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DEVELOPMENT AND ACCEPTABILITY OF NIPA PALM FRUIT (*Nypafrutican swumb)* INTO CHIPS

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ABSTRACT

This study focused on the development of chips made from Nipa Palm Fruit (*Nypa frutican swurmb*.) and aimed to evaluate their acceptability among consumers. The research specifically addressed several key questions, including the phyto-chemical composition and nutritive value of the Nipa Palm Fruit, as well as the physico-chemical properties of the resulting chips. Additionally, it assessed the microbial properties of the Nipa Palm Fruit through various counts, such as Aerobic Plate Count, Coliforms Count, Yeast and Molds Count, and Salmonella Determination Count. The study also explored the formulation and processes required for chip production and measured moisture content before and after drying. To determine sensory characteristics and overall acceptability, the study utilized a descriptive-developmental and experimental research design, involving a mixed methods approach for evaluating sensory attributes. A total of 57 respondents participated in assessing the chips' appearance, aroma, texture, taste, and overall acceptability. The research employed statistical tools such as mean, standard deviation, and One-Way Analysis of Variance (ANOVA) to analyze data related to sensory acceptability across different cooking methods: deep-fried, oven-baked, and air-fried. The findings revealed that the Oven Baked chips received the highest scores for Appearance, Aroma, Texture, and Overall Acceptability, with medians of 8, 8, 8, and 8, respectively. The Deep Fried chips had the highest median score for Taste (7), while the Air-Fried chips had the lowest median scores for Appearance, Aroma, and Texture (7 for each). Overall, the Oven Baked chips were the most accepted by the evaluators, followed by the Deep Fried and Air-Fried chips. Thus, this study is intended to provide insights into the potential of Nipa Palm Fruit as a nutritious snack alternative while promoting its utilization in food products.

Keywords: Nipa palm fruit, Chips products, Food Innovation, Perceptions

INTRODUCTION

Food innovation encompasses the development of new or improved food products, processes, and technologies aimed at enhancing quality, taste, nutritional value, safety, and sustainability. This innovation is increasingly important as it responds to evolving consumer preferences, health concerns, and environmental challenges. For instance, advancements in biotechnology and food processing techniques are being utilized to create unique food products that not only appeal to consumers but also address critical issues such as food waste reduction and the need for sustainable protein sources. As the food industry continues to evolve, it is essential to explore innovative solutions that align with these changing demands while promoting healthier dietary options.

The significance of nutrition in human health cannot be overstated; as articulated by Anthelme Brillat-Savarin, “We are what we eat.” This perspective is echoed by many researchers who emphasize the impact of food choices on overall health and productivity. A balanced diet is crucial for providing the necessary energy and nutrients for metabolic functions. However, a reliance on high-calorie foods can lead to undernourishment despite a feeling of fullness (Barwinska, 2019). In this context, the evolution of snacks has become particularly relevant, as consumers increasingly seek healthier alternatives that are both nutritious and satisfying. Healthy snacks are defined as those containing beneficial ingredients that

positively affect health, thereby providing an essential option for those looking to avoid unhealthy junk foods (Ciurzyńska et al., 2019).

The prevalence of junk food poses significant health risks, contributing to low energy levels, weight gain, and various illnesses. Although many popular snacks offer appealing flavors and textures, they often lack nutritional value. The market is flooded with conventional chips that fail to meet health standards. In response to this demand for healthier options, fruit and vegetable chips have emerged as promising alternatives (Tylewicz et al., 2020). Dried fruits, in particular, are recognized as nutritious snacks that align with dietary guidelines across many countries (Morais et al., 2018). Their production process enhances their nutritional profile by concentrating beneficial compounds such as minerals, antioxidants, and fiber (Jeszka-Skowron et al., 2017).

Among the underutilized resources in the snack industry is the nipa palm fruit, a tropical species found in coastal regions of the Philippines. Despite its culinary and ecological significance, nipa palm fruit remains largely unrecognized and underused in food production. This study aims to explore the feasibility of developing chips from nipa palm fruit to address consumer demand for nutritious snacks while promoting local ingredients. By highlighting the nutritional value of this unfamiliar fruit and its potential as an income-generating product, this research seeks to fill a gap in knowledge regarding its culinary applications. Ultimately, this study will contribute to raising awareness about nipa palm fruit as a viable snack option and support its introduction into the market.

STATEMENT OF THE PROBLEM

This study aimed to develop chips made from Nipa Palm Fruit (Nypafrutican swurmb) as the raw materials and evaluate the acceptability of the product. Specifically, it sought to answer the following questions:

1. What is the phyto-chemical analysis and nutritive value of Nipa Palm Fruit?

2. What are the physico-chemical analysis of the develop nipa palm fruit chips?

3. What are the microbial properties of Nipa Palm Fruit in terms of:
   3.1. Aerobic Plate Count;
   3.2. Coliforms Count;
   3.3. Yeast and Molds Count; and
   3.4. Salmonella Determination Count?

4. What are the formulation and processes needed in the production of Nipa Palm Fruit into Chips?

5. How much moisture content remains in the nipa palm fruit before and after the drying process?

6. What are the sensory characteristics and acceptability of Nipa Palm Fruit Chips as perceived by the respondents in terms of:
   6.1 Appearance;
   6.2 Aroma;
   6.3 Texture;
   6.4 Taste; and
   6.5 Over-all acceptability?

7. Is there a significant difference on the sensory acceptability of Nipa Chips undergoing different cooking methods in terms of:
   7.1 Deep-fried
   7.2 Oven-baked
   7.3 Air-fried

RESEARCH METHODOLOGY

Research Design

The study utilized the descriptive-developmental and experimental research design since this study develop a food product of chips made from nipa palm fruit. Mixed methods research design is determining the sensory attributes of the chips and determine the microbial properties of nipa palm fruit chips in terms of aerobic plate count, coliforms count, yeast and molds count and salmonella determination count. While the sensory acceptability of the food products that utilize the chips will be measured in terms of appearance, aroma, taste texture, and over-all acceptability.

Research Environment

The developmental research study on Nipa Chips was carried out in Food Technology Innovation Center in one of the state university in CARAGA Region.

Respondents

There were 57 respondents utilized in the study. They are the Foods Technology Teachers (9), Faculty and Staff (27) and foods technology students (21) of researchers school to determine the sensory acceptability of Nipa Palm Fruit Chips in terms of appearance, taste, texture as well as the over-all acceptability and the significant difference of the develop chips undergoing different cooking method.

Research Instrument

This study is purely product development. However, to determine the level of acceptability of the product, an adaptive-made questionnaire will be utilized, the potential products will be then evaluated using a Score Card and a Hedonic Scale especially in ascertaining the acceptability of the product in terms of appearance, aroma, taste, texture, and over-all acceptability by the panel of experts and consumers that were picked through a purposive random sampling. Multiple trials will be conduct to achieve a desired product.

Data Analysis

This study utilized the following statistical tools in analyzing the data:

Mean and Standard Deviation. These tools used to determine the sensory attributes acceptability of the food products made from chips using the perceived qualitative descriptions as used in the instrument (appearance, aroma, taste, texture and over-all acceptability).

One-Way Analysis of Variance (ANOVA). This tool used to determine the differences among the different cooking method in chips.

RESULTS AND DISCUSSIONS

Phyto-chemical analysis result of the nipa palm (Nypa frutican swurmb) fruit.

Table 1. Phyto- chemical result of Nipa Palm Fruit

Sample Code	Sample	Description	Parameter	Result
CHE-0327	Nipa Palm Fruit	1000g air-dried plant sample in plastic container	Volume of Extract Obtained	80mL
			Alkaloids	
			Confirmatory Test	
			(+) primary alkaloid	+
			(++) secondary alkaloid	
			(+++) tertiary alkaloid	
			Test for Quaternary Bases & Amine Oxide	-
			Steroids	
			Keller-Killini Test: For 2-deoxysugars	+
			Liebermann-Burchard Test: For Unsaturated	-
			Steroids	
			Flavanoids	
			Bate-Smith & Metcalf Method:	-
			For Leucoanthocyanins	

CHE-0327	Nipa Palm Fruit	1000g air-dried plant sample in plastic container	**Saponins**	
			Froth Test	-
			Tannins Ferric Chloride Test *Brownish-green Color indicates the presence of condensed tannins *Blue-black color indicates the presence of hydrolysable tannins	-

Based on the table2of analysis report for the presence of various compounds in a Nipa Palm Fruit Chips extract. Alkaloids are naturally occurring compounds that often have pharmacological effects. The confirmatory test mentioned in the table is a qualitative test to determine the presence of alkaloids in the Nipa Palm Fruit Chips extract. The grading system (+, ++, +++) indicates the relative concentration or intensity of alkaloids detected. Unfortunately, the table doesn't specify which alkaloids were tested for or detected. Further literature or analysis would be needed to determine the specific alkaloids present in Nipa Palm Fruit Chips.

Quaternary bases and amine oxides are organic compounds that contain a positively charged nitrogen atom. The table indicates that the test results for these compounds are not present. It's unclear if this means they were not detected or if the tests were not conducted. Steroids are a class of compounds with various biological activities. The table mentions two tests for steroids: the Keller-Killini Test and the Liebermann-Burchard Test. The Keller-Killini Test detects the presence of 2-deoxysugars, which are a type of sugar molecule commonly found in steroids. The Liebermann-Burchard Test, on the other hand, detects unsaturated steroids. The results in the table indicate that 2-deoxysugars were detected (indicated by a "+"), while unsaturated steroids were not detected ("-").

Flavonoids are a class of plant secondary metabolites known for their antioxidant and health-promoting properties. The Bate-Smith & Metcalf Method is mentioned as a test for leucoanthocyanins, a type of flavonoid compound. The result in the table indicates that leucoanthocyanins were detected (indicated by a "+").

Saponins are plant compounds known for their foaming properties and potential health benefits. The table mentions the Froth Test, which is a simple test to determine the presence of saponins. Unfortunately, the table doesn't provide the specific result for this test.

Tannins are a diverse group of compounds found in many plants and are known for their astringent properties. The table mentions the Ferric Chloride Test, which is a common test to detect the presence of tannins. The result in the table indicates the presence of tannins, with a brownish-green color indicating the presence of condensed tannins and a blue-black color indicating the presence of hydrolysable tannins.

Physico-chemical analysis result and nutritive value nipa palm (Nypa frutican swurmb) fruit chips

Table 2. Physico-chemical analysis of chips product.

Parameters	Unit	Result	Method
Moisture	%	10.6	Air Oven Drying
Fat	%	0.20	Soxhlet Extraction
Ash	%	2.68	Ignition-Gravimetric

The table2 provided contains various parameters and corresponding analysis methods for nipa palm fruit chips. The moisture content of the Nipa Palm Fruit Chips is found to be 10.6%. The Air Oven Drying method is employed to measure the moisture content. Gravimetric analysis involves measuring the weight loss of a sample upon drying to determine the moisture content.

The Ash content of the Nipa Palm Fruit Chips is determined as 2.68%. The Ignition-Gravimetric method is used for Ash analysis. The Ignition-Gravimetric method involves the simple heating of the filtered washed precipitates to appropriate temperature is termed as ignition. It helps to remove absorbed water, occluded water or water of hydration.

Microbial properties of Nipa Palm Fruit

Table 3. Microbial Properties of Nipa Palm Fruit

Analysis	Results	Standard Method/Reference Standard
Aerobic Plate Count, CFU/g	$8.6x10^{3}$	Pour plate method/BAM Online
Coliform Count, CFU/g	< 10 Est	Petrifilm/AOAC
Yeast and Mold Count, CFU/g	320 Est	Spread Plate Method/BAM Online
Salmonella spp, Detection per 25g	Negative	Conventional-Presumptive/BAM Online

Note: CFU-Colony Forming Units; Est – Estimated Colony Forming Units

The provided table seems to present the results of microbiological testing on a food product, showing various analyses performed, their results, and the methods or reference standards used for each test, It also indicates the total number of aerobic bacteria present in the sample. An APC of 8.6 x 10^3 CFU/g suggests a moderate level of microbial load, which can be acceptable depending on the product type and its intended use. High counts may suggest poor handling or contamination during processing. In addition, the coliform count is used as an indicator of sanitary quality and the potential presence of pathogens. A count of less than 10 is generally considered low and suggests that the product is likely safe from fecal contamination. Moreover, a count of 320 CFU/g indicates a moderate level of yeast and mold contamination. This could affect the quality and shelf-life of the product. In food safety, high yeast and mold levels might lead to spoilage, and it's important to analyze if this count meets regulatory standards for the specific food category being tested. Likewise, the absence of Salmonella spp. in a 25g sample is a significant finding, as Salmonella is a common foodborne pathogen. This negative result is essential for food safety, indicating that the sample is not likely to pose a risk for Salmonella-related illnesses, which is critical for public health.

Formulations and Processes of making Nipa Palm Fruit chips

The following are the procedural steps in the development of the chips:

Ingredients:

1.1000 grams Nipa Palm Fruit
2.4 tablespoon White Sugar
3.Banana Leaf

Procedures:

1.Prepare the tools and materials needed.
2.Wash the nipa palm fruit.
3.Remove the outer skin of the nipa fruit.
4.Scooped the gelatinous endosperm.
5.Blend the gelatinous endosperm together with the sugar.
6.Mashed some of the particles of gelatinous endosperm into a fine texture.
7.Placed the fine texture of nipa fruit into the banana leaf and used molder to achieve desire shape.
8.Dip the banana leaf with fine texture to the boiling water (100°C) for 5 minutes.
9.Drain and Cool the mixture.
10.Drying it into direct sunlight.
11.The next step varies to the cooking method used.
12.Deep-fried the fruit chips into 180°C for 1 minute or until done.
13.Baked the fruit chips into 175°C for 3 minutes or until done.
14.Air-fried the fruit chips into 175°C for 3 minutes or until done.
15.Cooling the air fried chips.
16.Packaging of the finished food product.

Sensory characteristics and acceptability of Nipa Palm Fruit Chips as perceived by the respondents

Table 4. Perceptions of the respondents on the sensory acceptability as to Appearance

Appearance	Air-Fried		Deep Fried		Oven Baked	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Color of the Nipa Chips.	7	like moderately	7	like moderately	8	like Very Much
2. Surface Texture of the Nipa Chips.	8	like Very Much	7	like moderately	8	like Very Much
3. Limpidity of the Nipa Chips	7	like moderately	7	like moderately	8	like Very Much
4. Luster of the Nipa Chips.	7	like moderately	7	like moderately	8	like Very Much
5. Wholeness of the Nipa Chips.	8	like Very Much	7	like moderately	8	like Very Much
Overall Median	**7**	**like moderately**	**7**	**like moderately**	**8**	**like Very Much**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

The table shows the sensory evaluation results of Nipa chips prepared using three different cooking methods: air-fried, deep-fried, and oven-baked. The responses are categorized by median scores, along with a qualitative description of the appearance of the chips for each method. The color ratings indicate that the color of Nipa chips from the oven-baked method is slightly preferred compared to the air-fried and deep-fried versions. The higher median score suggests better visual appeal, which can also affect perceived taste and quality, the texture is appreciated highly in both air-fried and oven-baked chips, indicating a desirable crunch. The deep-fried version has slightly lower scores. Texture is critical in snack food appeal, as a better texture can contribute to overall satisfaction.

Limpidity refers to the clarity and translucence of the chips. Again, the oven-baked chips rank highest, which may indicate a cleaner and more appealing product free from excessive oil, a common by-product in fried methods. However, the oven-baked chips also score higher in luster, suggesting that they have a shinier, more appetizing appearance. Luster contributes to the overall attractiveness of snacks and is often associated with freshness and quality. Also, the wholeness of the chips is well-rated for both air-fried and oven-baked methods, indicating that these methods produce less breakage during cooking, which often enhances consumer appeal.

The overall median scores indicate a clear preference for the oven-baked Nipa chips compared to both air-fried and deep-fried versions. The oven-baked method appears to deliver better color, texture, limpidity, luster, and wholeness, which collectively contribute to an appearance that is generally perceived as more favorable.

Table 5. Perceptions of the respondents on the sensory acceptability as to Aroma

Aroma	Air-Fried		Deep Fried		Oven Baked	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Balance of odor in all ingredients.	8	like Very Much	8	like Very Much	8	like Very Much
2. Odor from the Nipa Chips.	8	like Very Much	8	like Very Much	8	like Very Much
3. Odor whets the appetite.	**7**	like moderately	8	like Very Much	8	like Very Much
4. Fragrance heightens marketability.	**7**	like moderately	8	like Very Much	8	like Very Much
5. Odor enhances the flavor.	7	like moderately	8	like Very Much	8	like Very Much
Overall Median	**7**	**like moderately**	**8**	**like Very Much**	**8**	**like Very Much**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

All three cooking methods received an identical high score for the balance of odor, indicating that each preparation method effectively combines the different aromas of the ingredients. This balance is essential for creating a pleasant overall scent that may appeal to consumers. The pleasant odor specifically from the Nipa chips is rated highly across all methods, suggesting that regardless of how the chips are cooked, they have an attractive and appealing aroma. This factor is significant as aroma can strongly influence consumer preference and purchasing decisions.

In addition, the deep-fried and oven-baked chips scored higher for appetite appeal compared to the air-fried version. This suggests that the aromas produced by the deep-frying and oven-baking methods may be more effective in stimulating hunger, possibly due to the Maillard reaction and other cooking processes unique to these methods, as with appetite appeal, both the deep-fried and oven-baked Nipa chips rated higher in terms of marketability. The fragrance associated with these chips is likely perceived as more desirable, potentially enhancing consumer interest in purchasing them. Effective marketing strategies could highlight the appealing aromas of these methods.

The ability of the odor to enhance perceived flavor is rated higher for deep-fried and oven-baked chips, indicating that these methods create a more effective aromatic profile that complements the flavor experience. This aligns with the notion that aroma plays a critical role in taste perception, reinforcing the importance of cooking methods on overall sensory experience, while all three cooking methods produced high scores for aroma, the deep-fried and oven-baked Nipa chips significantly outperformed the air-fried version in several categories related to appetite appeal, marketability, and enhancement of flavor.

The findings suggest that while air-frying is popular for its health benefits, the traditional frying and baking methods may offer sensory advantages that could enhance consumer acceptance.

Table 6. Perceptions of the respondents on the sensory acceptability as to Texture

Texture	Air-Fried		Deep Fried		Oven Baked	
	Median	**Qualitative Description**	**Median**	**Qualitative Description**	**Median**	**Qualitative Description**
1. Balance of odor in all ingredients.	7	like moderately	8	like Very Much	8	like Very Much
2. Odor from the Nipa Chips.	7	like moderately	8	like Very Much	8	like Very Much
3. Odor whets the appetite.	7	like moderately	7	like moderately	7	like moderately
4. Fragrance heightens marketability.	8	like Very Much	8	like Very Much	8	like Very Much
5. Odor enhances the flavor.	8	like Very Much	8	like Very Much	8	like Very Much
Overall Median	**7**	**like moderately**	**8**	**like Very Much**	**8**	**like Very Much**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

The table "Texture" provides a comparison of the textural qualities of Nipa Chips prepared using three different cooking methods: Air-Fried, Deep Fried, and Oven Baked. The table presents the median scores and qualitative descriptions for each cooking method based on a sensory evaluation by a panel of judges. The evaluations were conducted on a scale of 1 to 9, where 1 represents "dislike extremely" and 9 represents "like extremely."

The table shows that overall, the Oven Baked Nipa Chips received the highest median scores for texture, with a median score of 8 for all attributes. The Deep Fried Nipa Chips received the second-highest scores, with a median score of 7 for all attributes except for "odor whets the appetite," which had a median score of 8. The Air-Fried Nipa Chips received the lowest median scores, with a median score of 7 for all attributes.

The qualitative descriptions provided for each cooking method offer more insight into the textural qualities of the Nipa Chips. For Air-Fried Nipa Chips, the texture was described as moderate for all attributes. For Deep Fried Nipa Chips, the texture was described as very much for all attributes except for "odor whets the appetite," which was described as moderate. For Oven Baked Nipa Chips, the texture was described as very much for all attributes.

Table 7. Perceptions of the respondents on the sensory acceptability as to Taste

Taste	Air-Fried		Deep Fried		Oven Baked	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
1. Balance of odor in all ingredients.	6	like Slightly	7	like moderately	7	like Very Much
2. Odor from the Nipa Chips.	5	Neither like nor dislike	6	like Slightly	5	like Very Much
3. Odor whets the appetite.	6	like Slightly	7	like moderately	6	like Very Much
4. Fragrance heightens marketability.	6	like Slightly	7	like moderately	6	like Very Much
5. Odor enhances the flavor.	6	like Slightly	7	like moderately	6	like Very Much
Overall Median	**6**	**like Slightly**	**7**	**like moderately**	**6**	**like Slightly**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

The table 7 presents the results of the sensory evaluation of Nipa Chips cooked using three different methods: Air-Fried, Deep Fried, and Oven Baked. The taste attributes evaluated include the balance of odor in all ingredients, odor from the Nipa Chips, odor that whets the appetite, fragrance that heightens marketability, and odor that enhances the flavor.

For Air-Fried Nipa Chips, the overall median was "like slightly," indicating that the taste was generally liked but not to a great extent. Deep Fried Nipa Chips had an overall median of "like moderately," suggesting that the taste was liked to a moderate degree. Oven Baked Nipa Chips had an overall median of "like slightly," which is similar to the Air-Fried Nipa Chips.

When comparing the three cooking methods, Deep Fried Nipa Chips were liked the most, followed by Oven Baked and then Air-Fried Nipa Chips. This could be due to the fact that deep frying enhances the flavor and aroma of the chips, making them more appealing to consumers.

In terms of specific taste attributes, Deep Fried Nipa Chips were consistently liked more than the other two methods for all attributes except for the balance of odor in all ingredients, where Oven Baked Nipa Chips were liked the most.

Table 8. Summary of Over-all acceptability for the Perceptions of the respondents

Criteria	Air-Fried		Deep Fried		Oven Baked	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Appearance	7	like moderately	7	like moderately	8	like Very Much
Aroma	7	like moderately	8	like Very Much	8	like Very Much
Texture	7	like moderately	8	like Very Much	8	like Very Much
Taste	6	like Slightly	7	like moderately	6	like Slightly
Overall Acceptability	**7**	**like moderately**	**7**	**like moderately**	**8**	**like Very Much**

The table shows the summary for Over-all acceptability for the Perceptions of the respondents. For Appearance, Aroma, and Texture, all three cooking methods received median scores of 7 or higher, indicating that the samples were generally liked. The Oven Baked Nipa Chips were liked "Very Much" for Appearance and Texture, while Deep Fried Nipa Chips were liked "Very Much" for Aroma.

However, for Taste, all three cooking methods received median scores of 6 or 7, suggesting that the taste was only moderately liked. Deep Fried Nipa Chips had the highest median score for Taste, with a score of 7, while Air-Fried and Oven Baked Nipa Chips both received a score of 6.

In terms of Overall Acceptability, Deep Fried and Oven Baked Nipa Chips received median scores of 7, indicating that they were moderately liked, while Air-Fried Nipa Chips received a median score of 8, suggesting that they were liked "Very Much."

Overall, the results indicate that Oven Baked Nipa Chips have the highest median scores for Appearance and Texture, Deep Fried Nipa Chips have the highest median score for Aroma, and Air-Fried Nipa

Chips have the highest median score for Overall Acceptability. These findings can be useful for manufacturers and consumers in selecting the preferred cooking method for Nipa Chips based on specific sensory attributes

Significant differences on the sensory acceptability of Nipa Chips when cooked in different cooking methods

Table 9. Significant differences on the sensory acceptability of Nipa Chips when cooked different cooking methods.

Variables	Methods	df	p-value	Decision
Sensory acceptability	Deep-fried	2	0.218	Not Rejected
	Oven-baked	**2**	**0.000**	**Rejected**
	Air-fried	2	0.103	Not Rejected

The table indicates and summarizes the results of a statistical test conducted to compare the sensory acceptability of Nipa Chips prepared using three different cooking methods. In this case, the p-value for deep-fried and air-fried cooking methods is greater than 0.05 (0.218 and 0.103, respectively), so the null hypothesis is not rejected for these methods. This means that there is no significant difference in the sensory acceptability of Nipa Chips prepared using deep-frying and air-frying methods.

However, the p-value for oven-baked Nipa Chips is less than 0.05 (0.000), so the null hypothesis is rejected. This indicates that there is a significant difference in the sensory acceptability of Nipa Chips prepared using the oven-baked method compared to the other two methods.

In summary, the results suggest that the sensory acceptability of Nipa Chips prepared using deep-frying and air-frying methods is not significantly different, but the oven-baked method yields Nipa Chips with significantly different sensory acceptability compared to the other two methods.

CONCLUSIONS

In conclusion, the analysis of Nipa Palm Fruit Chips extract revealed the presence of various compounds, including alkaloids, steroids, flavonoids, and tannins. The physico-chemical analysis showed a moisture content of 10.6% and an ash content of 2.68%. The sensory evaluation of Nipa Palm Fruit Chips prepared using three different methods (Air-Fried, Deep Fried, and Oven Baked) indicated that Oven Baked chips were the most accepted by evaluators, followed by Deep Fried and Air-Fried chips. The p-value for oven-baked Nipa chips being less than 0.05 suggests that oven-baked Nipa Chips have a significantly higher sensory acceptability than the other two methods, while the sensory acceptability of Nipa Chips prepared using deep-frying and air-frying methods is not significantly different.

RECOMMENDATIONS

1. Additional research should be conducted to investigate the specific pharmacological effects and potential health benefits of the identified compounds in Nipa Palm Fruit extract, which could lead to the development of medicinal or functional products.
2. Nipa Palm Fruit Chips seed flour should be used in various food products to capitalize on its nutritional composition and potential market demand.
3. The recipe for Nipa Palm Fruit Chips cookies can be optimized and standardized for production to ensure consistent quality and taste.
4. Design and branding of the packaging should emphasize the distinctive characteristics and health advantages of Nipa Palm Fruit Chips cookies, appealing to consumers who prioritize their well-being.
5. Involvement with local farmers, suppliers, and manufacturers can establish a sustainable supply chain for Nipa Palm fruits and seeds, supporting local agriculture and promoting sustainability.

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DEVELOPMENT AND ACCEPTABILITY OF BAMBOO (*Bambusa blumeana)* SHOOTS CANNED LOAF

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ABSTRACT

This research explores the development and evaluate the sensory acceptability of canned loaves made from bamboo shoots (*Bambusa blumeana*). The study aims to address the underutilization of this nutritious and sustainable ingredient, diversify food choices, and promote sustainable agriculture. The research involved a mixed-methods approach, including phytochemical and physico-chemical analysis, sensory evaluation, and consumer acceptability testing. The results showed that bamboo shoots contain specific chemical compounds and are rich in nutrients, particularly calcium and iron. Sensory evaluations revealed that the 1:1 mixture of bamboo shoots with wheat starch as a binder was the most preferred, indicating a favorable balance of sensory qualities. This research concludes that bamboo shoots offer a promising potential for developing innovative and sustainable food products, contributing to food security and dietary diversity. Recommendations include further research on the pharmacological effects of bamboo shoots, exploring their use in various food products, and developing a sustainable supply chain for this resource.

Keywords: Developmental Method, Bamboo shoots, Food Canning, Assessment, Perceptions

INTRODUCTION

The increasing urgency to address food insecurity has prompted a shift in the food industry towards enhancing indigenous staple foods with locally sourced, nutritious underutilized crops. Among these, bamboo shoots (BS) have garnered significant global interest due to their impressive nutritional profile and health-promoting properties. Bamboo shoots, the young edible stems of bamboo plants, are not only a culinary delight but also a versatile resource utilized in various aspects of life, including construction, medicine, and environmental conservation. As noted by Nyamayi (2022), communities have historically leveraged bamboo for multiple purposes, from livestock fodder to ornamental landscaping, highlighting its broad utility beyond just food.

Bamboo shoots belong to the Poaceae family and are typically harvested when they are a few weeks old or just before reaching a height of one foot. Their texture is often compared to asparagus, while their flavor resembles that of corn. Nutritionally, bamboo shoots are low in calories yet rich in dietary fiber, vitamins B6 and E, and essential minerals such as potassium and copper. This nutrient density contributes to various health benefits, including cholesterol reduction and improved gut health. Despite these advantages, the consumption and processing of bamboo shoots, particularly in the canning industry, remain underexplored areas in existing research.

While numerous studies have highlighted the nutritional benefits of bamboo shoots, there is a noticeable gap regarding their application in the canned food sector. The canning industry presents an opportunity to enhance the market presence of bamboo shoots by developing innovative products that cater to consumer preferences.

This study aims to fill this gap by conducting sensory evaluations and acceptability tests for bamboo shoot-based canned loaves. The research will focus on optimizing key sensory attributes such as color, aroma, taste, texture, and shelf stability to assess market potential.

The broader objectives of this study include evaluating the economic viability of bamboo shoot cultivation alongside canned loaf production, emphasizing sustainability in agricultural practices. By promoting bamboo cultivation as a sustainable agricultural method, this research seeks to contribute to dietary diversity by introducing a novel and nutritious food product to consumers. Ultimately, this initiative aims not only to reduce the environmental impact of food production but also to enhance food security through innovative uses of underutilized crops like bamboo shoots.

STATEMENT OF THE PROBLEM

This study aims to evaluate the acceptability of the developed canned loaf products made from bamboo shoots (*Bambusa blumeana*). It also evaluate the acceptability of the product when applied with different food binders.

Specifically, it sought to answer the following questions:

1. What is the phytochemical analysis of the *Bambusa blumeana*?
2. What is the physico-chemical analysis and nutritive value of the canned loaf made from *Bsambusa blumeana*?
3. What are the processes in the development of the *Bambusa blumeana* canned loaf product?
4. What are respondents' perceptions of the sensory acceptability of this potential product as to the use of the three different binders in terms of:
   4.1 Appearance;
   4.2 Texture;
   4.3 Flavor;
   4.4 Aroma; and
   4.5 General Acceptability?
5. What is the overall acceptability of the develop canned loaf bambusa blumeana products using three different proportion of binders below:
   5.1Cassava starch;
   5.2 Wheat starch; and
   5.3 Corn starch?

