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6. All contributions must be original.

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DEVELOPMENT OF HIGH PROTEIN PELLETS USING WATER FERN (*Azolla filiculoides*) FOR BROILER FEEDS

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ABSTRACT

This study investigates the development of high-protein feed pellets using *Azolla filiculoides* as an alternative protein source for broiler chickens, aiming to address challenges in feed cost, sustainability, and nutritional adequacy. Conventional protein sources such as soybean meal and fish meal are increasingly limited by cost and environmental concerns, driving interest in alternative resources. Azolla filiculoides, a fast-growing aquatic fern rich in protein and minerals, was incorporated at 10%, 15%, and 20% inclusion levels in broiler grower pellets, replacing portions of traditional feed components. An experimental design was implemented using 120 Cobb broiler chicks, divided into treatment groups, with growth performance, feed intake, and feed conversion ratio evaluated over a 30-day period. The study found that feed formulations with up to 15% Azolla inclusion maintained acceptable nutritional quality and growth performance in broilers. Proximate analysis revealed a modest protein content (6.82%) and high ash content (29.01%), indicating potential as a mineral-rich supplement rather than a primary protein source. Higher Azolla levels may compromise digestibility due to increased fiber and ash, highlighting the need for enzyme inclusion and improved cultivation practices to enhance nutrient content. Overall, the results demonstrate that Azolla can be feasibly integrated into broiler feed formulations as a cost-effective and sustainable alternative when inclusion levels are optimized and nutrient consistency is maintained.

Keywords: High protein pellet, Azolla fern, Broiler feed, Developmental study

INTRODUCTION

The increasing demand for sustainable and affordable livestock feed has driven significant research into alternative feed ingredients that can supplement or replace conventional sources such as soybean meal and fish meal. These conventional feed components are often associated with high costs, environmental concerns, and competition with human food systems (Ramachandran et al., 2022). As a result, there is a growing interest in identifying underutilized resources that are nutritionally viable and ecologically sustainable. One such promising candidate is *Azollafiliculoides*, a fast-growing aquatic fern rich in protein, essential amino acids, and bioactive compounds (Singh et al., 2021). Despite its nutritional potential, its application as a feed component remains underexplored, particularly in pelletized formulations for broiler diets.

Broiler production faces feed efficiency, growth performance, and feed cost optimization challenges. Traditional protein sources like soybean meal are prone to price fluctuations and limited availability in many regions, creating a need for locally available and cost-effective alternatives (FAO, 2020). Azolla, with its adaptability to various climates and rapid biomass production, represents an opportunity to bridge this gap. However, limitations such as its high moisture content and the potential presence of antinutritional factors need to be addressed to make it suitable for large-scale livestock feeding (Cherryl et al., 2019).

One major gap in the existing literature is the lack of research on developing Azolla-based feed formulations in pelletized form for broilers. Pelletized feeds offer several advantages, including improved feed intake, reduced wastage, and ease of transportation and storage (De Souza et al., 2021). While Azolla has been evaluated in its raw or partially processed forms for various livestock, studies on its inte-

gration into feed pellets that meet broiler nutritional requirements are limited. Addressing this gap requires a systematic approach to optimize the nutritional profile, reduce antinutritional factors, and evaluate the cost-effectiveness of such formulations.

Furthermore, the environmental benefits of incorporating Azolla into livestock feed systems remain underemphasized in current studies. Azolla is a nitrogen-fixing plant that contributes to reducing greenhouse gas emissions and enhancing soil fertility when cultivated (Roy et al., 2021). Incorporating it into feed not only addresses protein scarcity but also promotes sustainable agricultural practices by utilizing a renewable resource with minimal ecological impact. This dual role aligns with global efforts to improve sustainability in animal agriculture.

This study aims to develop high-protein pellets using *Azollafiliculoides* for broiler feed, addressing the dual challenge of nutritional adequacy and sustainability. The research will focus on optimizing the pellet formulation, assessing its impact on broiler growth performance, and evaluating its economic feasibility. By filling this critical gap, the study contributes to advancing sustainable livestock production practices while providing a cost-effective alternative to conventional feed ingredients.

STATEMENT OF THE PROBLEM

This study aims to develop high-protein pellets using water fern (Azolla filiculoides) for broiler raising, and meet the nutritional requirements of the broiler while ensuring economic viability and sustainability.

Specifically, the study aims to answer the following sub-problems:

1. What are the formulations and processes in the development of the high protein pellet in different percentage of azolla fern powder combined with other ingredients in terms of:
   1.1 Treatment 1- 10% azolla fern powder;
   1.2 Treatment 2- 15% azolla fern powder; and
   1.3 Treatment 3- 20% azolla fern powder?
2. What are the physicochemical analysis and nutritional qualities of the Azolla-based feed pellets?

RESEARCH METHODOLOGY

Research Design

This study will employ an experimental research design to evaluate the acceptability and effectiveness of high-protein pellets formulated using *Azollafiliculoides* as broiler feed. The research involves preparing feed pellets with varying proportions of these ingredients and testing them on a broiler to assess palatability, feed intake, and growth performance over a specified period. A control group fed with commercial broiler feed will be included for comparison. Data will be collected through observation of feeding behavior, measurement of weight gain, and cost analysis, with results analyzed using descriptive and inferential statistical methods.

Research Environment

The study will be conducted in SNCAT, Magpayang, Mainit, Surigao del Norte controlled farm setting that provides a suitable environment for broiler feeding trials. The farm will be equipped with standard housing facilities that ensure proper ventilation, hygiene, and adequate space for the broiler. The location is chosen for its accessibility to the raw materials needed for pellet formulation, such as Azolla filiculoides ensuring consistent supply and quality throughout the experiment.

Azolla fern Powder

This step involves creating the experimental feed pellets with varying formulations of Azolla fern. The researcher will prepare pellets with 10%, 15%, and 20% inclusion of dried azolla fern powder , mixed with other ingredients like binding agents, vitamins, and minerals to ensure a balanced nutritional profile for the broilers. The azolla fern leaves were pulverized using food blender and 500 grams of samples were collected and set aside for analysis of proximate nutritional composition at the Feed Analytical Laboratory of the Department of Agriculture Regional Field Office XIII, Butuan City.

Diet Preparation

The preparation of diets for experimental feeding was based on the desired proportion in weight for weight basis of commercial ingredients and azolla fern based pellet mixture. The 10, 15, and 20 percent azolla fern powder were added to 90, 85, and 80 percent commercial ration constituting treatments 2,3 and 4.

Subject of the Study

One hundred twenty (120) unsexed Cobb broiler (cornish cross breed) chicks as subject of the study were purchased from Pacifica Agrivet Supply, in Surigao City. They were selected according to the observed physical traits of alertness, dry feathers, and free from deformities. The chicks were then research brooded for 14 days starting March 19 – April 4, 2025 and followed by 30 days experimental feeding from April 5 – May 5, 2021 with the develop azolla fern based pellet at different levels.

Data Gathering

Upon distribution of experimental birds to different cages, the birds were weighed to assess the initial weight. Body weight and weight gains were assessed weekly. The feed intake was taken from the feed given minus the feed refused and were recorded daily.

The growth performance in terms of total mean weight gain and feed conversion ratio were derived using the following equations:

1. Mean weight gain = Body weight – initial weight
2. Feed conversion ratio = Feed intake/weight gain

Statistical Analysis

All gathered data were analyzed by one-way analysis of variance (ANOVA) in a completely randomized design (CRD) consisting of 4 treatments replicated four times. Pens were considered the experimental unit. Data were analyzed using IBM SPSS ver. 26 for windows. Significant results in ANOVA were subjected to further statistical analysis using Tukey's HSD tes

RESULT AND DISCUSSION

Formulations and Processes in the development of the protein enriched pellet in different percentage of azolla fern powder combined with other ingredients

Table 1. Azolla fern feed formulation for broiler grower.

Ingredient	Control (0% Azolla)	10% Azolla	15% Azolla	20% Azolla
Azolla (sun-dried)	0.00	10.00	15.00	20.00
Maize (corn)	50.00	45.00	42.00	38.00
Soybean meal (CP ~45%)	25.00	22.00	20.00	18.00
Rice bran	10.00	10.00	8.00	8.00
Fish meal (CP ~60%)	6.00	5.00	5.00	4.00
Oil (vegetable)	3.00	3.50	4.00	4.50
Dicalcium phosphate	2.00	1.80	1.70	1.60
Limestone	1.20	1.00	1.00	1.00
Salt	0.30	0.30	0.30	0.30
Premix + Additives*	2.50	1.40	1.00	0.60
Total	**100.00**	**100.00**	**100.00**	**100.00**

The table 1 presents the formulated broiler grower pellets incorporating Azolla fern at varying levels (10%, 15%, and 20%) demonstrate the potential of Azolla as a sustainable alternative protein and mineral source in poultry diets. As the Azolla inclusion increases, traditional protein sources such as soybean meal and fish meal are reduced to maintain the desired crude protein levels, while energy sources like maize and vegetable oil are adjusted to compensate for Azolla's lower energy content. Additionally, the inclusion of dicalcium phosphate and limestone is slightly reduced, reflecting Azolla's moderate calcium content. The formulation also accounts for the increased fiber content at higher Azolla levels by adjusting premix components and suggesting the use of digestive enzymes. Overall, these formulations aim to strike a balance between cost-effectiveness and nutritional adequacy, showing that Azolla can be feasibly incorporated up to 20% in broiler grower diets with appropriate adjustments.

Process for the development of broiler grower pellets incorporating Azolla fern at 10%, 15%, or 20% inclusion:

Raw Material Preparation

1. Harvest Azolla fern (preferably mature).
2. Wash thoroughly to remove dirt and possible contaminants.
3. Chop into small pieces for easier drying and grinding.
4. Dry under shade or in a mechanical dryer at 60–70°C to retain nutrients and reduce moisture to below 10%.
5. Grind the dried leaves into a fine meal using a hammer mill or grinder.

Ingredient Weighing and Mixing

1. Weigh all ingredients based on the selected formulation (10%, 15%, or 20% inclusion).
2. Use a batch mixer to thoroughly mix dry ingredients first (Madre de Agua meal, maize, soybean meal, fish meal, etc.).
3. Add liquid ingredients (e.g., vegetable oil, any vitamin solutions if applicable) and continue mixing until uniform.

Pelleting

1. Feed the mixed mash into a pellet mill.
2. Use a die size appropriate for broiler grower feed (commonly 3–4 mm diameter).
3. Adjust temperature (65–75°C) and pressure to form consistent pellets.

Cooling and Drying

1. Transfer hot pellets to a counterflow cooler or tray to bring temperature down and remove excess moisture.
2. Ensure final moisture content is below 12% to prevent mold and extend shelf life.

Screening and Packaging

1. Screen to remove fines and broken pellets (these can be recycled into new batches).
2. Package in clean, moisture-proof bags (e.g., polypropylene sacks).
3. Label each bag with formulation type (10%, 15%, 20%), production date, and batch number.

Storage and Quality Control

1. Store in a cool, dry, and rodent-free area.
2. Conduct periodic quality checks for moisture, protein, mold, and pellet durability.

