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Students' Perceptions and Attitudes Toward Problem-Solving in Calculus I in Relation to Teachers' Contextualized Teaching

Barawel, Daniel A[1], Besa, Arabella[2], De Vera, Roxanne E[3], Delloro, Marites C[4], Gonzales, Allesandra T[5]

[1]Instructor I, College of Arts and Sciences, Central Bicol State University of Agriculture
[2,3,4,5]Student, College of Arts and Sciences, Central Bicol State University of Agriculture

Abstract

This study investigates the relationship between students' perceptions and attitudes toward problem-solving in Calculus I and the use of contextualized teaching strategies by Central Bicol State University of Agriculture – Calabanga Campus instructors. Using a descriptive-correlational design, data were gathered from 109 students enrolled in Bachelor of Science in Mathematics and Bachelor of Science in Fisheries programs during the Academic Year 2023–2024. The study focused on two components of contextualized teaching: localization and indigenization. Findings revealed a positive perception and attitude toward problem-solving when instruction included real-life and culturally relevant contexts. Statistical analysis using Pearson correlation indicated a significant relationship between contextualized teaching and both students' perceptions ($r = 0.463$) and attitudes ($r = 0.456$). The results suggest that integrating contextualized approaches in Calculus instruction enhances student engagement and comprehension, supporting the value of culturally responsive pedagogy in mathematics education.

Keywords: Attitudes, Contextualized Teaching, Indigenization, Localization, Perceptions, Problem-Solving, Calculus I

Introduction

Education is a key foundation of societal growth, providing individuals with the learning and capacities needed to traverse and adapt to a constantly evolving environment. As society progresses, the educational environment must evolve to include creative teaching methods that promote creativity, reasoning, and problem-solving ability. Mathematics education is crucial in shaping students' future academic and professional success. Gravemeijer et al. (2017) highlighted that evolving mathematics education to prepare students for a technologically advanced society is necessary. Traditional mathematics teaching may not suffice for future societal demands, highlighting the importance of integrating various teaching methods into the curriculum. Calculus I often presents significant challenges for students, leading to high failure rates and persistent math anxiety. According to Ginatilan and Arcilla (2020), negative perceptions and high levels of math anxiety correlate with lower performance in Calculus, which explains the need for supportive teaching strategies to alleviate anxiety and improve outcomes. Traditional mathematics teaching methods often fail to engage students and foster a deep understanding of mathematical concepts.

As highlighted by Ay Emanet & Kezer, F. (2021), student-centered teaching methods are more effective in enhancing math achievement and improving attitudes toward mathematics compared to traditional methods. This highlights the importance of integrating various teaching methods into the curriculum.

Recent pedagogical shifts emphasize student-centered learning, with contextualized teaching emerging as a promising approach. Contextualized learning involves connecting educational content to real-life situations, making learning more relevant and meaningful for students. This method has been shown to improve students' ability to apply, comprehend, and retain knowledge and skills acquired in the classroom, according to the National Education Summit (2021). Contextualization directly addresses the limitations of traditional methods by embedding learning within relevant and meaningful real-world contexts. Teaching emphasizes active learning through authentic tasks and experiences, fostering deeper understanding and increased student engagement (Rosenbursch, 2020).

Localization and indigenization are examined as distinct components of contextualized teaching, each contributing uniquely to students' learning experiences in Calculus. Localization involves adapting educational content to reflect the local context, including language and environment, making learning more relevant to students' lives. On the other hand, indigenization refers to incorporating indigenous knowledge, practices, and perspectives into the curriculum, fostering a more inclusive and culturally responsive educational experience. Pelemeniano and Siega (2023) claim that educators can make abstract concepts more tangible and meaningful by developing instructional materials that integrate real-life scenarios familiar to students. These concepts address distinct yet complementary aspects of contextualized teaching. Separating these two concepts can more accurately assess their distinct influences on students' perceptions and attitudes. It allows for a clearer analysis of whether localization (making content locally relevant) and indigenization (embedding indigenous perspectives) uniquely shape students' engagement and problem-solving approaches in Calculus.