RESEARCH METHODOLOGY

Research Design

This study utilized a mixed-methods research design is likely to be the most suitable approach. Its main drive was the utilization and development of bamboo shoots as canned loaf as well as to determine its acceptability level among children, adolescents, and adults.

Research Environment

The developmental research study on bamboo shoots was conducted in Food Technology Innovation Center in one of the State University Caraga Region.

Respondents

The research made use of purposive random sampling. Forty- five respondents were drawn from the prospective consumer population. They were composed of 15 Teachers/food technology expert and members of the community; 15 Students from secondary; 15 Students from elementary. The study employed purposive random sampling technique in identifying the respondents' consumers. The study considered the Foods Technology experts and consumers in determining the sensory attributes of the bamboo shoots canned loaf and the acceptability of its potential food products.

Research Instrument

This study is purely product development. However, to determine the level of acceptability of the product, an adaptive-made questionnaire will be utilized, the potential products will be then evaluated using a Score Card and a Hedonic Scale especially in ascertaining the acceptability of the product in

terms of appearance, texture, odor and nutritional value by the panel of experts and consumers that were picked through a purposive random sampling. Multiple trials will be conduct to achieve a desired product.

Data Analysis

This study utilized the following statistical tools in analyzing the data:

Mean and Standard Deviation. These tools were used to determine the sensory attributes acceptability of the food products made from premix powder using the perceived qualitative descriptions as used in the instrument (appearance, texture and odor).

One-Way Analysis of Variance (ANOVA). This tool will be used to determine the differences among the different concentrations used for each flour sample.

RESULTS AND DISCUSSIONS

Phyto-chemical analysis result of the bamboo (bambusa Blumeana) shoots

Table 1. Phyto- chemical result of bamboo (Bambusa lumeana) shoots

Sample Code	Sample	Description	Parameter	Result
CHE-0301	Bamboo Shoot	251g plant sample stored in plastic container	Volume of Extract Obtained	120mL
			Alkaloids Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	-
			Test for Quaternary Bases & Amine Oxide	+
			Steroids Keller-Killini Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	+ -
			Flavanoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	-
			Saponins Froth Test Tannins Ferric Chloride Test *Brownish-Green indicates the presence of condensed tannins *Blue-black color indicates the presence of hydrolysable tannins	+ + Brownish-Green color

The phytochemical analysis of bamboo shoots (Bambusa blumeana) with sample code CHE-0301 involved a 251g plant sample, which produced 120mL of extract. The tests revealed a variety of chemical compounds in the bamboo shoots. Primary alkaloids were absent, while secondary and tertiary alkaloids were not detected. However, the test for quaternary bases and amine oxides returned a positive result, indicating their presence. Steroidal compounds were assessed with the Keller-Killini test, which detected 2-deoxysugars, but the Liebermann-Burchard test for unsaturated steroids was negative. Flavonoids, specifically leucoanthocyanins, were not found according to the Bate-Smith & Metcalf method. Saponins were tested but results were not specified. Finally, the Ferric Chloride test for tannins indicated a brownish-green color, confirming the presence of condensed tannins. Overall, the bamboo shoot extract contains quaternary bases, 2-deoxysugars, and condensed tannins, while secondary and tertiary alkaloids, unsaturated steroids, leucoanthocyanins, and saponins were not detected.

Physico-chemical analysis and nutritive value bamboo (*Bambusa blumeana*) shoots.

Table. 2. Physico- chemical analysis of Bamboo Loaf product.

Parameters	Unit	Result	Method
Calcium	ppm	563	Dry Ashing-AAS
Magnesium	ppm	96	Dry Ashing-AAS
Iron	ppm	36.9	Dry Ashing-AAS
Sodium	ppm	0.62	Dry Ashing-AAS
Potassium	%	0.22	Dry Ashing-AAS
Phosphorus	%	0.02	Spectrophotometric
Moisture	%	63.6	Gravimetric

Table 2 presents the physico-chemical analysis of a bamboo loaf product, detailing the nutrient content and moisture levels. The analysis shows that the product contains 563 ppm of calcium, 96 ppm of magnesium, and 36.9 ppm of iron, all measured using the Dry Ashing-AAS (Atomic Absorption Spectroscopy) method. Sodium was found to be 0.62 ppm, and potassium was measured at 0.22%, both also using Dry Ashing-AAS. Phosphorus content was determined to be 0.02% using spectrophotometric analysis. The moisture content of the bamboo loaf is 63.6%, assessed through gravimetric analysis. This table provides a comprehensive overview of the mineral composition and moisture content of the bamboo loaf, revealing significant levels of calcium and iron, along with substantial moisture, which could affect the product's shelf life and texture.

Processes of Bamboo shoot canned loaf

The following are the procedural steps in the development of the bamboo shoots canned loaf

1. Peel the tough leaves of each bamboo shoot to reveal the tender interior.
2. Cut off the firm top and bottom parts.
3. Shave off the bumpy part from the bottom part's outer layer. Once all the bamboo shoots are peeled out of tough leaves
4. Soak them in cold water for 30 minutes to remove any excess bitterness.
5. Wash with tap water.
6. Boil for 15 minutes.
7. Drain in colander.
8. Grind the thinly sliced bamboo Shoots and spices using food processor
9. Measure all the Ingredients and Mix evenly in three separate mixing bowl following the different binder.
10. Put in a sterilized can/bottle and cover.
11. Pasteurized for 90minutes in $212_{o}F$
12. Remove in pressure cooker and cool down in room temperature.
13. Store in cool dry place.

Perceptions of respondents on the sensory acceptability of this potential product as to the use of the three different binders

Table 3. Perceptions of the respondents on the sensory acceptability with a Cassava Starch as binder

Cassava Starch Binder	1:1 Mixture		1:1/2 Mixture		1:1/4 Mixture	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Appearance	6	like Slightly	6	like Slightly	5	Neither like nor dislike
Aroma	7	like moderately	6	like Slightly	5	Neither like nor dislike
Texture	6	like Slightly	7	like moderately	5	Neither like nor dislike
Taste	6	like Slightly	6	like Slightly	6	like Slightly
Overall Median	**6**	**like Slightly**	**6**	**like Slightly**	**5**	**Neither like nor dislike**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

Table 3. Provides insights into the sensory acceptability of products using cassava starch as a binder in different proportions: 1:1, 1:1/2, and 1:1/4 mixtures. The table includes medians and qualitative descriptions for four sensory attributes: appearance, aroma, texture, and taste. For the 1:1 mixture, respondents rated the appearance, aroma, texture, and taste with a median score of 6, indicating that they "like slightly" the product. In the 1:1/2 mixture, the median score for appearance and aroma was also 6, suggesting a slight preference, while texture was rated at 7 ("like moderately"), and taste remained at 6 ("like slightly"). The 1:1/4 mixture had median scores of 5 for appearance, aroma, and texture, indicating a neutral response ("neither like nor dislike"), though the taste still received a 6, suggesting a slight liking. Overall, the 1:1 and 1:1/2 mixtures received slightly better acceptability compared to the 1:1/4 mixture, with the latter generally being rated as neither liked nor disliked for most attributes. This indicates a general preference for higher proportions of cassava starch binder in terms of sensory attributes.

Table 4. Perceptions of the respondents on the sensory acceptability with a Wheat Starch as binder.

Wheat Starch Binder	1:1 Mixture		1:1/2 Mixture		1:1/4 Mixture	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Appearance	8	like very much	7	like moderately	4	Dislike slightly
Aroma	8	like very much	6	like Slightly	5	Neither like nor dislike
Texture	8	like very much	6	like Slightly	5	Neither like nor dislike
Taste	8	like very much	6	like Slightly	6	like Slightly
Overall median	**8**	**like very much**	**6**	**like Slightly**	**5**	**Neither like nor dislike**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

Table 4 presents the sensory acceptability of products using wheat starch as a binder in three different proportions: 1:1, 1:1/2, and 1:1/4 mixtures. For the 1:1 mixture, respondents gave high median scores of 8 for appearance, aroma, texture, and taste, indicating a strong preference ("like very much"). The 1:1/2 mixture also received favorable ratings with medians of 7 for appearance ("like moderately") and 6 for aroma, texture, and taste ("like slightly"). In contrast, the 1:1/4 mixture had lower median scores: 4 for appearance ("dislike slightly"), 5 for aroma and texture ("neither like nor dislike"), and 6 for taste ("like slightly"). Overall, the 1:1 mixture was highly favored, showing significant preference across all attributes, while the 1:1/2 mixture was moderately liked, and the 1:1/4 mixture was less favorable, especially in appearance. This suggests that higher proportions of wheat starch as a binder result in better sensory acceptability, particularly in terms of appearance, aroma, and texture.

Table 5. Perceptions of the respondents on the sensory acceptability with a Corn Starch as binder

Corn Starch Binder	1:1 Mixture		1:1/2 Mixture		1:1/4 Mixture	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Appearance	7	like moderately	6	like Slightly	5	Neither like nor dislike
Aroma	6	like Slightly	6	like Slightly	5	Neither like nor dislike
Texture	6	like Slightly	5	**Neither like nor dislike**	5	Neither like nor dislike
Taste	6	like Slightly	6	like Slightly	4	Dislike slightly
Overall median	**6**	**like Slightly**	**6**	**like Slightly**	**5**	**Neither like nor dislike**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

Table 5 evaluates the sensory acceptability of corn starch as a binder at three different proportions: 1:1, 1:1/2, and 1:1/4 mixtures. Using a nine-point hedonic scale, the median ratings for each attribute—appearance, aroma, texture, and taste—are detailed for each mixture ratio.

For the 1:1 mixture, respondents rated the appearance with a median score of 7, indicating they "like moderately," suggesting that this proportion offers a visually appealing product. Aroma and texture were both rated 6, reflecting a "like slightly" preference, and taste also received a median score of 6, indicating a slight liking. Overall, the 1:1 mixture is well-regarded, showing moderate to slight preference across all sensory attributes.

In the 1:1/2 mixture, median scores remained consistent at 6 for appearance, aroma, and texture, indicating a "like slightly" perception. This suggests that the product is generally acceptable but less impressive than the 1:1 mixture in terms of visual appeal and other sensory aspects. The taste was also rated 6, indicating a slight preference.

The 1:1/4 mixture had lower median scores: 5 for appearance, aroma, and texture, reflecting a "neither like nor dislike" response, and 4 for taste, indicating a "dislike slightly" perception. This proportion was least favored overall, particularly in taste, where it did not meet the expectations as well as the higher proportions.

Overall, the 1:1 mixture is preferred across all sensory attributes, providing the best balance of appearance, aroma, texture, and taste. The 1:1/2 mixture is acceptable but not as favorable, while the 1:1/4 mixture is generally less preferred, especially in taste. This pattern suggests that higher proportions of corn starch binder contribute to better sensory qualities, whereas lower proportions result in diminished sensory acceptability.

Table 6. Summary for Over-all Acceptability for the Perceptions of the respondents

Binders	1:1 Mixture		1:1/2 Mixture		1:1/4 mixture	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Cassava Starch	6	like Slightly	6	like Slightly	5	Neither like nor dislike
Wheat Starch	8	like very much	6	like Slightly	5	Neither like nor dislike
Corn Starch	6	like Slightly	6	like Slightly	5	Neither like nor dislike

The table summarizes the overall acceptability of different binders—cassava starch, wheat starch, and corn starch—used in various mixture ratios (1:1, 1:1/2, and 1:1/4) based on respondents' perceptions. For cassava starch, both the 1:1 and 1:1/2 mixtures received a median score of 6, indicating a slight liking, while the 1:1/4 mixture received a median score of 5, showing a neutral response. Wheat starch was rated highest in the 1:1 mixture, with a median score of 8, reflecting that respondents liked it very much.

However, the 1:1/2 and 1:1/4 mixtures were less favored, both scoring 6 and 5, respectively, with respondents slightly liking or being neutral about these ratios. Corn starch had consistent ratings across all mixtures, with both the 1:1 and 1:1/2 mixtures scoring a 6 (slightly liked) and the 1:1/4 mixture scoring a 5 (neither liked nor disliked).

Overall, wheat starch in a 1:1 mixture emerged as the most preferred binder, while other combinations were either slightly liked or received neutral feedback.

CONCLUSIONS

The findings highlight that bamboo shoots (Bambusa blumeana) contain specific chemical compounds, including quaternary bases, 2-deoxysugars, and condensed tannins, but lack several other phytochemicals. The bamboo loaf shows substantial mineral content, particularly in calcium and iron, with a high moisture level that may affect its shelf life and texture. Sensory evaluations indicate that the 1:1 mixture, especially with wheat starch as a binder, was the most preferred across all attributes, suggesting that this ratio offers the best balance of sensory qualities, making it the most favorable option among the tested formulations.

RECOMMENDATIONS

1. More research should be done to determine the particular pharmacological effects and potential health advantages of the substances found in bamboo shoots, which could lead to the development of medicinal or functional goods.
2. Bamboo (bambusa blumeana) shoots should be employed in a variety of food products to take advantage of their nutritious properties and potential commercial demand.
3. Bamboo (bambusa blumeana) shoots canned loaf recipe can be adjusted and standardized for production to ensure consistent quality and flavor.
4. The container design and branding should highlight the unique traits and health benefits of bamboo (bambusa blumeana) shoots, appealing to health-conscious consumers.
5. Participation with local farmers, suppliers, and manufacturers can develop a sustainable supply chain for bamboo (bambusa blumeana) shoots, supporting local agriculture and encouraging sustainability.

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DEVELOPMENT OF SEASHELL MEAT SIOMAI VARIETIES: A FOOD INNOVATION

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ABSTRACT

This study aimed to develop siomai using three varieties of seashell meat—spider conch (*Lambis scorpius*), mud clams (*Anadara cornea*), and black seashell (*Tegillarca granulosa*) as raw materials and to evaluate the products' acceptability. Employing an experimental research design, the study analyzed the physico-chemical composition and nutritional value of the siomai variants, as well as their sensory attributes, including appearance, texture, aroma, and taste. Both steamed and fried cooking methods were evaluated to assess their impact on consumer preferences. The respondents comprised 10 food experts and 50 cookery students, selected through purposive random sampling, who evaluated the siomai using scorecards and hedonic scales. Statistical tools such as mean, standard deviation, and ANOVA were applied to assess acceptability and identify variations across samples. Findings revealed that the seashell meat siomai achieved high acceptability across sensory attributes, with distinct strengths for each variant. Fried siomai exhibited notable consumer preference due to its superior texture and flavor, while steamed siomai was equally appreciated for its balanced sensory appeal. No significant differences in overall acceptability were found between the steamed and fried cooking methods, indicating consistent consumer satisfaction. This study highlights the potential of seashell meat as a nutritious and appealing ingredient for innovative food products, providing insights for culinary development and market strategies.

Keywords: Seashell meat siomai, Food innovation, Developmental study, Perceptions, Assessment

INTRODUCTION

Siomai, a popular Asian dumpling traditionally made with pork or shrimp, faces growing interest in innovative protein sources due to the rising demand for sustainable and diverse dietary options. Seashell meats, including spider conch, mud clams, and black seashells, present an underutilized yet promising alternative. Rich in essential nutrients such as proteins, minerals, and omega-3 fatty acids, seashell meat offers both nutritional and environmental advantages. Additionally, incorporating these marine resources into siomai aligns with global trends toward food innovation and sustainable culinary practices (Lakshmi & Devadason, 2011; Escamilla-Montes et al., 2019).

Despite the potential benefits, the use of seashell meats in siomai remains underexplored. Most siomai variants continue to rely on conventional ingredients such as pork, shrimp, or vegetables, overlooking the opportunity to diversify food products while promoting sustainable marine resource utilization (Hamel & Mercier, 2023). Mollusks, including seashells, are not only nutritious but also contribute to the socio-economic development of coastal communities. However, their integration into modern food innovations remains limited, underscoring the need for further research and development in this area (Escamilla-Montes et al., 2019). Addressing this gap could lead to more sustainable food systems and support local economies.

This study aims to develop and evaluate siomai variants using spider conch (Saang), mud clams (Toway), and black seashells (Dayo-Dayo) as alternative protein sources. It seeks to assess the sensory qualities, nutritional composition, and consumer acceptability of these innovative products. By expanding food choices and advocating for the sustainable use of marine resources, this research aspires to pro-

vide healthier siomai options for the people of Surigao while contributing to local economic growth and culinary diversity.

STATEMENT OF THE PROBLEM

This study aimed to develop siomai made from varieties of seashell meat as the raw materials and evaluate the acceptability of its potential products.

Specifically, it sought to answer the following questions:

1. What is the physico-chemical composition and nutritive value of mixed siomai using seashell meat namely:
   1.1 SaangSpider conch (Lambis Scorpius);
   1.2 Tuway Mud clams (Anadara cornea);
   1.3 Dayo-dayoBlack seashell (Tegillarcagranulosa)?
2. What are the Processes of the three potential products using varieties of seashell meat siomai?
3. What are the sensory acceptability of consumers respondents regarding seashell meat siomai in terms of:
   3.1 Appearance;
   3.2 Texture;
   3.3 Aroma; and
   3.4 Taste?
4. What are the perceptions of the respondents on the sensory acceptability of the potential food products in terms of cooking methods:
   4.1 Steam; and
   4.2 Fry?

RESEARCH METHODOLOGY

Research Design

The research employed experimental research methods to develop siomai, a food product crafted from diverse types of seashell meat. It utilized a mixed methods approach to assess the sensory characteristics and gauge the acceptability of these seashell meat siomai variants, including spider conch, mud clams, and black seashell. Evaluation encompassed aspects such as appearance, texture, aroma, flavor, and nutritional content.

Research Environment

The developmental research study on Banana flour was carried out in Food Technology Innovation Center in one of the state university in CARAGA Region.

Respondents

This study considered the total of 40 respondents consist of 10 (25%) are Panel/Food Experts and50 (83.3%) are Consumers/Cookery students to evaluate the sensory attributes of the developed potential food products and the acceptability of the based on the varieties of seashell meat siomai.

Research Instrument

This study is purely product development. However, to determine the level of acceptability of the product, an adaptive-made questionnaire will be utilized, the potential products will be then evaluated using a Score Card and a Hedonic Scale especially in ascertaining the acceptability of the product in terms of appearance, texture, aroma, taste and nutritional value by the panel of experts and consumers that were picked through a purposive random sampling. Multiple trials will be conduct to achieve a desired product.

Data Analysis

This study utilized the following statistical tools in analyzing the data:

Mean and Standard Deviation. These tools were used to determine the sensory attributes acceptability of the food products made from seashell meat siomai using the perceived qualitative descriptions as used in the instrument (appearance, texture and aroma).

One-Way Analysis of Variance (ANOVA). This tool will be used to determine the differences among the different concentrations used for each seashell meat siomai sample.

RESULTS AND DISCUSSION

Physico-chemical analysis and nutritive value result of mixed siomai using seashell meat

Table 1. Seashell Meat Siomai-Saang (Spider Conch)

Analysis	Results	Test Method
Crude Protein (N x 6.25), g/100g'	14.1	Kjeldahl Method
lron, mg/Kg	5.90	Flame AAS
Zinc, mg/Kg	3.01	
Magnesium, mg/Kg	355	

Table 1 reveals various parameters and their corresponding values for Seashell Meat Siomai-Saang, along with the methods used to determine those values. The crude protein content of Saang is indicated as 14.1%. This value represents the percentage of crude protein present in the seashell meat. The method used to determine this value is Kjeldahl. Kjeldahl analysis is a widely used method to measure the nitrogen content in a sample, which is then converted to protein content using a conversion factor.

The iron content of Saang is indicated as 5.90 mg/kg, zinc as 3.01 mg/kg, and magnesium as 355 mg/kg. This value represents the percentage of such elements present in the seashell meat. The method used to determine this value is Flame AAS. Flame AAS analysis enables the precise quantification of elements such as iron, zinc, and magnesium. This information is invaluable for various aspects of the food industry, from nutritional labeling to food safety assessments.

Overall, the table provides information about the composition of Seashell Meat Siomai-Saang, including the crude protein, iron, zinc, and magnesium content. The methods mentioned alongside each parameter indicate the analytical techniques used to measure those values.

Table 2. Seashell Meat Siomai-Toway (Nipa Clams)

Analysis	Results	Test Method
Crude Protein (N x 6.25), g/100g'	12.0	KjeldahlMethod
Crude Fat, g/100g	6.54	Mojonnier Extraction (Acid Hydrolysis)
lron, mg/Kg	136	Flame AAS
Zinc, mg/Kg	12.2	
Calcium, mg/Kg	128	

Table 2 reveals various parameters and their corresponding values for Seashell Meat Siomai-Toway, along with the methods used to determine those values. The crude protein content of Toway is indicated as 12.0%. This value represents the percentage of crude protein present in the seashell meat. The method used to determine this value is Kjeldahl. Kjeldahl analysis is a widely used method to measure the nitrogen content in a sample, which is then converted to protein content using a conversion factor.

The crude fatcontent of Toway is indicated as 6.54g/100g. This value represents the percentage of fat present in the seashell meat. The method used to determine this value is Mojonnier Extraction (Acid Hydrolysis). Mojonnier method is a gravimetric method that uses organic solvents to extract fat. Subsequently the solvent is evaporated and the fat is determined by weighing the dry fatty extract.The iron content of Toway is indicated as 136 mg/kg, zinc as 12.2 mg/kg, and magnesium as 128 mg/kg. This value represents the percentage of such elements present in the seashell meat. The method used to determine this value is Flame AAS. Flame AAS analysisenables the precise quantification ofelements such

as iron, zinc, and calcium. This information is invaluable for various aspects of the food industry, from nutritional labeling to food safety assessments.

Overall, the table provides information about the composition of Seashell Meat Siomai-Toway, including the crude protein, crude fat,iron,zinc, and calcium content. The methods mentioned alongside each parameter indicate the analytical techniques used to measure those values.

Table 3. Seashell Meat Siomai-Dayo-dayo (Black Seashell)

Analysis	Results	Test Method
Crude Protein (N x 6.25), g/100g'	13.5	KjeldahlMethod
Crude Fat, g/100g	7.15	Mojonnier Extraction (Acid Hydrolysis)
lron, mg/Kg	12.3	Flame AAS
Zinc, mg/Kg	4.42	
Magnesium, mg/Kg	315	

Table 3 reveals various parameters and their corresponding values for Seashell Meat Siomai-Dayo-dayo, along with the methods used to determine those values. The crude protein content of Dayo-dayo is indicated as 13.5%. This value represents the percentage of crude protein present in the seashell meat. The method used to determine this value is Kjeldahl. Kjeldahl analysis is a widely used method to measure the nitrogen content in a sample, which is then converted to protein content using a conversion factor.

The crude fat content of Dayo-dayo is indicated as 7.15g/100g. This value represents the percentage of fat present in the seashell meat. The method used to determine this value is Mojonnier Extraction (Acid Hydrolysis). Mojonnier method is a gravimetric method that uses organic solvents to extract fat. Subsequently the solvent is evaporated and the fat is determined by weighing the dry fatty extract.

The iron content of Dayo-dayo is indicated as12.3 mg/kg, zinc as 4.42 mg/kg, and magnesium as 315 mg/kg. This value represents the percentage of such elements present in the seashell meat. The method used to determine this value is Flame AAS. Flame AAS analysisenables the precise quantification of elements such as iron, zinc, and magnesium. This information is invaluable for various aspects of the food industry, from nutritional labeling to food safety assessments.

Overall, the table provides information about the composition of Seashell Meat Siomai-Dayo-dayo, including the crude protein, crude fat,iron,zinc, and magnesium content. The methods mentioned alongside each parameter indicate the analytical techniques used to measure those values.

Processes of the three potential products using varieties of Seashell Meat Siomai

The following are the procedural steps in the development of the Seashell Meat Siomai particularly:

1. Saang (Spider Conch) Siomai
2. Toway (Mud Clams) Siomai
3. Dayo-dayo (Black Seashell) Siomai

Part I- Mixing a Filling

1. Make a saang filling separately with the two binders used (cornstarch and all purpose flour). Mince 2 teaspoons onions, carrots, and garlic, 5 tablespoons of sesame oil, 3 tablespoons soy sauce and 1 tablespoon of ground paper. Put these in a mixing bowl and stir in 2 cups of ground saang, and 1 pc of small egg. Mix until all of the spices and ingredients are combined.
2. Mix together a flavorful toway filling with the two binders used (cornstarch and all purpose flour). Put 2 cups of ground Toway into a mixing bowl and stir in a 2 teaspoons onions, carrots, and garlic minced, 5 tablespoons of sesame oil, 3 tablespoons soy sauce and 1 tablespoon of ground paper. Stir until the spices and egg are completely mixed into the ground toway.
3. Combine dayo-dayo filling separately with the two binders used (cornstarch and all purpose flour). Mince 2 teaspoons onions, carrots, and garlic, 5 tablespoons of sesame oil, 3 tablespoons soy sauce and 1 tablespoon of ground paper. Put these in a mixing bowl and stir in 2 cups of ground dayo-dayo, and 1 pc of small egg. Mix until all of the spices and ingredients are combined.

Part II-Assembling the Siomai

1. Measure 1 tablespoon (8 g) of the filling into the center of 1 wrapper. Get out a 12 to 16-ounce (340 to 454 g) package of molo wrappers and remove 1 from the stack. Spoon 1 tablespoon (14.8 ml) (8 g) of your prepared filling into the center of the wrapper. Use square molo wrappers to make your siomai. If you can only find round wrappers, you'll need to shape them so the edges simply overlap.
2. Wet the edges of the wrapper and fold the corners in toward the center. Dip your index finger into a little water and run it along the edges of the won ton wrapper. Then bring 2 opposite corners up towards each other so they meet in the center.
3. Bring the other 2 corners towards the center and seal the sides. Pinch the corners that you've gathered at the center of the wrapper so they stay together. Then dip your fingers in the water again and run your fingers along the sides so they seal. Try to push out air that could be trapped between the filling and the won ton wrapper. This will prevent air pockets from forming when the siomai steam.
4. Wrap the corners along the bottom of the siomai. Dip your fingers in water again and touch them to the corners near the base of the dumpling. Press and fold the corner down and to the right. Repeat this for each corner so they're all wrapped in the same direction.
5. Squeeze the siomai gently and unfurl the wrapper near the top. Hold the assembled siomai and squeeze gently so the filling compresses a little. Keep ahold of the dumpling and use the fingers of your other hand to carefully peel back the wrapper near the top. Unfurling the wrapper near the top will help expose about 1-in (2.5 cm) of the filling. Assemble the remaining siomai until you run out of filling.

COOKING METHODS:

Steaming the Siomai Mixture

1. Bring 2 in (5 m) of water to boil in a large pot or skillet. Set the pot or skillet on the stove and turn the burner to high. The water should bubble vigorously. If you're using a metal steamer basket, use a pot so you can nestle the steamer basket inside. If you're using a bamboo steamer, you can set it inside a pot or place it directly onto a skillet of the same diameter.
2. Arrange the siomai in the steamer basket. Put the assembled siomai into the steamer basket or bamboo steamer. Leave about 1/2 in (1.3 cm) between each dumpling. Consider placing pieces of napa cabbage in the bottom of the steamer before you put the siomai in. The cabbage will prevent the siomai from sticking to the steamer basket.
3. Put the steamer into the pot and steam the siomai for 15 to 20 minutes. Lower the steamer basket into the pot or place the bamboo steamer directly onto the skillet. Cover the pot or put the lid on the bamboo steamer. Steam until the filling inside the siomai reaches 165 °F (74 °C) with an instant read thermometer. Ensure that the boiling water doesn't touch the bottom of the steamer. There should be at least 1 in (2.5 cm) of space between the water and the steamer. You may need to steam the siomai in batches. Remember to bring the water back to a boil before steaming another batch of siomai.
4. Serve the siomai immediately. Once you remove the siomai from the steamer basket, arrange them on a serving plate. Set out soy sauce to dip the siomai in. Garnish the siomai with minced scallions and slices of calamansi, lime, or lemon. While you can refrigerate leftover siomai in an airtight container in the refrigerator for up to 3 or 4 days, the texture is best immediately after steaming.

Frying the Siomai Mixture

1. Heat the Cooking Oil. In a deep fryer or a deep, heavy-bottomed pan, heat enough cooking oil for deep frying to around 350-375°F (175-190°C).
2. Fry the Siomai. Carefully place the siomai in the hot oil, ensuring they are not overcrowded. Fry until they turn golden brown and become crispy. This usually takes about 3-5 minutes. Use a slotted spoon to remove the fried siomai from the oil and place them on a plate lined with paper towels to absorb excess oil.

Perceptions of the consumer respondent's on the sensory acceptability of a develop seashell meat siomai in terms of Appearance, Aroma, Taste, and Texture.

