert validators generally perceived the learning material to possess a very high level of content validity, suggesting it is a well- designed and appropriate resource for its intended purpose

Establishing the content validity of instructional materials is a critical initial step in ensuring their

potential effectiveness. Morrison et al. (2019) underscore that content validity addresses whether the substance of an instrument or material adequately represents the content domain it is intended to measure or cover. A rigorous evaluation by subject matter experts, as employed in this study, directly contributes to ascertaining this crucial aspect of validity, thereby providing a foundational assurance that the learning material aligns with the intended curriculum and learning objectives.

The high overall content validity observed in the Contextualized Blaan Learning Material suggests that it has undergone a pertinent initial validation process as recommended in the field of instructional design.

Table 9. Mastery Level of Grade 10 students in Ecology before the study intervention

Score	Control Group		Experimental Group		Description
	<i>f</i>	%	<i>f</i>	%	
48 - 50	0	0	0	0	Mastered
43 - 47	0	0	0	0	Closely Approximating Mastery
33 - 42	0	0	0	0	Moving Towards Mastery
18 - 32	13	43.33	17	56.67	Average
8 - 17	17	56.67	13	43.33	Low
3 - 7	0	0	0	0	Very Low
0 - 2	0	0	0	0	Absolutely No Mastery
Mean	17.7		17.8		
Description	Average		Average		

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Table 9 presents the mastery level of Grade 10 students in Ecology during the pre-test assessment.

The results reveal that both the experimental and control groups exhibited an average level of mastery, with mean scores of 17.7 (SD = 4.29) for the control group and 17.8 (SD = 3.03) for the experimental group. These comparable mean scores suggest that the two groups were

academically similar before any intervention. Additionally, the standard deviations indicate a moderate variation within each group's performance prior to treatment.

Establishing this baseline mastery is crucial to ensure that any changes observed post-intervention are attributed to the use of contextualized materials rather than to pre-existing differences.

Table 10. Mastery Level of Grade 10 students in Ecology after the study intervention

Score	Control Group		Experimental Group		Description
	<i>f</i>	%	<i>f</i>	%	
48 - 50	0	0	1	3.33	Mastered
43 - 47	0	0	3	10	Closely Approximating Mastery
33 - 42	0	0	17	56.67	Moving Towards Mastery
18 - 32	30	100	9	30	Average
8 - 17	0	0	0	0	Low
3 - 7	0	0	0	0	Very Low
0 - 2	0	0	0	0	Absolutely No Mastery
Mean	24.9		36.0		
Description	Average		Moving Towards Mastery		

Table 10 presents the mastery level of Grade 10 students in Ecology based on the post-test assessment.

The results revealed that 100% of learners in the control group remained at the average mastery level, while 56.67% of learners in the experimental group progressed toward the

mastery level. This is supported by a mean score of 24.9 (SD = 3.65) for the control group and a notably higher mean score of 36.0 (SD = 5.16) for the experimental group.

These results suggest a substantial difference in academic performance between the two groups following the intervention. Furthermore, the

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relatively varied standard deviations indicate that although both groups showed diverse

performance outcomes, the experimental group's scores were markedly higher overall.

Table 11. Difference between Pre-test and Post-test Scores of the Control Group

Group	Mean	SD	t	p-value	Remarks	Decision
Pre-Test	17.7	4.29	-12.8	0.000*	Significant	Reject Null Hypothesis
Post-Test	24.9	3.65				

*Note. t is used to represent the t-test statistic. * indicates $p < 0.001$.*

Table 11 presents the results of a paired samples t-test assessing whether there is a significant difference between the pre-test and post-test scores of the control group. The results revealed a significant difference between the scores, as indicated by the t statistic of -12.8 and p-value of 0.000*. A p-value of less than 0.05 ($p = 0.000* < 0.05$) indicates that there is a

significant difference between the pre-test and post-test scores of the control group. Specifically, students in the control group achieved significantly higher scores in their post-test when compared to their pre-test.. These findings suggest that students in the control group improved their mastery in Ecology using the traditional approach.

Table 12. Difference between Pre-test and Post-test Scores of the Experimental Group

Group	Mean	SD	t	p-value	Remarks	Decision
Pre-Test	17.8	3.03	-17.4	0.000*	Significant	Reject Null Hypothesis
Post-Test	36.0	5.16				

*Note. t is used to represent the t-test statistic. * indicates $p < 0.001$.*

Table 12 presents the results of a paired samples t-test assessing whether there is a significant difference between the pre-test and post-test scores of the experimental group. The results revealed a significant difference between the scores, as indicated by the t-statistic of -17.4 and p-value of 0.000*. A p-value of less than 0.05 ($p = 0.000* < 0.05$) indicates that there is significant difference between the pre-test and

post-test scores of the experimental group. Specifically, students in the experimental group achieved significantly higher scores in their post-test when compared to their pre-test.