Students' perceptions and attitudes toward problem-solving in mathematics play a critical role in shaping their learning outcomes and persistence in the subject. Jusra and Iskandar (2020) observed that students with higher self-confidence and enthusiasm toward mathematics demonstrated superior problem-solving abilities, underscoring the importance of fostering positive attitudes to improve mathematical competencies. However, the relationship between contextualized teaching—specifically through localization and indigenization—and student perceptions or attitudes in Calculus remains under-researched. Addressing this gap is crucial for developing culturally responsive pedagogies that enhance understanding and positive attitudes toward mathematics.

This study focused on determining the Bachelor of Science in Mathematics and Bachelor of Science in Fisheries students' perceptions and attitudes toward problem-solving in Calculus concerning teachers' contextualized teaching who only took the said course from the College of Arts and Sciences Department at CBSUA-Calabanga Campus. Specifically, this research seeks to determine the following: (1) The demographic profile of the respondents in terms of (a) Age, (b) Sex, and (3) Year Level, (2) Contextualized teaching in Calculus I in terms of Localization and Indigenization, (3) Students' perceptions toward problem-solving in Calculus I, (4) Students' attitudes toward problem-solving in Calculus I, and (5) Significant relationship between contextualized teaching in terms of localization and indigenization and the student's perceptions and attitudes toward problem-solving in Calculus I.

Methodology

This study employed a descriptive-correlational research design with a quantitative approach to examine the perceptions and attitudes of first-year BSM and second-year BSFi students toward problem-solving in *Calculus I* about contextualized teaching practices. The design allowed for identifying patterns and relationships between teaching strategies and students' mathematical proficiency. Using stratified random sampling, 109 out of 149 eligible students from CBSUA-Calabanga Campus were selected, ensuring proportional representation by year level. Participants included 29 first-year BSM and 80 second-year BSFi students enrolled in *Calculus I* during A/Y 2023–2024.

Data were gathered through an online survey using a validated and modified questionnaire adapted from Mason et al. (2010) and Rhodes (2017), covering demographics, contextualized teaching (localization and indigenization), and students' perceptions and attitudes. Expert validation resulted in I-CVI and S-CVI scores 1.00 and Cronbach's Alpha coefficients between 0.85 and 0.90, indicating strong reliability.

Ethical standards were upheld throughout the study. Participants were fully informed of the study's purpose and voluntarily consented before data collection. Anonymity was maintained, as names were optional in the questionnaire, and individuals could withdraw at any time. Data confidentiality was ensured through secure storage, accessible only to authorized personnel. By respecting participant autonomy and ensuring anonymity, the study promoted honest responses, thereby enhancing the validity and integrity of the research findings.

Results and Discussion

Table 1: Demographics

Attributes	**Categories**	**Frequency (N=109)**	**Percent**
Age	18 -20	91	83.49
	21 – 23	18	16.51
Sex	Male	35	32.11
	Female	74	67.89
Year Level	BS Math (first year)	29	26.61
	BS Fisheries (second year)	80	73.39

Table 1 shows the distribution of participants. Based on this, 91 student-participants aged between 18-20 years old comprised 83.49% of the respondents, while 23 students aged between 21-23 years old, or 16.51%, made up the rest. The second distribution of the participants is in terms of sex. Among them are 35 males, equivalent to 32.11%, and 74 females, 67.89. Moreover, the third distribution of the participants is in terms of course and year level. Two (2) year levels served as the participants of the study, the first-year BSM college and second-year BS Fisheries students. The first-year level had 29 students, 26.61% of the total participants. It comprised two (2) sections, BS Mathematics 1A with 17 students and BS Mathematics 1B with 12 students. On the other hand, the second-year level had 80 students, equivalent to 73.39% of the total respondents. It is composed of three (3) sections: BS Fisheries 2A with 26 students, BS Fisheries 2B with 26 students, and BS Fisheries 2C with 28 students.