Table 4. Level of Acceptability on the Appearance, Aroma, Taste, and Texture of Dayo-Dayo Siomai

STEAMED DAYO DAYO SIOMAI	Mean	SD	Description
The product is visually appealing.	3.58	0.712	VMA
The product appears to be appetizing.	3.60	0.632	VMA
The product has good color combination.	3.48	0.640	MA
The product has its correct consistency.	3.63	0.774	VMA
APPEARANCE	**3.57**	**0.583**	**VMA**
The aroma is balance in all ingredients.	3.55	0.552	VMA
The product smells freshly cooked.	3.60	0.591	VMA
The product has a savory smell.	3.50	0.599	VMA
The product has an acceptable aroma.	3.73	0.599	VMA
AROMA	**3.59**	**0.403**	VMA
The tenderness of the product.	3.70	0.516	VMA
The product has a balanced flavor.	3.58	0.675	VMA
The product taste great.	3.55	0.846	VMA
The product complements the sauce.	3.60	0.672	VMA
TASTE	**3.61**	**0.453**	**VMA**
I can feel the softness of the product.	3.50	0.847	VMA
I can feel the chewiness of dayo-dayo in the filling.	3.45	0.597	MA
Slightly moist.	3.48	0.599	MA
It is appealing, it uses unique flavor.	3.60	0.632	VMA
TEXTURE	**3.51**	**0.511**	**VMA**
General Acceptability	**3.57**	**0.410**	**VMA**

Parameters	Verbal Interpretation
3.50 – 4.00	Very Much Acceptable (VMA)
2.51 – 3.49	Much Acceptable (MA)
1.50 – 2.50	Acceptable (A)
1.00 – 1.49	Not Acceptable (NA)

Table 4 showed that the most significant level of acceptability on appearance was Statement 4, "The product has its correct consistency." (M=3.63, SD= 0.774), verbally interpreted as —*Very Much Acceptable*. Statement 3 (M=3.48, SD= .640), "The product has good color combination.", has the lowest mean among the four statements, verbally interpreted as —*Much Acceptable*. Overall, the average acceptability level of Processed Siomai made of Dayo Dayo is "*high*" (M=3.57, SD= 0.583), verbally interpreted as "*Very Much Acceptable*," wherein the respondents strongly agree on the appearance of steamed Dayo Dayo siomai. The survey participants express strong agreement regarding the appearance of the steamed Dayo Dayo siomai, signaling a generally positive reception of the product's appearance. The results imply that the siomai's uniformity is its most valued characteristic, while the color scheme, although satisfactory, has room for enhancement. In general, the product's appearance is well-received.

The siomai made of Dayo-Dayo was widely liked, with most people finding it very acceptable. People's opinions were generally consistent, showing that most had a positive view of the siomai's quality regarding appearance, smell, taste, and texture. The high level of acceptance means that the siomai meets or exceeds consumer expectations, making it a successful product in the market. The acceptability of steamed Dayo-Dayo dumplings can vary depending on the ingredients used and sensory evaluation. A study on nutritionally enhanced dumplings with herbs found that combined ingredients were more satisfactory regarding sensory quality, indicating positive reception based on appearance, color, flavor, texture, taste, and overall acceptability (Deffodile & Mishra, 2022). Likewise, the steamed Dayo-Dayo siomai was widely enjoyed, with most people finding it very satisfying. Overall, people's opinions were pretty consistent, indicating a positive perception of the siomai quality in appearance, aroma, taste, and texture. The high level of acceptance suggests that the siomai meets or surpasses consumer expectations, making it a successful product in the market.

Table 5. Level of Acceptability on the Appearance, Aroma, Taste, and Texture of Toway Siomai

STEAMED TOWAY SIOMAI	Mean	SD	Description
The product is visually appealing.	3.45	0.714	MA
The product appears to be appetizing.	3.38	0.774	MA
The product has good color combination.	3.65	0.700	VMA
The product has its correct consistency.	3.67	0.616	VMA
APPEARANCE	**3.54**	**0.582**	**VMA**
The aroma is balance in all ingredients.	3.65	0.580	VMA
The product smells freshly cooked.	3.48	0.599	MA
The product has a savory smell.	3.48	0.679	MA
The product has an acceptable aroma.	3.73	0.506	VMA
AROMA	**3.58**	**0.421**	**VMA**
The tenderness of the product.	3.50	0.641	VMA
The product has a balanced flavor.	3.40	0.709	MA
The product taste great.	3.40	0.841	MA
The product complements the sauce.	3.70	0.608	VMA
TASTE	**3.50**	**0.543**	**VMA**
I can feel the softness of the product.	3.70	0.608	VMA
I can feel the chewiness of toway in the filling.	3.45	0.677	MA
Slightly moist.	3.38	0.667	MA
It is appealing, it uses unique flavor.	3.35	1.027	MA
TEXTURE	**3.47**	**0.578**	**MA**
General Acceptability	**3.52**	**0.479**	**VMA**

Parameters	Verbal Interpretation
3.50 – 4.00	Very Much Acceptable (VMA)
2.51 – 3.49	Much Acceptable (MA)
1.50 – 2.50	Acceptable (A)
1.00 – 1.49	Not Acceptable (NA)

Table 5 showed that the most significant level of acceptability on appearance was Statement 4, "The product has its correct consistency." (M=3.67, SD= 0.616), verbally interpreted as —*Very Much Acceptable*. Statement 2 (M=3.38, SD= .774), "The product appears to be appetizing.", has the lowest mean among the four statements, verbally interpreted as —*Much Acceptable*. Overall, the average acceptability level of Processed Siomai made of Toway is "*high*" (M=3.54, SD= 0.582), verbally interpreted as "*Very Much Acceptable*," wherein the respondents strongly agree on the appearance of steamed toway siomai. Hence, the average level of acceptability for the appearance of the siomai was high, showing that respondents strongly believe that the steamed Toway siomai is visually appealing and meets their expectations in terms of appearance. This positive feedback highlights the siomai's appeal and potential for consumer acceptance based on its appearance and characteristics.

The siomai made of Toway received a notably high overall general acceptability rating, with an average score of 3.52 and a standard deviation of 0.479. This high mean score suggests that, on average, participants found the texture, taste, aroma, and appearance of the steamed siomai highly acceptable. The relatively low standard deviation indicates minimal response variation, reflecting a solid consensus among participants regarding their positive perception of the steamed siomai. The consistently high rating across different aspects confirms that the Toway siomai meets or exceeds consumer expectations, positioning it as a potentially popular choice among consumers.

Furthermore, research on steamed dumplings with fillings containing rib materials, pickled Chinese cabbage, and mellea armillaria sporophore demonstrated that the taste was described as aromatic and delectable, suitable for individuals of all age groups (Du, 2016). The correlation between these results indicates that incorporating diverse and flavorful ingredients, as seen in both studies, contributes to the overall appeal of steamed dumplings. Du's (2016) study backs the notion that well-chosen, aromatic, and delicious fillings can make steamed dumplings attractive to a broad audience. Similarly, the high satisfaction rating of the steamed Toway siomai suggests that its ingredients and preparation methods effectively enhance its sensory attributes, making it a favored choice among customers. This agreement in findings underscores the significance of ingredient quality and variety in achieving high consumer contentment with steamed dumpling products.

Table 6. Level of Acceptability on the Appearance, Aroma, Taste, and Texture of Saang Siomai

STEAMED SAANG	Mean	SD	Description
The product is visually appealing.	3.77	0.480	VMA
The product appears to be appetizing.	3.67	0.526	VMA
The product has good color combination.	3.65	0.580	VMA
The product has its correct consistency.	3.52	0.640	VMA
APPEARANCE	**3.66**	**0.445**	**VMA**
The aroma is balance in all ingredients.	3.58	0.549	VMA
The product smells freshly cooked.	3.70	0.464	VMA
The product has a savory smell.	3.65	0.483	VMA
The product has an acceptable aroma.	3.73	0.554	VMA
AROMA	**3.66**	**0.369**	**VMA**
The tenderness of the product.	3.67	0.526	VMA
The product has a balanced flavor.	3.65	0.533	VMA
The product taste great.	3.58	0.594	VMA
The product complements the sauce.	3.58	0.675	VMA
TASTE	**3.62**	**0.446**	**VMA**
I can feel the softness of the product.	3.65	0.580	VMA
I can feel the chewiness of saang in the filling.	3.70	0.516	VMA
Slightly moist.	3.58	0.594	VMA
It is appealing, it uses unique flavor.	3.75	0.439	VMA
TEXTURE	**3.67**	**0.418**	**VMA**
General Acceptability	**3.65**	**0.366**	**VMA**

Parameters	Verbal Interpretation
3.50 – 4.00	Very Much Acceptable (VMA)
2.51 – 3.49	Much Acceptable (MA)
1.50 – 2.50	Acceptable (A)
1.00 – 1.49	Not Acceptable (NA)

Table 6 showed that the most significant level of acceptability on appearance was Statement 1, "The product is visually appealing." (M=3.77, SD= 0.480), verbally interpreted as ―*Very Much Acceptable*. Statement 4 (M=3.52, SD=.640), "The product has its correct consistency." has the lowest mean among the four statements, verbally interpreted as ―*Very Much Acceptable*. Overall, the average acceptability level of Processed Siomai made of Saang is "high" (M=3.66, SD=0.445), verbally interpreted as "*Very Much Acceptable*," wherein the respondents strongly agree on the appearance of steamed saang siomai.The study outcomes presented in Table 7 reveal a significant positive response to the appearance of steamed Saang siomai among the survey participants. The statement "The product looks appealing" garnered the highest level of approval, indicating that the respondents found the siomai to be very visually attractive. Although "The product has the right consistency" received the lowest average score among the four statements, it still received a high level of approval, suggesting that consistency is also highly valued. Overall, the average level of approval for the appearance of the siomai was high, indicating a consensus among the survey participants that the steamed Saang siomai is visually appealing and meets their expectations. This positive feedback emphasizes the stomach's strong visual appeal and suggests its potential market success based on its appearance alone.

The siomai made of Saang received a high overall acceptance, with a mean score of 3.65 and a standard deviation of 0.366. This suggests that respondents generally had a positive perception of this product. The high mean score indicates that most respondents considered the steamed Saang siomai highly acceptable based on its appearance, aroma, taste, and texture. The low standard deviation indicates slight variation in the responses, emphasizing the consistency of the positive feedback. The high level of acceptability suggests that the steamed Saang siomai has the potential for success in the market, as it effectively meets consumer expectations and is well-received.

Additionally, the creation of double bamboo tube-steamed fresh shrimp dumplings stressed the importance of the final product being visually appealing, with a clear, pure white, and vibrant color, as well as having a smooth, sweet, and aromatic flavor, which makes it suitable for consumers of all ages (Zhang, Mao, Qing, & Wu, 2016). The relationship between these discoveries underlines the significance of visual attractiveness and sensory characteristics in the acceptance of steamed dumplings. Zhang, Mao, Qing, and Wu (2016) showed that an appealing appearance, along with a delightful taste and scent, significantly increases the acceptability of steamed shrimp dumplings. Similarly, the popularity of steamed Saang siomai can be ascribed to its attractive appearance and positive sensory attributes. This correlation suggests that concentrating on both the visual and sensory aspects of steamed dumplings is vital in meeting consumer expectations and attaining significant success in the market.

Perceptions of the respondents on the sensory acceptability of the potential food products in terms of cooking methods

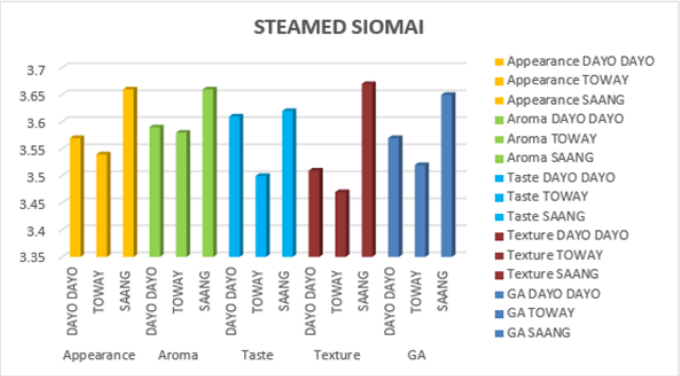

Figure 2. Level of Acceptability of Steamed Siomai Products

The data shown in Figure 2 demonstrates that Saang Siomai had the highest level of approval across different product attributes such as appearance, aroma, taste, and texture. Respondents consistently rated Saang Siomai the highest, indicating that it met consumer expectations across these dimensions. Following Saang Siomai, Dayo-Dayo Siomai received the second highest level of approval, showing generally positive feedback but slightly lower than Saang. Toway Siomai, while still receiving positive ratings, had the lowest level of acceptability among the three products in terms of appearance, aroma, taste, and texture. These findings highlight the varying consumer preferences and perceptions of different siomai products, with Saang Siomai emerging as the most preferred among the respondents in this study.

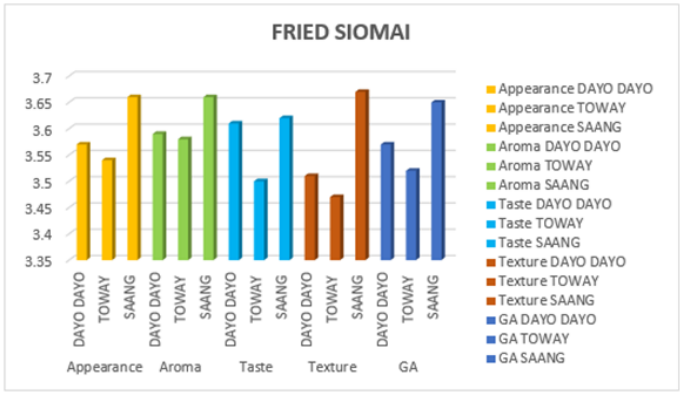

Figure 3. Level of Acceptability of Fried Siomai Products

Figure 3 shows that among the fried siomai options, Saang siomai had the highest level of acceptability, performing better than both Dayo-dayo and Toway. This thorough evaluation includes important characteristics like appearance, aroma, taste, and texture. In particular, Saang siomai stood out in terms of visual appeal, with its proper consistency and appealing appearance being well-received by the respondents. Its aroma, described as both acceptable and well-balanced, also contributed to its positive reception. The taste of Saang siomai, known for its tenderness and ability to complement the sauce, also received high ratings. Lastly, its texture, which is appealing and has a unique flavor, solidified its top position in the acceptability rankings. These findings emphasize Saang siomai's strong performance across various sensory dimensions, making it the preferred choice among the products evaluated. This overall acceptability indicates that Saang Siomai has significant market potential due to its well-rounded sensory appeal.

CONCLUSIONS

The findings highlight a diverse range of sensory preferences among consumers for both steamed and fried siomai variants, with distinct strengths across attributes such as taste, aroma, appearance, and texture. Steamed siomai variants exhibit consistent consumer satisfaction, with no significant differences in overall acceptability, demonstrating a uniform preference and robust appeal across Dayo Dayo, To-way, and Saang types. Similarly, fried siomai products show comparable high acceptability across all variants, with fried Saang Siomai emerging as the most favored due to its strong sensory appeal, particularly in appearance and aroma. The study also emphasizes a notable consumer inclination towards fried siomai, especially for its flavor and texture profiles, indicating its strong market potential. Overall, the results underscore the sensory versatility and widespread approval of both steamed and fried siomai options.

RECOMMENDATIONS

1. Highlight the unique sensory strengths of each siomai variant in marketing campaigns, such as the robust aroma of fried Saang Siomai and the balanced sensory appeal of steamed variants. This approach can cater to diverse consumer preferences and boost market reach.
2. Capitalize on the consumer preference for fried siomai by expanding its availability, introducing innovative flavor profiles, and promoting it as a popular choice for its strong flavor and texture appeal.
3. Ensure consistent quality in taste, texture, aroma, and appearance across all siomai types, as consumer satisfaction is uniformly high for both steamed and fried options. This consistency will strengthen brand trust and loyalty.
4. Introduce options for consumers to choose between steamed and fried siomai or customize their serving style, as this flexibility could enhance appeal to a broader audience and boost sales.
5. Design attractive and functional packaging that emphasizes the sensory strengths of the siomai, such as its aroma and texture. Include transparent or visually appealing designs that showcase the product's appearance to attract consumers.

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DIGITAL LITERACY AND ONLINE SAFETY PRACTICES AMONG HIGH SCHOOL STUDENTS IN MABINI: BASIS FOR A PROPOSED CYBERSECURITY EDUCATION PROGRAM

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ABSTRACT

In the contemporary digital era, where technology and the internet play pivotal roles in our daily lives, the significance of digital literacy cannot be overstated. The ability to navigate the vast expanse of online information was a critical aspect of digital literacy, particularly for high school students who encounter diverse sources. This study adopted descriptive correlational research methods, utilizing a survey instrument to assess the impact of digital literacy and online safety practices on cybersecurity education programs in selected high schools in Mabini, Batangas. The research, focusing on students in Mabini, Batangas, employs Slovin's formula to determine a sample size of 171 students from an estimated population of 555 junior high school students. The study ensured the reliability of the test questionnaires through a test-retest reliability process, obtaining a Cronbach alpha reliability score of 0.858. The findings reveal a positive perception of digital tools for communication, with students expressing agreement on their digital data, information, visual, media, and meta literacy levels. Notably, the respondents exhibit a commitment to online safety practices. The comparison between online safety practices and digital literacy levels yields significant relationships, highlighting the interconnected nature of these aspects. This study provides valuable insights into the digital landscape proficiency of high school students, emphasizing the need for holistic digital literacy education to foster responsible digital citizenship. The findings underscore the importance of integrating cybersecurity education into high school curricula, considering the positive correlation between online safety practices and various dimensions of digital literacy. This comprehensive approach aims to equip students with the knowledge and skills necessary for secure and responsible engagement in the digital realm, preparing them for the challenges and opportunities of the modern information age.

Keywords: digital literacy, online safety practices, high school students, cybersecurity education program

INTRODUCTION

In today's digitally driven world, where the internet and technology have become integral parts of our daily lives, the concept of digital literacy has never been more crucial. High school students, often referred to as digital natives, were growing up in an era where technology was pervasive, and information was at their fingertips. While this may seem advantageous, it also presents a series of challenges, particularly in the realm of online safety (Purnama et al., 2021).

As high school students are increasingly engaging with digital devices and platforms, the need for digital literacy has become a pressing concern. Digital literacy encompasses a range of skills that go beyond the ability to use digital tools; it involves understanding the intricacies of digital communication, discerning the reliability of online information, and practicing responsible and ethical behavior in the digital sphere. Without a strong foundation in digital literacy, high school students may find themselves vulnerable to various online threats, including cyberbullying, identity theft, online scams, and misinformation. Hence, it was essential to promote digital literacy as a means of enhancing online safety practices (Tomczyk, 2020).

Navigating the vast array of information on the internet was a crucial aspect of digital literacy. High school students encounter numerous information sources, necessitating the ability to discern between

credible and unreliable ones. Developing research skills and understanding the consequences of spreading false information were imperative. By nurturing these skills, students can shield themselves from misinformation and make informed decisions online.

In the contemporary age, the Philippines, like the rest of the world, has witnessed an unprecedented surge in digital technology adoption. High school students across the archipelago were growing up in a society where digital devices, internet connectivity, and social media platforms have become ubiquitous facets of their lives. As digital natives, these students possess a profound understanding of technology, but the implications of this digital immersion extend far beyond convenience (Atoy Jr et al., 2020).

The Philippines, a nation known for its diverse and vibrant culture, was also home to a generation of high school students who were embracing the digital age with unparalleled enthusiasm. They were engaging in online learning, social networking, and digital information consumption as part of their daily routine. The need for digital literacy, encompassing the ability to navigate, understand, and critically engage with digital technology, has never been more pertinent. Beyond basic digital skills, students must also cultivate a heightened sense of online safety, recognizing the digital perils they may encounter in an ever-expanding online world (Camiling, 2019).

In the era of social media, educating high school students about the consequences of their online actions was essential. Digital literacy fosters responsible behavior, encouraging students to think before posting, respect privacy, and practice good digital etiquette. Emphasizing empathy and kindness in online communication contributes to a more respectful digital environment. As technology evolves, high school students must adapt and be proactive in their digital literacy. Identifying and responding to emerging online threats, including deepfakes and disinformation, was vital in a changing digital landscape. Adaptability ensures students navigate the digital realm confidently and securely.

Online safety practices were particularly relevant in the Philippine context, where high school students, like their global counterparts, face challenges related to cyberbullying, identity theft, misinformation, and online privacy breaches. The significance of these issues cannot be overstated, as they have far-reaching consequences on students' mental health, personal security, and academic endeavors. This study endeavored to delve into these concerns, providing a comprehensive examination of the online safety landscape within the Philippines and proposing strategies to empower high school students to protect themselves effectively in the digital realm.

Moreover, considering the unique cultural and regional aspects of the Philippines was essential when addressing digital literacy and online safety. The Philippines was characterized by a rich tapestry of languages, traditions, and socioeconomic disparities, all of which influence how students engage with the digital world. This regional diversity must be acknowledged when designing interventions that cater to the specific needs and challenges high school students face across different parts of the country.

Online safety practices, too, take on a unique dimension in Mabini, Batangas. In this specific geographical context, high school students must address the risks associated with online interactions while leveraging the internet for their education and social connections. Issues such as cyberbullying, identity theft, and online scams transcend geographical boundaries, impacting the lives of students. Understanding these issues and implementing protective measures tailored to their region's specific challenges was crucial to safeguarding their online experiences.

Mabini, like many other regions, was not immune to pervasive issues concerning digital literacy and online safety. High school students were exposed to a vast and ever-changing digital environment, wherein critical aspects such as discerning credible information, understanding the consequences of online actions, and safeguarding personal data demand heightened attention. The study aimed to unravel the unique challenges faced by students in Mabini, considering the local context, socio-cultural nuances, and the specific digital landscape shaping their online experiences.

Moreover, recognizing the cultural and regional nuances in Mabini, Batangas, was essential in crafting effective strategies for promoting digital literacy and online safety. Factors like local traditions, languages, and access to technology may influence how students engage with the digital world (Lazonder et al., 2019). Understanding these factors helped educators, parents, and policymakers in Mabini, Batangas, design interventions that resonate with the local context, ensuring that high school students receive targeted support.

This study sought to unravel the intricate relationship between digital literacy and online safety practices in Mabini, Batangas, and provide insights into how these aspects can be cultivated effectively within the unique regional context. By doing so, the study aimed to contribute to the development of tailored

approaches that empower high school students to navigate the digital world safely and responsibly while considering the specific challenges and opportunities they face in this picturesque town.

This study on digital literacy and online safety practices among high school students in Mabini was motivated by the urgent need to address the complex challenges presented by the digital age. Recognizing the unique socio-cultural factors influencing the digital experiences of students in Mabini, the research aims to investigate specific issues such as misinformation, cyberbullying, and privacy concerns within this local context. The rationale was grounded in the understanding that high school students, immersed in an ever-evolving digital landscape, require tailored interventions and strategies that consider cultural norms, technological infrastructure, and educational resources. By shedding light on these challenges, the study sought to contribute insights that inform the development of targeted educational programs, policy recommendations, and community initiatives. The overarching goal was to empower high school students in Mabini with the necessary skills and awareness to navigate the digital realm responsibly and securely, fostering a safer and more informed digital environment in their community.

Statement of the Problem

The study aimed to determine the impact of digital literacy by online safety practices to the context of cybersecurity education program in selected high schools in Mabini, Batangas. Specifically, this study pursued to answer the following questions:

1. What was the level of digital literacy of the respondents in terms of:
   1.1 data;
   1.2 information;
   1.3 visual;
   1.4 media; and;
   1.5 meta?
2. What were the online safety practices of the respondents?
3. Is there any significant relationship between the level of digital literacy and the online safety practices of the respondents?
4. What intervention program should be proposed to enhance digital literacy and online safety practices?

METHODOLOGY

In this chapter, the methodology utilized in the study was clarified. It includes discussions on the research design, data resources, the target demographic, the validation of tools, the data collection process, ethical considerations, data management, and the techniques applied for data analysis.

Research Design

The study employed descriptive correlational research methods, integrating a survey instrument to evaluate the influence of digital literacy and online safety practices on cybersecurity education programs in selected high schools in Mabini, Batangas.

Participants

The research focused on Grade 7 students currently enrolled in selected high schools in Mabini, Batangas. By employing Raosoft's formula, maximizing the confidence level of 95% and 5% margin of error, the study has effectively determined an appropriate sample size of 171 students from the total enrollees of 555 grade 7 students in selected high schools Mabini, Batangas.

Research Instrument

The research utilized a self-made questionnaire created by the researcher to assess the influence of integrating digital literacy with online safety practices. This survey was integral for gaining a comprehensive understanding of how the combination of digital literacy and online safety practices can positively impact cybersecurity education within a specific context.

Data Analysis

To provide an analysis of the data, the researcher applied the following statistical methodologies. The interpretation of data involved the use of weighted mean, ranking, and Pearson r were used.

RESULTS AND DISCUSSIONS

This part of the study provided the presentation, analysis, and interpretation of the gathered data from the questionnaires answered by the respondents in accordance with the specific questions posited on the objectives of the study.

1. Level of Digital Literacy of the Student-Respondents.

1.1 In Terms of Data Literacy

Table 1. Level of Digital Data Literacy of the Student-Respondents

Items	Weighted Mean	Interpretation	Rank
1. I can effectively use digital tools for communication (e.g., email, messaging apps).	4.25	Always	1
I am confident in my ability to critically evaluate online information sources.	3.75	Often	3
I can discern credible news sources from unreliable ones.	3.53	Often	4
I am skilled in creating and sharing multimedia content (images, videos, etc.).	3.47	Often	5
I can identify and avoid fake news and misinformation online.	3.81	Often	2
Composite Mean	**3.76**	**Often**	

As gleaned in Table 1, the student-respondents assessed that they can always use effectively digital tools for communication (e.g. email, messaging app) which gained the highest equal weighted mean of 4.25 and the highest rank of 1. This finding suggested a high level of comfort and competence among the students in employing digital platforms for communication purposes.

1.2. In Terms of Information Literacy

Table 2. Level of Digital Information Literacy of the Student-Respondents

Items	Weighted Mean	Interpretation	Rank
1. Evaluating the credibility of digital information was something I do.	3.74	Often	3
2. I find it easy to identify reliable sources of information online.	3.95	Often	1
3. My ability to discern between trustworthy and unreliable digital information was always well-developed.	3.65	Often	4
4. I am adept at critically evaluating the accuracy of digital information.	3.49	Often	5
5. I consistently make informed decisions based on my assessments of digital information.	3.94	Often	2
Composite Mean	**3.75**	**Often**	

As gleaned in Table 2, the student-respondents assessed that they often find it easy to identify reliable sources of information online which got the highest weighted mean of 3.95 and the highest rank of 1. This indicates a collective confidence among the respondents in their ability to discern and access trustworthy and credible information on the internet.

1.3. In Terms of Visual Literacy

Table 3. Level of Digital Visual Literacy of the Student-Respondents

Items	Weighted Mean	Interpretation	Rank
1. Interpreting and creating visual content in digital formats was something I excel at.	3.56	Often	4
2. I feel confident in my ability to convey information effectively through visual means.	3.74	Often	2
3. Analyzing visual data or representations was something I do with ease.	3.58	Often	3
4. My visual literacy skills contribute positively to my overall digital literacy.	3.76	Often	1
5. I create visually appealing and informative digital content.	3.49	Often	5
Composite Mean	**3.63**	**Often**	

As gleaned in Table 3, the student-respondents displayed that their visual literacy skills often contribute positively to their overall digital literacy which made the highest weighted mean of 3.76 and the highest rank of 1. The results acknowledged the positive impact of visual literacy skills which suggests that they were adept at comprehending and producing visual content in digital formats, contributing to their broader proficiency in the digital realm.

1.4. In Terms of Media Literacy

Table 4. Level of Digital Media Literacy of the Student-Respondents

Items	Weighted Mean	Interpretation	Rank
1. I critically assess the content and messages conveyed through digital media.	3.97	Often	1
2. Creating digital media content was something I excel at.	3.35	Sometimes	5
3. I am proficient in distinguishing between different forms of digital media.	3.40	Often	4
4. My media literacy skills contribute positively to my overall digital literacy.	3.70	Often	2
5. I can identify potential biases or misinformation in digital media.	3.56	Often	3
Composite Mean	**3.59**	**Often**	

As stated in Table 4, the student-respondents perceived that they often critically assess the content and messages conveyed through digital media which made the highest weighted mean of 3.97 and the highest rank of 1. This suggests a proactive and discerning approach to the information they encounter in the digital sphere.

1.5. In Terms of Meta Literacy

Table 5. Level of Digital Meta Literacy of the Student-Respondents

Items	Weighted Mean	Interpretation	Rank
1. I understand the importance and relevance of metadata in a digital context.	3.96	Often	1
2. Using metadata to enhance the search and retrieval of digital information was something I do.	3.71	Often	2
3. I consistently consider ethical considerations related to metadata use in digital environments.	3.40	Often	5
4. My awareness of metadata contributes positively to my overall digital literacy.	3.68	Often	4
5. I adeptly utilize metadata to organize and categorize digital information effectively.	3.70	Often	3
Composite Mean	**3.69**	**Often**	

As given in Table 5, the respondents affirmed that they often understand the importance and relevance of metadata in a digital context which got the highest weighted mean of 3.96 and the highest rank of 1. This acknowledgment suggests that the participants were well-versed in recognizing the significance of metadata, which refers to descriptive information about digital data.

2. Online Safety Practices of the Respondents

Table 6. Online Safety Practices of the Respondents

Items	Weighted Mean	Interpretation	Rank
I am cautious about sharing personal information on social media.	3.92	Practiced	9
I review and adjust my privacy settings on social networking sites.	3.99	Practiced	8
I regularly update my passwords for online accounts.	3.74	Practiced	10
I am aware of the potential risks of connecting with strangers on social media.	4.05	Practiced	4
I avoid clicking on suspicious links or attachments in messages.	4.15	Practiced	1
I report any instances of cyberbullying or harassment that I encounter.	4.04	Practiced	5
I am selective in accepting friend or connection requests on social media.	4.03	Practiced	6
I am mindful of my online behavior and its potential consequences.	4.01	Practiced	7
I do not engage in online bullying or harassment of others.	4.12	Practiced	2
I use strong and unique passwords for my online accounts.	4.09	Practiced	3
Composite Mean	**4.01**	**Practiced**	

As seen in Table 6, the student-respondents replied that they practiced and avoided the clicking on suspicious links or attachments in messages which got the highest weighted mean of 4.15 and the highest rank of 1. This suggested that the respondent's behavior reflects a heightened awareness and vigilance regarding online security.