These findings suggest that students in the experimental group improved their mastery in Ecology using the Contextualized Blaen Learning Material.

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Table 13. Difference in the Pre-test Scores of the Control and Experimental Groups

Group	Mean	SD	t	p-value	Remarks	Decision
Control	17.7	4.29	-0.139	0.890*	Not Significant	Accept Null Hypothesis
Experimental	17.8	3.03				

*Note. t is used to represent the t-test statistic. * indicates $p < 0.001$.*

Table 13 presents the results of an independent sample t-test assessing whether there is a significant difference between the pre-test scores of the control and experimental groups.

The results revealed no significant difference between the pre-test scores, as indicated by a t-statistic of -0.139 and a p-value of 0.890. A p-value greater than 0.05 ($p = 0.890 > 0.05$) suggests that the difference in pre-test scores between the two groups is not statistically significant. This finding highlights the importance of carefully matching students based

on their initial mastery level in ecology prior to the implementation of different treatments.

The statistically insignificant difference in mean pre-test scores supports the assumption that both groups were at a comparable level of learning performance, thereby reducing potential biases.

According to the Publication Manual of the American Psychological Association (7th edition), establishing baseline comparability is essential for ensuring the internal validity of experimental research designs.

Table 14. Difference in the Post-test Scores of the Control and Experimental Groups

Group	Mean	SD	t	p-value	Remarks	Decision
Control	24.9	3.65	-9.65	0.000*	Significant	Reject Null Hypothesis
Experimental	36.0	5.16				

*Note. t is used to represent the t-test statistic. * indicates $p < 0.001$.*

Table 14 presents the results of an independent samples t-test assessing whether there is a significant difference between the post-test scores of the control and experimental groups.

The results revealed a significant difference between the post-test scores of these groups, as indicated by the t statistic of -9.65 and p-value of 0.000*. A p-value of less than 0.05 ($p = 0.000* < 0.05$) indicates that there is significant

difference between the post- test scores of the control and experimental groups.

Specifically, students in the experimental group achieved significantly higher scores in their post-test when compared to the control group.

This underscores the effectiveness of utilizing Contextualized Blaan Learning Material in teaching compared to traditional methods.

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Table 15. Difference in the Mean Gain Scores of the Control and Experimental Groups

Group	Mean	SD	t	p-value	Remarks	Decision
Control	7.20	3.09	-9.24	0.000*	Significant	Reject Null Hypothesis
Experimental	18.2	5.74				

*Note. t is used to represent the t-test statistic. * indicates $p < 0.001$.*

Table 15 presents the results of an independent samples t-test assessing whether there is a significant difference between the mean gain scores of the control and experimental groups.

The results revealed a significant difference between the mean gain score, as indicated by the t statistic of -9.24 and p-value of 0.000*. A p value of less than 0.05 ($p = 0.000* < 0.05$) indicates that there is significant difference in the mean gain score between the control and

experimental groups. Specifically, students in the experimental group achieved significantly higher mean gain score compared to the control group.

These results underscore the effectiveness of using Contextualized B'laan Learning Material in the teaching process, leading to significantly higher mean gain score for students in the experimental group compared to those in the control group

3.1 Comparative Analysis of Mastery Gains and Pedagogical Efficacy

The empirical findings of this study demonstrate a significant shift in the conceptual mastery of Grade 10 learners following exposure to the Contextualized B'laan Learning Material (CBLM). While both cohorts exhibited "Average Mastery" at baseline—with mean pre-test scores of 51.07% for the control and 51.80% for the experimental group—the post-intervention data revealed a marked disparity in achievement. The experimental group attained a post-test mean of 83.53% ("Closely Approximating Mastery"), effectively doubling the mean gain of the control group (31.73% vs. 15.73%).

This substantial variance underscores that conventional, non-contextualized instructional modalities often fail to optimize the cognitive potential of Indigenous learners, a finding consistent with Abrams et al. (2017) and Robles (2016).

The transition from "Average" to "Closely Approximating Mastery" suggests that the

CBLM serves as a critical pedagogical intervention that reconciles academic standards with the learners' sociocultural reality.