Table 2: Contextualized teaching in Calculus I in terms of Localization

Statements	**Weighted Mean**	**Interpretation**	**Rank**
1. The teacher uses examples and scenarios relevant to the community.	3.31	Strongly Agree	1
2. The teacher utilizes local resources, such as community members or local businesses, to enhance learning.	3.13	Agree	11
3. The teacher adapts teaching methods and materials to suit the local learning styles and preferences.	3.30	Strongly Agree	3
4. The teacher uses local language and dialect in the classroom when appropriate.	3.28	Strongly Agree	4
5. The teacher connects learning to local customs.	3.21	Agree	6
6. The teacher incorporates local environmental issues and concerns into the curriculum.	3.13	Agree	11
7. The teacher facilitates student projects that address local problems or needs.	3.17	Agree	9
8. The teacher uses local technology or tools to enhance learning.	3.25	Strongly Agree	5
9. The teachers collaborate with local organizations or institutions to support student learning.	3.20	Agree	8
10. The teacher assesses student understanding through culturally relevant methods.	3.31	Strongly Agree	1
11. The teacher creates a classroom environment that is welcoming and inclusive of local diversity.	3.21	Agree	6
12. The teacher demonstrates a genuine interest in and respect for the local community.	3.17	Agree	9
TOTAL	**3.22**	**Agree**	

Legend: 1.00 - 1.74 = Strongly Disagree, 1.75 - 2.49 = Disagree, 2.50 -3.24 = Agree, 3.25 - 4.00 = Strongly Agree

Table 2 shows an assessment of contextualized teaching in Calculus I in terms of localization. The overall weighted mean is 3.22, which falls under the "Agree" category, indicating that localization practices are incorporated into the teaching process. Among the 12 statements, the highest weighted mean of 3.31, interpreted as "Strongly Agree," which was shared by two items: "The teacher uses examples and scenarios relevant to the community" and "The teacher assesses student understanding through culturally relevant methods.". These imply that educators emphasize making learning relatable to students' real-life contexts while ensuring that assessment methods are aligned with cultural relevance, thereby enhancing comprehension and engagement. According to Gay (2020), culturally responsive teaching practices, which emphasize using real-life examples and culturally relevant assessments, significantly enhance students' academic engagement and comprehension. Gay's findings highlighted that when teachers incorporate community-relevant scenarios and culturally grounded assessment strategies, students demonstrate improved critical thinking skills and a deeper connection to the subject matter. This supports the idea that learning becomes more meaningful when tied to students' lived experiences. On the other hand, the lowest weighted mean of 3.13, interpreted as "Agree," was observed in two items, namely, "The teacher utilizes local resources, such as community members or local businesses, to enhance learning" and "The teacher incorporates local environmental issues and concerns into the curriculum." While still positive, these scores highlight areas where contextualization could be strengthened. It appears that direct collaboration with community resources and integrating local environmental concerns into the curriculum are less prioritized compared to other localization strategies.

Table 3: Contextualized teaching in Calculus I in terms of Indigenization

Statements	Weighted Mean	Interpretation	Rank
1. The teacher incorporates indigenous knowledge systems and practices into the curriculum.	3.16	Agree	9
2. The teacher uses indigenous languages and storytelling traditions in the classroom.	3.24	Agree	4
3. The teacher collaborates with indigenous elders and knowledge holders to enrich learning.	3.11	Agree	12
4. The teacher centers the curriculum around indigenous perspectives and worldviews.	3.19	Agree	7
5. The teacher uses indigenous methods of teaching and learning, such as hands-on activities and experiential learning.	3.25	Strongly Agree	3
6. The teachers promote indigenous cultural values and practices in the classroom.	3.29	Strongly Agree	2
7. The teacher fosters respect and understanding for indigenous cultures and histories.	3.24	Agree	4
8. The teacher supports indigenous students' identity and sense of belonging.	3.16	Agree	9
9. The teacher advocates for indigenous rights and self-determination.	3.17	Agree	8
10. The teacher uses indigenous art, music, and dance to enhance learning.	3.12	Agree	11
11. The teacher facilitates students' projects that address indigenous issues and concerns.	3.30	Strongly Agree	1
12. The teacher creates a classroom environment that is culturally sensitive and inclusive of indigenous perspectives.	3.20	Agree	6
TOTAL	**3.20**	**Agree**	