3. Relationship Between the Online Safety Practices of the Respondents and their Level of Digital Literacy

Table 7. Relationship Between the Online Safety Practices of the Respondents and their Level of Digital Literacy

Variables Compared	r-value	p-value	Decision	Interpretation
Data Literacy	0.57	0.00000	p<0.01, Reject Ho	Highly Significant
Information	0.53	0.00000	p<0.01, Reject Ho	Highly Significant
Visual	0.59	0.00000	p<0.01, Reject Ho	Highly Significant
Media	0.59	0.00000	p<0.01, Reject Ho	Highly Significant
Meta Literacy	0.61	0.00000	p<0.01, Reject Ho	Highly Significant

As revealed in Table 7, when the responses of the respondents on their online safety practices and level of digital literacy were compared, the computed r-values of 0.57 for data literacy, 0.53 for information literacy, 0.59 for visual literacy, 0.59 for media literacy, and 0.61 for meta literacy have corresponding p-values of less than 0.01, thus rejecting the hypothesis.

4. Proposed Intervention Program to Enhance Digital Literacy and Online Safety Practices

Table 8. Intervention Program

PROGRAM	OBJECTIVES	OUTPUTS	TIME FRAME
Digital Communication Proficiency Initiative	Improve students' proficiency in using digital tools for effective communication. Enhance their understanding of various communication platforms and etiquette.	Increased competence in email and messaging app communication. Heightened awareness of online communication etiquette	Months 1-3: Conduct workshops on effective digital communication. Months 4-6: Encourage practical application in class projects.
Digital Information Literacy Workshop Series	Strengthen students' skills in digital information literacy. Enable them to critically assess information accuracy and discern reliable online sources.	Improved ability to distinguish between credible and unreliable sources. Enhanced critical thinking skills in evaluating online information.	Months 1-3: Develop and implement information literacy workshops. Months 4-6: Integrate information literacy into research-oriented assignments.
Visual Literacy and Multimedia Content Creation Bootcamp	Foster creative engagement in digital media. Develop students' visual literacy and proficiency in generating multimedia content.	Increased capability to create visually appealing and informative digital content. Enhanced understanding of the synergy between visual and digital literacy.	Months 1-3: Design and conduct visual literacy workshops. Months 4-6: Facilitate hands-on multimedia content creation sessions.
Metadata Awareness and Ethical Digital Practices Seminars	Promote understanding of metadata and ethical considerations in the digital realm. Raise awareness about responsible digital behavior and content creation.	Increased comprehension of metadata and its significance. Heightened awareness of ethical considerations in digital media.	Months 1-3: Organize seminars on metadata and ethical digital practices. Months 4-6: Incorporate ethical considerations into various digital projects.
Collaborative Digital Projects and Industry Insights Program	Establish a collaborative learning environment. Provide insights into industry practices and emerging technologies through collaborations.	Successful completion of collaborative digital projects. Exposure to real-world insights through interactions with industry experts.	Months 1-3: Facilitate collaborative project planning and execution. Months 4-6: Organize guest lectures and industry interaction sessions.

Table 8 shows the intervention plan based on the findings of the study. It was a multifaceted initiative aimed at bolstering students' digital skills which will be beneficial and useful for a cybersecurity education program. It includes a Digital Communication Proficiency Initiative, Digital Information Literacy Workshop Series, Visual Literacy and Multimedia Content Creation Bootcamp, Metadata Awareness and Ethical Digital Practices Seminars, and Collaborative Digital Projects with Industry Insights Program. The plan focuses on enhancing students' proficiency in digital communication, critical thinking, creative engagement in digital media, understanding metadata, and fostering ethical digital practices. This comprehensive approach ensures students develop practical skills, critical thinking abilities, and industry relevance, preparing them as responsible digital citizens for the challenges of the digital era.

CONCLUSIONS

The study delved into the multifaceted landscape of digital literacy and online safety practices among the student-respondents. The findings revealed a positive inclination towards incorporating digital tools into communication practices, highlighting the contemporary nature of their interactions. This underscored the crucial role of digital literacy and communication skills in the educational landscape, as students adeptly navigated various technological resources for effective communication.

Moreover, the study reflected the students' proficiency in digital information literacy, showcasing their ability to distinguish credible sources and critically assess information accuracy. This proficiency was not only crucial for academic pursuits but also for navigating the complexities of the digital landscape responsibly. The exploration of digital visual literacy demonstrated the synergy between visual and digital literacy, emphasizing the importance of incorporating visual literacy into broader digital literacy education. The students' consistent practice of generating visually appealing and informative content signified their comfort and proficiency in leveraging digital tools for creative expression.

In terms of digital media literacy, the study suggested that students were active and discerning participants in the digital information landscape, equipped with the skills to navigate and evaluate online content. This showcased a generation well-versed in the language of digital media, capable of contributing to the digital information ecosystem. The emphasis on digital meta-literacy highlighted a comprehension of metadata, showcasing a level of digital literacy that extended beyond basic navigation. The participants' focus on ethical considerations aligned with the evolving discourse on responsible and ethical technology use.

On contrary, while the study extensively discusses the positive aspects of students' digital literacy skills and their commitment to online safety, the weakest aspect might be the limited exploration of potential challenges or barriers faced by high school students in implementing online safety practices, in which it overlooks potential obstacles such as cyberbullying, privacy concerns, or exposure to inappropriate content. Addressing these challenges would provide a more comprehensive understanding of the digital landscape's complexities and the practical implications of promoting online safety among high school students, thus enhancing the study's relevance and applicability.

Lastly, the commitment to online safety practices underscored a responsible and informed use of technology. The study revealed a strong correlation between online safety practices and various aspects of digital literacy, emphasizing the holistic nature of digital competence. This underscored the importance of comprehensive digital literacy education for navigating the digital landscape securely and responsibly in contemporary society.

Overall, this study illuminated the digital landscape proficiency of student-respondents. Their adept use of digital tools for communication, strong digital information literacy, creative engagement in digital media, and ethical consideration in metadata underscored their comprehensive digital literacy. Additionally, their commitment to online safety practices indicated a responsible approach to navigating the digital realm. The study highlighted the interconnectedness of these skills and emphasized the need for holistic digital literacy education. It provided valuable insights for educational institutions aiming to foster responsible digital citizenship, ensuring students were well-prepared for active and secure participation in the digital age.

RECOMMENDATIONS

The study's conclusion points to several actionable recommendations for educational institutions aiming to enhance digital literacy among high school students in Mabini.

1. The Department of Education and the educational institutions need to revisit and enrich the digital literacy curriculum, ensuring it covers various dimensions such as digital tools for communication, information literacy, visual literacy, media literacy, and meta-literacy. This should include both theoretical understanding and practical application.
2. An emphasis on ethical considerations should be integrated into the curriculum, fostering responsible and ethical technology use, including issues related to privacy and online behavior.
3. The promotion of collaborative projects can encourage teamwork and creativity, allowing students to apply their digital literacy skills in real-world scenarios. Offering specialized workshops focusing on specific aspects of digital literacy, such as metadata comprehension and ethical considerations, was another key recommendation.
4. Establishing a support system within educational institutions, comprising resources, mentors, or digital literacy ambassadors, can assist students in navigating the digital landscape effectively.
5. Collaboration with industry experts, professionals, or organizations working in the digital domain can provide students with real-world insights into current industry practices and emerging technologies.

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INCLUSIVE PEDAGOGY IN FILIPINO SUBJECT IN SELECTED HIGH SCHOOLS IN MABINI DISTRICT: BASIS FOR A SCHOOL DEVELOPMENT PLAN

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ABSTRACT

In contemporary global education, fostering inclusivity and diversity has been a central aim, particularly through the lens of inclusive pedagogy. This study delved into the influence of inclusive pedagogy on the teaching of the Filipino subject in selected high schools within the Mabini district. The research aimed to gauge the level of inclusive pedagogy in terms of teaching style and proficiency in Filipino language among high school teachers, and its impact on teacher training and competence. Utilizing a descriptive-correlational research design, the study surveyed 25 senior high school Filipino teachers from various public high schools in Mabini, Batangas. The questionnaire underwent reliability testing, affirming its validity. Findings revealed that teachers widely employed technology to augment teaching practices, emphasizing a variety of instructional strategies to accommodate diverse learning needs. They also provided additional support to students struggling with the Filipino language and integrated cultural elements into lessons to enhance language proficiency. Teachers felt their Filipino teaching training met subject and student needs but lacked professional development. They consistently reflected on teaching and applied inclusive pedagogy confidently. Correlation analysis showed a significant relationship between inclusive pedagogy, teaching style, Filipino proficiency, and teacher training. Higher inclusive pedagogy levels correlated with more relevant training. However, there was no significant correlation between Filipino proficiency and teacher competence. This indicated that while inclusive pedagogy and training positively impacted teaching, proficiency in Filipino might not reflect teacher competence in applying these principles. The study underscored the importance of inclusive pedagogy in Filipino subject education, particularly in training teachers to address diverse student needs effectively. Recommendations may include tailored professional development programs to enhance teaching skills and promote cultural integration within language instruction. These findings contributed to ongoing efforts to create inclusive and equitable educational environments in the Mabini district and beyond.

Keywords: inclusive pedagogy, Filipino subject, high schools

INTRODUCTION

In the ever-evolving landscape of global education, the fundamental goal has always been to provide every student with an equitable and enriching learning experience. As the study embarked on the 21st century, societies across the globe were making strides towards inclusion, diversity, and equity in all aspects of life, including education. In this pursuit of a more inclusive and diverse educational environment, a significant focus has been placed on the field of inclusive pedagogy, which seeks to cater to the unique needs of students from various backgrounds, abilities, and teaching styles.

The Filipino subject holds a special place in the hearts of the Filipino people as it embodies their culture, identity, and language. It was not merely a subject in the curriculum but a vessel for understanding the nation's rich heritage, values, and traditions (Nunez & Rosales, 2021). However, this subject also poses unique challenges due to its diverse learner demographic, which includes students with various linguistic backgrounds, learning abilities, and cultural experiences. Recognizing this diversity, there was an urgent need to adapt teaching methods to ensure that the Filipino subject was accessible and meaningful to all students.

Inclusive pedagogy was rooted in the belief that education should be accessible to all students, regardless of their background or abilities. It was a concept that acknowledges the uniqueness of each stu-

dent and aims to create a learning environment where all individuals can thrive (Raguindin et al., 2020). While it was crucial for every subject and classroom, it holds special significance in the teaching of Filipino. The Philippines was a nation with a rich tapestry of languages, cultures, and traditions, and Filipino students come from diverse backgrounds, including indigenous communities, linguistic minorities, and individuals with different learning abilities. Inclusive pedagogy recognizes this diversity and seeks to adapt teaching methods to accommodate it.

In the landscape of Philippine education, the implementation of inclusive pedagogy in the teaching of the Filipino subject within selected high schools in the Mabini District has emerged as a critical area of concern. In recent years, there has been a growing awareness of the need for inclusive education to address the diverse learning needs of students, including those with disabilities, different teaching styles, and varied cultural backgrounds (Lualhati, 2019). However, despite the recognition of the importance of inclusive pedagogy, there remains a noticeable gap in its effective integration into the teaching practices within the Filipino subject, a cornerstone of the national curriculum.

When discussing inclusion, the perspective extends beyond the mere integration of students with disabilities into regular classrooms. It embraces a broader spectrum, encompassing students of varying socio-economic backgrounds, linguistic abilities, and those encountering challenges with the Filipino language. Inclusive pedagogy was viewed as a multifaceted approach with the objective of granting every student an equal opportunity to learn, develop, and thrive. This approach entails adapting teaching methods, materials, and assessment strategies to align with the diverse needs of students.

The importance of inclusive pedagogy in Filipino subjects becomes even more pronounced considering the Philippines' multicultural and multilingual landscape. With over 170 languages and dialects spoken throughout the country, the task of teaching the national language, Filipino, becomes inherently complex (Miranda et al., 2021). Students entering Filipino classrooms bring with them a diverse linguistic repertoire, some of which might differ significantly from the standard Filipino language. In this context, inclusive pedagogy offers an opportunity to bridge linguistic gaps, ensuring that all students, regardless of their linguistic backgrounds, can engage with the subject effectively.

One of the primary problems contributing to this gap was the insufficient training and professional development opportunities for educators on inclusive teaching strategies. Many teachers in the selected high schools may not possess the necessary skills or knowledge to adapt their instructional methods to accommodate a wide range of learners effectively. This lack of training can result in a limited ability to create an inclusive and supportive learning environment where all students, regardless of their abilities or backgrounds, can actively participate and excel in the Filipino subject.

Additionally, another significant challenge was the limited availability of resources and materials that cater to diverse learning needs. The current curriculum and teaching materials may not adequately address the diverse linguistic, cognitive, and sensory needs of students. This limitation can hinder the implementation of inclusive pedagogy in the Filipino subject, as teachers may struggle to find or create suitable materials that support the learning objectives for all students.

A key aspect of inclusive pedagogy was the use of differentiated instruction. This approach tailors teaching methods to suit individual students' teaching styles, abilities, and needs. When applied to the Filipino subject, differentiated instruction might involve providing additional support for students who struggle with the language, offering advanced materials for those who excel, and employing a variety of teaching strategies to engage students with different learning preferences. By personalizing instruction, inclusive pedagogy ensures that all students can access and excel in the Filipino subject, irrespective of their initial proficiency.

The introduction of inclusive pedagogy in Filipino classrooms was also vital for addressing the needs of students with disabilities (Miranda et al., 2021). These students often face unique challenges in accessing the curriculum and may require specialized support and accommodation. Inclusive pedagogy promotes the use of Universal Design for Learning (UDL) principles, which involve creating teaching materials and methods that were accessible to all students, including those with disabilities. In the Filipino subject, this might involve providing alternative formats for reading materials, using assistive technology, or modifying assessment methods to accommodate different abilities.

Inclusive pedagogy doesn't just benefit students with disabilities or those who struggle with the language; it also enhances the learning experience for all students. By embracing diversity and adapting teaching methods, educators can create a more engaging and enriching classroom environment. Students

from different backgrounds and abilities can learn from one another, fostering a sense of empathy and respect for diversity that extends beyond the classroom.

The implementation of inclusive pedagogy in Filipino subjects presents an opportunity to instill a sense of pride and cultural identity in students. As Filipino educators adapt their teaching methods to accommodate diverse linguistic backgrounds, they can help students connect with their own heritage and the broader culture of the Philippines. Inclusive pedagogy in the Filipino subject goes beyond language proficiency; it was about instilling a sense of belonging and cultural understanding among all students.

In the Mabini District, the pursuit of inclusive pedagogy takes on a distinct context as it relates to the high school classrooms. It was an extension of the broader commitment to inclusive education, offering the unique opportunity to adapt and refine pedagogical approaches in the teaching of the Filipino subject. The focus on this specific district allows for a detailed exploration of the challenges and opportunities that arise in the context of a particular geographic and demographic setting.

One of the key challenges in implementing inclusive pedagogy in Filipino classrooms in the Mabini District was the availability of resources and training. Educators need access to professional development opportunities and teaching materials that support inclusive practices. This includes training on differentiated instruction, UDL principles, and strategies for accommodating diverse learners. Additionally, it requires the development of culturally relevant and inclusive teaching materials for the Filipino subject. These resources should reflect the diversity of the Philippines and cater to students with different linguistic backgrounds and abilities.

Furthermore, the cultural diversity within the Mabini District also poses an additional layer of complexity to the effective implementation of inclusive pedagogy. The Filipino subject, which encompasses language, literature, and culture, requires a nuanced approach that acknowledges and celebrates the diverse cultural backgrounds of students. However, the current situation may not fully embrace these diversities, potentially leading to cultural insensitivity in teaching practices and materials.

In light of these challenges, it becomes imperative to explore and understand the current state of inclusive pedagogy within the Filipino subject in selected high schools in the Mabini District. By identifying the specific hurdles faced by educators, the lack of resources, and the cultural considerations at play, this study aims to shed light on the existing gaps and provide valuable insights for the development of targeted interventions that promote a more inclusive and effective teaching environment. This thesis delved into the nuances and challenges of implementing inclusive pedagogy in Filipino classrooms in selected high schools within the Mabini District. By exploring the potential of inclusive pedagogy in these unique educational settings, the study aimed to shed light on the transformative possibilities of this approach, not only for the Filipino subject but for the broader educational landscape in the Philippines. It was a journey toward a more inclusive and equitable education system, where every student has the opportunity to access, engage with, and excel in the subject that carries the essence of Filipino culture and identity.

Statement of the Problem

The study aimed to determine the influence of inclusive pedagogy in Filipino subject in selected high schools in Mabini district. Specifically, this study seeks to answer the following questions:

1. What is the level of inclusive pedagogy of the respondents in terms of:
   1.1 Teaching Style; and
   1.2 proficiency in the Filipino Language?

2. What is the efficiency level of Filipino subject education through inclusive pedagogy of the respondents in terms of:
   2.1 Teacher training; and
   2.2 Teacher competence?

3. Is there any significant relationship between level of inclusive pedagogy and the efficiency level of Filipino subject education?

4. What plans and programs to be proposed to enhance the Filipino instructional strategies?

METHODOLOGY

In this chapter, the research provides a comprehensive explanation of the methodology used in this study, which includes the research design, data sources, study population, instrumentation and its validation, data collection procedures, ethical considerations, data handling, and the analysis techniques applied. The study detailed the approach employed in this research, from the selected research strategy for conducting the study to the eventual sharing of the findings.

Research Design

This research made use of descriptive correlational research design, incorporating a survey tool to assess the influence of inclusive pedagogy on the Filipino subject within specific high schools in Mabini district. The selection of a quantitative approach was motivated by the desire to quantify and visually represent the feedback obtained from the study's participants.

Participants

The analysis of this study concentrated on public school Filipino Teachers who were presently employed in chosen high schools in Mabini, Batangas. Specifically, the research focused on maximizing the participation of 25 senior high school Filipino teachers, derived from the estimated total population in the selected schools in Mabini, Batangas.

Research Instrument

The research used a specially crafted questionnaire to explore how inclusive pedagogy influences Filipino subject education and learning. This survey was essential for understanding how incorporating inclusive pedagogy into the learning process can positively impact Filipino subject education in a specific context.

Data Analysis

To provide analyzation of the data, the researcher applied the following statistical methodologies. The interpretation of data involved the use of weighted mean, ranking, and Pearson's r.

RESULTS AND DISCUSSIONS

This part of the study provided the presentation, analysis, and interpretation of the gathered data from the questionnaires answered by the respondents in accordance with the specific questions posited on the objectives of the study.

1. Level of Inclusive Pedagogy in Filipino

1.1 In Terms of Teaching Style

Table 1. Level of Inclusive Pedagogy in Filipino in Terms of Teaching Style

Items	Weighted Mean	Interpretation	Rank
1. My teaching style incorporates a variety of instructional strategies to cater to diverse learning needs.	4.52	Always	5
2. I adapt my teaching methods based on the individual characteristics and abilities of my students.	4.64	Always	3
3. I create an inclusive and engaging learning environment in my classroom.	4.60	Always	4
4. I regularly seek feedback from students to refine and improve my teaching style.	4.72	Always	2
5. I employ technology effectively to enhance my teaching practices.	4.80	Always	1
Composite Mean	**4.66**	**Always**	

As presented in Table 1, the respondents assessed that they employ technology effectively to enhance my teaching practices with the highest weighted mean of 4.80 and the highest rank of 1. The find-

ings implied a positive and deliberate integration of technological tools and resources into the teaching methods employed by the individuals or group under consideration.

1.2. In Terms of Proficiency in Filipino Language

Table 2. Level of Inclusive Pedagogy in Filipino in Terms of Proficiency in Filipino Language

Items	Weighted Mean	Interpretation	Rank
1. I am proficient in using the Filipino language to communicate effectively with my students.	4.76	Always	3.5
2. I integrate Filipino cultural elements into my lessons to enhance language proficiency.	4.60	Always	5
3. I provide additional support to students who may struggle with the Filipino language.	4.84	Always	1.5
4. I adapt my language use to accommodate students with varying levels of proficiency in Filipino.	4.76	Always	3.5
5. I actively seek opportunities to enhance my proficiency in the Filipino language.	4.84	Always	1.5
Composite Mean	**4.76**	**Always**	

As reflected in Table 2, the respondents perceived that they always provide additional support to students who may struggle with the Filipino language, and they always actively seek opportunities to enhance their proficiency in the Filipino language with the highest equal weighted means of 4.84 and the highest ranks of 1.5. This finding reflected a pedagogical approach that goes beyond traditional instruction, with educators actively identifying and assisting students who may require extra help in mastering the intricacies of the Filipino language.

2. Level of Filipino Subject Education Through Inclusive Pedagogy

2.1 In Terms of Teacher Training

Table 3. Level of Filipino Subject Education Through Inclusive Pedagogy In Terms of Teacher Training

Items	Weighted Mean	Interpretation	Rank
1. The training programs I have attended have equipped me with effective teaching strategies in Filipino.	4.60	Always	3
2. I receive ongoing training in teaching Filipino to stay updated on the latest educational practices.	4.60	Always	3
Filipino Training programs have adequately prepared me to implement inclusive pedagogy.	4.60	Always	3
I participate in professional development activities to enhance my teaching skills in Filipino.	4.56	Always	5
The training I receive in teaching Filipino is relevant to the specific needs of my Subject and students.	4.76	Always	1
Composite Mean	**4.62**	**Always**	

As revealed in Table 3, the respondents agreed that the training that they always receive in teaching Filipino is relevant to the specific needs of their Subject and students with the highest weighted mean of 4.76 and the highest rank of 1. The results suggested a positive evaluation of the training programs they undergo, indicating that the content and methodologies are tailored to address the unique challenges and requirements associated with teaching Filipino language.

2.2 In Terms of Teacher Competence

As gleaned in Table 4, the respondents answered that they always continuously reflect on their Filipino Subject teaching practices to identify areas for improvement with the highest weighted mean of 4.84 and the highest rank of 1. This finding suggested that these educators actively assess and analyze their teaching practices on an ongoing basis, aiming to identify areas that may benefit from improvement.

Table 4. Level of Filipino Subject Education Through Inclusive Pedagogy In Terms of Teacher Competence

Items	Weighted Mean	Interpretation	Rank
1. I feel competent in applying inclusive pedagogy principles in Filipino to enhance student learning.	4.56	Always	5
2. I am confident in my ability to address the diverse learning needs of my students in Filipino.	4.68	Always	4
3. I actively seek feedback from colleagues and supervisors to improve my teaching competence.	4.72	Always	3
4. I continuously reflect on my Filipino Subject teaching practices to identify areas for improvement.	4.84	Always	1
5. I am open to adopting new teaching methods in Filipino to enhance my overall competence.	4.76	Always	2
Composite Mean	**4.71**	**Always**	

Furthermore, the said group of respondents assumed that they always feel competent in applying inclusive pedagogy principles in Filipino to enhance student learning with the least weighted mean of 4.56 and the least rank of 5. This assumption suggests that the educators feel competent in implementing teaching strategies that cater to diverse learning needs, fostering an inclusive environment where all students can thrive.

3. Relationship Between the Level of Inclusive Pedagogy in Filipino and Filipino Subject Education Through Inclusive Pedagogy

Table 5. Relationship Between the Level of Inclusive Pedagogy in Filipino and Filipino Subject Education Through Inclusive Pedagogy

Variable	r-value	p-value	Decision	Interpretation
Level of Inclusive Pedagogy in Filipino in Terms of Teaching Style versus Level of Filipino Subject Education Through Inclusive Pedagogy				
Teacher Training	0.60	0.00152	Reject Ho	Highly Significant
Teacher Competence	0.24	0.24786	Failed to Reject Ho	Not Significant
Level of Inclusive Pedagogy in Filipino in Terms of Proficiency in Filipino Language Versus Filipino Subject Education Through Inclusive Pedagogy				
Teacher Training	0.59	0.00191	Reject Ho	Highly Significant
Teacher Competence	0.32	0.11890	Failed to Reject Ho	Not Significant

As written in Table 5, when the responses of the respondents on the Level of inclusive pedagogy in Filipino in terms of teaching style were compared to the Level of Filipino Subject Education Through Inclusive Pedagogy, the computed r-value of 0.60 for teacher training has a corresponding p-value of less than 0.01, thus rejecting the hypothesis.

On the contrary, the computed r-value of 0.24 for teacher competence has a corresponding p-value of more than 0.05, thus failing to reject the hypothesis.

4. Proposed Plans and Programs to Enhance the Filipino Instructional Strategies

Table 6. Action Plan

PROGRAM	OBJECTIVE	OUTPUT	TIMEFRAME
Institutionalizing Inclusive Pedagogy Frameworks	Embed inclusive pedagogy guidelines into the national curriculum for Filipino language subjects.	Inclusive pedagogy frameworks integrated into curriculum guidelines for Filipino language subjects.	12 months
Enhancing Technology Literacy Among Filipino Teachers	Improve technology literacy among Filipino teachers to effectively integrate digital tools into teaching practices.	Increased proficiency in utilizing digital learning platforms, multimedia presentations, and collaboration tools.	6 months
Cultivating Cultural Integration Across Subjects	Develop interdisciplinary strategies emphasizing the interconnectedness of language and culture across various subjects.	Integration of cultural elements into teaching practices across multiple disciplines.	9 months
Strengthening Continuous Professional Development	Strengthen and sustain continuous professional development programs for Filipino subject educators.	Increased accessibility and frequency of professional development programs focusing on subject-specific training, inclusive pedagogy, technology integration, and cultural sensitivity.	Ongoing with regular evaluations
Promoting Research on Teacher Competence and Inclusive Pedagogy Linkage	Initiate research exploring the relationship between teacher competence and the effective application of inclusive pedagogy in language education.	Research findings informing the development of targeted interventions.	18 months

Presented on Table 6 was the Action Plan to be proposed based on the findings of the study. The action plan to enhance Filipino language education in the Philippines featured several key objectives that aimed to improve teaching and learning practices.

CONCLUSIONS

This part of the study presented the findings of this study underscoring the dynamic and comprehensive approach embraced by Filipino teachers in enhancing the quality of education within the context of teaching the Filipino language. The educators' utilization of technology, commitment to diverse instructional strategies, and emphasis on inclusive pedagogy principles reveal a proactive stance toward creating an inclusive, culturally enriched, and effective learning environment.

Filipino teachers exhibit a comprehensive and proactive approach to education, integrating technology, diverse instructional strategies, and inclusive pedagogy principles. In terms of teaching style, these educators recognize the transformative role of technology, incorporating digital learning platforms, multimedia presentations, online collaboration tools, and various educational software into their instructional methods. The respondents' proactive stance toward technological advancements reflects a commitment to enhancing the quality of education and adapting to contemporary learning needs. Additionally, their emphasis on diverse instructional strategies underscores a dedication to inclusivity and an awareness of addressing individual learning needs.

Furthermore, the Filipino teachers place a strong emphasis on inclusive pedagogy, aiming to create an inclusive and effective learning environment. This involves incorporating a variety of approaches that cater to diverse learning styles, fostering better engagement and understanding among a diverse group of students. The commitment to inclusive pedagogy extends beyond linguistic proficiency, emphasizing cultural sensitivity and understanding. This recognition reflects a broader educational philosophy that values the interconnectedness of language and culture.

In terms of proficiency in the Filipino language, the respondents demonstrate a continuous commitment to personal and professional growth. Actively seeking opportunities for language enrichment and professional development, these educators adopt a comprehensive approach to language education. Their commitment to integrating cultural elements into teaching not only enriches the language-learning environment but also aligns with a broader philosophy valuing the connection between language and culture. The integration of cultural elements aims to create a more immersive and culturally enriched learning experience for their students.

Teacher training plays a pivotal role in the development of Filipino subject educators. The respondents collectively affirm the importance of ongoing professional development directly aligned with the subject matter and the characteristics of their student population. This commitment to continuous learning and improvement aligns with best practices in education, ensuring a targeted and effective approach to teaching Filipino. The incorporation of inclusive pedagogy into teacher training reflects a forward-thinking approach, acknowledging the necessity to adapt teaching practices for an equitable and accessible education.

On contrary, the weakest finding of the study might have been the lack of specific evidence or data demonstrating the direct correlation between the implementation of inclusive pedagogy principles and the proficiency in the Filipino language among students. While the study extensively discussed Filipino teachers' commitment to inclusive pedagogy, integration of technology, and diverse instructional strategies, it did not present concrete outcomes or assessments of students' language proficiency as a result of these approaches. Without empirical evidence linking inclusive pedagogy practices to improved language proficiency, the strength of this finding may have been limited. Including such data could have strengthened the study's conclusions and provided more actionable insights for enhancing language education in high schools.

Analyzing the relationship between the level of inclusive pedagogy in teaching style and Filipino Subject Education Through Inclusive Pedagogy, it becomes apparent that teachers may not directly associate their competence with the incorporation of inclusive pedagogy principles. Understanding these nuances is crucial for tailoring professional development effectively, ensuring a comprehensive approach to inclusive pedagogy in Filipino language education.

Similarly, the relationship between the level of inclusive pedagogy in proficiency in the Filipino language and Filipino Subject Education Through Inclusive Pedagogy indicates that teachers may view proficiency-related teaching practices as separate from their overall competence. Recognizing these dynamics is vital for refining professional development strategies and ensuring a holistic approach to inclusive pedagogy in Filipino language education.

Overall, Filipino teachers demonstrate a holistic and adaptive approach to education. Their integration of technology, commitment to diverse instructional strategies, and emphasis on inclusive pedagogy principles reflect a dedication to creating an inclusive, culturally enriched, and effective learning environment for their students. Continuous efforts towards personal and professional growth underscore a commitment to excellence in teaching Filipino, ensuring a positive and impactful educational experience.

RECOMMENDATIONS

In the context of Philippine education, where Filipino teachers exhibit a comprehensive and proactive approach to teaching, it is recommended to institutionalize inclusive pedagogy frameworks within the national curriculum. This involves collaborating with curriculum developers, the Department of Education (Dep Ed), and school administrators to embed guidelines for inclusive pedagogy directly into the curriculum for Filipino language subjects, ensuring a standardized and systemic approach across diverse educational settings. Recognizing the transformative role of technology in teaching styles, initiatives should be implemented to enhance technology literacy among Filipino teachers.