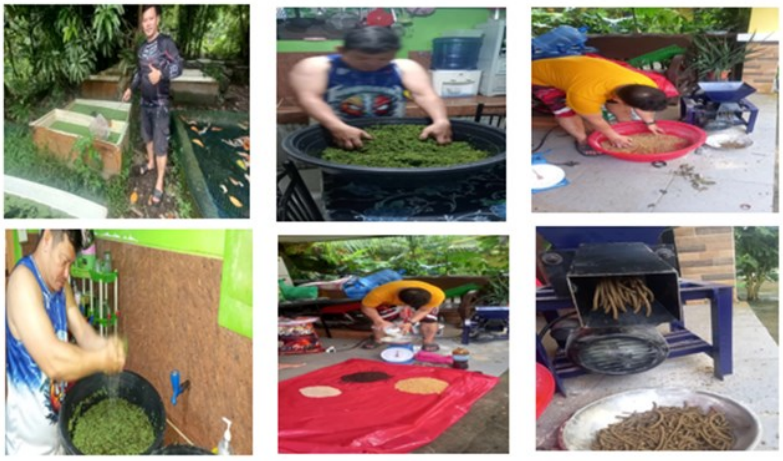
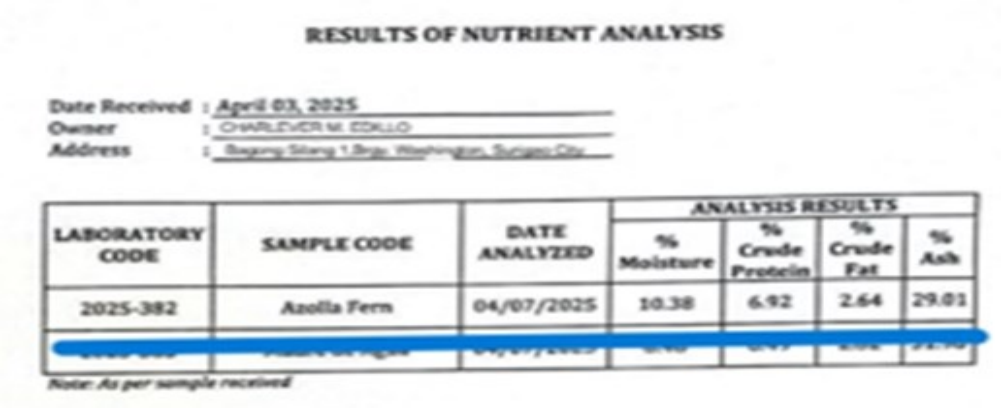


Figure 1. Processes in the development of the azolla based pellet

Proximate analysis of the develop Azolla based pellet



RESULTS OF NUTRIENT ANALYSIS

Date Received : April 03, 2025
Owner : CHARLEMER M. EDILLO
Address : Bagong Silang 1 Brgy. Washington, Surigao City

LABORATORY CODE	SAMPLE CODE	DATE ANALYZED	ANALYSIS RESULTS			
			% Moisture	% Crude Protein	% Crude Fat	% Ash
2025-382	Azolla Fern	04/07/2025	10.38	6.92	2.64	29.01

Note: As per sample received

Figure 2. Result of the nutrient analysis of the develop feed.

Figure 2 disclose the laboratory analysis of the Azolla-based feed shows a moisture content of 10.38%, which is relatively low and favorable for storage stability, reducing the risk of microbial spoilage. The crude protein level is 6.82%, which is lower than typical values expected from Azolla (commonly 20–30% on a dry matter basis). This suggests the sample may have been diluted with other materials or harvested under suboptimal growing conditions. While this protein level may not suffice as a primary protein source, it can still contribute to the overall protein content in a mixed ration.

The crude fat content of 2.64% provides modest energy, while the ash content is notably high at 29.01%, reflecting Azolla's richness in minerals such as calcium and iron. While beneficial for animal health, excessive ash can affect feed digestibility and reduce energy density. Overall, this Azolla feed is best suited as a supplementary feed ingredient, especially for livestock needing mineral enrichment. To improve its nutritional value, particularly the protein content, cultivation practices should be optimized, or the Azolla can be combined with higher-protein feed ingredients.

RECOMMENDATIONS

1. Limit Azolla inclusion to a maximum of 15% unless protein content is confirmed to meet expected levels, as higher ash and lower protein may reduce feed efficiency.

2. Improve Azolla cultivation practices (e.g., nutrient-rich water, proper harvesting stage) to enhance protein content and reduce ash levels.

3. Incorporate fiber-degrading enzymes in formulations with ≥15% Azolla to improve digestibility and nutrient absorption.

4. Conduct regular proximate analysis of Azolla batches before feed formulation to ensure consistency in nutrient content.

5. Store pellets in cool, dry, and rodent-free conditions and label clearly by inclusion level to maintain quality and traceability.

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DEVELOPMENT AND EVALUATION OF FRENCH MACARONS ENRICHED WITH GUYABANO (*Annona muricata*) POWDER

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ABSTRACT

This study explores the development of a premium confectionery product—French macarons enriched with Guyabano (*Annona muricata*) powder—highlighting the fusion of local agricultural resources and culinary innovation. Guyabano, a tropical fruit rich in alkaloids, flavonoids, saponins, and tannins, was processed into flour and incorporated into macaron shells and fillings. A developmental and mixed-methods research design was employed to assess the product's nutritional composition, sensory attributes, and market potential. Sensory evaluations with both food experts and consumers revealed high acceptability in terms of taste, aroma, and texture. Nutritional analysis demonstrated that the macarons offer moderate protein content and bioactive benefits, positioning them as a healthier alternative to traditional desserts. By aligning with the United Nations Sustainable Development Goals (SDGs) and the i2Fame innovation framework, this research emphasizes responsible consumption, local economic development, and food innovation. The study also supports national agendas such as Ambisyon Natin 2040 by promoting health-conscious, value-added products that highlight Filipino ingenuity. Ultimately, Guyabano-enriched French macarons offer not only indulgent appeal but also a platform for sustainable and inclusive food product development. Further research is recommended to optimize formulation techniques and extend applications to other high-value confectionery items.

Keywords: Guyabano (Annona muricata), French macarons, functional food, sensory evaluation, sustainable innovation

INTRODUCTION

Guyabano (*Annona muricata*), commonly known as soursop, is a tropical fruit celebrated for its sweet, tangy flavor and rich nutritional profile. As a natural source of vitamins, minerals, and antioxidants, Guyabano offers numerous health benefits and holds great potential for culinary innovation. In the Philippines, where Guyabano is widely cultivated, the fruit is an abundant resource that can be utilized to create unique and nutritious food products. With the growing demand for health-conscious and novel food options, incorporating Guyabano into traditional recipes can present a significant opportunity to showcase its versatility and value. This study explores the potential of Guyabano in the development of a premium confectionery product: French macarons enriched with Guyabano powder.

French macarons, known for their delicate texture, aesthetic appeal, and intricate preparation, serve as an ideal platform to integrate the unique flavor and nutritional benefits of Guyabano. Previous studies have demonstrated the successful incorporation of tropical fruits into baked goods, enhancing both flavor and nutritional value (Reyes et al., 2020). Similarly, Liu et al. (2021) highlighted the strong consumer acceptance of exotic fruit powders in confectionery products due to their novelty and health benefits. Despite the rise of fruit-based innovations in the food industry, research on utilizing Guyabano in high-end desserts remains limited, with most studies focusing on its medicinal properties (Garcia et al., 2019), antioxidant activity (Lopez et al., 2022), and juice production (Santos et al., 2021).

This research aligns with key global, national, and regional priorities. It contributes to the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production), by promoting the sustainable use of local resources and re-

ducing food waste through the utilization of Guyabano by-products. It supports SDG 3 (Good Health and Well-being) by offering a health-conscious product and SDG 8 (Decent Work and Economic Growth) by fostering economic opportunities for local farmers and food entrepreneurs (United Nations, 2015). At the national level, the study aligns with the Philippine Research Agenda, focusing on agricultural innovation, food security, and nutrition. It also resonates with the Caraga Regional Research Development and Innovation Agenda, emphasizing value-adding processes and sustainable resource utilization in agriculture to stimulate regional competitiveness.

Furthermore, the research is guided by the i2Fame framework, which emphasizes innovation, inclusivity, and sustainability. By introducing an innovative product that incorporates locally sourced, natural ingredients, the study fosters inclusivity by engaging local communities and contributing to sustainable development. Additionally, the study aligns with AmbisyonNatin 2040, the national long-term vision for a "matatag, maginhawa, at panatag na buhay," by promoting healthier food choices, economic opportunities, and showcasing Filipino creativity in global culinary contexts (NEDA, 2016).

Ultimately, this research seeks to optimize the flavor, texture, and stability of Guyabano-enriched French macarons for market acceptance, paving the way for further applications of tropical fruits in high-end confectionery. By bridging the gap in existing literature and addressing consumer demand for premium, nutritious, and sustainable food products, this study makes a valuable contribution to food innovation and sustainable development.

STATEMENT OF THE PROBLEM

This study aimed to develop and evaluate French Macarons enriched with Guyabano (*Annona Muricata*) powder that maximizes flavor, texture, and stability for market potential.

Specifically, the following questions are addressed in this study:

1. What is the phytochemical composition and nutritional profile of the Guyabano (*Annona muricata*) used in the macaron?
2. What are the formulations and processes in the development of Guyabano-Infused French Macaron?
3. What is the physico-chemical analysis and nutritional facts of the develop Guyabano-Infused French Macaron?

RESEARCH METHODOLOGY

Research Design

This study will be utilizing a developmental research design and a mixed-methods research design. Since this study creates and optimizes French Macarons enriched with Guyabano (Annona Muricata) powder through formulation and process refinements aimed at acquiring favorable sensory characteristics, flavor, texture, and stability, this design is quite appropriate. Mixed-methods research design will be used to evaluate the acceptability of the product based on its appearance, aroma, taste, texture, and appeal. Quantitative methods will be applied through sensory evaluation by using a structured survey instrument and a 9-point Hedonic Scale to collect measurable data about the product characteristics. Qualitative methods would add further insights on the development process by elaborating challenges and opportunities for improvement as well as feedback from the respondents. The mixed-method approach in the assessment of nutritional value and stability is also used to analyze the French Macarons enriched with Guyabano (*Annona Muricata*) powder so that the final product achieves safety, quality, and market standards.

Research Environment

The developmental research study on Guyabano flour will be carried out in Food Technology Innovation Center in Surigao del Norte State University, Surigao City.

Respondents

This research focuses on the participation of food experts and consumers in establishing the acceptability of the respondents will be engaged in sensory evaluation, testing, and providing feedback from the

survey. The following table shows the distribution of the respondents. There are (50) respondents under study, 20 (40.0%) are food experts and 30 (60.0%) are consumers.

Research Instrument

The research instruments for this study are structured to gather detailed feedback on the acceptability of French Macarons enriched with Guyabano (*Annona Muricata*) powder while ensuring the safety of participants, especially those with food allergies. A sensory evaluation form using a 9-point hedonic scale will be employed to assess the macarons' sensory attributes, including appearance, aroma, flavor, texture, and overall acceptability. The hedonic scale, ranging from "dislike extremely" to "like extremely," allows participants to express their preferences quantitatively.

Data Analysis

Some statistical instruments will be used to run various analyses on the data retrieved through questionnaires. These include but are not limited to.

Frequency count and percent. This tool will be applicable in describing the demographic information among participants. These include age and the frequency along with per cents depicting any given characteristic among participants undertaking the study.

Percent. Percentages will also be used to calculate the ratio of certain formulations that are prepared in making the French Macarons enriched with Guyabano (*Annona Muricata*) powder, which help in the improvement and refinement of the product.

Mean and Standard Deviation. The mean and standard deviation will be obtained to determine the acceptability of the French Macarons enriched with Guyabano (*Annona Muricata*) powder. Such statistical tools will quantify the descriptive results of the sensory assessment of the product's appearance, aroma, taste, texture, and overall acceptability.

RESULTS AND DISCUSSIONS

Phytochemical composition and nutritional profile of the Guyabano (*Annona muricata*)

REPORT OF CHEMICAL ANALYSIS

Request Reference No.	: R13-032025-CHE-0180
Location of Testing	: In-house
Date Submitted	: March 24, 2025
Date of Analysis	: March 24 – 27, 2025
Date of Issue	: March 31, 2025
Sample Submitted	: *Guyabano Flesh*
Submitted by	: *Genalyn P. Bernasor*
Address	: *Surigao del Norte State University / Narciso St., Surigao City, Surigao del Norte*
Contact Number	: *09685091653*
Page	: Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE-0303	*Guyabano Flesh*	600g air dried sample in plastic container	Volume of Extract Obtained	60 mL
			Alkaloids Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	+
			Test for Quaternary Bases & Amine Oxide	-
			Steroids Keller-Killiani Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	+ +
			Flavonoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	+
			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	+ Brownish -green

METHODOLOGY:

The procedure for the conduct of Phytochemical Screening was obtained from the book entitled " **A Guidebook to Plant Screening: Phytochemical and Biological**".