Table 3 shows the weighted mean scores of 14 statements assessing the contextualized teaching of calculus through indigenization, with an overall weighted mean of 3.20, categorized as "Agree." The highest weighted mean of 3.30, interpreted as "Strongly Agree," was attributed to the statement, "The teacher facilitates students' projects that address Indigenous issues and concerns." This strongly emphasized engaging students with real-world Indigenous issues, promoting critical thinking, and fostering a deeper connection to Indigenous contexts through project-based learning. Conversely, the lowest weighted mean of 3.11, still falling within the "Agree" category, pertains to the statement, "The teacher collaborates with Indigenous elders and knowledge holders to enrich learning." This implies that while the overall approach is successful, there is room for improvement in explicitly connecting learning to tangible local features. According to Mwale, M. (2023), partnering with Indigenous educators and experts is crucial for bridging gaps in understanding and effectively incorporating Indigenous perspectives into teaching practices. This finding highlighted the need for increased collaboration between teachers and indigenous knowledge holders to enhance contextualized teaching in Calculus I.

Table 4: Perception of Students Towards Problem-solving in Calculus I

Statement	Weighted Mean	Interpretation	Rank
1. I feel confident in my ability to solve calculus problems.	2.95	Agree	20
2. I feel that understanding the fundamental concepts of calculus is essential for solving problems.	3.20	Agree	9
3. I learn from my mistakes when solving calculus problems.	3.20	Agree	9
4. I find calculus problem-solving intimidating and challenging.	3.19	Agree	11
5. Solving calculus problems helps me understand real-world applications of mathematics.	3.13	Agree	14
6. Problem-solving in calculus feels disconnected from practical applications.	3.02	Agree	19
7. The difficulty of calculus problems is appropriate for my current understanding.	3.13	Agree	14
8. I often find calculus problems too difficult to solve independently.	3.07	Agree	15
9. I lose interest when faced with complex calculus problems.	2.82	Strongly Agree	21
10. I see contextualized calculus problems as tasks to be completed, but I don't necessarily find them enjoyable.	3.32	Strongly Agree	2
11. Guidance from my instructor significantly helps me improve my problem-solving skills in calculus.	3.25	Strongly Agree	7
12. I find contextualized calculus problems to be unrealistic or contrived, lacking practical value or relevance to my life.	3.13	Agree	14
13. I struggle to decide which approach to use when solving a calculus problem.	3.04	Agree	15
14. The complexity of contextualized calculus problems can sometimes feel overwhelming, leaving me unsure where to start.	3.31	Strongly Agree	3
15. Solving calculus problems requires more time than I can usually allocate.	3.18	Agree	13
16. Receiving timely feedback on my solutions improves my problem-solving skills in calculus.	3.37	Strongly Agree	1
17. I feel that the feedback I receive on my calculus problem-solving is insufficient.	3.27	Strongly Agree	5
18. I see connections between calculus problem-solving and real-	3.26	Strongly Agree	6

life situations.			
19. I struggle to relate calculus problems to practical or real-world scenarios.	3.28	Strongly Agree	4
20. I enjoy the challenge of solving calculus problems.	3.19	Agree	11
21. Problem-solving in calculus feels like a tedious task rather than an enjoyable activity.	3.21	Agree	8
TOTAL	**3.17**	**Agree**	

Table 4 shows the weighted mean scores of student responses to 21 statements assessing their perception towards problem-solving. The data showed that students generally have a positive perception of contextualized teaching in Calculus I, with an overall weighted mean of 3.17, interpreted as "Agree." The highest weighted mean is 3.37, corresponding to the statement, "Receiving timely feedback on my solutions improves my problem-solving skills in calculus," which suggests that students highly value prompt feedback in enhancing their understanding and skills. According to Smith, J., Brown, L., & Taylor, K. (2021), immediate and constructive feedback significantly improves students' mathematical problem-solving abilities by reinforcing correct approaches and clarifying misconceptions. Their study highlighted that students who receive timely feedback demonstrate higher confidence and accuracy in solving complex mathematical problems, aligning with the highest-rated statement in this study. Conversely, the lowest weighted mean is 2.82, linked to the statement, "I lose interest when faced with complex calculus problems," indicating that while students appreciate contextualized teaching, difficulties in problem complexity can diminish their motivation.