Professional development programs should prioritize training educators in utilizing digital learning platforms, multimedia presentations, and collaboration tools effectively, aligning with the evolving educational landscape.

Moreover, the commitment to integrating cultural elements into language education presents an opportunity to extend this approach across various subjects within the curriculum. The Dep Ed and the education institutions can develop interdisciplinary strategies emphasizing the interconnectedness of language and culture, fostering a holistic educational experience. This ensures a seamless integration of cultural elements into teaching practices across multiple disciplines, contributing to a well-rounded educational environment.

The significance of ongoing professional development, particularly in teacher training, calls for a strengthened and sustained commitment from educational institutions and authorities.

Resources should be allocated to enhance the accessibility and frequency of professional development programs for Filipino subject educators. These programs should not only focus on subject-specific training but also emphasize inclusive pedagogy, technology integration, and cultural sensitivity. Additionally, the identified gap in teachers associating their competence with the incorporation of inclusive pedagogy principles suggests a need for further research.

Funding and support should be allocated to research initiatives exploring the nuances of this relationship. The findings can inform the development of targeted interventions, ensuring that Filipino teachers perceive a direct link between their competence and the effective application of inclusive pedagogy in language education.

Implementing these recommendations will contribute to the ongoing evolution of the Philippine education system. By prioritizing inclusive pedagogy, technology integration, cultural enrichment, and continuous professional development, the education landscape can be more adaptive, equitable, and responsive to the diverse needs of Filipino learners, fostering a positive and impactful educational experience.

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DEVELOPMENT AND ACCEPTABILITY OF SWEET POTATO *(Ipomea batatas)* LEAVES -BASED CHIPS

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ABSTRACT

This study aimed to develop and evaluate the acceptability of sweet potato (*Ipomoea batatas*) leaves-based chips. The research focused on analyzing the phytochemical and nutritive content of sweet potato leaves, determining the physicochemical properties of the chips (moisture, fiber, and fat), and assessing the formulations and processes used to create three chip variants. Using a descriptive-developmental research design, the study also explored consumer perceptions of the chips' taste, texture, aroma, and appearance. The level of acceptability was evaluated through a hedonic scale by 110 respondents, comprising junior high school students and cookery teachers. Statistical tools, including Mean, Standard Deviation, and ANOVA, were employed to analyze the data and assess significant differences in preferences among the three chip variants. Findings revealed that sweet potato leaves contained beneficial phytochemicals, including primary alkaloids, steroids, and condensed tannins. The chips were low in fat (1.7%), had a moisture content of 13.6%, and were rich in carbohydrates (69.9%). Among the three variants, the chips made with commercial flour (Variant 1) achieved the highest level of acceptability across all sensory attributes, with respondents rating its taste, texture, aroma, and appearance as "like extremely." Variants 2 and 3 showed moderate levels of acceptability, suggesting room for improvement. Statistical analysis confirmed significant differences in respondent preferences among the three variants, emphasizing the need to refine formulations to enhance flavor, texture, and visual appeal. This study highlights the potential of sweet potato leaves as a nutritious and acceptable ingredient for snack production.

Keywords: Sweet potato leaves -based chips, Developmental study, Perceptions, Assessment

INTRODUCTION

Good nutrition plays a crucial role in the physical and cognitive development of students, significantly influencing their overall well-being and academic performance. The academic environment is a key factor in shaping the dietary habits of young individuals, as access to nutritious foods is essential for their success in school. Research consistently highlights that better nutrition is linked to improved concentration, memory, and academic outcomes, underscoring the importance of schools in fostering healthy eating habits among students (Infante et al., 2017; Coelho et al., 2018). However, there remains a gap in understanding how specific local food resources can be utilized to enhance student nutrition.

Amidst the growing prevalence of processed and unhealthy snack options, there is an urgent need to explore innovative alternatives that can positively influence students' dietary choices. Sweet potatoes (Ipomoea batatas) are widely cultivated and recognized for their rich nutritional profile, including essential vitamins and minerals such as vitamins A and C, iron, calcium, and dietary fiber (Selvakumaran et al., 2017). Despite their nutritional benefits, sweet potato leaves are often underutilized in many regions. This study aims to address this gap by investigating the acceptability of sweet potato leaves as a primary ingredient in snack products for students.

The problem of inadequate nutrition among students is compounded by their increasing preference for easily accessible, commercially processed snacks that are high in unhealthy fats and sugars. These choices not only contribute to poor dietary habits but also expose students to health risks such as obesity and related complications (Oh et al., 2017). Furthermore, the underutilization of locally available nutrient-rich resources like sweet potato leaves highlights a missed opportunity for improving student diets.

By focusing on these aspects, the research seeks to promote healthier snacking alternatives that can satisfy students' cravings while providing essential nutrients.

Thus, this study aimed to explore how transforming sweet potato leaves into chips can serve as a viable snack option for students. The research will assess the acceptability of this innovative product while promoting better nutrition and sustainable food practices within school environments. By addressing these dietary concerns, the study not only seeks to enhance the nutritional quality of student diets but also supports local agricultural economies through the utilization of locally sourced ingredients.

STATEMENT OF THE PROBLEM

This study aimed to developed and evaluate the acceptability of Sweet potato (*Ipomoea batatas*) leaves- based chips.

Specifically, it sought to answer the following question:

1. What is the phytochemical analysis and nutritive value of the sweet potato leaves?
2. What are the physicochemical characteristics of the developed sweet potato leaves chips in terms of:
   2.1 Moisture content;
   2.2 Fiber; and
   2.3 Fat?
3. What are the formulations and processes in the development of the sweet potato leaves chips product?
4. What is the perceptions of the respondents on the level of acceptability of the developed chips made from sweet camote leaves across three different variants in terms of:
   4.1 Taste
   4.2 Texture;
   4.3 Aroma; and
   4.4 Appearance?
5. Is there a significant difference on the perceptions of the respondents in the level of acceptability of the sweet potato leaves chips according to its variants?

RESEARCH METHODOLOGY

Research Design

The study utilized the descriptive-developmental research design technique as its approach to generate a culinary product comprising of chips derived from sweet potato leaves. This design is the optimal method to utilize as it entails collecting data from a selection of participants at a specific moment in time.

Research Environment

The developmental research study was conducted in one the State University in CARAGA Region.

Respondents

The study utilized a total of (110) respondents under survey, wherein 100 (90.9%) of which are Junior High School Students and 10 (9.1%) are cookery teachers who will evaluate the acceptability of the chips made from sweet potato leaves.

Research Instrument

This study is exclusively focused on product development. In order to assess the product's level of acceptability, a customized questionnaire will be used. The potential products will then be evaluated using a Score Card and a Hedonic Scale, specifically to determine their acceptability in terms of taste, texture, aroma, and appearance. This evaluation will be conducted by a panel of experts and consumers who were selected through purposive random sampling. Several attempts will be undertaken to attain the intended outcome.

Data Analysis

This study will utilize the following statistical tools in analyzing the data: Mean & Standard Deviation. This will be used to represent the average mean of the participants' responses on the level of their acceptability towards the sweet potato leaves chips in terms of taste, texture, aroma appearance. ANOVA.This will be used to analyze the significant differences between the levels of the respondents' acceptability towards the sweet potato leaf chips according to its variants.

RESULTS AND DISCUSSIONS

Phytochemical analysis and nutritive value of the sweet potato leaves

Table 1. Phyto-chemical analysis result of the sweet potato (*Ipomoea batatas*) leaves

Sample Code	Sample	Description	Parameter	Result
CHE-0333	Sweet Potato Leaves	245g air-dried sample in reusable bag	Volume of Extract Obtained	150mL
			Alkaloids Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	+
			Test for Quaternary Bases & Amine Oxide	-
			Steroids Keller-Killini Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	+ -
			Flavanoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	-
			Saponins Froth Test	+
			Tannins Ferric Chloride Test *Brownish-Green indicates the presence of condensed tannins *Blue-black color indicates the presence of hydrolysable tannins	-

The table 1 summarizes the phytochemical analysis of sweet potato leaves (Ipomoea batatas) chips, focusing on various bioactive compounds present in the sample. The sample, labeled as CHE-0333, consists of 245 grams of air-dried sweet potato leaves stored in a reusable bag. The analysis yielded a volume of 150 mL of extract from the sample.

Several tests were conducted to identify the presence of different phytochemicals. The confirmatory test for alkaloids indicated a positive result for primary alkaloids, marked with a "+" sign, suggesting that these compounds are present in the sample. However, no secondary or tertiary alkaloids were detected.

The test for quaternary bases and amine oxides returned a negative result, indicating the absence of these compounds. For steroids, the Keller-Killiani test, which is specific for 2-deoxysugars, showed a positive result, confirming the presence of certain steroidal compounds. Conversely, the Liebermann-Burchard test, which detects unsaturated steroids, returned a negative result.

Regarding flavonoids, the Bate-Smith & Metcalf method, used to identify leucoanthocyanins, did not detect any flavonoids in the sample. The froth test for saponins also yielded no positive results.

The tannin analysis, using the Ferric Chloride test, indicated the presence of condensed tannins, as evidenced by a brownish-green color change. However, no hydrolysable tannins were detected, as there was no blue-black coloration.

In summary, the sweet potato leaves chips exhibit the presence of primary alkaloids, specific steroids, and condensed tannins, while showing a lack of other tested phytochemicals such as flavonoids, saponins, and hydrolysable tannins.

Physico-Chemical Analysis Characteristics of Sweet Potato (*Ipomoea Batatas*) Leaves Chips

Table 2. Physico-chemical analysis and nutritive value Sweet Potato Leaves (*Ipomoea batatas*) Chips

Parameters	Unit	Result	Method
Moisture	%	13.6	Gravimetric
Crude Fat	%	1.7	Soxhlet
Carbohydrates	%	69.9	By Calculation (Kjeldahl;Gravimetric)
Calories/100g	%	342	

The table 2 presents the physico-chemical analysis and nutritive value of sweet potato leaves (Ipomoea batatas) chips. The moisture content of the chips is 13.6%, as determined using the gravimetric method, which indicates the amount of water present in the product. The crude fat content is measured at 1.7% using the Soxhlet extraction method, reflecting the amount of fat or lipid in the chips. Carbohydrates constitute 69.9% of the chips, calculated using a combination of Kjeldahl and gravimetric methods, highlighting the primary source of energy in the product. Additionally, the caloric value is noted as 342 calories per 100 grams of the chips, providing an estimate of the energy content. These results provide a comprehensive understanding of the nutritional profile and physico-chemical properties of the sweet potato leaves chips, making them a potentially healthy snack option with a balanced moisture content, low fat, and high carbohydrate levels.

Formulations and Processes in the Development of the Sweet Potato Leaves Chips Product

Here is a tabular presentation of the formulations and processes for developing sweet potato leaves chips in three variants.

Table 3. Presents the formulations and processes for developing sweet potato leaves chips in three variants.

Variant	Formulations	Procedure
Variant 1: Sweet Potato Leaves Chips with Commercial Flour	- Camote leaves - 1 cup All-Purpose flour - 2 tsp Black pepper - 2 tsp Garlic powder - 2 tsp Iodized salt - 2 tsp Baking Powder (Calumet) - Oil	1. Wash the camote leaves with tap water. 2. Blend the camote leaves with a little water until a powder is formed. 3. Mix the camote powder with all-purpose flour, black pepper, garlic powder, iodized salt, and baking powder. 4. Flatten the mixture and dry under the sun. 5. Fry in oil.
Variant 2: Sweet Potato Leaves Chips with Camote Flour	- Camote leaves - 1 cup Camote flour - 2 tsp Black pepper - 2 tsp Garlic powder - 2 tsp Iodized salt - 2 tsp Baking Powder (Calumet) - Oil	Follow the same steps as in Variant 1.
Variant 3: Sweet Potato Leaves Chips with Commercial & Camote Flour	- Camote leaves - ½ cup All-Purpose flour - ½ cup Camote flour - 2 tsp Black pepper - 2 tsp Garlic powder - 2 tsp Iodized salt - 2 tsp Baking Powder (Calumet) - Oil	Follow the same steps as in Variant 1.

The table 3 summarizes the formulations and development process for each variant of the sweet potato leaves chips.

Perceptions of the respondents on the level of acceptability of the developed chips made from sweet camote leaves across three different variants

Table 4.Level of acceptability of sweet potato leaves across three variants

Criteria	Variant 1		Variant 2		Variant 3	
	Median	Qualitative Description	Median	Qualitative Description	Median	Qualitative Description
Appearance	9	like extremely	6	like Slightly	6	like Slightly
Aroma	8	like very much	6	like Slightly	7	like moderately
Texture	9	like extremely	7	like moderately	7	like moderately
Taste	9	like extremely	6	like Slightly	7	like moderately
Overall median	**9**	**like extremely**	**6**	**like Slightly**	**7**	**like moderately**

For scoring, we utilized the nine-point hedonic scale (1 to 9), where 1 = dislike extremely; 2 = dislike very much; 3 = dislike moderately; 4 = dislike slightly; 5 = neither like nor dislike; 6 = like slightly; 7 = like moderately; 8 = like very much; 9 = like extremely (Pimentel et al., 2016)

The table 4 presents an analysis of the respondents' level of acceptability of sweet potato leaves across three different variants, focusing on key sensory attributes such as appearance, aroma, texture, and taste. Each variant was evaluated by respondents, and the median scores, along with their corresponding qualitative descriptions, offer insights into the overall acceptability of each variant.

Variant 1 emerged as the most favored across all criteria, with a remarkable median score of 9 for appearance, texture, and taste, which corresponds to "like extremely" in the qualitative description. This suggests that respondents found Variant 1 exceptionally appealing in terms of its visual appeal, aroma, texture, and flavor. The strong preference for Variant 1 indicates that it likely possessed a visually attractive presentation, a highly pleasing aroma, a desirable texture, and a flavor profile that resonated well with the respondents. The unanimous high ratings across these attributes suggest that Variant 1 sets a benchmark for what is considered an ideal preparation of sweet potato leaves. The overall median score of 9, described as "like extremely," reinforces the high level of satisfaction and preference for this variant among the respondents.

Variant 2 received more moderate evaluations, with median scores of 6 across appearance, aroma, and taste, translating to "like slightly" in the qualitative description. The texture of Variant 2, however, was rated slightly higher, with a median score of 7, corresponding to "like moderately." These scores suggest that while Variant 2 was generally acceptable to respondents, it did not stand out as strongly as Variant 1. The lower scores in appearance, aroma, and taste imply that this variant may have lacked the visual appeal, aromatic richness, or flavor intensity that characterized Variant 1. However, the slightly higher rating for texture indicates that respondents found the mouthfeel or consistency of Variant 2 to be more agreeable, even if other attributes were less impressive. The overall median score of 6 reflects a slight liking, indicating that while Variant 2 was not poorly received, it did not excite the respondents to the same extent as Variant 1.

Variant 3 falls between Variant 1 and Variant 2 in terms of respondent preference, with median scores of 7 for aroma, texture, and taste, corresponding to "like moderately." However, its appearance was rated similarly to Variant 2, with a median score of 6, indicating a slight liking. The moderate ratings for aroma, texture, and taste suggest that Variant 3 had a more balanced appeal compared to Variant 2, offering a more satisfactory sensory experience, particularly in taste and aroma. The slightly lower score for appearance, however, indicates that Variant 3 may not have been as visually appealing, which could have influenced the overall perception of the variant. The overall median score of 7 reflects a moderate level of satisfaction among respondents, positioning Variant 3 as a generally acceptable option, though not as outstanding as Variant 1.

In evidence, the table clearly indicates a hierarchy of preference among the three variants of sweet potato leaves, with Variant 1 being the most highly favored across all sensory attributes. Variant 3 follows with moderate acceptance, and Variant 2, while acceptable, shows less appeal overall. These findings suggest that factors such as appearance, aroma, texture, and taste play crucial roles in determining the acceptability of sweet potato leaves, and that optimizing these attributes could enhance consumer satisfaction.

To enhance the overall acceptability and market potential of Variant 3, focused improvements in taste and aroma are recommended. Drawing insights from the success factors of Variant 1 can provide valuable guidance in this regard. By identifying and incorporating the specific elements that contribute to the appeal of Variant 1 into Variant 3, the product can potentially elevate its market position and compete more effectively against its counterparts. Overall, this highlights the importance of leveraging successful attributes from existing variants to inform product development and enhance consumer satisfaction and market.

The flavor of sweet potato leaf chips might differ based on their preparation and seasoning. In a research led by Lebogang et al. (2019), it was discovered that the taste of sweet potato leaf chips was typically well-liked when they were seasoned with a mixture of salt and spices. The inherent sweetness of sweet potato leaves, when adequately conserved during the preparation procedure, might enhance the overall flavor (Sithole et al., 2020). Nevertheless, an abundance of bitterness, which is frequently linked to overcooking or the utilization of aged leaves, might detrimentally affect the acceptability of flavor (Nakasone & Paull, 2018).

The acceptance of sweet potato leaf chips is heavily influenced by their texture. Agbor-Egbe and Ihekoronye (2018) conducted research that revealed the texture of sweet potato leaf chips can range from crisp to resilient, depending on the drying technique and moisture level. Crunchy chips are typically favored due to their pleasing texture and higher level of acceptability. Chips that are dried and stored correctly retain their intended texture as time passes (Oladipo et al., 2018).

The aroma of sweet potato leaves chips, like any other food product, greatly influences our sensory experience. The fragrance of these chips is determined by the specific type of sweet potato utilized and the method of cooking employed. Tumuhimbise et al. (2018) conducted a study that found sweet potato leaf chips made by a regulated drying method maintained a pleasant and mildly sweet scent, which was favorably received by customers. Nevertheless, inadequate drying techniques might result in unpleasant odors, such as charred or musty scents, which can have a detrimental impact on acceptability.

The aesthetic attractiveness of sweet potato leaf chips is crucial for consumer acceptance. The study conducted by Kapinga et al. (2019) highlighted that chips exhibiting a vivid green hue and consistent thickness were perceived as visually attractive and therefore more likely to be accepted. Consumers were less likely to select chips that had black areas, irregular slices, or signs of discoloration.

Significant difference on the perceptions of the respondents in the level of acceptability of the sweet potato leaves chips according to its variants

Table 5. Difference on the perceptions of the respondents in the Level of Acceptability of the Sweet Potato Leaves Chips

	df	Mean Square	*p*- value	Conclusion
N= 108	35	1.00E-05	7.50E-33	There is a significant Difference

The table presents the analysis of the respondents' acceptability of sweet potato leaves chips. The data indicates that the number of respondents (N) is 108, and the degrees of freedom (df) are 35. The mean square value is reported as 1.00E-05, which suggests a very small variance among the groups being compared. The p-value, given as 7.50E-33, is extremely low, indicating a highly significant result. Based on this p-value, which is much smaller than the typical alpha level (e.g., 0.05), the conclusion is that there is a significant difference in the level of acceptability of the sweet potato leaves chips among the respondents. This means that the variation in responses is not due to random chance, but rather reflects a real difference in how the respondents perceive the acceptability of the product.

With this regard, the notable findings justify a thorough investigation into consumer preferences for these several chip variations. Gaining insight into these preferences can inform product development, enabling proponents or businesses to modify formulations in order to more effectively cater to consumer interests, potentially improving product satisfaction and increasing market success. Manufacturers should also investigate the precise elements of the flour combination (such as taste, texture, and appearance) that affect acceptability.

CONCLUSION

The study on sweet potato leaves chips highlights significant findings regarding their phytochemical composition, nutritional value, formulation, and consumer acceptability across three variants.

The phytochemical analysis revealed the presence of bioactive compounds such as primary alkaloids, specific steroids, and condensed tannins, which underscore the nutritional and potential health benefits of sweet potato leaves.

The chips exhibited a balanced nutritional profile, with a moisture content of 13.6%, low fat content (1.7%), high carbohydrates (69.9%), and a caloric value of 342 calories per 100 grams, making them a viable, healthy snack option.

Variant 1, formulated with commercial flour, emerged as the most preferred option, receiving the highest scores in sensory attributes such as appearance, aroma, texture, and taste, whereas Variants 2 and 3 exhibited moderate acceptability.

The statistical analysis confirmed significant differences in respondents' perceptions of the three variants, emphasizing the importance of product formulation in consumer preference.

The success of Variant 1 can serve as a benchmark for improving the other variants, particularly in enhancing taste and aroma. Additionally, the findings underscore the need for manufacturers to focus on factors like texture and visual appeal, which significantly impact acceptability.

Incorporating insights from consumer feedback and leveraging the successful attributes of the preferred variant can guide the optimization of sweet potato leaves chips.

This approach not only enhances consumer satisfaction but also boosts market potential, positioning the product as a competitive and nutritious alternative in the snack industry.

RECOMMENDATIONS

1. To improve consumer acceptability, particularly for Variants 2 and 3, focus on enhancing the taste by optimizing seasoning combinations. Drawing inspiration from Variant 1, incorporate additional spices or flavor enhancers that complement the natural sweetness of the sweet potato leaves while balancing any bitterness.

2. Invest in refining the preparation process to ensure uniformity in chip size, thickness, and color. Techniques such as controlled drying methods can help retain the vibrant green hue of the leaves, improving overall aesthetic appeal and boosting consumer preference.

3. Implement advanced drying and frying techniques to ensure a consistent, crunchy texture across all variants. Maintaining optimal moisture levels during processing and storage is critical for achieving and retaining the desired texture.

4. Highlight the phytochemical content and nutritional profile of the sweet potato leaves chips in marketing campaigns. Emphasize their low-fat content, high carbohydrate levels, and the presence of bioactive compounds to attract health-conscious consumers.

5. Engage a broader demographic for further sensory evaluation to refine formulations. Consider exploring alternative flours or blends, like whole-grain or gluten-free options, to cater to diverse dietary preferences and expand market reach.

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GROWTH AND YIELD PERFORMANCE OF SWEET POTATO (*Ipomoea batatas*) APPLIED WITH DIFFERENT LEVELS OF POWDERED GOLDEN APPLE SNAILS FERTILIZER

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ABSTRACT

This research aimed to explores the effectiveness of powdered golden apple snail (PGS), a destructive species of snails, as a natural source of fertilizer for sweet potato (*Ipomoea batatas*). The study was designed to assess the impact of applying PGS, together with a decrease in inorganic NPK fertilizer usage, on sweet potato vigor, production, and quality of tubers. It aimed at identifying the appropriate amounts of PGS to apply as well as the possibility of using the product to an extent to which it can partly meet synthetic fertilizer requirements. A containerized field experiment was carried out with RCBD with four replications in four treatments that include 100% recommended dose of NPK (100% RD-NPK) and three treatments with 20% RD-NPK with different levels of PGS (100g, 200g, 300g). All the growth parameters, yield attributes, and nutrient content of the tubers were recorded at 30 and 50 DAT and at the time of harvesting. Higher FGAS rates (200g and 300g) with 20% RD-NPK significantly increased vine length at 50 days after transplanting (61.85 cm and 60.05 cm, respectively) compared to 100% RD-NPK (52.65 cm) ($p < 0.05$). These treatments also significantly enhanced the tuber number (11.40 and 11.15, respectively) compared to 100% RD-NPK (9.15) ($p < 0.05$). However, tuber size parameters and nutrient content showed no significant differences among treatments ($p > 0.05$). PGS demonstrated potential as a partial substitute for synthetic fertilizers in sweet potato cultivation, effectively enhancing vine growth and tuber number even at reduced NPK levels. However, its impact on tuber size and nutrient content was limited, suggesting a complex interplay between fertilizer inputs and the crop's genetic potential. Further research should focus on optimizing PGS application rates, investigating long-term effects on soil health, and exploring cultivar-specific responses. Economic analyses of PGS production and application are crucial to assess its viability as a sustainable fertilizer alternative. These findings contribute to developing environmentally friendly farming practices while addressing the management of an invasive species.

Keywords: Sweet potato, Growth and yield performance, Golden apple snails, Organic fertilizer, experimental study, assessment

INTRODUCTION

The golden apple snail (*Pomacea canaliculata*) is a notorious invasive species that has significantly impacted rice agriculture across Asia. Originally introduced from South America in the 1980s, these snails have proliferated rapidly, becoming voracious feeders that damage young rice plants and cause substantial economic losses, estimated at over one billion dollars annually due to crop destruction (Demetillo et al., 2015; Miranda et al., 2017; IRRI Rice Knowledge Bank). Despite their reputation as pests, research indicates that the nutritional composition of their shells and residues can enhance soil fertility, presenting a duality in their ecological role. Studies by Wang et al. (2019, 2020) have shown that when incorporated into agricultural practices, the slow release of nutrients from decomposing snail components can improve soil quality and promote higher crop yields, suggesting a potential avenue for sustainable agricultural practices.

While there is growing interest in utilizing golden apple snails as organic fertilizers, a significant research gap remains regarding their specific nutrient profiles and efficacy in enhancing the growth and

yield of economically important crops like sweet potato (Ipomoea batatas L. Lam.). Sweet potato is a globally significant food crop recognized for its nutritional value and versatility, ranking as the sixth most important food crop worldwide (Huaman, 1992; FAOSTAT, 2020). China leads in its production, with Asia contributing the majority of global output (Cartabiano-Leite et al., 2020). The crop's historical cultivation and its spread across various regions continue to attract scholarly attention, yet comprehensive studies on the interaction between sweet potato cultivation and snail-derived fertilizers are lacking.

In the Philippines, sweet potato holds cultural significance among various ethnolinguistic groups, particularly in the Northern regions where it is referred to by numerous local names (Meldoz et al., 2016; Gayao et al., 2016). This root crop is highly valued not only as a staple food but also for its adaptability to different growing conditions, allowing for extended cultivation periods. Among communities such as the Ivatans and Kalanguyas, sweet potato is often prioritized as a key agricultural product due to its multiple uses and resilience in adverse conditions (Gayao et al., 2016). However, despite its importance, research on enhancing sweet potato productivity through innovative fertilization methods remains limited.

Beyond its culinary uses, sweet potato also serves various industrial applications due to its rich nutrient profile. Orange-fleshed varieties are particularly noted for their high β-carotene content, which is essential for combating vitamin A deficiency globally (Truong et al., 2018). Studies have demonstrated that increased consumption of these varieties can significantly improve vitamin A levels among vulnerable populations (Low et al., 2008; Hotz et al., 2012). Additionally, sweet potato can be processed into diverse products such as starch, flour, and biofuels (Bach et al., 2021; Mwakamu et al., 2022; Awogbemi et al., 2022). Given the existing knowledge gaps regarding the application of processed golden apple snails as organic fertilizers for sweet potatoes, this study aims to explore their effectiveness in improving soil nutrient profiles and enhancing crop yield compared to conventional fertilizers. This investigation seeks to provide insights that could inform sustainable agricultural practices while addressing the challenges posed by invasive species.

STATEMENT OF THE PROBLEM

The study aimed to to explores the effectiveness of powdered golden apple snail (PGS), a destructive species of snails, as a natural source of fertilizer for sweet potato (Ipomoea batatas). The study was designed to assess the impact of applying PGS, together with a decrease in inorganic NPK fertilizer usage, on sweet potato vigor, production, and quality of tubers.

Specifically, it sought to answer the following:

1. What is the effects of reducing NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on the vegetative growth performance of sweet potato plants at 30 and 50 days after transplanting (DAT) under different fertilizer treatments in terms of:
   1.1 Vine length;
   1.2 Number of leaves; and
   1.3 Number of branches?

2. What is the effects of reducing NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on yield traits of sweet potato at 30 and 50 days after transplanting (DAT) under different fertilizer treatments in terms of:
   2.1 Number of tubers;
   2.2 Tuber diameter;
   2.3 Tuber length;
   2.4 Weight of marketable tubers; and
   2.5 Weight of non-marketable tubers?

3. What is physico-chemical characteristics of the soil before and after planting when applied with different levels of powdered golden apple snail (PGS) fertilizer?

RESEARCH METHODOLOGY

Location and Duration of the Study

The designated area for the field experiments is situated in one of the campus of one of the state university in Surigao del Norte, Philippines. The study site's geographic coordinates are approximately 9.5360 latitude and 125.5624 longitude, located on the island of Mindanao. The elevation at these coordinates is estimated to be 48.4 meters or 158.8 feet above mean sea level.

Harvest roots as soon as they reach eating size and before a frost. Sweet potatoes generally mature in 85 to 120 days. Check root size after 80 to 85 days because they don't stop growing and can start to split when overgrown.

The sweet potato fertilizer trial was transpired over a complete growing season, spanning 85 to 120 days from crop establishment to harvest under typical cultivation practices. This rapid crop growth cycle facilitated the full investigation of vegetative development and reproductive yields in response to the various golden snail derivative amendments compared to traditional inorganic fertilizers.

Experimental Design and Treatment

The experimental design consisted of four treatment combinations, each representing a unique fertilizer application strategy following a randomized completely block design (RCBD), with each treatment replicated four times (Table 1). Within each replication, five containers were individually planted with sweet potato cutting as the experimental unit. Each container contains one cubic foot of soil media. Treatment 1 served as the control group, the Recommended Dose of NPK (RD-NPK). The subsequent treatments, Treatment 2 through Treatment 4, contained a reduced 20% RD-NPK combined with PGS applied at 100g, 200g, and 300g, respectively. All treatment combinations were applied to every container bag containing one cubic foot of soil media.