3.2 Cognitive, Affective, and Cultural Drivers of Contextualization

The efficacy of the CBLM is rooted in complex cognitive and affective mechanisms that facilitate deeper learning. From a cognitive perspective, contextualization triggers schema activation, where students anchor abstract ecological processes—such as energy flow and nutrient cycling—onto existing mental frameworks derived from their daily interactions with the B'laan landscape. By utilizing familiar narratives and local terminology, the CBLM reduces the extraneous cognitive load often associated with decoding Western-centric scientific language.

This aligns with Greene's (2021) conceptualization of mastery, where learners transition from rote recall to the ability to apply and transfer scientific knowledge within real-world contexts.

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Affectively, the integration of Indigenous Knowledge Systems and Practices (IKSP) addresses the cultural "disconnect" historically prevalent in Indigenous education. When learners recognize their community's ecological wisdom validated within a formal academic setting, it stimulates intrinsic motivation and academic self-efficacy.

This affective resonance is supported by Malong et al. (2018), who noted that B'laan students demonstrate superior mastery when scientific inquiries are contextualized through community-based narratives. Consequently, the CBLM does not merely function as a teaching tool but as a bridge that fosters both academic success and cultural pride, creating a holistic and inclusive learning environment.

3.3 Theoretical Synthesis and Statistical Validation

The statistical significance of the results—indicated by a t-value of -7.61 and a p-value of 0.000 ($p < 0.05$)—provides robust empirical validation for the study's theoretical underpinnings. Specifically, the data reinforces Vygotsky's (1978) Socio-Cultural Theory, which posits that cognitive development is a socially

mediated process occurring through culturally meaningful tools. In this study, the CBLM functioned as a "cultural mediator," allowing students to navigate the Zone of Proximal Development (ZPD) by utilizing culturally anchored scaffolding.

Furthermore, the results exemplify the objectives of Culturally Responsive Pedagogy (CRP), as described by Sánchez Tapia et al. (2017) and Zidny et al. (2021). By situating ecological science within the B'laan worldview, the intervention mitigated the marginalization of Indigenous perspectives, ensuring that the achievement of mastery was both scientifically rigorous and culturally sustaining. In conclusion, the significant improvement in student performance validates that contextualized materials are essential components of an effective science curriculum.

This study affirms that when ecological concepts are synthesized with Indigenous traditions, learners develop a profound ability to think critically and apply scientific knowledge in ways that are relevant to both their academic advancement and their cultural heritage.

4. Conclusion

The empirical evidence and statistical validation provided by this study lead to the conclusion that the Contextualized B'laan Learning Material (CBLM) is a robust and effective pedagogical intervention for Indigenous learners. Expert evaluation across dimensions of objectives, usability, and cultural appropriateness confirms that the material achieves high curricular and cultural validity, ensuring that ecological concepts are delivered without compromising scientific accuracy or Indigenous integrity.

Critically, the transition of the experimental group from "Average Mastery" to "Closely Approximating Mastery" demonstrates that

culturally grounded instruction is significantly more effective than traditional teaching modalities in bridging conceptual gaps.

While traditional methods remain capable of reinforcing foundational knowledge through structured repetition, they lack the socio-cultural mechanisms required to drive higher-order conceptual understanding and critical thinking in B'laan learners.

This study affirms that when ecological science is synthesized with Indigenous narratives and lived experiences, it fosters a profound, lasting form of mastery that is both academically rigorous and culturally sustaining

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5. Recommendations

The findings of this study provide a foundation for systemic and pedagogical reforms aimed at achieving educational equity for Indigenous learners. It is recommended that educational policymakers and the Department of Education (DepEd) prioritize the formal recognition, institutionalization, and funding of "Indigenized" learning resources. Moving from localized success to systemic equity requires a strategic expansion of the CBLM and similar materials across other educational centers serving B'laan communities, ensuring that the curriculum reflects the diverse cultural identities of the students it serves.

Furthermore, to maximize the efficacy of these materials, there is a critical need for professional development programs focused on Culturally Responsive Pedagogy. Educators must be equipped with the capacity to design and

implement contextualized experiences that systematically blend traditional instructional strengths with localized, culturally infused approaches through training in Indigenous Knowledge Systems and Practices (IKSP).

Finally, future research should pursue methodological extensions to address the current study's limitations. Transitioning to longitudinal designs will allow researchers to track the retention of mastery gains over time, while multi-site replication studies involving different grade levels and various Indigenous communities will help validate the scalability of this approach. Broadening the research scope to include other science domains and academic disciplines will further advance the development of a culturally sustaining curriculum that fosters deep cognitive engagement across the entire educational landscape

Supplementary Details

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