Fig. 1 result on the phytochemical analysis of gubayano fruit

As gleaned in figure 1 the chemical analysis report shows positive results for several phytochemical tests performed on Guyabano (Soursop) flesh extract. The sample (GDS-0003) tested positive for alkaloids through a primary alkaloid test, flavonoids using the Bate-Smith & Metcalf method, saponins through foam testing, and tannins with a ferric chloride test that produced a brownish-green color indicating the presence of condensed tannins. The tests for quaternary bases, amino acids, and unsaturated steroids yielded negative results. The analysis was conducted using a 60 mL volume of extract obtained using methodologies from "A Guidebook to Plant Screening, Phytochemical and Biological." This suggests the Guyabano sample contains several bioactive compounds that could potentially contribute to its reported medicinal properties, particularly the presence of alkaloids, flavonoids, saponins, and tannins, which are known for various therapeutic effects including antioxidant, anti-inflammatory, and antimicrobial properties.

Processes and Procedures of making Guyabano flour and formulation of making Guyabano French Macarons.

Processes in making Guyabano Flour

The following are the raw materials used in making the Guyabano flour including its step-by-step procedures and processes.

Ingredients/Materials:

- Ripe Guyabano fruits
- Knife or fruit peeler
- Blender or food processor
- Drying equipment (dehydrator)
- Grinder/pulvurizer
- Airtight storage container

Procedures:

1. Selection of Fruits: Choose fully ripe, unbruised Guyabano fruits.

Fig. 2 selection of guyabano fruits

2. Washing: Wash thoroughly under running water to remove dirt and contaminants.

Fig. 3 washing of guyabano fruit

3. Peeling and Deseeding: Remove the green peel and separate the flesh from the seeds.

Fig. 4 peeling and deseeding

4. Drying: (Dehydrator): Spread the flesh guyabano thinly on a baking sheet and dry at 60°C (140°F) for 10-12 hours.

Fig. 5 drying of the fruit flesh

5. Grinding: Once dried and crisp, grind into fine powder using a grinder or pulverizer.

Fig. 6 grinding of dried flesh

6. Storage: Store the flour in airtight containers in a cool, dry place.

Fig. 7 storing the develop flour

Formulations for Guyabano French Macarons

Macaron Shell Ingredients:

- 50g almond flour (finely ground, sifted)
- 25g all-purpose flour (finely ground, sifted)
- 25g guyabano flour (finely ground, sifted)
- 50g egg whites (aged 1–2 days in fridge, room temp)
- 40g granulated sugar

- ¼ tsp. cream of tartar
- Food coloring (gel, optional)

Guyabano Cheese Cream Filling:
- 50 g unsalted butter, softened
- 50 g cream cheese, softened
- 40 g powdered sugar
- 3–5 tbspGuyabano puree
- 1 tsp vanilla extract (optional)
- A pinch of salt

Macarons Shell Procedure (Meringue Method)

1. Prepare all the ingredients: Measure them to get the right amount needed.

Fig. 8 preparations of all ingredients

2. **Sift Dry Ingredients**: Combine almond flour, all-purpose flour, and guyabano flour. Sift 2–3 times to remove lumps and ensure smooth shells.

Fig. 9 sifting of dry ingredients

3. **Make the Meringue**: Whip egg whites until foamy. Gradually add granulated sugar. Beat to stiff peaks (glossy and holds shape). Add gel food coloring at this stage (optional).

Fig. 10 making of meringue

4. **Macaronage (Folding):** Gently fold almond mixture into meringue.

Fold until it flows like lava — when you lift the spatula, the batter should ribbon and melt back into itself in 10 seconds.

Fig. 11 macaronage folding

5. **Pipe the Shells**: Transfer batter into a piping bag with a round tip. Pipe onto a silicone mat or parchment-lined tray. Tap tray to remove air bubbles.

Fig. 12 piping the shells

6. **Rest**: Let macarons sit at room temp 30–60 minutes until tops are dry and no batter sticks to your finger.

Fig. 13 Rest the recipe

7. **Bake**: Bake at 150–160°C (300–320°F) for 10–12 minutes. Let cool completely before removing from tray.

Fig. 14 Baking of the macarons

Guyabano Cream Cheese Frosting:

1. **Prepare the Guyabano Pulp**: Using fresh guyabano, remove seeds and blend or mash the pulp until smooth. Strain excess juice for a thicker frosting, unless you want a softer texture.

Fig. 15 preparation of guyabano pulp

2. **Cream the Butter and Cream Cheese**: In a large bowl, beat the softened butter and cream cheese together until smooth and fluffy (about 2–3 minutes).

Fig. 16 creaming the butter and cheese

3. **Add Guyabano**: Mix in the guyabano pulp until well combined. The mixture may appear slightly loose depending on the moisture of the fruit.

Fig. 17 adding guyabano to the mixture

4. **Add Sugar and Flavoring**: Gradually add powdered sugar, until your desired sweetness and consistency are reached. Add vanilla extract and a pinch of salt to enhance flavor.

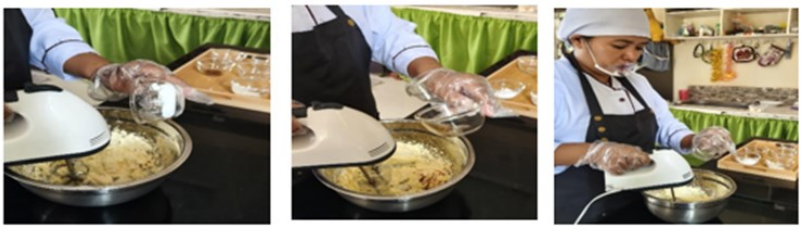

Fig. 18 adding sugar and flavoring

5. **Chill if Needed**: If the frosting is too soft (from the fruit moisture), chill it in the refrigerator for 20–30 minutes before using

Fig. 19 chilling the frosting

Assembling Guyabano-Filled Macarons

Steps:

1. **Match the Macaron Shells**: Pair up the macaron shells by size. Try to match them as evenly as possible.

Fig. 20 matching of macaron shells

2. **Pipe the Filling**: Fill a piping bag with the frosting. Pipe a generous dollop (about 1 tsp) onto the flat side of one shell in each pair, leaving a little space at the edge for natural spreading.

Fig. 21 filling the piping bag with frosting

3. **Sandwich the Macarons**: Gently press the second shell on top, flat side down, to create a sandwich. Be careful not to crack the shells.

Fig. 22 sandwich the macaroons

4. **Mature the Macarons**: Place the filled macarons in an airtight container and refrigerate them for 24–48 hours. This allows the shells to absorb moisture from the filling and become perfectly chewy.

Fig. 23 filling the macaroons in an airtight container

5. **Serve**: Let the macarons sit at room temperature for about 15–20 minutes before serving for the best texture and flavor.

Fig. 24 Packaging the final product of macaroons

Physico-chemical analysis and nutritional facts of the develop Guyabano-Infused French Macarons

REPORT OF CHEMICAL ANALYSIS

Request Reference No. : R13-042025-CHE-0218
Location of Testing : In-house
Date Submitted : April 14, 2025
Date of Analysis : April 14, 2025 (Moisture, Ash Content)
April 14 – 15, 2025 (Crude Protein, Total Fat)
April 15 & 21, 2025 (Sodium)
Date of Issue : April 25, 2025
Sample Submitted : *Guyabano French Macarons*
Submitted by : *Genalyn P. Bernasor*
Address : *Surigao del Norte State University, Surigao City, Surigao del Norte*
Contact Number : *09685091653*
Page : Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE – 0354	*Guyabano French Macarons*	2x 150g in plastic container	Moisture	17.08 g/100g
			Ash Content	1.18 g/100g
			Crude Protein	8.73 g/100g*
			Total Fat	11.84 g/100g*
			Sodium	91.37 mg/100g*

* Test results which are outside the laboratory's scope of accreditation

Fig. 25 result of physico chemical analysis of the developed product

Figure 25 disclose the chemical analysis that presents the nutritional composition of Guyabano French Macarons. The analysis reveals that these macarons contain 17.08 g/100g of moisture, suggesting a moderately moist product typical for pastries. The ash content is relatively low at 1.18 g/100g, indicating minimal mineral content. The macarons contain 8.73 g/100g of crude protein, which is noteworthy for a dessert item and likely comes from egg whites and possibly the guyabano incorporation. With 11.84 g/100g of total fat, the product has a substantial fat content consistent with traditional macaron recipes that use almond flour and butter. The sodium level is measured at 91.37 mg/100g, which is moderate for a sweet baked good. These nutritional parameters suggest the Guyabano French Macarons offer

a balance of macronutrients while incorporating the tropical guyabano (soursop) flavor, presenting both indulgence and some nutritional value beyond typical desserts.

REPORT OF COMPUTATION OF NUTRITION FACTS

Request Reference No. : R13-042025-CHE-0219
Location of Testing : In-house
Date Submitted : April 14, 2025
Date of Computation : April 25, 2025
Date of Issue : April 25, 2025
Sample Submitted : *Guyabano French Macarons*
Submitted by : *Genalyn P. Bernasor*
Address : *Surigao del Norte State University, Surigao City, Surigao del Norte*
Contact Number : *09685091653*
Page : Page 1 of 2

Food Nutrient	Result of Chemical Analysis (per 100g)*	Amount of Food Nutrient per Serving Size (Rounded Value)	% Daily Value (based on 2000 Calorie Diet, Rounded Value)**	% RENI (based on FNRI reference adult requirement of males 19-29 years old)
Calories	386.16	190		6
Calories from Fat	106.56	50		
Total Fat (g)	11.84	6	8	
Sodium (mg)	91.37	45	2	
Total Carbohydrates (g)	63.17	32	12	
Protein (g)	6.73	3	6	5

*Based on the Report of Chemical Analysis
** The % Daily Value is based on the New Nutrition Facts Labeled finalized May 20, 2016

Fig. 26 result on the nutritional facts of the developed macaroons

Figure 26 disclosed the nutrition facts report for Guyabano French Macarons reveals significant nutritional information about this specialty dessert. A single serving (likely one macaron) provides 190 calories, with 50 calories (26%) coming from fat. Each serving contains 6g of total fat (8% of daily value based on a 2000-calorie diet), 45mg of sodium (2% daily value), 32g of carbohydrates (12% daily value), and 3g of protein. The report also indicates the contribution to RENI (Recommended Energy and Nutrient Intake) for Filipino males aged 19-29, showing that a serving provides 6% of daily energy requirements and 5% of protein requirements. These values suggest that while the Guyabano French Macarons are primarily a carbohydrate-rich treat with moderate fat content as expected for a dessert item, they also provide a modest amount of protein, likely from ingredients such as egg whites and possibly the incorporation of guyabano (soursop) fruit, making them a more balanced indulgence than many traditional desserts.

RECOMMENDATIONS

1. Highlight the health benefits of the bioactive compounds (alkaloids, flavonoids, saponins, tannins) found in Guyabano in product marketing.
2. Improve the drying process by exploring alternative methods that retain more nutrients and reduce processing time.
3. Ensure consistency in macaron shell texture by standardizing the macaronage technique and resting time.
4. Emphasize the moderate protein content and tropical flavor of the macarons as a unique selling point.
5. Consider reducing the sugar content slightly to improve nutritional value while maintaining taste appeal.