Table 5: Students' Attitude Towards Problem-Solving in Calculus I

Statements	Weighted Mean	Interpretation	Rank
1. The idea of applying Calculus to real-world situations excites me, and I want to understand how it works in practice.	3.17	Agree	16
2. When a calculus problem is presented in a real-world context, I find myself drawn in and eager to tackle it.	3.18	Agree	14
3. I feel a sense of determination to find a solution to contextualized calculus problems, and I'm not easily discouraged.	3.15	Agree	18
4. Facing a contextualized calculus problem doesn't intimidate me: I'm confident enough to try different approaches.	3.14	Agree	20
5. I enjoy the challenge of thinking creatively and exploring multiple ways to solve a contextualized calculus problem.	3.19	Agree	12
6. I'm persistent when it comes to solving contextualized calculus problems, even if it requires extra time and effort.	3.17	Agree	16
7. I find myself reflecting on the problem and my solution process, thinking critically about how it all fits together.	3.28	Strongly Agree	3
8. I enjoy collaborating with others to solve contextualized calculus problems, bouncing ideas off each other and learning	3.23	Agree	8

from different perspectives.			
9. I'm resourceful when solving contextualized calculus problems, utilizing available resources to help me find a solution.	3.19	Agree	12
10. I have access to sufficient resources (e.g., textbooks, online to help me solve calculus problems.	2.92	Agree	21
11. I approach contextualized calculus problems with a neutral attitude, neither particularly excited nor uninterested.	3.28	Strongly Agree	3
12. I approach contextualized calculus problems with a sense of caution and hesitation, needing time to process the information.	3.21	Agree	11
13. I focus on the practical aspects of contextualized calculus problems, trying to understand how they relate to real-life situations.	3.36	Strongly Agree	1
14. I prefer a structured approach to solving contextualized calculus problems, breaking them down into smaller, manageable steps.	3.34	Strongly Agree	2
15. I get frustrated when I struggle to understand a contextualized calculus problem or find a solution, which can lead to feelings of discouragement.	3.28	Strongly Agree	3
16. I find myself disengaged from the problem-solving process when faced with contextualized calculus problems, lacking the motivation to fully participate.	3.23	Agree	8
17. I lack the interest or motivation to solve contextualized calculus problems, find them uninteresting or irrelevant.	3.27	Strongly Agree	7
18. I resist the use of contextualized calculus problems, preferring more abstract or theoretical problems.	3.23	Agree	8
19. I dismiss the importance of contextualized calculus problems, believing they don't contribute significantly to my understanding of math.	3.18	Agree	14
20. I experience anxiety when faced with contextualized calculus problems, feeling pressure to perform well and solve them correctly.	3.28	Strongly Agree	3
21. I feel unprepared to solve contextualized calculus problems due to a lack of skills or knowledge, leading to a sense of inadequacy.	3.15	Agree	18
TOTAL	**3.21**	**Strongly Agree**	

Table 5 shows the weighted mean scores of student responses to 21 statements assessing their attitude towards Calculus problem-solving. The data revealed a predominantly positive attitude, with most items receiving an "Agree" rating. However, a closer examination revealed significant variation. The statement, "I focus on the practical aspects of contextualized calculus problems, trying to understand how they relate to real-life situations," indicated that students generally recognize the relevance of Calculus in real-world contexts and actively seek to connect mathematical concepts with practical applications. According to Giangan and Gurat (2022), students acknowledged the importance of Calculus, noting that it encouraged deep thinking and improved their decision-making abilities in daily life. This finding suggested that students recognize the relevance of Calculus in real-world contexts.