Table 1. Treatment code and fertilizer ratio used of the experiment

Treatment code	Fertilizer rate		Container ($ft.^3$)
	RDF (%)	PGS (g)	
Treatment 1	100% RD-NPK	0g	1 con. @ $1ft.^3$ soil
Treatment 2	20% RD-NPK	100g	1 con. @ $1ft.^3$ soil
Treatment 3	20% RD-NPK	200g	1 con. @ $1ft.^3$ soil
Treatment 4	20% RD-NPK	300g	1 con. @ $1ft.^3$ soil

Collection of Golden Apple Snails

Golden apple snails (*Pomacea canaliculata*) were handpicked directly from infested rice fields in the surrounding locality agricultural areas. This manual collection provides a targeted method to capture invasive snail pests with minimal effort and without disrupting local habitats or endemic species. Approximately 5 kg of adult golden snails measuring 3-6 cm in diameter were gathered over two weeks. The fresh snail samples were placed in labeled meshed bags and transported to the processing facility located at the field station. There, the golden apple snails were thoroughly washed with fresh water to remove debris, mucus secretions, sand, and surface microbes.

Determination of Macronutrient contents of Golden Apple Snails

The freshly gathered golden apple snails undergo processing to prepare samples for macronutrient analysis. First, the shells were manually cracked using a small hammer to access the inner soft tissues. The shell fragments, meat, and visceral remains from approximately 500g of snails were composited. These samples were oven-dried for 72 hours at 40°C to remove moisture completely. The dehydrated materials were milled into a fine homogeneous powder using a stainless-steel blender. Three replicate 100g samples of the dried golden apple snail powder were weighed out and sealed in labeled plastic bags. These samples were submitted to the Regional Soil Testing Laboratory based in the Regional Soils Laboratory in the Department of Agriculture – Regional Field Office XIII, Philippines. Standard methods were followed to quantitatively determine concentrations of essential macro-nutrients, including nitrogen (N), phosphorus (P), potassium (K), and pH, in the snail samples using an elemental analyzer.

Pre- and Post-harvest Soil Sampling

To ensure homogeneity, the experiment used potting containers to hold the soil media spread in an open field. Before potting, a bulk load of garden soil (equivalent to 1 dump truck load) was collected. Paid laborers thoroughly mixed the soil using shovels and then uniformly bagged it in empty cement sacks to contain one cubic foot of soil media. Subsequently, a 500g to 1000g sample was retained for soil nutrient analysis composition before planting.

Once the crops were harvested, post-harvest soil sampling was conducted. At this stage, new soil samples were collected from each container per treatment to represent the sample for post-harvest soil nutrient composition analysis.

Experimental Plot and Lay-outing

The field experiment involving containerized sweet potatoes took place in one of the locality of Surigao del Norte, covering an area of approximately 200 m^2. Adhering to an RCBD layout, a total of 80 containers (empty cement sacks) were organized into four blocks/replicates, and then each treatment was randomly represented within each block. Each block consisted of four rows of five pot pots, each containing one sweet potato cutting. Specific combinations of inorganic fertilizers and golden apple snail amendments were applied according to the designated treatment units for each group.

Preparation of soil media and treatment application

The collected garden soil was thoroughly mixed and homogenized using shovels by hired laborers. It was repeatedly turned and mixed to achieve a consistent composition throughout the bulk load. During this mixing phase, the assigned treatment combinations (Treatment 1-4) were incorporated into the soil according to their respective formulations. Treatment 1 served as the control; treatment received the Recommended Dose of NPK, while Treatments 2-4 consisted of a 20% reduced RD-NPK combined with varying amounts of Powdered Golden Apple Snails (PGS) at 100g, 200g and 300g respectively. After thorough mixing and incorporation of the treatments, the homogenized soil was bagged into empty cement sacks, with each sack containing one cubic foot (approximately 28 liters) of soil media. The bagged soil media was distributed randomly into the experimental area, ready for planting sweet potato cuttings.

Source of sweet potato cuttings

The sweet potato VSP-4 (V2-27) variety, which demonstrated minimal weight loss, shriveling, and decay during a 3-month storage period, was sourced from the SNSU-Mainit Campus root crops production area. Approximately 300 cuttings measuring 25-30 cm in length were cut from stems with 4-5 nodes each from a two-month-old VSP-4 sweet potato crop.

Sweet potato planting

The collected planting material (cuttings) was immediately planted into the prepared soil media in the experimental containers. One cutting was planted per container, with the cutting placed vertically into the center of the soil at a depth of approximately 5-10 cm. Care was taken to ensure that at least two nodes were buried in the soil, promoting robust root establishment and sprout development. The planted cuttings were gently firmed into the soil and uniformly watered to initiate the growth process.

Maintenance and Monitoring

The experimental plots undergo regular maintenance checks to uphold optimal growing conditions. Crop stand counts were conducted weekly to confirm consistent populations across all treatments. Plant vigor and signs of pest damage were visually inspected weekly. Any abnormalities in terms of stunted growth, chlorosis, necrosis, wilting, or notable pest infestations were promptly addressed through appropriate organic control methods.

Watering and Weeding

Water the sweet potatoes regularly to maintain soil moisture at an even level and avoid waterlogging. Watering was conducted via overhead sprinklers as needed. The plots were closely monitored after fertilizer applications and during warmer periods to increase watering frequency potentially and volume if needed. Care should be exercised by applying water gently and evenly across all treatments.

Regularly inspect the sweet potatoes in the sacks and remove any weeds that appear by hand. Upon detection, unwanted vegetation competing for sunlight, nutrients, and soil moisture was swiftly uprooted using hand trowels. Care will be taken during weeding to avoid disturbing the crop stand or damaging the sweet potato plants.

Insect Pest Prevention and Control

The experimental plots were monitored regularly for early signs of insect infestations or damage, and sustainable control methods were employed if infestation was detected. These methods can include the manual removal of pests, the application of botanical insecticides derived from neem or other plant-based sources, or, as a last resort, the consideration of low-toxicity synthetic insecticides.

Harvesting

The sweet potato tubers were harvested at approximately 60 days after planting. The containers were gently broken to loosen the soil around each plant using a fork or hoe, taking care not to damage the storage roots. The vines were gently pulled to lift the entire plant, including the storage roots, from the soil. After extraction, the storage roots were separated from the vines, and any adhering soil was gently brushed off. Any damaged or undersized roots were discarded as non-marketable roots, while the remaining marketable roots were collected and sorted according to their respective treatment groups. The harvested roots from each treatment were weighed individually to determine the total yield.

Data Gathering

(Growth Performance)

Vine Length. Measurements of vine length were taken from a subset of plants in each treatment group at 30 and 50 days after transplanting (DAT). A flexible measuring tape was used to record the length of the primary vine, measured from the base of the plant to the apical meristem. Care was taken to gently extend the vine along the soil surface during measurement to prevent any damage or breakage.

Number of Leaves. Leaf counts were conducted concurrently with the vine length measurements. For each sampled plant, the total number of fully expanded leaves along the primary vine was manually counted and recorded.

Number of Branches. The number of secondary branches originating from the primary vine was documented and counted. Branches were counted if they had developed a minimum length of 10 cm, ensuring consistency in data collection.

(Yield Traits)

Number of Tubers. During the harvesting process, the total number of storage roots (tubers) produced by each plant was counted and recorded. Care was taken to ensure that all tubers, regardless of size, were included in this count.

Tuber Diameter and Length. Individual measurements of tuber diameter and length were taken using a digital caliper or ruler for a representative subset of tubers from each treatment. The maximum diameter and length of each tuber were recorded to the nearest millimeter.

Weight of Marketable Tubers. After harvesting, storage roots were sorted based on their marketability, with undersized or damaged tubers discarded. The remaining marketable tubers from each plant were weighed collectively using a calibrated scale or balance.

Processing of Gathered Data. The data collected on vine length, leaf count, branch number, tuber characteristics, and yield parameters was systematically organized and recorded in a standardized format, such as spreadsheets or databases. This ensured accurate documentation and traceability. Prior to statistical analysis, thorough quality control checks were conducted to identify and address any potential errors, outliers, or missing values. Appropriate data cleaning and transformation techniques were applied as necessary to meet the assumptions of the intended statistical tests.

Statistical Analysis

The collected sweet potato growth metrics and yield data were statistically analyzed by the Friedman Test of SPSS version 25 due to the non-normal distribution of the data, which prevented the use of ANOVA. Friedman's stepwise step-down procedure was applied to determine which specific treatments significantly differed from the others using the same SPSS package for Windows. Consequently, Analy-

sis of variance (ANOVA) was performed on the soil analysis data, while Tukey's HSD post hoc analysis was used to compare the specific differences that occur between fertilizer combinations.

RESULTS AND DISCUSSIONS

Vegetative Growth Parameters

Comparison on the effects of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on VINE LENGTHS in sweet potato plants at 30 and 50 days after transplanting (DAT) under different fertilizer treatments.

Table 2. Effect of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on vine length of sweet potato at 30 and 50 days after transplanting (DAT)

Treatment	30 DAT (cm)	50 DAT (cm)
100% RD-NPK	37.85	52.65^{ab}
20% RD-NPK + 100 g PGS	33.85	52.15^{a}
20% RD-NPK + 200 g PGS	34.90	61.85^{b}
20% RD-NPK + 300 g PGS	33.85	60.05^{b}
Chi-square	0.402	8.262
Asymp. Sig.	0.94^{ns}	0.041*

Table 2 shows the comparison of mean vine lengths in sweet potato plants at 30 and 50 days after transplanting (DAT) under different fertilizer treatments. At 30 DAT, there were no significant differences in vine length among the treatments ($p < 0.05$). By 50 DAT, the treatments with reduced NPK fertilizer (20% RD-NPK) combined with higher levels of powdered golden apple snail (PGS), particularly 200 g PGS (T3) and 300 g PGS (T4), showed significantly enhanced vine lengths compared to the lower level of 100 g PGS (T2) treatment (61.85 cm and 60.05 cm vs. 52.15 cm, respectively). The application of powdered golden apple snails can effectively compensate for the reduced inorganic fertilizer input, leading to improved vine growth and development in sweet potato plants. The increased vine length observed with the PGS treatments indicates that the organic amendment was able to provide sufficient nutrients to support enhanced vegetative growth despite the lower levels of synthetic fertilizers applied.

The increased dose of PGS in T3 and T4 likely provided a greater supply of essential nutrients, particularly nitrogen, to support enhanced vine elongation in the sweet potato plants. Metay et al. (2014) emphasize that nitrogen is necessary for key growth processes, and deficiency leads to inhibited growth. Similarly, Euring et al. (2014) suggest that nitrogen impacts gene expression related to growth and cell wall formation, further underscoring its vital role. Thus, the enhanced vine elongation observed in the sweet potato plants can be attributed to the greater nitrogen availability from the increased PGS dose, which supports overall vegetative growth and development, similar to the effects observed in grapevines and poplars. In contrast, the 100 g PGS rate in T2 may not have been sufficient to fully offset the nutrient deficiencies caused by the 80% reduction in synthetic NPK fertilizer. This resulted in a less vigorous vine growth response compared to the higher 300 g PGS application. The statistical significance of this difference indicates that the vine length response was sensitive to the PGS application rate when coupled with the reduced inorganic fertilizer input. This highlights the importance of optimizing the organic amendment level to achieve the desired vegetative growth outcomes. McGeehan (2012) highlights how varying nitrogen levels, influenced by organic amendment rates, impact vegetation growth.

Effect of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on NUMBER OF LEAVES in sweet potato at 30 and 50 days after transplanting (DAT)

Table 3. Effect of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on number of leaves in sweet potato at 30 and 50 days after transplanting (DAT)

Treatment	30 DAT	50 DAT
100% RD-NPK	50.95	54.25
20% RD-NPK + 100 g PGS	34.40	50.2
20% RD-NPK + 200 g PGS	42.25	42.55
20% RD-NPK + 300 g PGS	35.05	43.85
Chi-square	7.16	4.227
Asymp. Sig.	0.067^{ns}	0.23^{ns}

At 30 days after transplanting (DAT), the number of leaves ranged from 34.40 to 50.95, with the 100% recommended dose of NPK (RD-NPK) treatment resulting in the highest leaf count of 50.95 (Table 3). However, the differences in leaf number among the treatments were not statistically significant at this early growth stage. By 50 DAT, the trends in leaf production remained similar, with the 100% RD-NPK treatment having the highest mean number of leaves at 54.25. The other treatments involving reduced NPK fertilizer (20% RD-NPK) combined with increasing levels of powdered golden apple snail (PGS) had leaf counts ranging from 42.55 to 50.2. However, these differences were also not statistically significant. These results indicate that the application of PGS, even at reduced NPK fertilizer levels, did not have a significant impact on the number of leaves produced by the sweet potato plants throughout the growing period. Unlike the vine length response, the leaf number appears to be a more stable characteristic that was not strongly influenced by the fertilizer treatments tested in this study. The lack of significant differences in leaf production suggests that the sweet potato cultivar used in this experiment may have an inherent genetic propensity to maintain a relatively consistent leaf number, irrespective of the variations in nutrient inputs from the PGS and reduced NPK fertilizer. Leaf development in sweet potatoes is likely controlled by complex physiological mechanisms that are not easily altered by the tested fertilizer regimes.

While the PGS amendments were able to enhance vine elongation, they did not translate to proportional increases in leaf production. Plants have a limited number of resources (such as nutrients, water, and energy) that they allocate to different growth processes. When organic amendments, such as compost or manure, are applied, they often provide essential nutrients like nitrogen (Cassity-Duffey et al., 2020), which can promote cell division and elongation, particularly in stem tissues (Euring et al., 2014). This may result in enhanced vine elongation as the plant prioritizes vertical growth. However, this does not necessarily mean that these resources are equally directed towards leaf production. If most of the available resources are used for vine elongation, less might be available for the development of new leaves. This highlights the need to investigate further the specific nutrient requirements and growth responses of different sweet potato cultivars to understand better how organic and inorganic fertilizer combinations can be optimized to target both vegetative growth parameters.

Effects of reducing NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on NUMBER OF BRANCHES in sweet potato at 30 and 50 days after transplanting (DAT)

Table 4. Effect of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on number of branches in sweet potato at 30 and 50 days after transplanting (DAT)

Treatment	30 DAT	50 DAT
100% RD-NPK	2.95	5.65
20% RD-NPK + 100 g PGS	2.80	5.85
20% RD-NPK + 200 g PGS	2.45	5.6
20% RD-NPK + 300 g PGS	2.75	5.55
Chi-square	2.517	0.772
Asymp. Sig.	0.47^{ns}	0.85^{ns}

At 30 days after transplanting (DAT), the mean number of branches ranged from 2.45 to 2.95, with the 100% recommended dose of NPK (RD-NPK) treatment having the highest branch count at 2.95 (Table 4). However, the statistical analysis showed no significant differences in branch number among the treatments at this early growth stage. By 50 DAT, the number of branches increased across all treatments, with values ranging from 5.55 to 5.85. Again, the 100% RD-NPK treatment had the highest mean branch count at 5.65, but the differences between the fertilizer regimes were not statistically significant. These results indicate that the application of powdered golden apple snail (PGS) fertilizer, even at reduced NPK levels, did not have a notable impact on the branching characteristics of the sweet potato plants throughout the growing period. The number of branches was a relatively stable trait that was not strongly influenced by the variations in nutrient inputs provided by the different fertilizer treatments. The lack of significant differences in branch production suggests that this vegetative parameter may be more closely tied to the inherent genetic potential of the sweet potato cultivar used in the study. Branching patterns in sweet potatoes are governed by complex developmental processes, which may be less responsive to the nutrient availability changes introduced by the PGS and reduced NPK fertilizer combinations.

Although the PGS amendments were able to enhance vine length, as observed in Table 1, they did not translate to proportional increases in the number of branches produced by the sweet potato plants. This study was conducted using containerized planting in the field, where crowding of plants was not an issue. This setting provided ample space for each sweet potato plant, reducing the need for competitive growth strategies typically associated with dense planting conditions. In such an environment, the PGS (presumably an organic soil amendment or fertilizer) amendments may have provided nutrients that were preferentially utilized for vine elongation rather than branching.

In plants, resources such as carbohydrates and nitrogen are distributed among various growth processes, including stem elongation, branching, and leaf development. Suppose the PGS amendments increased the availability of these resources. In that case, the plants might have allocated more towards vertical growth (vine elongation) to capitalize on their environment, which was free from crowding pressures. In a non-crowded setup, plants do not experience shading from neighboring plants and, therefore, do not require increased branching to capture light (Forster et al., 2011). Instead, they might focus on extending their vines to grow taller or cover more ground.

Yield Traits

Effects of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on YIELD TRAITS of sweet potato

Table 5. Effects of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on tuber characteristics of sweet potato

Treatment	Tuber length (cm)	Tuber diameter (mm)	Tuber weight (g)	Number of tubers
100% RD-NPK	122.60	36.20	117.25	9.15^{ab}
20% RD-NPK + 100 g PGS	121.70	38.90	117.40	7.55^{a}
20% RD-NPK + 200 g PGS	116.75	36.85	95.10	11.40^{b}
20% RD-NPK + 300 g PGS	109.15	35.00	113.30	11.15^{b}
Chi-square	1.516	3.373	0.061	10.037
Asymp. Sig.	0.67^{ns}	0.33^{ns}	0.99^{ns}	0.018*

Column means of different letters are statistically significant at 0.05 levels
**Significant at 0.05 level*
^{ns}Not significant

Tuber Length. The tuber lengths for 100% RD-NPK treatment ranged from 109.15 cm to 122.60 cm, which was the longest tubers at 122.60 cm compared to all of the reduced RD-NPK in combination with increasing levels of PGS, though no significant differences were noted (Table 5). The treatments with reduced NPK (20% RD-NPK) combined with increasing levels of powdered golden apple snail (PGS) had tuber lengths ranging from 116.75 cm to 121.70 cm, but these were not statistically different from the 100% RD-NPK treatment.

Tuber Diameter. Similarly, the fertilizer regimes did not significantly affect the tuber diameter. The mean tuber diameter varied from 35.00 cm to 38.90 cm, with the 20% RD-NPK + 100 g PGS treatment having the largest tuber diameter of 38.90 cm. However, the differences in tuber diameter among all the treatments were not statistically significant.

Tuber Weight. The total weight of sweet potato tubers also presented no variation in weight across the fertilizer treatments. The tuber weights varied from 95. 10 g to 117. 40 g, out of all the treatments, 20% RD-NPK + 100 g PGS and 100% RD-NPK, received the same highest tuber weights of 117. 40 g and 117. 25 g, respectively. These values were not statistically different from the other fertilizer treatments.

Number of Tubers. Among the tuber characteristics, the number of tubers revealed a totally different result. The 20% RD-NPK + 200 g PGS and 20% RD-NPK + 300 g PGS treatments produced a greater number of tubers than the 100% RD-NPK treatment, 11. 40 and 11. 15, respectively, while the 20% RD-NPK + 100g PGS treatment produced 7.55 tubers. The considerably higher number of tubers that were noted under the higher PGS application rates, even with a lower NPK fertilizer input, means that the organic amendment was in a position to supply adequate nutrients for tuber initiation and growth.

This indicates that the PGS can effectively compensate for the lower inorganic fertilizer input in terms of enhancing tuber production in sweet potatoes. However, the increased tuber number did not translate to significantly higher tuber length, diameter, or total weight compared to the 100% RD-NPK treatment. This implies that while the PGS amendments promoted more tuber formation, the individual tuber size and overall yield needed to be substantially improved. This differential response of tuber number versus tuber size/weight can be attributed to the underlying physiological processes governing these tuber characteristics in sweet potatoes. The increased number of tubers observed with the higher PGS application rates suggests that the organic amendment was able to provide the necessary nutrients, particularly nitrogen, to support enhanced tuber initiation and early development. Nitrogen is a key nutrient that promotes vegetative growth (Euring et al., 2014) and stimulates the formation of storage organs like tubers (Gao et al., 2014; Dong et al., 2022). The PGS likely supplied readily available nitrogen that could be absorbed by the sweet potato plants, leading to the initiation of more tuber primordia and subsequent tuber formation. This enhanced tuber initiation response is likely due to the ability of the organic PGS to gradually release nutrients over time, ensuring a sustained supply to meet the crop's needs during the critical tuber development stage (Shaji et al., 2021).

In contrast, the lack of significant differences in tuber length, diameter, and total weight across the fertilizer treatments indicates that the factors controlling individual tuber size and bulking could have been more responsive to the variations in nutrient availability provided by the PGS and reduced NPK inputs. Hence, tuber size is a combination of genetic, physiological, and or environmental factors. Once the tubers are initiated, the pattern of tubers' growth and expansion becomes controlled by the plant's capability to transport assimilates to tubers and tubers to accumulate storage compounds like starch. These processes may be more strongly determined by the inherent genetic potential of the sweet potato cultivar used in the study rather than being easily manipulated by the tested fertilizer regimes. Sweet potato plants may have an innate capacity to maintain tuber size characteristics, even when faced with variations in nutrient availability. Additionally, other environmental factors, such as temperature, moisture, and solar radiation, can also influence tuber bulking and size expansion. These factors were likely similar across the experimental treatments, leading to the comparable tuber size responses observed.

Physico-chemical Characteristics of the Soil Before and After Planting

Effects of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on nutrient uptake by sweet potato before and after planting

Table 6. Effect of reduced NPK fertilizer with increasing levels of powdered golden apple snail (PGS) on nutrient uptake by sweet potato before and after planting

Treatment	Nitrogen (%)		Phosphorous (%)		Potassium (%)		Moisture (%)	
	Before	After	Before	After	Before	After	Before	After
100% RDF	1.70	1.67	0.66	0.49	0.34	0.30	2.32	2.345
20% RDF + 100 g PGS	1.70	1.58	0.66	0.53	0.34	0.21	2.32	2.2525
20% RDF + 200 g PGS	1.70	1.65	0.66	0.54	0.34	0.28	2.32	2.2275
20% RDF + 300 g PGS	1.70	1.61	0.66	0.51	0.34	0.24	2.32	2.245
CV		3.66		18.48		23.43		14.08
p Value		0.30^{ns}		0.876^{ns}		0.309^{ns}		0.904^{ns}

^{ns} *Not significant*

Nitrogen. The soil nitrogen content showed a slight decrease across all treatments after sweet potato cultivation (Table 6). It was 1. 70 % in all the treatments at the beginning of the experimental period. The nitrogen levels changed after harvesting, from 1. 58% to 1. 67 %. The 100 % RD-NPK treatment maintained the highest nitrogen content of 1. 67 %. However, these differences were not statistically significant as a result of the analysis, leading to a higher p-value of 0. 309.

Phosphorous. Soil phosphorous levels decreased in all treatments after sweet potato cultivation. The initial phosphorous content was 0.66% across all treatments. Post-harvest levels ranged from 0.49% to 0.54%, with the 20% RD-NPK + 200g FGAS treatment retaining the highest phosphorous content (0.54%). The differences among treatments were not statistically significant (p=0.876).

Potassium. Soil potassium content also decreased after sweet potato cultivation in all treatments. The initial potassium level was 0.34% for all treatments. Post-harvest levels varied from 0.21% to

0.30%, with the 100% RD-NPK treatment maintaining the highest potassium content (0.30%). These differences were not statistically significant (p=0.309).

Moisture. Soil moisture content showed minimal changes after sweet potato cultivation. The initial moisture level was 2.32% for all treatments. Post-harvest levels ranged from 2.2275% to 2.345%, with the 100% RD-NPK treatment showing a slight increase in moisture content (2.345%). The differences among treatments were not statistically significant (p=0.904).

The comparison of pre and post-sweet potato nutrient removal indicates the decay trend of nutrients after sweet potato cultivation and the effects of varying dosages of fertilizer on sweet potato and nutrient availability. First, all treatments did reduce the nitrogen, phosphorus, and potassium content in the soil, as hinted by the sweet potato uptake. This aligns with the expected nutrient demands of sweet potatoes during their growth cycle. Despite the variations in fertilizer treatments—ranging from 100% RD-NPK to 20% RD-NPK combined with different levels of FGAS—there were no statistically significant differences in the post-harvest nutrient levels among treatments. This suggests that the application of FGAS, even with reduced NPK levels, maintained soil nutrient status comparable to the standard NPK treatment. The 100% RD-NPK treatment showed the highest post-harvest nitrogen content (1.67%), though not significantly different from other treatments. This could indicate a slightly higher nitrogen use efficiency in the FGAS treatments, as they maintained similar soil nitrogen levels with reduced inorganic nitrogen input. The percent retention of phosphorus and potassium also followed an increasing trend in the case of treatments with FGAS at the end of the experimentation period. It was at par or slightly higher than the percent retention of 100% RD-NPK treatment, implying that FGAS might increase soil availability or retention of these nutrients.

Further, the slight changes in the moisture content in the soil for the varied treatments mean that the varied fertilizer applications impacted minimally the water-holding capacity of the soil. That FGAS treatments allowed the retention of the 100% RD-NPK level of available nutrients without high inorganic fertilizer input implies that FGAS could enhance nutrient cycling in the substrate. These findings indicate that applying FGAS, even at reduced NPK fertilizer levels, can maintain soil fertility status similar to standard NPK fertilization practices in sweet potato cultivation. This supports the potential of FGAS as a partial substitute for synthetic fertilizers, contributing to more sustainable soil management practices. However, long-term studies would be beneficial to assess the cumulative effects of FGAS application on soil fertility and structure over multiple growing seasons.

CONCLUSIONS

The results of this study demonstrate that the application of powdered golden apple snail (PGS) as an organic fertilizer can effectively enhance certain vegetative growth parameters in sweet potato plants, particularly vine length, while also influencing tuber production. At 50 days after transplanting, treatments combining reduced NPK fertilizer with higher levels of PGS significantly increased vine lengths compared to lower PGS applications.

This suggests that PGS can provide essential nutrients, particularly nitrogen, which is crucial for promoting vegetative growth. However, while the number of tubers increased with higher PGS applications, this did not translate into significant improvements in tuber size or weight. The findings indicate that while PGS can compensate for reduced inorganic fertilizer inputs in terms of tuber initiation, the genetic and physiological traits of the sweet potato cultivar may play a more dominant role in determining tuber size and overall yield.

Overall, the study highlights the potential of integrating organic amendments like powdered golden apple snail into sweet potato cultivation as a sustainable alternative to conventional fertilizers. The ability of PGS to enhance vine growth and increase the number of storage roots presents an opportunity for improving sweet potato production while reducing reliance on chemical fertilizers. However, further research is needed to explore the specific nutrient dynamics and physiological responses of different sweet potato cultivars to optimize the use of organic amendments. Understanding how these factors interact will be essential for developing effective fertilization strategies that maximize both yield and sustainability in sweet potato farming practices.

RECOMMENDATIONS

1. It is recommended to optimize the application rates of powdered golden apple snail (PGS) to maximize vegetative growth in sweet potato plants. The study indicated that higher levels of PGS (200 g and 300 g) significantly enhanced vine lengths compared to lower levels. Therefore, conducting further trials to determine the most effective PGS application rate for achieving desired growth outcomes while minimizing synthetic fertilizer use could lead to more sustainable agricultural practices.
2. Future research should focus on understanding the specific nutrient dynamics associated with the application of PGS in sweet potato cultivation. While the study observed an increase in the number of tubers with higher PGS applications, it did not translate into larger tuber size or weight. Investigating how different nutrient profiles from PGS interact with sweet potato physiology will help in tailoring fertilization strategies that enhance both yield quantity and quality.
3. Explore how different sweet potato varieties respond to PGS and reduced NPK fertilizer combinations. Trials involving multiple cultivars could identify those that are more responsive to organic amendments, providing farmers with options that align with their specific agricultural conditions and market demands.
4. Assess the long-term effects of using PGS as an organic amendment on soil health and fertility. Continuous use of organic fertilizers like PGS could improve soil structure, microbial activity, and nutrient retention over time. Longitudinal studies should be conducted to assess these impacts, ensuring that sustainable practices not only enhance crop yields but also contribute positively to soil ecosystems.
5. Effectively implement these findings in practice, it is vital to promote education and training programs for farmers on the benefits and application methods of using PGS as a sustainable fertilizer alternative. Workshops and field demonstrations can help farmers understand how to integrate PGS into their existing fertilization regimes, thereby improving their crop productivity while reducing reliance on chemical fertilizers.

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STUDENT ENGAGEMENT STRATEGIES AND READING ASSESSMENT PRACTICES IN SELECTED PUBLIC ELEMENTARY SCHOOLS IN LIAN, BATANGAS: BASIS FOR A READING ENHANCEMENT PROGRAM

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ABSTRACT

The study investigated the influence of student engagement strategies and reading assessment practices on reading enhancement in elementary schools in Lian District, Batangas. It explored the degree of student engagement strategies, including active learning, differentiated learning, and collaborative learning, as assessed by teachers. Additionally, it examined the level of reading assessment practices of students in terms of progress monitoring and instructional materials, also assessed by teachers. The research aimed to uncover any significant relationships between student engagement strategies and reading assessment practices and propose reading enhancement programs accordingly. Utilizing a descriptive-correlational research design, the study surveyed 33 English teachers from Grades 1 to 3 in selected elementary schools. The findings indicated that students were engaged in active learning strategies, such as class discussions and tailored learning objectives. However, they were less engaged in differentiated learning activities, such as tiered assignments. Furthermore, the study revealed a positive perception of collaborative learning culture promoted by the school administration. Students were engaged in sharing resources and best practices with each other. In terms of reading assessment practices, students actively communicated their reading progress to parents, but engagement with benchmark assessments was moderate. Statistical analysis revealed significant relationships between student engagement strategies and reading assessment practices, particularly in progress monitoring and differentiated learning. However, the relationship with instructional materials was not significant.

Keywords: student engagement strategies, reading assessment practices, public elementary schools

INTRODUCTION

In today's educational landscape, fostering student engagement and enhancing reading skills was a paramount concern, particularly in the foundational years of global elementary education. The ability to read fluently and comprehend text was a fundamental skill that underpins academic success across all subjects. Moreover, a high level of student engagement was vital for effective learning experiences, as it directly influences motivation, participation, and overall achievement in the classroom (Fredricks et al., 2019).

The importance of early literacy cannot be overstated, as it was the cornerstone upon which future educational achievement was built. Without proficient reading skills, students may encounter difficulties in comprehending subject matter across various disciplines and may ultimately face challenges in their educational journey. Thus, it was crucial to explore innovative ways to bolster reading abilities in elementary schools (Chiu, 2022). Additionally, the role of student engagement in the learning process was pivotal. When students were actively involved in their education, they were more likely to grasp, retain, and apply knowledge, thus promoting holistic development.