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DEVELOPMENT OF PROTEIN-ENRICHED PELLET USING MADRE DE AGUA (*Trichantera gigantea*) FOR BROILER FEEDS

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ABSTRACT

This study explores the development of protein-enriched feed pellets using Madre de Agua (*Trichanthera gigantea*) as a sustainable alternative ingredient for broiler chicken diets. With rising costs and limited availability of conventional feed materials such as maize and soybean meal, Madre de Agua presents a promising solution due to its adaptability, local abundance, and nutritional value. The research utilized a true experimental design, incorporating varying inclusion levels of Madre de Agua leaf meal (10%, 15%, and 20%) into pellet formulations, alongside standard ingredients such as fish meal, maize, and soybean. One hundred twenty unsexed Cobb broilers were randomly assigned to four treatment groups, including a commercial feed control. The effects of the formulated feeds on broiler growth performance, feed conversion efficiency, and carcass characteristics were examined over a 30-day period following a brooding phase. Proximate analysis of the developed feed revealed a crude protein content of 6.49% and high ash content (31.90%), suggesting the formulation may serve better as a supplementary rather than primary feed source. Results indicated that the inclusion of Madre de Agua must be carefully balanced to avoid dilution of energy and protein while still taking advantage of its fibrous and mineral-rich profile. Recommendations include increasing high-protein ingredients, adjusting mineral content, and exploring advanced processing methods to enhance protein digestibility. This study concludes that Madre de Agua holds strong potential as a cost-effective and sustainable feed component for poultry production in resource-limited settings, contributing to local food security and aligning with global sustainable agriculture goals.

Keywords: Protein enriched pellets, Madre de Agua, Broiler Feeds, Developmental study

INTRODUCTION

The poultry industry has become one of the most important industries that produce enough animal products to ensure the food security of the world population in recent years (Kumar et al., 2021). The increasing demand for sustainable and affordable livestock and agriculture feeds highlights the importance of alternative feed ingredients that can optimize productivity while reducing environmental and economic costs (OJAFR, 2020). One of protein-source animal products are chickens. More farmers are into raising broiler chickens to cope up to the demand food in the world.

To deal with these difficulties Global food demand, especially of protein, is expected to increase sharply in the next decades driven by the growth of the world population (FAO, nd). Furthermore, alternative protein sources, particularly plant-based options, remain underexplored (Caturao, Dorotheo, & Labnao, 2024).

One promising solution is *Trichantera gigantea*, commonly known as Madre de Agua. Renowned for its high protein content and adaptability, this plant has shown potential to replace conventional feed components (Nguyen, 2021). Globally, Madre de Agua has been integrated into various agricultural applications, yielding significant benefits for livestock and Studies conducted by the Bureau of Animal In-

dustry demonstrated that diets supplemented with 10% Madre de Agua leaf meal resulted in optimal growth rates and improved economic returns for pigs and poultry.

With the information mentioned above, the farmers in Loreto, Dinagat Islands face persistent challenges with feed affordability and quality, affecting the sustainability of livestock and agriculture practices.

Thus, this study aims to address these gaps by developing protein-enriched feed pellets using Madre de Agua. Building on various researches on the plant's potential benefits which highlights Madre de Agua's efficacy in improving protein content and feed conversion efficiency, this study seeks to tailor feed formulations to the specific needs of broiler raisers. Since Madre de Agua is foraged and considered a Multiple Purpose Tree Species used for ruminants and poultry animals with a good potential source of protein and contain good amino acid (Abuan, et al. 2022).By addressing nutritional, economic, and environmental aspects, the research aligns with local agricultural goals and global Sustainable Development Goals (SDGs), particularly in promoting food security and sustainable farming practices offering as an alternative food source for the locality.

Thus, the researcher believe that Madre de Agua can also be a potential source of nutrients not just in livestock and aquaculture but as well as in poultry farming specifically in broiler raising offering an alternative source food as well as boosting economic income of the community.

STATEMENT OF THE PROBLEM

This study aims to develop a Protein-Enriched Pellet Using Madre de Agua (Trichantera gigantea) for broiler raising and address the challenge of improving feed quality and sustainability in poultry raising practices.

Specifically, this research seeks to answer the following questions:

1. What are the formulations and processes in the development of the protein enriched pellet in different percentage of madre de agua powder combined with other ingredients in terms of:
   - 1.1 T1-100% Commercial feeds;
   - 1.2 T2- 10% madre de agua powder;
   - 1.3 T3- 15% madre de agua powder; and
   - 1.4 T4- 20% madre de agua powder?
2. What is nutritional value and other laboratory result of the develop protein enriched pellet?

RESEARCH METHODOLOGY

Research Design

The study employs a mixed-methods approach, integrating an experimental and qualitative research designs. A mixed-methods approach combines quantitative and qualitative data collection and analysis, allowing for a more comprehensive understanding of the research problem (Creswell & Creswell, 2023).

The researcher specifically uses a true experimental research design, which is characterized by controlled manipulation of independent variables and random assignment to treatments (Kumar, 2020). In this study, the experimental design focuses on varying the inclusion levels of Madre de Agua (*Trichanthera gigantea*) at 10%, 15% and 20% in pellet formulations. These formulations are then evaluated based on their effects on the growth performance and carcass characteristics of broiler chicken. Furthermore, experimental research is crucial for establishing causal relationships and determining the effectiveness of interventions in controlled settings, making it highly appropriate for this research study.

Research Environment

The study was conducted in the backyard of the researcher residence in Brgy Luna, Surigao City. The experimental period lasted for thirty (30) days which was started from April 5 to May 5, 2025 excluding the brooding period.

Madre de Agua Powder

This step involves creating the experimental feed pellets with varying formulations of Madre de Agua (*Trichantera gigantea*). The researcher will prepare pellets with 10%, 15%, and 20% inclusion of dried Madre de Agua powder , mixed with other ingredients like binding agents, vitamins, and minerals to ensure a balanced nutritional profile for the broilers. The dried madre de agua leaves were pulverized using food blender and 500 grams of samples were collected and set aside for analysis of proximate nutritional composition at the Feed Analytical Laboratory of the Department of Agriculture Regional Field Office XIII, Butuan City.

Diet Preparation

The preparation of diets for experimental feeding was based on the desired proportion in weight for weight basis of commercial and madre de agua based pellet mixture. The 10, 15, and 20 percent madre de agua powder were added to 90, 85, and 80 percent commercial ration constituting treatments 2,3 and 4.

Subject of the Study

One hundred twenty (120) unsexed Cobb broiler (cornish cross breed) chicks as subject of the study were purchased from Pacifica Agrivet Supply, in Surigao City. They were selected according to the observed physical traits of alertness, dry feathers, and free from deformities. The chicks were then research brooded for 14 days starting March 19 – April 4, 2025 and followed by 30 days experimentatal feeding from April 5 – May 5, 2021 with the develop madre de agua based pellet at different levels.

Data Gathering

Upon distribution of experimental birds to different cages, the birds were weighed to assess the initial weight. Body weight and weight gains were assessed weekly. The feed intake was taken from the feed given minus the feed refused and were recorded daily.

The growth performance in terms of total mean weight gain and feed conversion ratio were derived using the following equations:

1. Mean weight gain = Body weight – initial weight
2. Feed conversion ratio = Feed intake/weight gain

Statistical Analysis

All gathered data were analyzed by one-way analysis of variance (ANOVA) in a completely randomized design (CRD) consisting of 4 treatments replicated four times. Pens were considered the experimental unit. Data were analyzed using IBM SPSS ver. 26 for windows. Significant results in ANOVA were subjected to further statistical analysis using Tukey's HSD tes

RESULT AND DISCUSSION

Formulations and Processes in the development of the protein enriched pellet in different percentage of madre de agua powder combined with other ingredients

Table 1. Madre de Agua feed formulation for broiler grower.

Ingredient	10% Inclusion	15% Inclusion	20% Inclusion
Madre de Agua (leaf meal)	10.00%	15.00%	20.00%
Maize (yellow corn)	45.00%	41.00%	37.00%
Soybean Meal	25.00%	24.00%	23.00%
Rice Bran	6.00%	6.00%	6.00%
Fish Meal	6.00%	6.00%	6.00%
Vegetable Oil	3.00%	3.00%	3.00%
Dicalcium Phosphate	1.80%	1.80%	1.80%
Limestone	1.00%	1.00%	1.00%
Salt	0.30%	0.30%	0.30%
Vitamin-Mineral Premix	1.00%	1.00%	1.00%
DL-Methionine + Lysine	0.40%	0.40%	0.40%
Total	**100.00%**	**100.00%**	**100.00%**

The table 1 presents three broiler grower feed formulations that incorporate varying levels of Madre de Agua leaf meal (10%, 15%, and 20%) while maintaining a balanced nutrient profile for optimal growth. As the inclusion of Madre de Agua increases, the proportions of maize and soybean meal—the main energy and protein sources—are slightly reduced to accommodate the added forage without exceeding the 100% total. Despite these adjustments, key components like fish meal, vegetable oil, and amino acid supplements (DL-methionine and lysine) remain constant to ensure sufficient levels of high-quality protein, fat, and essential nutrients. This strategy leverages Madre de Agua's fibrous and mineral-rich properties while controlling fiber and energy levels, making the formulations suitable for sustainable and cost-effective broiler feeding.

Process for the development of broiler grower pellets incorporating Madre de Agua at 10%, 15%, or 20% inclusion:

Raw Material Preparation

1. Harvest Madre de Agua leaves (preferably mature but not woody).
2. Wash thoroughly to remove dirt and possible contaminants.
3. Chop into small pieces for easier drying and grinding.
4. Dry under shade or in a mechanical dryer at 60–70°C to retain nutrients and reduce moisture to below 10%.
5. Grind the dried leaves into a fine meal using a hammer mill or grinder.

Ingredient Weighing and Mixing

1. Weigh all ingredients based on the selected formulation (10%, 15%, or 20% inclusion).
2. Use a batch mixer to thoroughly mix dry ingredients first (Madre de Agua meal, maize, soybean meal, fish meal, etc.).
3. Add liquid ingredients (e.g., vegetable oil, any vitamin solutions if applicable) and continue mixing until uniform.

Pelleting

1. Feed the mixed mash into a pellet mill.
2. Use a die size appropriate for broiler grower feed (commonly 3–4 mm diameter).
3. Adjust temperature (65–75°C) and pressure to form consistent pellets.

Cooling and Drying

1. Transfer hot pellets to a counterflow cooler or tray to bring temperature down and remove excess moisture.
2. Ensure final moisture content is below 12% to prevent mold and extend shelf life.

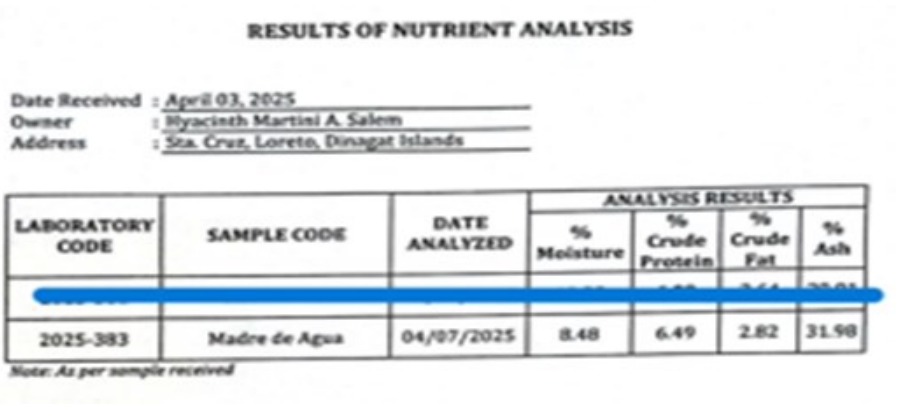
Screening and Packaging

1. Screen to remove fines and broken pellets (these can be recycled into new batches).
2. Package in clean, moisture-proof bags (e.g., polypropylene sacks).
3. Label each bag with formulation type (10%, 15%, 20%), production date, and batch number.

Storage and Quality Control

1. Store in a cool, dry, and rodent-free area.
2. Conduct periodic quality checks for moisture, protein, mold, and pellet durability.

Proximate analysis of the develop Madre de Agua based pellet



RESULTS OF NUTRIENT ANALYSIS

Date Received : April 03, 2025
Owner : Hyacinth Martini A. Salem
Address : Sta. Cruz, Loreto, Dinagat Islands

LABORATORY CODE	SAMPLE CODE	DATE ANALYZED	ANALYSIS RESULTS			
			% Moisture	% Crude Protein	% Crude Fat	% Ash
2025-383	Madre de Agua	04/07/2025	8.48	6.49	2.82	31.98

Note: As per sample received

Figure 1. Result of the nutrient analysis of the develop feed.