In contrast, the statement, "I have access to sufficient resources (e.g., textbooks, online to help me solve calculus problems.", obtained the lowest weighted mean of 2.92. This implies that students may struggle with finding adequate learning materials to support their understanding of Calculus. This also inferred a potential gap in resource availability or accessibility, which could hinder their ability to engage effectively with contextualized teaching.

Table 6: Relationship Between Contextualized Teaching and Students' Perception and Attitude On Problem-Solving in Calculus I

Variables	**Pearson Correlation**	**Significance**	**Stat Significance**
Relationship of Contextualized teaching and Students' perception towards problem-solving in Calculus I	**.463**	**.000**	**VHS**
Relationship of Contextualized teaching and Students' attitude towards problem-solving in Calculus I	**.456**	**.000**	**VHS**

Legend: Sig. = > 05 – Not Significant (NS), Sig. = ≤ 05 –Significant (S), Sig. = ≤ 01 –Highly Significant (HS), Sig. = ≤ 001 –Very Highly Significant (VHS)

The table above shows that regression analysis indicated a significant relationship, as manifested by the Pearson "r" of 0.463, between contextualized teaching and students' perceptions toward problem-solving in Calculus I. Also, a significant relationship and low yet evident correlation exists, as manifested by the Pearson "r" of 0.456 between contextualized teaching and students' attitudes toward problem-solving in Calculus I. This result was supported by the study of Regis and Gomez (2023), which also revealed a significant relationship between contextualized teaching and students' perceptions and attitudes toward problem-solving.

Conclusion and Recommendations

The study revealed that most participants were between 18 and 20 years old, indicating that *Calculus I* classes primarily comprise younger students in their first and second college years. Female students outnumbered male students by 35.78%, and second-year students comprised most respondents, outnumbering first-year students by 47%. These findings suggest that *Calculus I* cohorts are dominated by young, female, second-year students.

Students generally held positive perceptions regarding contextualized teaching in Calculus I. The overall weighted means for localization and indigenization were 3.22 and 3.20, respectively, indicating agreement on the effectiveness of using real-life, community-based examples and project-based learning. However, the lowest-rated items highlighted a lack of full integration of local resources, environmental concerns, and indigenous knowledge holders into the curriculum. This underscores the need for a more structured and intentional approach to contextualized teaching to maximize student engagement and understanding. It is recommended that educators strengthen partnerships with local communities, businesses, and indigenous elders, enhance access to localized and indigenous learning materials, and pursue professional development in culturally responsive teaching. Further research is also encouraged to assess the long-term effects of contextualized teaching on student outcomes in mathematics.

With regard to students' perceptions of problem-solving in *Calculus I,* the findings indicated an overall positive view, with a mean score of 3.17. Students valued immediate and constructive feedback, which helped clarify misconceptions and reinforced learning. However, complex mathematical tasks posed motivational challenges, suggesting a need for more supportive instructional strategies. Educators are encouraged to prioritize timely feedback, use step-by-step problem-solving strategies, and integrate real-world applications and interactive tools to support diverse learners better.

Students also demonstrated a generally positive attitude toward problem-solving in a contextualized *Calculus I* environment, appreciating the subject's real-world relevance. Nevertheless, the availability of learning materials emerged as a concern, highlighting a significant barrier to engagement. To address this, institutions should prioritize expanding digital and printed educational resources, integrate open-access tools, and implement regular assessments of students' resource needs to enhance inclusivity and effectiveness in teaching.

Finally, the study found a significant relationship between contextualized teaching and students' perceptions (r = 0.463) and attitudes (r = 0.456) toward problem-solving. These correlations, while moderate to low, were statistically significant and aligned with findings from related studies. This reinforces the importance of integrating contextualized strategies in *Calculus I* instruction to improve student engagement and learning outcomes. It is recommended that educators continue to adopt culturally responsive approaches while exploring additional methods and factors that influence student performance in mathematics.

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