At the core of this study was the belief that there was no one-size-fits-all solution for improving reading and fostering engagement. Instead, a varied and dynamic approach that considered the unique characteristics and needs of each school was essential. By understanding the strategies that have proven successful in different contexts, the study can offer valuable insights to educators and administrators looking to enhance reading instruction and student participation in their own schools.

In parallel with the analysis of reading assessment practices, the study investigated the strategies that schools employ to engage students in the learning process. Student engagement was a multifaceted concept that includes factors like classroom environment, teacher-student interactions, and the use of technology. By examining the range of strategies utilized by schools to boost engagement, the study aimed to unearth innovative and effective approaches that can be shared and implemented more broadly.

In the dynamic landscape of education in the Philippines, the pursuit of effective student engagement strategies and reading assessment practices takes center stage in the quest for enhancing reading skills among young learners. A solid foundation in reading was fundamental to academic success, and student engagement was a critical factor in ensuring that students actively participate in the learning process. Literacy was the bedrock upon which future educational achievement was built. Proficient reading skills were not only essential for understanding the world but also for comprehending and excelling in various academic subjects (Guanzon & Ancho, 2020).

In the Philippine context, where English was one of the official languages and medium of instruction, reading proficiency was of paramount importance. It enables students to access a wealth of information, build critical thinking skills, and excel in their studies.

FLAT, or the Functional Literacy Assessment Tool, is utilized by the Department of Education (DepEd) to gauge the functional literacy levels of students in both elementary and secondary schools. This assessment evaluates essential reading and numeracy competencies required for daily life, encompassing skills such as text comprehension and basic arithmetic operations. By identifying students who may require additional support, FLAT assists schools and teachers in designing tailored literacy intervention programs. Administered periodically, standardized FLAT tests enable schools to monitor students' progress in acquiring functional knowledge across different grades or year levels.

According to the outcomes derived from the FLAT conducted at Bagong Pook Elementary School during the academic year 2021-2022, a significant proportion of the students demonstrated enhancements in their literacy skills, particularly in reading proficiency, recognition of written material, oral recitation, and comprehension. Employing a pre-test and post-test assessment methodology, the school effectively evaluated the literacy development of its students. This indicated a positive trend in the students' literacy levels, showcasing the efficacy of the school's educational strategies and interventions aimed at bolstering literacy competencies.

In the most recent assessment conducted for the school year 2023-2024, the findings from the FLAT administered at Bagong Pook Elementary School revealed that most students, ranging from Grades 1 to 3, attained functional literacy at the paragraph level. This signified a positive advancement in their ability to comprehend and engage with text at a more complex level. However, it is disheartening to note that many learners exhibit low levels of story comprehension and struggle with local material comprehension in terms of their overall literacy proficiency. These results underscored the need for targeted interventions and support mechanisms to address specific areas of weakness, particularly in understanding narrative structures and local contexts. By recognizing these areas of challenge, educators and administrators can implement tailored literacy enhancement programs to further uplift the literacy standards among students at Bagong Pook Elementary School.

Student engagement, on the other hand, was the driving force behind effective learning. Engaged students were motivated, participative, and more likely to excel academically. They take ownership of their learning journey and were enthusiastic about acquiring new knowledge and skills. In the context of Philippine elementary schools, nurturing student engagement was key to not only improving reading skills but also to instilling a love for learning that can last a lifetime.

In navigating the intersection of student engagement strategies and reading assessment practices, educators encounter several challenges. Balancing diverse learning styles and preferences, maintaining student interest in reading, and ensuring assessments align with individual progress pose ongoing hurdles (Lucas et al., 2020). Technology integration for engagement may face accessibility issues, potentially exacerbating educational disparities. Additionally, the need to address diverse literacy levels within a single classroom can strain resources. Striking a harmonious balance between innovative engagement methods and accurate reading assessments requires ongoing adaptation, professional development, and a nuanced understanding of individual student needs, presenting a multifaceted challenge for educators and educational institutions (Bond, 2020).

This study seeks to investigate, understand, and promote the best student engagement strategies and reading assessment practices in selected public elementary schools across the Lian, Batangas. By delv-

ing into the unique challenges and opportunities presented in different regions and school settings within the country, the study aimed to provide a comprehensive perspective on how to improve reading skills and foster engagement effectively.

The ultimate goal of this study was to offer practical insights and recommendations that can empower educators, school administrators, and policymakers. By understanding and implementing effective student engagement strategies and reading assessment practices, the study aimed to contribute to the development of a more robust educational system that equips young learners with the essential skills they need to succeed in school and beyond. Through this research, the study sought to enhance reading proficiency and foster a love for learning among Filipino elementary school students, thereby shaping a brighter and more literate future for the nation.

Statement of the Problem

The study aimed to determine the influence of student engagement strategies and reading assessment practices on reading enhancement within the context of selected elementary schools in Lian District. Specifically, this study pursues to answer the following questions:

1. What is the degree of student engagement strategies as assessed by the teachers in terms of:
   1.1 active learning;
   1.2 differentiated learning; and
   1.3 collaborative learning?
2. What is the level of reading assessment practices of the students as assessed by the teachers in terms of:
   2.1 progress monitoring; and
   2.2 instructional materials?
3. Is there any significant relationship between the degree of student engagement strategies and the level of reading assessment practices of the students?
4. What reading enhancement programs should be proposed?

METHODOLOGY

This chapter elucidates the methodological approach employed in this study, encompassing the research design, data sources, study population, instrumentation and its validation, procedure for data collection, ethical considerations, treatment of data, and data analysis techniques employed.

Research Design

This research made use of descriptive-correlational research methodologies, incorporating a survey tool to assess the influence of student engagement strategies, and reading assessment practices on reading enhancement in selected elementary schools in Lian district. The selection of a quantitative approach was motivated by the desire to quantify and visually represent the feedback obtained from the study's participants.

Participants

The research centered its analysis on teachers who were currently employed from the selected elementary schools in Lian, Batangas. The study maximized 33 English teachers of Grades 1 to 3 from the total population of primary school teachers from the selected elementary schools in Lian, Batangas.

Research Instrument

In this study, a custom-designed survey was utilized to gain a deeper understanding of how the combination of these strategies can positively affect reading improvement. The research seeks to evaluate the quality of student engagement strategies in subsequent key areas: active learning, differentiated learning and collaborative learning. It also aims to measure the extent to which parents were involved in reading assessment practices, specifically in terms of progress monitoring and instructional materials. These aspects provide valuable insights into the measures needed to improve educational outcomes and promote reading enhancement.

Data Analysis

To provide an analysis of the data, the researcher applied the following statistical methodologies. The interpretation of data involved the use of weighted mean, ranking, and Pearson's r.

RESULTS AND DISCUSSIONS

This part of the study provided the presentation, analysis, and interpretation of the gathered data from the questionnaires answered by the respondents in accordance with the specific questions posited on the objectives of the study.

1. Degree of student Engagement Strategies as assessed by the Teachers

1.1 In Terms of active Learning

Table 1. Degree of student Engagement Strategies as Assessed by the Teachers in Terms of Active Learning

Items	Weighted Mean	Interpretation	Rank
The students…			
are encouraged to actively participate in class discussions.	3.91	Engaged	1.5
incorporate hands-on activities and experiments into their learning.	3.82	Engaged	3
are provided opportunities to work in groups or collaborate on projects.	3.76	Engaged	4.5
are allowed to choose topics or projects based on their interests.	3.64	Engaged	9
used technology, such as educational apps or multimedia resources, to enhance their active learning.	3.73	Engaged	7
adapted their teachers teaching methods to meet their diverse learning needs.	3.76	Engaged	4.5
are assigned to use tiered assignments to challenge their individual skill levels.	3.45	Engaged	10
are provided personalized learning plans who require additional support.	3.73	Engaged	7
are offered in grouping based on their learning styles and abilities.	3.91	Engaged	1.5
prior knowledge is assessed to adjust learning methods accordingly.	3.73	Engaged	7
Composite Mean	**3.74**	**Engaged**	

As gleaned in Table 1, the respondents assessed that the students were engaged and encouraged students to actively participate in class discussions, and engaged in offering grouping based on their learning styles and abilities which made the highest equal weighted means of 3.91 and similar ranks of 1.5. The results presented that the educators were noted to play a significant role in this engagement by not only encouraging but also facilitating active participation in class discussions.

1.2 In Terms of Differentiated Learning

Table 2. Degree of student Engagement Strategies as Assessed by the Teachers in Terms of Differentiated Learning

Items	Weighted Mean	Interpretation	Rank
The students…			
Adapt learning methods to meet their diverse learning needs	3.63	Engaged	8
prior knowledge are assessed and adjust learning methods accordingly.	3.58	Engaged	9
believed that differentiated learning is an effective approach to enhance their reading skills.	3.76	Engaged	5
collaborate with colleagues or co-students to share best practices in differentiated learning.	3.73	Engaged	7
Are involved in self-assessment and goal setting to enhance their learning.	3.85	Engaged	2.5
are offered flexibility in grouping based on their learning styles and abilities.	3.85	Engaged	2.5
are provided personalized learning plans and require additional support.	3.76	Engaged	5
instructional materials are adjusted and reviewed regularly to suit their abilities	3.76	Engaged	5
are given clear learning objectives that are adapted to their needs.	3.91	Engaged	1
use tiered assignments to challenge their individual skill levels.	3.48	Engaged	10
Composite Mean	**3.73**	**Engaged**	

As revealed in Table 2, the respondents responded that the students were engaged and are given clear learning objectives that are adapted to their needs with the highest weighted mean of 3.91 and the highest rank of 1.

1.3 In Terms of Collaborative Learning

Table 3. Degree of student Engagement Strategies as assessed by the Teachers in Terms of Collaborative Learning

Items	Weighted Mean	Interpretation	Rank
The school administration actively promotes a culture of collaborative learning among students.	3.94	Engaged	1
Regular collaborative learning sessions are scheduled and facilitated within the school.	3.55	Engaged	5.5
The students believe that collaborative learning enhances the overall effectiveness of learning practices.	3.73	Engaged	2
The students in the school share best practices and resources with each other.	3.18	Moderately Engaged	10
Collaborative learning opportunities are accessible to students of all experience levels in the school.	3.55	Engaged	5.5
The school provides adequate resources and support for collaborative projects among students.	3.39	Moderately Engaged	8.5
The students feel well-supported on their efforts to collaborate with fellow students to enhance their learning experiences.	3.39	Moderately Engaged	8.5
The school values and recognizes the contributions of students who actively engage in collaborative learning	3.55	Engaged	5.5
The communication environment is positive and open among students to facilitate collaboration.	3.55	Engaged	5.5
The students believe that collaborative learning has a positive impact on their achievement in the school.	3.64	Engaged	3
Composite Mean	**3.55**	**Engaged**	

As reflected in Table 3, the respondents perceived that the school administration actively engaged and promotes a culture of collaborative learning among students which made the highest weighted mean of 3.94 and the highest rank of 1. This finding means that the administration took steps to promote teamwork, cooperation, and shared learning experiences among students.

2. Level of Reading Assessment Practices of the Students as Assessed by the Teachers

2.1 In Terms of Progress Monitoring

Table 4. Level of Reading Assessment Practices of the Students as Assessed by the Teachers in Terms of Progress Monitoring

Items	Weighted Mean	Interpretation	Rank
The students…			
reading progress are assessed throughout the school year.	4.00	Engaged	1.5
are given benchmark assessments to measure their reading levels.	3.42	Engaged	10
are provided variety of assessment tools to evaluate their comprehension and fluency.	3.85	Engaged	5
are provided with constructive feedback based on their assessment results.	3.88	Engaged	4
are given differentiated reading assessments to accommodate those with diverse needs.	3.76	Engaged	6
are provided clear reading goals for them to achieve during the academic year.	3.91	Engaged	3
are involved in self-assessment and reflection on their reading progress.	3.64	Engaged	9
are furnished with formative assessments to guide learning adjustments.	3.67	Engaged	8
reading progress are communicated to their parents.	4.00	Engaged	1.5
are collaborated with colleagues to share best practices in progress monitoring.	3.73	Engaged	7
Composite Mean	**3.78**	**Engaged**	

As displayed in Table 4, the respondents assessed that students were engaged in reading progress that are assessed throughout the school year, and also engaged in communicating their reading progress to their parents which yielded the highest equal weighted means of 4.00 and the highest ranks of 1.5. This finding meant that students were likely engaged in various reading activities and assessments to track their growth and development in reading skills over time.

3.2. In Terms of Instructional Materials

Table 5. Level of Reading Assessment Practices of the Students as Assessed by the Teachers in Terms of Instructional Materials

Items	Weighted Mean	Interpretation	Rank
The students believe that the instructional and learning materials provided are up-to-date and aligned with the curriculum	3.64	Engaged	4
The availability of instructional and learning materials adequately supports varied learning strategies.	3.64	Engaged	4
The instructional and learning materials effectively cater to diverse learning styles and abilities in the classroom.	3.64	Engaged	4
Teachers are provided with the necessary training to effectively utilize instructional materials and to enhance students reading practices.	3.55	Engaged	7
The school seeks feedback from students regarding the effectiveness of instructional and learning materials.	3.36	Moderately Engaged	10
Instructional and learning materials are easily accessible and well-organized for students to use.	3.45	Engaged	9
The school allocates sufficient budget and resources for the procurement of quality instructional and learning materials.	3.67	Engaged	2
Instructional and learning materials significantly contribute to enhancing the learning experiences of students.	3.73	Engaged	1
students have the flexibility to choose instructional and learning materials that best suit their teaching styles.	3.55	Engaged	7
The school encourages innovation in the use of instructional and learning materials to enhance teaching and learning.	3.55	Engaged	7
Composite Mean	**3.58**	**Engaged**	

As provided in table 5, the respondents affirmed that the students were engaged and believed that instructional and learning materials significantly contribute to enhancing their learning experiences which obtained the highest weighted mean of 3.73 and the highest rank of 1.

Relationship Between the Degree of Student Engagement Strategies and the Level of Reading Assessment Practices of the Students

Table 6. Relationship Between the Degree of Student Engagement Strategies and the Level of Reading Assessment Practices of the Students

Variables	r-value	p-value	Decision	Interpretation
Active Learning Versus:				
Progress Monitoring	0.48	0.00470	Reject Ho	Highly Significant
Instructional Materials	0.20	0.26445	Failed to Reject Ho	Not Significant
Differentiated Learning Versus:				
Progress Monitoring	0.53	0.00151	Reject Ho	Highly Significant
Instructional Materials	0.45	0.00860	Reject Ho	Highly Significant
Collaborative Learning Versus:				
Progress Monitoring	0.28	0.01145	Reject Ho	Significant
Instructional Materials	0.35	0.04585	Reject Ho	Significant

As discussed in the above results presented in Table 6, when the responses of the teacher-respondents on the degree of student engagement strategies in terms of active learning were compared to the level of reading practices of the students, the computed r-value of 0.48 for progress monitoring has a corresponding p-value of less than 0.01, thus, rejecting the hypothesis.

3. Proposed Reading Enhancement Programs

Table 7. Reading Enhancement Programs

Programs to be Proposed	Description	Objectives	Output
Reading Buddies Program	The Reading Buddies Program pairs older students with younger peers to engage in collaborative reading activities. Older students serve as mentors and role models, providing support and encouragement to younger students as they develop their reading skills.	The objective of the Reading Buddies Program is to enhance reading engagement, foster positive peer relationships, and improve reading comprehension and fluency among participating students.	Improved reading comprehension and fluency among younger students Increased motivation and confidence in reading Positive peer relationships and collaboration skills
Book Club Initiative	The Book Club Initiative establishes student-led book clubs within the school community, where students have the opportunity to select and discuss books of interest in a collaborative and supportive environment.	The objective of the Book Club Initiative is to promote a culture of reading, critical thinking, and discussion among students, while also fostering collaboration and social interaction.	Increased reading engagement and interest among participating students. Improved critical thinking and analytical skills through book discussions. Enhanced social skills and peer relationships.
Reading Rewards Program	The Reading Rewards Program incentivizes reading achievement through a reward system, where students earn points or prizes for meeting reading goals, completing book reports, or participating in reading-related activities.	The objective of the Reading Rewards Program is to motivate students to read regularly, set reading goals, and track their progress, ultimately improving reading comprehension and fostering a love for reading.	Increased reading frequency and duration among students. Improved reading comprehension and vocabulary acquisition. Positive reinforcement of reading habits and behaviors.
Reading Assessment Clinic	The Reading Assessment Clinic provides targeted support and intervention for students struggling with reading comprehension or fluency. Trained educators conduct diagnostic assessments, develop personalized reading plans, and provide one-on-one or small group instruction to address specific areas of need.	The objective of the Reading Assessment Clinic is to identify and address reading difficulties early, provide individualized support and intervention, and improve overall reading proficiency among struggling students.	Improved reading comprehension and fluency among participating students. Increased confidence and self-efficacy in reading. Individualized reading plans tailored to each student's needs.
Literacy Enrichment Week	The Literacy Enrichment Week is a school-wide event dedicated to celebrating literacy and promoting reading culture. Activities may include author visits, book fairs, themed dress-up days, literacy-themed competitions, and interactive reading workshops.	The objective of the Literacy Enrichment Week is to create a fun and engaging environment that celebrates the joy of reading, fosters a sense of community around literacy, and encourages students to explore and appreciate diverse forms of literature.	Increased enthusiasm and appreciation for reading among students. Enhanced awareness of literacy resources and opportunities. Strengthened school community bonds through shared literacy experiences.

Derived from the results, presented in table 7 are the proposed reading enhancement programs. By implementing these programs, elementary schools can create a supportive and enriching environment that promotes reading engagement, fosters collaboration, and enhances overall reading proficiency among students.

CONCLUSIONS

The findings of the study underscored the critical role of student engagement strategies, differentiated learning, collaborative learning, and effective reading assessment practices in promoting a dynamic and inclusive learning environment. The results suggested that educators were successful in fostering active learning atmospheres, tailored to students' diverse needs and abilities, which led to deeper learning and better retention of knowledge. Additionally, the study revealed a commitment to implementing effective teaching strategies, such as differentiated learning, to cater to individual learning styles and preferences, promoting inclusivity and personalized learning experiences.

Furthermore, the findings emphasized the importance of collaborative learning approaches in enhancing student engagement, critical thinking, and social skills development. The proactive approach to progress monitoring and communication of reading progress between students, teachers, and parents highlighted a commitment to supporting students' literacy development and fostering collaborative relationships within the school community.

In contrary, the study's weakest finding lay in its limited exploration of student involvement in shaping their learning environments. While recognizing the significance of instructional materials and effective teaching strategies, it overlooked the active participation of students in providing feedback. Involving students in this process could have enhanced their sense of ownership and engagement in learning. By incorporating student feedback, reading assessment practices could have been further refined, contributing to the creation of more student-centered learning environments. This oversight suggests a missed opportunity to fully leverage students' perspectives and contributions in the development of effective reading enhancement programs.

Regarding instructional materials, the study highlighted the significance of incorporating relevant and supportive resources in reading assessment practices. While acknowledging the importance of instructional materials, there was potential for further involvement of students in providing feedback and shaping their learning environments.

Overall, the study underscored the interconnectedness between student engagement strategies, differentiated learning, collaborative learning, effective reading assessment practices, and instructional materials. By fostering active engagement, differentiation, collaboration, and effective assessment practices, educators were able to create inclusive and effective learning environments where every student could succeed.

RECOMMENDATIONS

Based on the conclusion drawn from the study, the following recommendations are proposed to further enhance student engagement strategies, differentiated learning, collaborative learning, effective reading assessment practices, and instructional materials in elementary schools.

1. The educational institutions, with the assistance of the Department of Education must provide ongoing training and professional development opportunities for teachers to further enhance their knowledge and skills in implementing student engagement strategies, differentiated instruction, and collaborative learning approaches. This can include workshops, seminars, and peer collaboration sessions focused on innovative teaching practices.
2. Review and revise the curriculum to ensure alignment with best practices in student-centered learning, differentiation, and collaborative learning. Integrate opportunities for active learning, problem-solving tasks, and group projects into the curriculum to promote deeper understanding and engagement among students.
3. Implement strategies to support diverse learners by providing additional resources, accommodations, and support services tailored to individual needs. This can include specialized training for teachers, access to assistive technologies, and collaboration with support staff to address the unique needs of students with disabilities or English language learners.
4. Foster collaboration and communication between parents, teachers, and the wider community to support student learning and development. Organize parent workshops, family literacy nights, and community outreach events to promote awareness of effective teaching practices and encourage parental involvement in their child's education.

5. Establish regular evaluation and feedback mechanisms to assess the effectiveness of student engagement strategies, differentiated learning approaches, and collaborative learning initiatives. Solicit input from students, teachers, parents, and stakeholders to identify areas for improvement and implement targeted interventions to address challenges.
6. Allocate sufficient resources, including funding, materials, and technology, to support the implementation of effective student engagement strategies and differentiated instruction. Ensure equitable access to instructional materials and technology tools to support diverse learning needs and enhance student engagement in the learning process.
7. Encourage research and innovation in the field of student engagement, differentiated instruction, and collaborative learning to stay abreast of emerging trends and best practices. Support teachers and educational researchers in conducting action research projects to explore new teaching strategies and assess their impact on student learning outcomes.

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COMPETENCE AND CHANGE MANAGEMENT AS PREDICTORS OF RESILIENCE AMONG PUBLIC ELEMENTARY SCHOOL TEACHERS IN REGION XI: A CONVERGENT DESIGN

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ABSTRACT

This study employed mixed methods research, specifically convergent design to determine the significant influence of competence and change management on teacher resilience. The data were gathered from public elementary school teachers in Region XI, Philippines. Sets of validated adapted and adopted survey tools with a five–point Likert scale and interview guide were used to gather data. The statistical tools used to treat the quantitative data were mean, standard deviation and multiple regression analysis, while in the qualitative phase, thematic analysis was employed. In the quantitative phase, results showed that the level of competence, change management and resilience were all rated very high. Also, competence and change management significantly influenced resilience. Further, based on the lived experiences of the participants on resilience, there were three themes generated such as demonstrating change management practices, manifesting highly effective teaching, and embodying a value-laden self. Furthermore, on the role of experiences in shaping the beliefs of the participants, the themes generated were acceptance as remarkable element of resiliency, change is transformation for the better, submissiveness to God in the midst of uncertainties, keeping a positive mindset, being proactive, strong determination in portraying resiliency, becoming a dedicated teacher. Finally, the nature of data integration revealed merging – converging.

Keywords: Education, competence, change management, resilience, teachers, convergent design, Philippines

INTRODUCTION

Resilience is the capacity of a person to preserve mental health and regular functioning in the face of significant adversity (White, 2023). In education context, resilience refers to teachers' ability to sustain their effectiveness despite the numerous job demands and constraints (Zhang & Luo, 2023). Accordingly, this concept includes qualities like motivation, teaching effectiveness, work satisfaction, well-being, and professional identity (Mansfield et al., 2016). However, reports revealed a pressing problem of lacking resilience among teachers that poses the leading cause of higher rates of teacher attrition, reduced adaptability, and diminished instructional effectiveness (Smith et al., 2023). And, as recorded in the Teacher Wellbeing Index (2021) report, 54 percent of over 3000 teachers had considered leaving the profession, mainly due to mental health reasons and low resilience problems (Scanlan & Savill-Smith, 2021). The said contexts, hence, highlights the pressing need to address issues related to poor resilience in order safeguard the quality of education (Smith et al., 2021).

On a global scale, a recent study by the Association of Pacific Rim Universities (APRU) involving 26 countries found that more than 25 percent of the population exhibits a low resilience level, with a higher prevalence observed in the Americas and European countries compared to the Asia Pacific regions (Wong et al., 2023). Also, numerous studies, spanning over 50 instances across various countries, have documented elevated rates of teachers leaving the education profession due to lacking resilience. In Australia, a study by Arnup and Bowles (2016) revealed that lower resilience significantly predicts the intention to leave the teaching profession, independently contributing to this intention beyond factors such as job satisfaction and teacher demographics. In a study conducted by Agyapong et al. (2024) among teachers in three Canadian provinces, 40.1 percent of teachers reported low resilience, while 26.3 percent experienced high stress levels The study also highlights that teachers with low resilience are sig-

nificantly more likely to experience high stress. The increased attrition rates among teachers are alarming, with estimates suggesting that up to 50 percent of teachers leave the profession within the first five years of teaching, often due to lower resilience. Moreover, Schoeps et al. (2023) found that 57.20 percent of teachers in Chile exhibit low resilience and emotional balance, impacting the education sector. Also, the World Bank (2018) highlighted a comprehensive report regarding the global patterns of low resilience in developing countries, attributing challenges such as inadequate compensation, challenging working conditions, and limited professional development opportunities as key contributors. Additionally, a meta-analysis by Wang et al. (2015) synthesized findings from diverse countries, including China, Canada, and Germany, revealing consistent low resilience.

In the national context, teachers often face a challenging test of resilience in schools (Banal & Ortega-dela Cruz, 2022). With the current Philippine classroom setting, resilience of the teachers may be normally challenged. Confirming this issue, 58 elementary school teachers in Quezon City acknowledged their struggle with resilience in the face of difficulty. The compromised motivational resilience is further exacerbated by problems such as inadequate compensation, as noted by Santos and Reyes (2020), impacting teachers' motivation to remain in the profession. Consequently, teachers experience decline in resilience along with heightened stress levels and struggle to cope with job demands. This cumulative impact of stressors prompts educators to contemplate leaving the profession resulting to their low level of resilience at work (Angoluan, 2020).

In Mindanao, resilience remains a challenge for teachers who experienced difficulties in their personal relationships. Such difficulties were also caused by their tiredness and a lack of energy due to multiple workload (Into & Gempes, 2018). In addition, poor resilience was also the problem and a challenge encountered by schools in Davao Del Sur, Region XI due to multiple ancillary functions of teachers. In the context of these issues, it affirms the need for resilience to be strengthened and be part of teacher education (Retubada, 2014).

Moving towards another context of the study, it is claimed that when teachers perceived themselves as competent in their field of expertise and teaching practices, they successfully demonstrate heightened levels of resilience when confronted with challenges at work. In like manner, teachers with higher self-confidence in their skills are more likely resilient and less likely to experience burnout, even in challenging workplace. (Alexander et al., 2019). This relates to teacher competence by signifying that a teacher's self-efficacy rooted in their professional skills and knowledge enhances teacher resilience. Therefore, competent teachers, who are confident in their teaching abilities, are more likely to demonstrate emotional resilience, that may help them manage stress and prevent burnout. Thus, improving teacher competence can lead to higher resilience, creating a more positive educational environment (Daniilidou et al., 2020). Also, research study has established that professional development opportunities are vital in developing teachers' competence which associates the importance of competence in developing resilience and effectively addressing the problems of modern education. (Darling-Hammond et al., 2017).

Moreover, recent empirical research also recognized the relationship between competence and resilience that becomes a significant area of study in education. The competence of teachers, which includes their pedagogical skills, content knowledge, and classroom management abilities, is extremely important in promoting resilience among educators. According to Day and Gu (2014), teachers who have a strong belief in their own competence in their professional positions are more likely to show greater resilience when faced with adversities. Added on, Mansfield et al. (2012), pointed on the four broad dimensions that enhance teacher resilience which specifically related to the profession (self-efficacy beliefs and pedagogical competence), emotional aspects (positive emotions and emotional management), social aspects and motivational aspects.

Viewing another element of the study, one key component in the field of education is the connection between the change management of teachers and their resilience. In the education context, it is believed that successful implementation of changes and initiatives is essential for educators to exhibit a large amount of adaptability and flexibility throughout their careers. Continuous practices of innovative pedagogical approaches and the constant application of the technology integration into educational environments are examples of initiatives that fall under this category (Wang & Zhang, 2018). Among the many examples of such endeavors is the implementation of recently developed instructional strategies. When these shifts are taken into consideration, the resilience of educators becomes a crucial component in determining the degree to which they are able to successfully manage the stressors that are associated with their work. Existing research suggests that there is a correlation between the resilience of teachers and

their ability to adjust to changing conditions and effectively manage the problems that are brought about by change. Furthermore, the chances for professional development that are inherent in change management have the potential to greatly contribute to the personal growth of teachers and, as a result, contribute to the strengthening of their resilience (Hargreaves & Fullan, 2012).

Consequently, collaborative effort and a supportive school environment during change processes are crucial factors that can foster resilience among teachers (Ingersoll & Strong, 2011). For an organization in education to be resilient, it must anticipate, prepare for, respond and adapt to incremental change and sudden disruptions to its survival and thrive. However, in a competitive environment, teachers who are knowledgeable of their resilience strengths are also more equipped to find opportunities out of a crisis (Tamunomiebi & Lawrence, 2020).

Moreover, successful change management can, as well, lead to a range of positive outcomes. By involving the teachers in the change process and addressing their concerns It can also increase their satisfaction to be resilient in their job responsibilities. Change management practices, therefore, foster resilience by engaging educators in the process and addressing their concerns, which builds adaptability to new circumstances. This process allows schools to create a culture where teachers feel empowered to navigate change confidently (Abbas, 2023). In addition to these benefits, successful change management can help teachers build resilience by proactively preparing for and navigating through challenges, teachers can develop the ability to bounce back from setbacks and continue delivering value to their stakeholders. This can involve developing scripted routines, simple rules, and the ability to improvise in response to changing circumstances (Robles et al., 2023). Resilience, as it enables a person to bounce back and thrive through change, needs to be nurtured each day. Education leaders must also create habits to see and manage the change as teachers embrace change management and create our evolving path into resiliency. Overall, these findings underscore the intricate interplay between change management strategies and teachers' resilience, emphasizing the need for a holistic approach to educational transformation that considers the psychological well-being of educators (Federici, 2022).