The laboratory results for the Madre de Agua-based feed show a moisture content of 6.48%, indicating a relatively dry feed that is favorable for longer shelf life and reduced spoilage risk. The crude protein content is 6.49%, which, like the Azolla-based feed, is on the lower side and may not meet the protein requirements of most livestock if used as the sole feed source. On a dry matter basis, the protein would be approximately 6.94%, which is still below the optimal level expected from well-managed forage crops like Madre de Agua (*Trichanthera gigantea*), which typically ranges between 18–22%.

The crude fat content is 2.82%, slightly higher than that of the Azolla sample, providing a small boost in energy value. The ash content is 31.90%, which is very high and indicates a rich mineral composition. While this can be beneficial in supplementing dietary minerals, excessive ash can dilute the overall energy and digestible nutrient content. As with the Azolla feed, the Madre de Agua-based feed is better suited as a supplementary rather than a primary feed source. Enhancing cultivation practices and integrating higher-protein ingredients could help improve the overall nutritional balance for livestock feeding.

RECOMMENDATIONS

1. Increase the inclusion of high-protein ingredients such as soybean meal, fish meal, or even other leguminous forages to compensate for the low protein levels in Madre de Agua. For instance, a formulation with 15-20% inclusion of Madre de Agua, combined with higher amounts of soybean meal or fish meal, could better meet the broilers' protein needs.
2. Balance mineral content by adjusting the ratio of Madre de Agua in the formulation. Using too much of the forage could lead to mineral imbalances, potentially affecting feed efficiency. A reduction in inclusion percentage (e.g., 10%) may help reduce the ash content without compromising the overall nutrient profile.
3. Test pellet durability under real-world storage conditions to confirm that the pellets retain their integrity over time and do not degrade or break apart, which could result in feed waste or reduced feed intake.
4. Investigate the economic feasibility of scaling up the use of Madre de Agua as an alternative feed source, especially in regions with limited access to conventional feed ingredients. The cost of cultivating, processing, and incorporating Madre de Agua in poultry feed should be compared against conventional feed costs to evaluate its sustainability.
5. Continue exploring alternative processing techniques (e.g., fermentation or enzymatic treatment) to improve the protein digestibility and bioavailability in Madre de Agua.

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DEVELOPMENT AND EVALUATION OF BLUE TERNATE (*Clitoria ternatea*) KROPEK

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ABSTRACT

This study explored the development and evaluation of kropek using blue ternate (*Clitoria ternatea*) flower powder as a functional ingredient. Known for its antioxidant-rich phytochemicals—such as flavonoids, tannins, and alkaloids—blue ternate was subjected to phytochemical screening, confirming its potential health benefits. The research formulated three variations of kropek with different concentrations of blue ternate powder (60g, 45g, and 30g) while maintaining constant amounts of other ingredients. Physicochemical analysis revealed the product's desirable moisture (7.87%), low fat (1.59%), moderate ash (4.77%), and protein content (5.76%), indicating its viability as a nutritious, shelf-stable, low-fat snack. A mixed-methods approach was used to evaluate the product's formulation, processing, and acceptability through sensory assessment and statistical analysis. The findings support the functional use of blue ternate in plant-based snack innovations, particularly for health-conscious consumers. Furthermore, the product's nutritional profile, combined with its natural blue color and health-promoting properties, makes it an attractive candidate for commercial snack production. This research encourages the utilization of underused plant species and presents blue ternate kropek as a sustainable and marketable food product.

Keywords: Clitoria ternatea, Blue ternate kropek, Phytochemical analysis, Functional food, Plant-based snack

INTRODUCTION

The tropical plant *Clitoria ternatea*, also called blue ternate, is indigenous to South and Southeast Asia. It is well-known for its vivid blue blooms, which are packed with anthocyanins, which are strong antioxidants that give the plant its vivid hue and a host of health advantages (Shiau et al., 2024). Blue ternate has long been utilized in herbal teas and medical procedures throughout Asia. It is prized for its anti-inflammatory, analgesic, and antidiabetic benefits, which make it a useful component of functional meals (Shankar, 2023). Additionally, the plant is abundant in vital nutrients that support heart health, digestive function, immune support, and general well-being, including as potassium, dietary fiber, and vitamins A and C (Rashid et al., 2021; Shiau et al., 2024). Blue ternate is a viable option for usage in nutraceuticals and food items with a health focus because of these bioactive components.

Blue ternate has become well-known in the culinary world as a natural food coloring and flavoring, especially in Southeast Asian cuisine, where it is used to improve the appearance of a variety of foods like rice, ice cream, and drinks (Astillo & Avenido, 2023). Blue ternate's vivid blue hue and health-promoting qualities present interesting opportunities for food product innovation, especially in plant-based snacks.

There is a notable gap in studies exploring the incorporation of blue ternate in innovative food products, particularly in snacks, where its nutritional benefits can be fully utilized. This research aims to fill this gap by exploring the development, nutritional value, and consumer acceptability of blue ternate kropek, contributing to the diversification of plant-based cuisine and offering a sustainable and health-conscious alternative in the snack industry.

This study advances the creation of wholesome and sustainable food options by revealing the possibilities of powdered blue ternate in a variety of snacks recipes. The results of this study could encourage the use of underused plant species, spur innovation in the food business, and give customers more options for tasty, healthful snacks.

STATEMENT OF THE PROBLEM

This study aims to develop kropek made from Blue Ternate (*Clitoria ternatea*) as the raw materials in snack food product.

Specifically, it will answer the following questions:

1. What is the phytochemical analysis of the Blue Ternate (*Clitoria ternatea*) flower?
2. What are the formulations and processes in the development kropek made from blue ternate flowers?
3. What is the physicochemical and nutritional value of Blue Ternate (*Clitoria ternatea*)Kropek?

RESEARCH METHODOLOGY

Research Design

The study utilized a mixed-methods approach combining qualitative and quantitative research design. The design is aimed at exploring the awareness and utilization of blue ternate in food preparation and evaluating its potential as a functional ingredient.

Moreover, it was experimental because it determined which of the formulations or mixtures of blue ternate is acceptable. The study utilized the developmental research design and mixed methods research design since this study develop a food product with blue ternate powder. Mixed methods research design is determining the acceptability of the product as measured in terms of color, odor, crunchiness, taste and texture.

Research Environment

The developmental research study on Blue Ternate powder will be carried out in Food Technology Innovation Center of Surigao del Norte State University, Surigao City. It is one of the universities in CARAGA Region, the university offers many courses from undergraduate programs to post-graduate programs. It has four (4) campuses, and the main campus is located at Surigao City.

The Food Technology Innovation Center at SNSU will serve as the site for the experiments. This facility is well-equipped with the tools and supplies needed for food preparation, testing, and evaluation. Its controlled setting ensures that studies are conducted safely and methodically, particularly when assessing and refining food products derived from powdered blue ternate.

Research Respondents

This study involves diverse group of respondents from Surigao del Norte State University (SNSU) Main Campus. Since they represent a varied population within the university community, these groups offer a wide range of information that is essential for determining if kropek made from blue ternate are acceptable as innovative food products. Their inclusion ensures a comprehensive evaluation of the food products acceptability, usefulness, and sensory attributes, representing a variety of consumer tastes and needs. There are (50) respondents under study, 20 (40.0%) are food experts and 30 (60.0%) are consumers.

Research Instrument

An adaptive questionnaire will be used to assess the acceptability of blue ternate kropek. This research uses 9-point hedonic scale as primary tools in data collection, to gather both quantitative and qualitative data necessary to support the objectives of this study. These were carefully crafted to evaluate the sensory attributes and consumer preferences, acceptability of Blue Ternate Kropek.

The Sensory Evaluation Forms make use of the 9-point hedonic scale to quantify specific sensory attributes of the products such as appearance, aroma, crunchiness, taste and texture. The scale runs between "dislike extremely" to "like extremely" allowing the respondent to give quantified feedback on the

sensory experience. The data from these forms are analyzed statistically for trends, measures of preferences, and overall appeal of the products.

Data Analysis

To analyze the collected data of this study, the following statistical tools were also utilized:

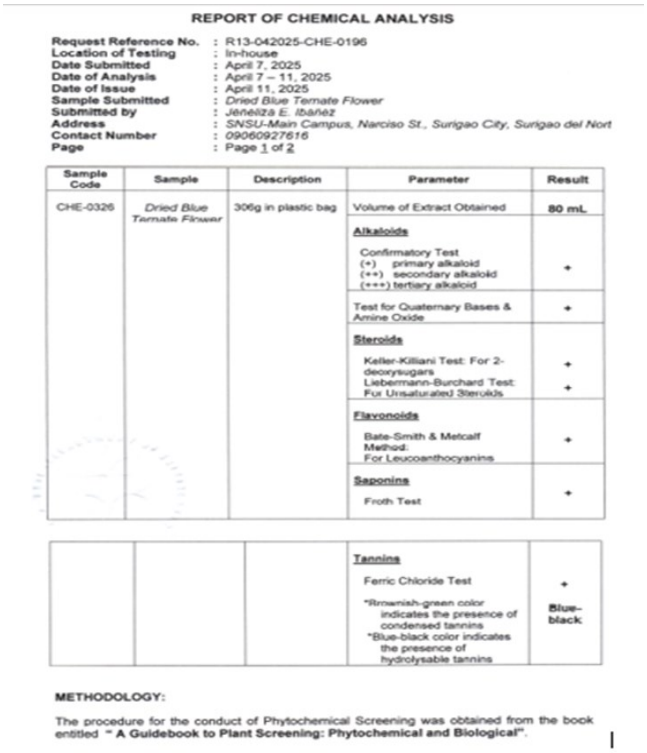
Percent. This tool will use to determine the amount in grams of blue ternate powder which are the main ingredients in this food product.

Mean and Standard Deviation. These tools will use for the development and acceptability of the blue ternate kropek that are both quantitative; for the measurements of ingredients and qualitative descriptions as perceived by the consumers in (appearance, aroma, crunchiness, taste, and texture).

One-Way Analysis of Variance (ANOVA). This tool will use to determine the differences of the different concentrations of Blue ternate used for each powder sample.

RESULTS AND DISCUSSIONS

Phytochemical Analysis of the Blue Ternate (Clitoria Ternatea) flower



REPORT OF CHEMICAL ANALYSIS

Request Reference No. : R13-042025-CHE-0196
Location of Testing : In-house
Date Submitted : April 7, 2025
Date of Analysis : April 7 – 11, 2025
Date of Issue : April 11, 2025
Sample Submitted : *Dried Blue Ternate Flower*
Submitted by : *Jeneliza E. Ibañez*
Address : *SNSU-Main Campus, Narciso St., Surigao City, Surigao del Nort*
Contact Number : *09060927616*
Page : Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE-0326	*Dried Blue Ternate Flower*	306g in plastic bag	Volume of Extract Obtained	80 mL
			Alkaloids Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	+
			Test for Quaternary Bases & Amine Oxide	+
			Steroids Keller-Killiani Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	+ +
			Flavonoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	+
			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	+ Blue-black

METHODOLOGY:

The procedure for the conduct of Phytochemical Screening was obtained from the book entitled " **A Guidebook to Plant Screening: Phytochemical and Biological**".

Fig. 1 Result of phytochemical analysis for blue ternate flower

The figure 1 disclose the chemical analysis report of the dried blue ternate flower (Sample Code: CHE-0326) reveals that the 30g sample yielded 80 mL of extract, which was subjected to various phytochemical screening tests. The results indicate the presence of multiple beneficial phytochemicals, including alkaloids, steroids, flavonoids, saponins, and tannins. Alkaloids were confirmed through positive results in the standard alkaloid tests, including those for primary, secondary, and tertiary alkaloids, as well as tests for quaternary bases and amine oxide. Steroids were detected using the Keller-Killiani and Liebermann-Burchard tests, confirming the presence of both 2-deoxy sugars and unsaturated steroids. The presence of flavonoids was verified using the Bate-Smith & Metcalf method and tests for leucoanthocyanins, both yielding positive results.

Additionally, the Froth Test confirmed the presence of saponins, which are known for their surfactant properties and potential health benefits. Most notably, the Ferric Chloride Test for tannins produced a blue-black coloration, which is indicative of hydrolyzable tannins—a class of polyphenolic compounds known for their antioxidant properties. The presence of these bioactive compounds supports the functional value of blue ternate flower in formulations intended for health-promoting or therapeutic uses. The results also reinforce the flower's traditional use in herbal medicine and suggest its potential for further application in food, nutraceutical, or pharmaceutical products.

Formulations and Processes in the Development of Kropek made from Blue Ternate Flowers

Formulations of the developed kropek made from blue ternate flowers.

Table 1. Formulations of the developed kropek.

Ingredient	Formulation A	Formulation B	Formulation C
Blue Ternate Powder	60 g (100%)	45 g (75%)	30 g (50%)
Cassava Starch	200 g	200 g	200 g
Rice Flour	100 g	100 g	100 g
Water	100 ml	100 ml	100 ml
Salt	5 g	5 g	5 g
Sugar	10 g	10 g	10 g
Baking Powder	3 g	3 g	3 g
White Pepper	2 g	2 g	2 g
Garlic Powder	2 g	2 g	2 g

The table 1 presents three formulations (A, B, and C) that vary primarily in the amount of blue ternate powder used, while all other ingredients remain constant. Formulation A contains the highest amount of blue ternate powder at 60 grams (100%), followed by Formulation B with 45 grams (75%), and Formulation C with 30 grams (50%). This gradation allows for comparative analysis of how varying levels of blue ternate powder affect the final product's color, flavor, nutritional content, or functional properties. The consistency in the quantities of cassava starch, rice flour, water, salt, sugar, baking powder, white pepper, and garlic powder across all three formulations ensures that any observed differences in the outcome can be attributed primarily to the concentration of blue ternate powder.

Processes in the development kropek made from blue ternate flowers

Fig. 2 Harvesting, drying and grinding of blue ternate flower

Fig. 3 making of kropek dough

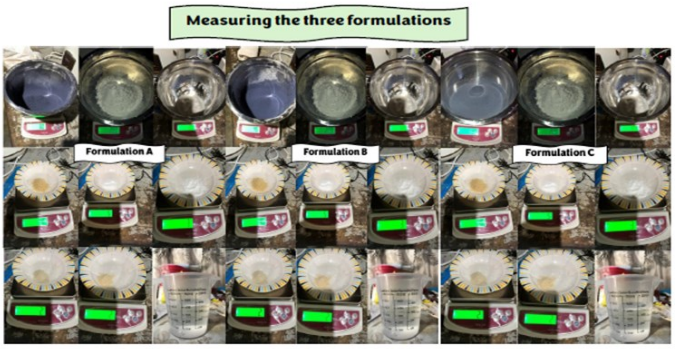


Fig. 4 measuring of the three formulations

Fig. 5 mixing of all the ingredients

Fig. 6 dough making, steaming and cooling

Fig. 7 slicing of the product into kropek

Fig. 8 drying of the slices

Fig. 9 frying, storing and packaging of the final product.

Physicochemical and Nutritional Value of Blue Ternate (*Clitoria ternatea*) Kropek

TEST REPORT

CUSTOMER	: JENELIZA E. IBAÑEZ
ADDRESS	: San Juan, Loreto, Dinagat Islands
PROJECT NAME	: BLUE TERNATE KROPEK
PROJECT ADDRES	: SNSU – Main Campus, Surigao City
CONTACT PERSON	: Jeneliza E. Ibañez
CONTACT DETAILS	: jibanez2@ssct.edu.ph
SAMPLE(S) SUBMITTED	: BLUE TERNATE KROPEK (In Sealed Packed) (As Declared)
SAMPLE CODE	: CD2504-2075-01
SAMPLED BY	: Customer
DATE / TIME RECEIVED	: 07 April 2025 / 5:20 PM
DATE ANALYZED	: 21 – 24 April 2025
DATE REPORTED	: 30 April 2025

Parameters	Unit	Results	Test Method
Moisture	%	**7.87**	AOAC No. 935.39 Air Oven
Fat	%	**1.59**	AOAC No. 922.06, Acid / Hydrolysis
Ash	%	**4.77**	AOAC No. 923.03, Ignition
Crude Protein (%N x 6.25)	%	**5.76**	AOAC 2001.11 AOAC 21st Ed, Kjeldahl Method

Note: Outsourced to *F.A.S.T.* Laboratories recognized subcontractor.

Reference: Official Method of Analysis of AOAC International, 21st ed., 2019.

Results are those obtained at time of examination and relate only to the sample(s) tested.

Fig. 10 result of the physicochemical and nutritional value analysis of the develop product

The figure 10 disclose the physico-chemical analysis of the developed blue ternate kropek (in seed pack) provides valuable insights into its nutritional and compositional profile. The moisture content was found to be 7.87% using the air oven test method, indicating good product stability and shelf life. Low moisture content is desirable in snack products like kropek as it helps prevent microbial growth and spoilage, thus extending storage potential. The fat content, determined through the acid hydrolysis method, was 1.59%, suggesting that the kropek is a relatively low-fat snack option. This could appeal to health-conscious consumers seeking lower-calorie alternatives to traditional fried snacks.

The ash content measured at 4.77% through ignition method indicates the total mineral content in the kropek, which reflects the presence of inorganic components like calcium, magnesium, and potassium—nutrients potentially enhanced by the blue ternate flower. Additionally, the crude protein content of 5.76%, determined via the Kjeldahl method, reveals that the product contains a moderate amount of protein, likely derived from ingredients such as rice flour, cassava starch, and the blue ternate powder itself. This protein level can contribute to the snack's nutritional value, supporting muscle maintenance and satiety. Overall, the analysis highlights that the developed kropek is a low-fat, moderately proteinaceous product with good mineral content and shelf stability, making it a potentially healthy and marketable functional snack.

RECOMMENDATIONS

1. Further studies should be conducted to evaluate the sensory qualities (taste, color, texture) of the different kropek formulations to identify the most acceptable version for consumers.
2. Shelf-life testing is recommended to determine how long the product retains its quality under various storage conditions.
3. Nutritional labeling and health claims should be developed for marketing purposes, highlighting the presence of antioxidants and other beneficial compounds from blue ternate flower.
4. Scale-up production trials should be conducted to test the consistency and feasibility of large-scale kropek manufacturing.
5. Explore alternative packaging materials that can preserve the nutritional and physical quality of the kropek while maintaining its eco-friendliness.

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Rashid, A., Hashim, N., Azhar, N., & Shamsudin, R. (2021). Microencapsulation of anthocyanins from *Clitoria ternatea*: Improving stability and applications in food products. Arabian Journal for Science and Engineering, 46(5), 3977–3987.

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DEVELOPMENT AND EVALUATION OF PAKO (*Diplazium esculentum*) SAUCE FOR VARIED CULINARY APPLICATION

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ABSTRACT

This study explores the development and evaluation of Pako Sauce, a novel culinary product derived from *Diplazium esculentum* (pako), a native edible fern recognized for its nutritional and functional properties. Pako is rich in bioactive compounds such as flavonoids, tannins, and saponins, which offer antioxidant, antimicrobial, and anti-inflammatory benefits. The research utilized a developmental design and mixed-methods approach to formulate and optimize the sauce, incorporating ingredients like olive oil, peanuts, cheese, and calamansi juice to complement the pako powder. Sensory evaluation using a 9-point hedonic scale assessed the product's acceptability in terms of flavor, texture, aroma, and overall appeal, with results indicating strong consumer and expert approval. In addition to sensory evaluation, the study conducted physico-chemical and nutritional analyses, revealing that Pako Sauce has a low moisture content (12.9%), high fat content (47.0%), and moderate protein (10.0%) and ash (5.08%) levels, suggesting its suitability as a nutrient-dense, shelf-stable condiment. The integration of pako into a ready-to-use sauce offers a sustainable solution to food security, enhances dietary diversity, and supports the promotion of indigenous food resources. This research not only highlights the potential of *Diplazium esculentum* as a health-enhancing ingredient but also contributes to community empowerment through sustainable agriculture, local food innovation, and alignment with the United Nations Sustainable Development Goals (SDGs).

Keywords: Pako sauce, Food product, Culinary application, Product Development

INTRODUCTION

Pako (*Diplazium esculentum*), or vegetable fern, is a plant with significant nutritional, physiological, and ecological benefits. Rich in proteins, dietary fiber, vitamins, and minerals such as iron and calcium, it supports overall health and helps prevent nutrient deficiencies, particularly in vulnerable populations (Raina et al., 2023). Its antioxidant, antibacterial, and anti-inflammatory properties further highlight its potential as a functional food ingredient that may reduce the risk of chronic diseases and improve overall well-being (Kumar et al., 2021). Traditionally, *D. esculentum* has been a staple in Southeast Asian diets due to its accessibility, affordability, and versatility in cooking, making it an integral part of local food traditions (Roy & Chaudhuri, 2020). Additionally, its status as a fast-growing, sustainable crop underscores its ecological value and potential as a modern, environmentally friendly food source (Raina et al., 2023).

Beyond its individual health benefits, *D. esculentum* has the potential to contribute significantly to community health by addressing food security and providing a nutrient-dense option for local diets. Its cultivation and use can empower communities by promoting sustainable agricultural practices, creating opportunities for local entrepreneurship, and supporting traditional food systems. Despite these attributes, research has primarily focused on its traditional culinary uses and bioactive components, with limited exploration of its application in developing processed, shelf-stable products such as sauces. Sensory evaluation and consumer acceptability studies of *D. esculentum*-based products remain underexplored,

even though such studies are essential for determining market viability. Furthermore, the adaptability of D. esculentum in diverse culinary applications has been largely overlooked.

The incorporation of Pako, a native and nutrient-dense plant, into culinary products could enhance food security by providing an affordable and nutritious food source, which supports local agricultural practices and reduces dependency on imported food items (Sari et al., 2021). Additionally, promoting the consumption of Pako could encourage healthier diets, as it is rich in vitamins, minerals, and antioxidants, contributing to the prevention of malnutrition and diet-related diseases (Gonzales et al., 2022). By sourcing local ingredients like Pako, the project also supports sustainable consumption patterns, reducing the environmental footprint associated with food production and transportation (Martinez et al., 2023).

Furthermore, promoting the cultivation of indigenous plants like Pako can boost local economies by creating new opportunities for farmers and entrepreneurs in rural areas, contributing to economic growth and job creation (Del Rosario & Reyes, 2024). In this way, the development of Pako-based products not only addresses local food security and health concerns but also supports environmental sustainability and economic development in alignment with the SDGs.

This study aims to address these gaps by developing and evaluating Pako Sauce, a novel product leveraging the nutritional and functional properties of *D. esculentum*. By investigating its sensory acceptability, health benefits, and culinary versatility, this research contributes to functional food innovation while supporting community health and sustainability.

STATEMENT OF THE PROBLEM

This study aimed to develop Pao sauce and evaluate the flavor profile and nutritional benefits of *Diplazium esculentum* (pako) when incorporated into a sauce, exploring its potential as a sustainable and health-enhancing ingredient.

Specifically, the following questions are addressed in this study:

1. What is the phytochemical composition and nutritional profile of the Pako (*Diplazium esculentum*) when used as sauce?
2. What are the formulations and processes in the development of Pako (*Diplazium esculentum*) sauce?
3. What is the physico-chemical analysis and nutritive value of the Pako (*Diplazium esculentum*) sauce?