Undeniably, existing studies have made significant strides in exploring various aspects of teacher resilience, competence, and change management. While studies have investigated the role of teacher competence in fostering resilience (Wang, 2021; Daniilidou et al., 2020), and others have examined the effects of change management on educators (Brown & Davis, 2018; Wang & Zhang, 2019), limited research systematically investigate the intertwined effects of competence and change management on teacher resilience. Therefore, addressing this research gap is crucial for developing targeted interventions and policies that comprehensively support teachers in navigating change while maintaining and enhancing their resilience.

Further, the emphasis on the resilience of public elementary school teachers in Region XI is believed to have immense social value. By delving into the relationship between competence, change management, and teacher resilience, it intends to understand how these factors greatly affect the emotional strength of teachers amidst evolving educational landscapes and societal challenges. These implications go beyond individual teachers which in turn, contribute to a more developed educational policies and training, leading to a more resilient education system and a generation better equipped with necessary skills to positively impact the future of the society.

STATEMENT OF THE PROBLEM

This study determined the significant influence of competence and change management on resilience among public elementary school teachers in Region XI. Specifically, the study sought answers to the following questions:

1. What is the level of competence, change management, and resilience of teachers?
2. Do competence and change management significantly influence resilience?
3. What are the lived experiences of the participants as regards resilience?
4. How do these experiences shape the beliefs, attitude, and commitment of the public elementary school teachers?
5. Do the qualitative findings corroborate with the quantitative data?

METHODOLOGY

This study notably utilized the mixed methods approach, specifically employing a convergent design. Mixed methods research refers to the process of gathering and combining both quantitative and qualitative data in a study (Creswell & Clark, 2018). It also employed to collect both qualitative and quantitative data in order to address research questions or hypotheses. Utilizing this research approach can yield a more comprehensive understanding of research issues, hence augmenting the results of the study (Creswell & Creswell, 2017).

Mixed methods research requires a decisive mixing of methods in collecting data, analyzing data, and interpreting evidence (Shorten & Smith, 2017). Moreover, mixed methods design was used for conducting research that involves collecting, analyzing, and integrating quantitative and qualitative research in a single study or a longitudinal program of inquiry (Creswell, 2018). The purpose of this kind of research was that both quantitative and qualitative research, in combination, give a clearer insight into a research problem or issue than either research approach alone (Creswell, 2018). Convergent design, also known as the convergent parallel design, is a research methodology in which a researcher simultaneously combines both quantitative and qualitative phases of the study. By employing the methodologies typically linked to each specific type of data, this framework enables the separate and independent gathering and analysis of data. Afterwards, the results are combined or mixed together during the process of interpretation (Creswell & Clark, 2011).

Moreover, in the quantitative phase, the researcher employed the descriptive correlational design. It was used to obtain information about the current status of the phenomena to describe "what exists" concerning variables or conditions in a situation. Correlational research further examines the association of the dependent and independent variables (Kipchumba, 2019). According to Fraenkel and Wallen (2019), correlational designs are useful for studying the relationships between variables and may provide a detailed understanding of how changes in one variable may be related to changes in another.

The qualitative phase utilized the phenomenological approach. Phenomenology is one of the basic traditions of qualitative inquiry that examines the lived experiences of individuals. The qualitative data provided additional information to the statistical results, giving a detailed and contextualized representation of the factors being studied. The description of the phenomenon provides what the individuals had experienced and how they experienced it (Creswell & Creswell, 2017).

Locale of the Study

This research study was conducted within Region XI, with a specific focus on public elementary schools encompassing the divisions within Region XI, namely Davao del Norte, Davao del Sur, Davao Occidental, Davao Oriental, Davao City, Digos City, Mati City, Panabo City, Samal City, and Tagum City. Geographically, Region XI, designated as Davao Region, is situated in the southeastern portion of Mindanao.

Regarding the selection of schools to participate in this study, the requirements included a harmonious blend of urban and rural representation, acknowledging the unique difficulties and advantages linked to diverse educational settings in the area. Further, through active involvement of the local schools, principals and teachers in the research process, the researcher also believed that the study was designed to promote collaboration and shared responsibility. Furthermore, the research recognized the possible differences in regional policies, curriculum implementation, and educational initiatives which may have an impact on their resilience.

Participants

For the quantitative phase, 300 teachers from the different public elementary schools in Region XI were the respondents as the target population. The needed sample size was based on the Raosoft sample size calculator with a 5% margin of error and 95% confidence level. Thus, the total number of participants in the sample was determined to be 300 respondents after combining the computed sample numbers for each stratum.

For the qualitative phase, there were 17 public elementary school teachers in Region XI who were invited to participate in the IDI and FGD. There were 10 participants who joined in IDI and seven for the FGD. These participants were selected based on specific inclusion and exclusion criteria. The criteria required the participants to be full-time teachers with at least five years of teaching experience. Howev-

er, it is essential to note that these participants were distinct from the 300 respondents in the quantitative strand of the study. The results of the IDI and FGD were utilized to explore the generated themes based on their lived experiences.

Data analysis

This study utilized a suitable statistical approach and method to classify, evaluate, and interpret the data. The mixed methods process was used to obtain the essential data, including both quantitative and qualitative procedures. The quantitative data were analyzed using mean, standard deviation, and multiple regression analysis. The level of competence, change management and resilience of public elementary school teachers were analyzed through weighted means. In identifying what particular variable significantly influences resilience, multiple regression analysis was applied. In the qualitative phase, a systematic process was applied to analyze the verbatim data collected by the researcher through IDI and FGD. The study used Colaizzi's Method (1978), which has seven discrete stages, to explore the actual encounters of the participants in relation to the topic under investigation. In this study, quantitative and qualitative data were collected and integrated. Particularly, several data were collected during the quantitative stage. This data was the basis for evaluating the influence of competence and change management on the resilience of public elementary school teachers. Meanwhile, the findings from the qualitive phase explained the lived experiences of the participants regarding resilience. Consequently, data integration and analysis were employed to ensure that the quantitative data are aligned with the qualitative data in a convergent manner in a joint display of salient quantitative and qualitative results.

FINDINGS

Quantitative Results

Level of Competence

Indicators	Mean	SD	Description
Pedagogical Content Knowledge	4.32	0.76	Very High
Constructivist Belief	4.24	0.79	Very High
Self-Efficacy	4.27	0.83	Very High
Enthusiasm	4.39	0.81	Very High
Total Mean	**4.30**	**0.77**	**Very High**

The level of competence of teachers has an overall mean of 4.30, which is described as very high, which means that competence of teachers in public elementary schools of Region XI is always manifested.

Level of Change Management

Indicators	Mean	SD	Description
Organizational Goal	4.23	0.87	Very High
Transformational Leadership	4.40	0.81	Very High
Participation and Communication	4.32	0.82	Very High
Education and Training	4.33	0.79	Very High
Total Mean	**4.32**	**0.81**	**Very High**

The level of change management has an overall mean is 4.32, with a description of very high indicating that change management is always evident among teachers in public elementary schools in Region XI.

Level of Resilience of Teachers

Indicators	Mean	SD	Description
Professional Resilience	4.34	0.79	Very High
Emotional Resilience	4.18	0.83	High
Motivational Resilience	4.28	0.80	Very High
Social Resilience	4.39	0.80	Very High
Total Mean	**4.30**	**0.79**	**Very High**

The level of resilience of teachers in public elementary schools yielded an overall mean rating of 4.30, which is described as very high indicating that resilience of teachers in Region XI is always demonstrated.

Significance of the Influence of Competence and Change Management on Resilience

Table 1 shows the results of the multiple regression analysis. Also, standardized beta coefficients and t-statistics results of the influence of the independent variables namely: competence and change management, and the dependent variables which is resilience are presented. Based on the individual capacity of the variable competence, the findings revealed that competence significantly influenced resilience of teachers as seen in the p-value which is less than .05 and a standardized beta coefficient of .686. This indicates that for every one unit increase in the competence of teachers, their resilience also increased by .686. More so, in the variable change management, the findings revealed that change management significantly influenced resilience of teachers as seen in the p-value which is less than .05 and a standardized beta coefficient of .261. This indicates that for every one unit increase in the change management, resilience of teachers also increased by .261.

As a whole, the R-square value is reported at .873 indicating that 87.3 percent in the variability of resilience can be explained by the combined influence of competence and change management. Relatively, 12.7 percent of the variation of resilience can be attributed to other factors or independent variables not included in the study.

Table 1. Significance of the Influence of Competence and Change Management on Resilience

Resilience	Standardized Beta Coefficients	t	p-value	Remarks
Competence	.686	11.976	.000	Significance
Change Management	.261	4.558	.000	Significance

R=.934, R-square = .873, F=1019.019, p<.05

Qualitative Results

Data revealed the 17 participants both in IDI and FGD. There were 10 participants in IDI and seven in FGD. These participants were selected from public elementary schools in Region XI. The researcher chose them to get the necessary salient information using the mixed method for the qualitative strand. Moreover, to protect the identity of the participants and the anonymity of the schools involved in this study, the researcher assigned codes for each participant and disclosed specific categories only, like sex, study group, and address.

Lived Experiences of Participants as regards Resilience

From their narratives in the IDI and FGD, there are three themes generated: demonstrating change management practices, manifesting highly effective teaching, and embodying a value-laden Self.

Demonstrating Change Management Practices. During the interview when asked about their personal experiences, participants shared their heartfelt stories on how they value their critical roles of demonstrating change management practices in strengthening their resilience. Many of them found that resilience flourished when they approached these changes with a positive attitude and received consistent support from their school leaders. It's clear from their experiences that resilience isn't just about surviving; it's about growing stronger through the very process of change. Such ideas were disclosed when participants shared their sentiments as they said:

> My resiliency is flourishing. I consider changes as constant, hence, preparing me to be more flexible and proactive and be more adept to cope with the demands of these times. (IDIP1)
>
> I just keep my focus, keep my list of priorities of what is urgent and needs to be accomplished within the day so I can have proper time management. (IDIP6)

Manifesting Highly Effective Teaching. As the participants shared their thoughts during the interview, they revealed that manifesting highly effective teaching was a cornerstone of their resilience. Many teachers believe that being highly effective is manifested on how they prioritized building a wel-

coming classroom atmosphere. t was about creating a sense of purpose, staying motivated through challenges, and finding joy in their students' growth. These sentiments were revealed as participants shared their viewpoints:

> As a teacher, my resilience is characterized by my ability to adapt to change, persist through challenges, and consistently support my students' growth and learning. (IDIP3)
>
> I demonstrate my commitment by creating interesting classes, offering helpful criticism, and creating a welcoming classroom atmosphere. (IDIP10)

Embodying a Value-Laden Self. As participants reflected on their journeys, they shared compelling reflections on how their personal values have become cornerstones of their resilience. For them, resilience apart from enduring challenges was also about drawing strength from deeply held values of patience, perseverance, and a positive mindset. These sentiments were revealed as participants shared these thoughts:

> Yes, I am resilient. I can keep my composure despite the daily challenges of nurturing the learners. Being resilient has helped me persevere through challenges, (FGD7)
>
> I believe that in attaining your objectives, one must be composed, self-trusting, having the attitude of never giving up and being patient to achieve the goal. (FGD6)

Role of Experiences in Shaping the Beliefs of the Participants on Resilience

The beliefs of the participants were clustered into three essential themes: acceptance as remarkable element of resilience, change is transformation for the better, submissiveness to God in the midst of uncertainties.

Acceptance as Remarkable Element of Resilience. As the interview continued, the participants shared how acceptance had become a defining element of their resilience. They painted a vivid picture of how embracing change, learning from setbacks, and adapting with purpose have become vital element of their resilience. For these teachers, acceptance is not about passivity but about actively choosing to adapt and find meaning in challenges. Through their experiences, it became evident that acceptance is not about giving up; it is about letting go of resistance, opening themselves up to growth, and finding strength in the willingness to adapt. These meaningful discussions of participants on resilience were revealed as they share these sentiments:

> Collaboration is also necessary to work with people who can help you best at work. (IDIP6)
>
> Learning from setbacks. Learn to accept failures and rise from them. Take that as a learning opportunity. (IDIP3)

Change is Transformation for the Better. When participants were asked about their beliefs, they viewed that resilience thrives when change is embraced as a force for transformation. Their experiences reflect how they direct change with optimism, flexibility, and a commitment for growth. These participants strongly believe that accepting failures is part of the process that as they experience mistakes, it gives them opportunity to grow as a person. Participants revealed these deep insights as they expressed the following sentiments:

> As a leader, my resilience is honed to always work with grace under pressure. (IDIP6)
>
> The ability to recover and rebound from challenges in all aspects…Despite this challenge I remain calm and positive minded. (IDIP9)

Submissiveness to God in the Midst of Uncertainties. For the participants, their resilience is deeply rooted from their deep belief in God and submission to His will. For them being submissive to God does not mean passivity or inaction; rather, it is an active choice to place their trust in a higher power, believing that there is a greater purpose behind every challenge face. For them, this spiritual foundation allows

them to navigate life's challenges with strength and stability, providing them with a sense of purpose and hope even in times of uncertainties. These meaningful experiences from the participants' sharing were made clear when they expressed their beliefs:

> In Romans 8:31, if God is for us, who can be against us…as long as you are grounded on truth, you flourish. If you keep your mind and heart attuned to our Creator, you will truly be resilient. (IDIP1)
>
> Just do everything with love. It also strengthens my spiritual belief that I can do all things with Christ who strengthens me. (IDIP6)

Role of Experiences in Shaping the Attitude of the Participants on Resilience

The experiences help teachers in public elementary schools in Region XI mold their attitudes on resilience. Thus, the beliefs of the participants were clustered into two essential themes: keeping a positive mindset and being proactive.

Keeping a Positive Mindset. During the interviews, participants revealed how a positive mindset has influenced their resilience. For them maintaining optimism, even when faced with the daily pressures of their profession enabled them to carry problems with grace and perseverance. teachers' stories also highlighted the importance of staying calm amidst stress, to lean into their positive mindset, reminding themselves to stay grounded and avoid succumbing to panic. These sentiments were evident from the following responses of the participants during the sharing:

> Being mindful in the midst of arising challenges…For me, it can foster resilience by helping an individual stay grounded and calm amidst chaos. (IDIP2)
>
> Perhaps, I learned to do things without complaining. Also, be optimistic always to finish everything on time. (FGD6)

Being Proactive. When participants shared their thoughts on resilience, a common theme emerged: their ability to be proactive played a crucial role in how they managed the challenges of teaching. For them, being proactive was about taking initiative, staying prepared, and responding effectively to different situations. By preparing for different circumstances, these teachers felt better equipped to handle surprises calmly and effectively, maintaining a positive and stable learning environment for her students. Participants revealed these deep insights as they expressed the following sentiments:

> I need to understand the meaning and value of what I do…Being flexible and willing to do what is good for the betterment of everyone. (FGD1)
>
> I have now the attitude to openly accept that the learners need … So, what I did was to build an atmosphere where they will feel accepted and understood. (FGD4)

Role of Experiences in Shaping the Commitment of the Participants on Resilience

The role of experiences helps teachers in public elementary schools in Region XI mold their commitment on resilience. Moreover, the beliefs of the participants were clustered into three emerged essential themes: strong determination in portraying resiliency and becoming a dedicated teacher.

Strong Determination in Portraying Resiliency. As participants reflected on the personal experiences, they emphasized their firm determination to stay persistent in the face of challenges. For them, being always adaptive, positive to attain goal success and flexible in any transition exemplify their resilience. The participants thus, emphasized the value of how persistence and influencing others positively can lead to success. Participants revealed these meaningful discussions as they expressed the following sentiments:

I have committed to remain cool and in good composure every time I am under pressure. I have also committed not to work alone but learn the value of collaboration with co-workers. (IDIP6)

Commitment to continuous learning. By embracing positive mindset and seeking new learning strategies effective to the learning needs. (FGD7)

Becoming a Dedicated Teacher. When participants reflected on what shaped their deep commitment, they believed that it's all about becoming a dedicated teacher. This dedication is rooted in their selfless service, compassion, and deep sense of purpose for God and their community. For them, teaching goes beyond the classroom—it is about living their values. This willingness to take on additional responsibilities reflects their daily commitment to their profession that true dedication is about more than just doing the work, it's about serving with heart. Participants revealed these deep insights on resilience as they expressed the following sentiments:

The commitment to "walk the talk" is vital...As a teacher, it is crucial to demonstrate consistency and integrity by aligning actions. (IDIP8)

I am committed to be at my best…amid these present times full of procrastination. This is always a constant reminder to me, as a teacher and a servant of the Living God. (IDIP1)

Influence of Competence and Change Management on Resilience	Competence significantly influenced resilience of teachers as seen in the p-value which is less than .05 and a standardized beta coefficient of .686. Also, change management significantly influenced resilience of teachers as seen in the p -value which is less than .05 and a standardized beta coefficient of .261. The R-square value is reported at .873.	The more competent and adept in change management the teachers are, the more resilient and adaptable they are even in changing circumstances.	**Merging-Converging**

Significance of the Influence of Competence and Change Management on Resilience. On the focal point influence of competence and change management on resilience, the nature of integration follows a merging-converging approach. The findings of the quantitative data revealed that competence and change management significantly influenced resilience of teachers when seen through the lens of qualitative data by merging, converges directly with the data demonstrating that the more competent and adept in change management the teachers are, the more resilient and adaptable they are even in changing circumstances. The two data sets converge because they emphasize the significant contribution and substantial role of competence and change management in cultivating the resilience of teachers even in the face of educational challenges and changes.

Aspect or Focal Point	Quantitative Findings	Qualitative Findings	Nature of Integration
Competence	Table 1.1 on Competence, under indicator, Content Pedagogical Knowledge, on item, incorporating question and answer activities into the lessons, possessing skills in assessing students' performance in the classroom, is rated Very High, M=4.32, SD=.76 Table 1.1 on Competence, under indicator, Constructivist Belief, on item, facilitating easy communication for parents, is rated Very High, M=4.24, SD=.79 Table 1.1 on Competence, under indicator, Self-efficacy, on item, being confident in their continuous growth in addressing students' needs, is rated Very High, M= 4.27, SD=.83 Table 1.1 on Competence, under indicator, Enthusiasm, on the item, genuinely enjoying teaching in the classroom, is rated Very High, M=4.39, SD=.81	Table 3 on Lived Experiences, has core ideas on the aspect of, continuously seeking and teaching in innovative ways to improve students' learning performance, with the theme, manifesting highly effective teaching. Table 3 on Lived Experiences, has core ideas, observing professionalism and proper communication during collaboration and feedbacking, has a theme, embodying a value-laden self Table 4.2 on Shaping Attitudes, has core ideas, seeking new teaching strategies appropriate to the new educational setting, has a theme, being proactive Table 3 on Lived Experiences, has core ideas, creating a welcoming classroom atmosphere, has a theme, manifesting highly effective teaching, and Table 4.2 on Shaping Attitudes, has core ideas, becoming stronger in adapting new educational set-up, optimistic in facing new challenges in the teaching learning process, has a theme, keeping a positive mindset	**Merging-Converging** **Merging-Converging** **Merging-Converging** **Merging-Converging**

Change Management	Table 1.2 on Change Management, under indicator, Organizational Goal, on item, being clear about the organizational goals of their educational institution, is rated Very High, M=4.23, SD=.87	Table 4.3 on Shaping Commitment, has core ideas, acting positively to changes to attain goal success, with the theme, strong determination in portraying resiliency	**Merging-Converging**
	Table 1.2 on Change Management, under indicator, Transformational Leadership, on item, having an educational leader that supports professional development as a teacher, is rated Very High, M=4.40, SD=.81	Table 3 on Lived Experiences, has core ideas, preparing always oneself professionally and personally in adapting whatever changes that occur, under the theme, demonstrating change management practices	**Merging-Converging**
	Table 1.2 on Change Management, under indicator, Participation and Communication, on item, considering the needs of teachers and students' decisions in fair manner in their institutions, is rated Very High, M=4.32, SD=.82	Table 3 on Lived Experiences, has core ideas, dealing with colleagues, students, parents, school heads, stakeholders with respect especially in decision making, under the theme, embodying a value-laden self	**Merging-Converging**
	Table 1.2 on Change Management, under indicator, Education and Training, on item, constantly developing themselves, is rated Very High, M=4.33, SD=.79	Table 3 on Lived Experiences, has core ideas, preparing always oneself professionally and personally in adapting whatever changes that occur, under the theme, demonstrating change management practices	**Merging-Converging**
Resilience	Table 1.3 on Resilience, under indicator, Professional Resilience, on item, dealing with whatever comes, is rated Very High, M=4.34, SD= .79	Table 3 on Lived Experiences has core ideas, adept in coping the demands of educational change, with the theme, demonstrating change management practices	**Merging - Converging**
	Table 1.3 on Resilience, under indicator, Emotional Resilience, on item, having a problem at school, I usually think twice, is rated Very High, M=4.18, SD= .83	Table 3 on Lived Experiences has core ideas, being reflective before taking actions, with the theme, embodying a value-laden self	**Merging-Converging**
	Table 1.3 on Resilience, under indicator, Motivational Resilience, on item, thinking the problem at work is just a challenge, is rated Very High, M=4.28, SD= .80	Table 4.3 on Shaping Commitment, has core ideas, looking at changes and challenges as continuous improvement, with the theme, strong determination in portraying resiliency	**Merging-Converging**
	Table 1.3 on Resilience, under indicator, Social Resilience, on item, building new friendship with others, is rated Very High, M=4.39, SD=.79	Table 4.3 on Shaping Commitment, has core ideas, having a heart that sees and understands students, colleagues, school heads, stakeholders, and work with the theme, becoming a dedicated teacher	**Merging-Converging**

Data Integration and Corroboration of the Salient Qualitative and Quantitative Findings

Similarities were found when the two sets of data were compared making the nature of data integration, merging-converging. Hence, the various pieces of information from the study's results, when combined, corroborated and are described as both merging and converging. Moreover, there are salient quantitative and qualitative findings on the on the focal point competence under indicator content pedagogical knowledge aligning with the theme on manifesting highly effective teaching. This implies that teachers who incorporate varied activities in their lesson delivery and continuously seek for new methods of teaching are also skilled in providing a conducive and positive classroom environment. Their ability to teach their students effectively and implement innovative strategies reflects their effectiveness in their lesson delivery. On the focal point Competence under indicator Constructivist Belief converges with the qualitative finding on, embodying a value-laden self. Such connection highlights how teachers promote the values of trust, respect, and positive educational outcomes while building active engagement with parents. This suggests that facilitating easy communication and observing professionalism during collaboration demonstrates and promotes values of trust, respect, and positive educational engagement with parents and colleagues. Another concept of integration was found on the focal point Competence under indicator Self-efficacy through the quantitative data on being confident in their continuous growth in addressing students' needs which evidently corresponded with the qualitative results on being proactive. This particularly emphasize that when teachers possess confidence to address students' needs and continuously seek for professional growth, they develop a sense of proactive attitude to seek and employ effective teaching approaches. In exploring more the data integration concerning the focal point Competence, the indicator Enthusiasm converges with the qualitative information on highly effective teaching and

keeping a positive mindset. This implies that having enthusiasm strengthens teachers' ability to provide a welcoming atmosphere for learners and adapt to new educational setups, which in turn also promotes a positive approach even when these teachers are confronted with challenges in the teaching practices.

In the focal point Change Management, salient quantitative and qualitative findings have surfaced, Correspondingly, convergence was apparent between the quantitative findings on the indicator, Organizational Goal and qualitative data on strong determination in portraying resiliency. This reflects that by having a clear understanding of the school's organizational goals, teachers are given clear direction and guidance to effectively navigate change and challenges and thereby foster resilience. In exploring more the integration as regards the focal point Change Management, the indicator Transformational Leadership converges with qualitative data on demonstrating change management practices. This further means that when school leaders show active support for teachers' professional development, it enhances their resilience and adaptability to easily adjust from rapid changes in curriculum. In addition, convergence was apparent between the quantitative findings on the indicator Participation and Communication and qualitative data on embodying a value-laden self. This means that participation and communication between school leaders and teacher in decision-making processes can create a work place where trust and collaboration thrive. Moreover, the quantitative data under indicator education and training also converges with the qualitative results on demonstrating change management practices. Consequently, this means that when teachers are devoted to continual development and learning, they become more adept in solving problems, and adaptive to the growing educational demands.

In the last focal point Resilience, salient quantitative and qualitative findings have also been found. Correspondingly, convergence was apparent between the quantitative findings on the indicator, Professional Resilience, and qualitative information on demonstrating change management practices. This means that teachers who exhibit professional resilience also demonstrate change management practices. These teachers have the capacity to manage stress, remain flexible, and maintain effectiveness despite obstacles experienced in the school. Another concept of integration was found on the focal point Resilience. Under the indicator Emotional Resilience, its quantitative data converged and corresponded with the qualitative results on embodying a value-laden self. This means that emotional resilience demonstrates the belief that encountering problems involves considering the situation carefully before taking action. Another meaningful integration was also found under the indicator social resilience with its quantitative findings that converged with the qualitative data on becoming a dedicated teacher. This means that teachers who build new relationships and cultivate social connections are better suited to negotiate the intricacies of their roles. This, in turn, contributes to their overall effectiveness and dedication. This suggests that teachers who cultivate strong social connections and relationships with others are better equipped to stay resilient and dedicated.

CONCLUSION

The study concluded that the level of competence of public elementary school teachers was rated very high, indicating that competence is always manifested. This signifies that public elementary school teachers in Region XI exhibit the necessary skills and attributes to effectively fulfill their rigorous expectations and requirements of their profession. This further indicates that elementary teachers in the region manifest high level of competence and perceive themselves as competent in their pedagogical proficiency and their ability to adjust to the depth and various needs and demands of their profession.

Meanwhile, the level of change management was rated very high, indicating that good change management is always evident. This implies that positive change management practices of the public elementary school teachers in Region XI are always evident. Further, the findings showed that teachers possess high level of change management skills and confirms their capacity to effectively handle change as they frequently face uncertainties and disruptions in their work life. This, in turn, reveals a positive outcome in taking proactive step in addressing the demands to integrate new pedagogical practices. Furthermore, teachers who have strong management skills tend to be more adaptable and resilient even in the midst of educational reforms and transformation.

More so, the level of resilience among public elementary school teachers was also rated very high. This means that resilience is consistently demonstrated. This also implies that public elementary school teachers can thrive in stressful situations and difficulties in the classroom and can adapt to stressful situ-

ations at work. Further, high resilience primarily serves as a driving force for teachers to survive and adapt to changing work environments which can ultimately lead to enjoy a satisfying professional life. In equal essence, these educators have established resilience in the workplace by sustaining their effectiveness at the same time enhancing their coping mechanisms to create balance and positive adaptation.

Further, the findings revealed that competence significantly influenced the resilience of public elementary school teachers. This finding further shows the positive significant effect of competence on resilience. This further indicates that the more competent the teachers are, the more resilient they have become in the workplace. In like manner, change management significantly influences teachers' resilience. This further implies that the more adept in change management the teachers are, the more resilient and adaptable they are even in changing circumstances.

Furthermore, from the lived experiences of teachers, three essential themes were generated, namely: demonstrating change management practices, manifesting highly effective teaching, and embodying a value-laden self. Moreover, the role of the lived experiences of the participants shaped their beliefs, attitude and commitment toward resilience. The participants believed that resilience could be enhanced through acceptance as remarkable element of resiliency, viewing change as transformation for the better, and submissiveness to God in the midst of uncertainties. In addition, having the attitude of keeping a positive mindset and being proactive are significant in cultivating resilience. Additionally, having strong determination in portraying resiliency and becoming a dedicated teacher also mark their commitment in building a resilient character.

Lastly, the nature of integration showed merging and converging. The focal points comprised the quantitative variables that distinctly expressed related viewpoints, and the essential themes that emerged and generated from the qualitative data gathering were identified as merging-converging. The salient quantitative and qualitative findings of competence and change management with regard to teachers' resilience revealed a substantiating result. This corroboration, therefore, means that the quantitative and qualitative data merged and converged with each other.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were suggested:

1. Since the level of competence is rated very high, this may be sustained. School administrators may provide continuously professional development programs for the educators in order to maintain the level of competence that is noticed among educators. These professional development programs may provide adaptive change management techniques, innovations in teaching methods and modern pedagogical practices for teachers to constantly enhance their abilities and at the same time maintain their level of competence and meet the continuous demands of their job.
2. Since the level of change management is rated very high, this may be sustained. School administrators may incorporate change management training workshops placing an emphasis on proactive approaches and strategies that create resilience specifically designed to stress effective change management methods.
3. Since emotional resilience is rated high, this may be further cultivated and enhanced. School leaders may conduct strategic planning to institutionalize the existing initiatives of Department of Education such as leveraging the Philippine Professional Standards for Teachers (PPST) by conducting professional development sessions focusing more on emotional resilience, stress management, and work-life balance to further strengthen teacher quality and continuous growth. School heads may also devise a comprehensive plan to implement and integrate DepEd's Mental Health and Psychosocial Support Services (MHPSS) and Wellness Check Series in the School Improvement Plan (SIP) to further organize an annual structured program matrix in providing a platform for teachers to engage in mindfulness and self-care workshops, seminars and health-promoting activities alongside students. Furthermore, school heads may also enrich teachers' lives through spiritual enhancement activities and values formation programs such as retreats or faith-based workshops, specifically designed for teachers to provide them opportunities to reflect on their personal values and beliefs, fostering a supportive community that may enhance their overall well-being.
4. Building on the key findings from data integration indicating a merging-converging nature, the researcher recommended that the schools implement a well-coordinated and ongoing system of support

between school heads and teachers to strengthen resilience. School leaders may establish continuous collaboration with teachers which be achieved by ensuring ongoing access to personal and professional development opportunities, including seminars, workshops, and health-promoting activities, aimed at enhancing teachers' resilience. Quality assurance, regular evaluations and feedback mechanisms may also be included to assess the impact of these programs, allowing for data-driven adjustments and improvements.

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