RESEARCH METHODOLOGY

Research design

This study will employ a developmental research design combined with a mixed-methods approach to explore the culinary versatility of Pako (Diplazium esculentum) as a distinctive sauce for diverse cuisines. The developmental design will focus on creating and optimizing a Pako sauce by refining its formulation, ingredient composition, and preparation techniques to achieve desirable sensory characteristics such as flavor, texture, color, and stability. A mixed-methods approach will be used to assess the sauce's acceptability across various culinary applications. Quantitative data will be collected through a structured sensory evaluation survey using a 9-point Hedonic Scale to measure the product's appearance, aroma, taste, texture, and overall appeal. Statistical analysis will determine the overall acceptability and preferences across different versions of the sauce. Qualitative methods, including in-depth interviews and focus groups, will gather detailed feedback on the sauce's versatility, potential improvements, and its appeal to different cuisines.

Research environment

The study will be conducted at the Food Technology Innovation Center of Surigao del Norte State University, located in Surigao City, Caraga Region. The study focuses on exploring the potential as a sustainable, innovative ingredient in varied culinary application of Pako (Diplazium esculentum). The university's advanced tools and expertise will support this research, highlighting pako as a resource that blends tradition with contemporary culinary trends.

Research respondents

This study will involve a total of 50 diverse group of respondents to evaluate the nutritional potential, culinary versatility, and sensory acceptability of Diplazium esculentum (pako) in pasta sauce. Expert evaluations and consumer perspectives will provide comprehensive insights into the product's potential for integration into local diets and its marketability. There are (50) respondents under study, 20 (40.0%) are food experts and 30 (60.0%) are consumers.

Research instrument

The research instruments for this study are structured to gather detailed feedback on the development and acceptability of Pako sauce in varied culinary applications while ensuring the safety of participants, especially those with food allergies. A sensory evaluation form using a 9-point hedonic scale will be employed to assess the sauces sensory attributes, including appearance, aroma, flavor, texture, and overall acceptability. The hedonic scale, ranging from "dislike extremely" to "like extremely," allows participants to express their preferences quantitatively.

A demographic profile questionnaire will collect data on participants' age, gender, dietary preferences, and any known food allergies. This ensures inclusivity and a well-rounded dataset. The combined use of the hedonic scale and allergy screening ensures that the study collects reliable data while prioritizing the safety of all respondents.

Data Analysis

Some statistical instruments will be used to run various analyses on the data retrieved through questionnaires. These include but are not limited to;

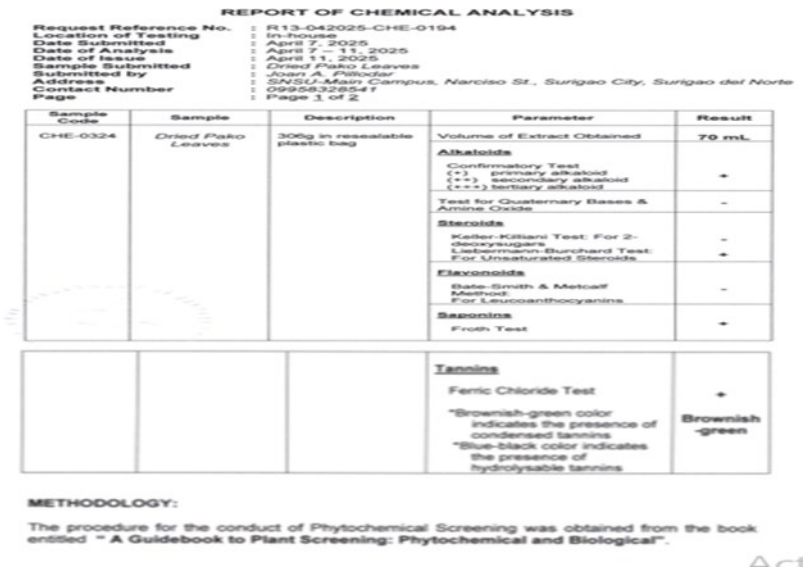
Frequency count and percent. This tool will be applicable in describing the demographic information among participants. These include age and the frequency along with per cents depicting any given characteristic among participants undertaking the study.

Percent. Percentages will also be used to calculate the ratio of certain formulations that are prepared in making the Pako sauce, which help in the improvement and refinement of the product.

Mean and Standard Deviation. The mean and standard deviation will be obtained to determine the acceptability of the Pako sauce. Such statistical tools will quantify the descriptive results of the sensory assessment of the product's appearance, aroma, taste, texture, and overall acceptability.

RESULTS AND DISCUSSION

Phytochemical composition and nutritional profile of the Pako (Diplazium esculentum) leaves.



REPORT OF CHEMICAL ANALYSIS

Request Reference No. : R13-042025-CHE-0194
Location of Testing : In-house
Date Submitted : April 7, 2025
Date of Analysis : April 7 – 11, 2025
Date of Issue : April 11, 2025
Sample Submitted : *Dried Pako Leaves*
Submitted by : *Joan A. Pallodar*
Address : *SNSU-Main Campus, Narciso St., Surigao City, Surigao del Norte*
Contact Number : *09958328541*
Page : Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE-0324	*Dried Pako Leaves*	306g in resealable plastic bag	Volume of Extract Obtained	70 mL
			Alkaloids	
			Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	+
			Test for Quaternary Bases & Amine Oxide	-
			Steroids	
			Keller-Killiani Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	- +
			Flavonoids	
			Bate-Smith & Metcalf Method: For Leucoanthocyanins	-
			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	+ Brownish -green

METHODOLOGY:

The procedure for the conduct of Phytochemical Screening was obtained from the book entitled " **A Guidebook to Plant Screening: Phytochemical and Biological**".

Figure 1. Phytochemical analysis and Nutritional profile result of the Pako leaves sample

The figure 1 disclose the phytochemical screening of dried Pako (*Diplazium esculentum*) leaves revealed the presence of several important bioactive compounds, including alkaloids, glycosides, flavonoids, tannins, and saponins. These phytochemicals are known for their various health-promoting properties. Alkaloids, for example, often exhibit antimicrobial and analgesic effects, making them significant for potential therapeutic applications. The positive result for flavonoids and tannins suggests strong antioxidant potential, which may help in reducing oxidative stress and preventing cellular damage. Glycosides, particularly cardiac glycosides, are known to support cardiovascular health, while saponins contribute to immune modulation and possess cholesterol-lowering and antimicrobial properties.

The absence of amino acids, proteins, steroids, and anthraquinones indicates that while Pako may not be a significant source of protein or steroid-based compounds, its medicinal potential lies in its phytochemical profile rather than nutritional protein content. The findings reinforce the suitability of Pako leaves for use in functional food formulations, such as sauces or health supplements, where antioxidant and wellness benefits are desired. This supports the integration of Pako into health-oriented diets and culinary innovations aimed at promoting natural, plant-based nutrition and preventive healthcare.

Formulations and Processes in the Development of Pako (*Diplazium esculentum*) Sauce

Formulation of the develop Pako Sauce.

Table 1. Formulations of the develop Pako Sauce.

Ingredient	Quantity	Function in Sauce
Olive Oil	200 ml	Serves as the base; adds smooth texture and richness; helps emulsify the mixture.
Toasted Peanut	70 grams	Adds nutty flavor and body; serves as a thickening agent and protein source.
Grated Cheese	70 grams	Contributes creaminess, umami, and depth of flavor.
Fresh Garlic (cloves)	5 cloves	Adds pungency and aromatic flavor.
Calamansi Juice	10 grams	Provides acidity and brightness to balance richness.
Salt	5 grams	Enhances overall taste; adjust as needed.
Pepper	2 grams	Adds mild heat and depth.
Pako Powder	50 grams	Key ingredient; imparts earthy, green notes and nutritional value.

The table 1 disclose the formulation of Pako sauce incorporates a thoughtful blend of ingredients that each contribute to its flavor, texture, and nutritional profile. Olive oil serves as the base, providing smoothness and helping to bind the mixture, while toasted peanuts and grated cheese add body, richness, and a savory umami depth. Fresh garlic enhances the sauce's aroma and provides a sharp, pungent taste, balanced by the bright acidity of calamansi juice. Salt and pepper are used to fine-tune the seasoning, adding depth and mild heat. The standout component, Pako powder, introduces a distinct earthy flavor and enriches the sauce with nutrients, making it both flavorful and health-oriented. This well-balanced combination makes the sauce versatile for a variety of culinary applications.

Processes in the Development of Pako (*Diplazium esculentum*) Sauce

Harvesting and Selection. Fresh Pako (*Diplazium esculentum*) leaves are harvested and carefully selected to ensure quality and freshness.

Washing and Drying. The selected Pako leaves are thoroughly washed to remove dirt and impurities, then dried using air-drying or oven-drying methods.

Grinding into Powder. Once dried, the Pako leaves are ground into fine powder and stored in airtight containers.

Preparation of Other Ingredients. Toasted peanuts are prepared, garlic cloves are peeled, and cheese is grated.

Measuring Ingredients. All ingredients (olive oil, Pako powder, peanuts, cheese, garlic, calamansi juice, salt, and pepper) are accurately measured based on the established formulation.

Blending Process. The ingredients are combined in a blender or food processor and blended until a smooth, emulsified sauce is achieved.

Packaging. The finished sauce is transferred into sterilized glass jars to maintain cleanliness and preserve quality.

Labeling and Storage. Labeled jars are stored properly and are now ready for distribution or culinary use.

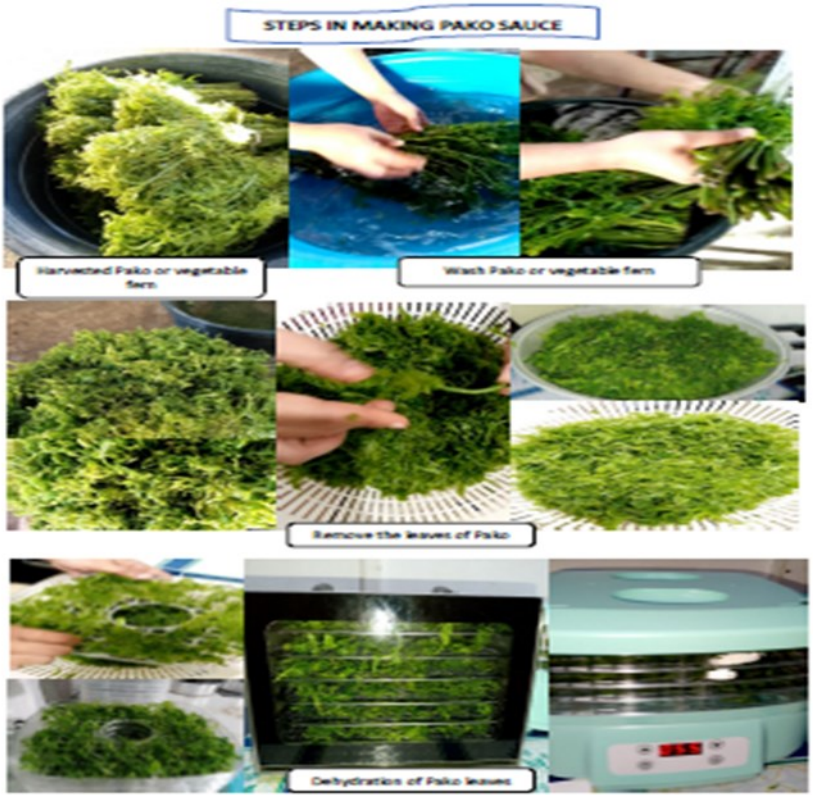


Figure 2. Harvesting, washing and drying for pako leaves

Figure 3. Grinding, shifting and measuring other ingredients

Figure 4. Mixing and blending of all ingredients

Figure 5. Packaging and labeling of the finished product

Physico-chemical Analysis and Nutritive Value of the Pako (*Diplazium Esculentum*) Sauce

TEST REPORT

CUSTOMER	: JOAN A. PILLODAR
ADDRESS	: Brgy. Esperanza, Loreto, Dinagat Islands
CONTACT PERSON	: Joan A. Pillodar
CONTACT DETAILS	: joan.pillodar001@deped.gov.ph
SAMPLE(S) SUBMITTED	: PAKO SAUCE PD: 06 APR. 2025 (In Glass Jar) (As Declared)
SAMPLE CODE	: CD2504-2077-01
SAMPLED BY	: Customer
DATE / TIME RECEIVED	: 07 April 2025 / 5:30 PM
DATE ANALYZED	: 21 – 24 April 2025
DATE REPORTED	: 30 April 2025

Parameters	Unit	Results	Test Method
Moisture	%	**12.9**	AOAC No. 935.39 Air Oven
Fat	%	**47.0**	AOAC No. 922.06, Acid / Hydrolysis
Ash	%	**5.08**	AOAC No. 923.03, Ignition
Crude Protein (%N x 6.25)	%	**10.0**	AOAC 2001.11 AOAC 21st Ed, Kjeldahl Method

Note: Outsourced to *F.A.S.T.* Laboratories recognized subcontractor.

Reference: Official Method of Analysis of AOAC International, 21st ed., 2019.

Results are those obtained at time of examination and relate only to the sample(s) tested.

As gleaned in Figure 6 the physico-chemical analysis of the Pako sauce sample, as reported, provides important insights into its nutritional and compositional profile. The moisture content was recorded at 12.9%, indicating relatively low water activity, which contributes to the product's stability and extended

shelf life. A low moisture level minimizes microbial growth, making the sauce safer and more durable for storage. The fat content was notably high at 47.0%, primarily due to the inclusion of high-fat ingredients such as olive oil, peanuts, and cheese. This high fat percentage contributes to the sauce's rich texture, flavor intensity, and caloric density, making it suitable for applications where a full-bodied and creamy consistency is desired.

The analysis also revealed an ash content of 5.08%, reflecting the total mineral content of the sauce. This suggests that the Pako sauce contains a moderate level of essential minerals, which may enhance its nutritional value. Additionally, the crude protein content was found to be 10.0%, attributed largely to the peanuts and cheese in the formulation. This indicates that the sauce is not only a flavorful condiment but also a source of plant and dairy-based proteins, potentially supporting dietary protein intake. Overall, the physico-chemical characteristics confirm that the Pako sauce is a nutrient-dense product with a balanced composition suitable for both culinary enhancement and nutritional supplementation.

RECOMMENDATION

1. Promote Pako sauce as a functional food due to its rich phytochemical content, especially antioxidants like flavonoids and tannins.
2. Enhance marketing strategies by emphasizing the sauce's health benefits, such as immune support and cardiovascular wellness.
3. Consider reducing fat content slightly for consumers seeking lower-calorie or heart-healthy options, while maintaining the creamy texture.
4. Encourage the use of Pako sauce in various dishes to increase dietary intake of plant-based nutrients and antioxidants.
5. Further product development and shelf-life testing are recommended to ensure quality and safety over extended storage periods.

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DEVELOPMENT AND EVALUATION OF SNACK BAR USING ANTIPOLO (*Artocarpus blancoi*) FRUIT SEED FLOUR

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Student, Graduate School, Surigao del Norte State University, Surigao City, Philippines

Randy O. Descarten, PhEdD
James M. Dumaguit, PhD
Faculty, Surigao del Norte State University, Surigao City, Philippines

ABSTRACT

This study explores the potential of Antipolo fruit seeds (*Artocarpus blancoi*) as an alternative flour source for the development of a nutritious and sustainable snack bar. Native to the Philippines, Antipolo fruit has historically been underutilized despite its abundance and nutritional content. This research aimed to process the seeds into flour and incorporate it into a functional snack product. A comprehensive developmental and mixed-methods approach was employed, including phytochemical screening, flour production, snack bar formulation, sensory evaluation, and nutritional analysis. Results from the phytochemical screening indicated an absence of secondary metabolites such as flavonoids, tannins, and alkaloids, while the flour and developed snack bar showed significant nutritional value, particularly high fat and protein content. The findings revealed that Antipolo seed flour is viable for food product innovation, particularly in meeting consumer demand for health-focused, locally-sourced alternatives. The snack bar developed demonstrated acceptable sensory qualities based on expert and consumer evaluations. Its nutritional profile supports goals for food security and sustainable resource utilization. This study contributes to circular economy practices by transforming fruit waste into a value-added product, aligning with national development frameworks like Ambisyon Natin 2040 and global Sustainable Development Goals. The Antipolo snack bar serves as a promising model for future functional food products derived from underutilized indigenous resources.

Keywords: Antipolo seed flour, Artocarpus blancoi, sustainable food innovation, snack bar development, nutritional analysis

INTRODUCTION

Antipolo, also known as *Artocarpus blancoi*, is a tropical fruit native to Southeast Asia, particularly the Philippines, known for its high nutritional value. Belonging to the Moraceae family, which includes mulberry and fig trees, Antipolo fruit is typically consumed fresh but holds untapped potential as a sustainable and nutrient-dense ingredient in food product development. The increasing global demand for healthy and eco-friendly food alternatives presents an opportunity to explore Antipolo fruit seeds as a novel resource. This study focuses on developing a snack bar using flour derived from Antipolo fruit seeds, showcasing its viability as a key ingredient for the food industry.

The utilization of alternative flour sources has grown in recent years due to their nutritional benefits and contributions to health-oriented innovation. Research on quinoa flour (Aguilar et al., 2019) and cactus flour (Dick et al., 2020) highlights the potential of alternative flours to enhance food products with high phenolic content, antioxidant properties, and other health-promoting compounds. Similarly, Antipolo fruit seed flour holds promise as a nutrient-rich, sustainable ingredient, but existing research primarily addresses its direct consumption and medicinal properties (Luzon et al., 2021), energy potential (Ramos et al., 2022), and nutritional composition (De la Cruz et al., 2020). This leaves a significant gap in its application as a processed ingredient for value-added products like snack bars, which this study aims to address.

The development of Antipolo fruit seed flour contributes to the United Nations' Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) by promoting food security through nutrient-

dense products, and Goal 12 (Responsible Consumption and Production) by repurposing agricultural by-products, reducing food waste, and supporting sustainable practices. Moreover, the transformation of fruit waste into a valuable ingredient aligns with i2Fame's focus on innovation, inclusivity, food security, and agricultural sustainability, emphasizing the use of local resources to create competitive and health -promoting food products.

This initiative also supports Ambisyon Natin 2040, the long-term vision for a prosperous and sustainable Philippines. By addressing consumer demand for affordable, nutritious, and eco-friendly food options, this study contributes to a matatag (strong), maginhawa (comfortable), and panatag (secure) life for Filipinos. The snack bar developed through this research exemplifies the balance between health, sustainability, and economic opportunity, fostering a future where local resources are utilized to their fullest potential.

By harnessing the abundance of Antipolo fruit in the Philippines and transforming its seeds into a functional and sustainable flour, this study not only introduces a new food innovation but also promotes environmental conservation and sustainable development. The resulting snack bar serves as a testament to the potential of alternative ingredients in meeting global health and sustainability goals, paving the way for competitive, healthy, and eco-conscious food products in the market.

STATEMENT OF THE PROBLEM

This study aimed to develop a flour and snack bar made from Antipolo fruit seeds (*Artocarpus blancoi*) as the primary raw material.

Specifically, it sought to answer the following sub-problems:

What is the phytochemical analysis of the Antipolo fruit seed?

2. What are the formulations and processes for producing Antipolo fruit seed flour and formulating Antipolo fruit seed-based snack bars?

3. What is the physicochemical composition of the Antipolo fruit seed flour and the nutritional value of a snack bar using the flour?

RESEARCH METHODOLOGY

Research Design

This study will utilize a developmental research design and a mixed-methods research design. The developmental research design will be employed as the study will focus on developing a food product using flour prepared from Antipolo fruit seeds (Artocarpus blancoi) as the primary ingredient for snack bar production.

The mixed-methods research design will be utilized to determine the acceptability of the product in terms of appearance/color, aroma/odor, taste, texture, and overall acceptability. Quantitative methods will be employed in the sensory evaluation to assess the product's characteristics, while qualitative methods will provide insights into the development process, including challenges, opportunities, and potential areas for improvement. Furthermore, the mixed-methods approach will be employed to evaluate the nutritional value of the Antipolo fruit seed flour, ensuring that the snack bar product to be developed will meet safety and quality standards.

Research Environment

The developmental research study on snack bar using Antipolo seed flour will be carried out in Food Technology Innovation Center in Surigao del Norte State University, Surigao City. It is one of the university in CARAGA Region.

Respondents

This study consider 50 respondents comprise of 20 food technology experts, and 30 consumers in determining the acceptability of the Antipolo fruit seed flour product.

Research Instrument

This study focuses on product development and consumer acceptability. To determine the level of acceptability of the developed snack bar, a hedonic scale questionnaire will be used. This questionnaire will assess the product's color, odor, taste, and texture using a nine-point scale. The sensory evaluation will involve a panel of participant's selected using purposive random sampling, including food experts and consumers. Multiple product development trials will be conducted to optimize the snack bar's quality.

Data Analysis

This study will utilize the following statistical tools in analyzing the data:

Frequency count and percent. These tools will be used to describe the demographic profile of the respondents.

Percent. This tool will be used to determine the proportion of Antipolo fruit (Artocarpus blancoi) seed flour that will be used in each snack bar mixture during product development.

Mean and standard deviation. These statistical tools will be utilized to assess the acceptability of the snack bar product made from Antipolo fruit seed flour using a descriptive method that will gather opinions based on respondents' perceptions about its appearance, aroma, color, texture, and taste. The mean will represent the general level of acceptability, and the standard deviation will reflect the variability of perceptions among the respondents.

RESULTS AND DISCUSSIONS

Phytochemical Analysis of the Antipolo Fruit Seed

REPORT OF CHEMICAL ANALYSIS

Request Reference No. : R13-032025-CHE-0182
Location of Testing : In-house
Date Submitted : March 24, 2025
Date of Analysis : March 24 – 27, 2025
Date of Issue : March 31, 2025
Sample Submitted : *Antipolo Seeds*
Submitted by : *Liza B. Valiente*
Address : *Surigao del Norte State University / Narciso Street, Surigao City, Surigao del Norte*
Contact Number : *09672569604*
Page : Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE-0305	*Antipolo Seeds*	340g in plastic bag	Volume of Extract Obtained	50 mL
			Alkaloids Confirmatory Test (+) primary alkaloid (++) secondary alkaloid (+++) tertiary alkaloid	+
			Test for Quaternary Bases & Amine Oxide	-
			Steroids Keller-Killiani Test: For 2-deoxysugars Liebermann-Burchard Test: For Unsaturated Steroids	+ +
			Flavonoids Bate-Smith & Metcalf Method: For Leucoanthocyanins	+
			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	-

METHODOLOGY:

The procedure for the conduct of Phytochemical Screening was obtained from the book entitled **" A Guidebook to Plant Screening: Phytochemical and Biological"**.

Fig. 1 result of phytochemical analysis for antipolo fruit seed

As gleaned in figure 1 the result of phytochemical analysis for an "Antipolo Seeds" various chemical tests were performed to identify the presence of different compounds, including alkaloids, carbohydrates, steroids, flavonoids, saponins, and tannins. All test results are marked with negative indicators (-), suggesting the absence of these compounds in the Antipolo Seeds sample. The methodology section indicates that the procedures for phytochemical screening were obtained from a guidebook for plant screening.

The analysis appears to be part of a comprehensive evaluation of Antipolo Seeds, likely for research or product development purposes. The consistently negative results across all phytochemical tests is notable and might suggest that while the seeds contain significant nutritional components (particularly fats and proteins as seen in the previous report), they lack the secondary plant metabolites typically associated with medicinal properties or bitter flavors.

Processes of making Antipolo Fruit Seed Flour and Formulation of making Antipolo Snack Bar.

Processes in making Antipolo Fruit Seed Flour.

The following are the raw materials used in making the Antipolo flour including the step-by-step procedures.

Raw Materials Used: Antipolo Fruit seeds

Step 1: Preparing. Collect and gather Antipolo fruit seeds. Wash the seeds thoroughly under running water to remove any pulp or debris. Soak the seeds in clean water for at least 5 minutes to soften them.

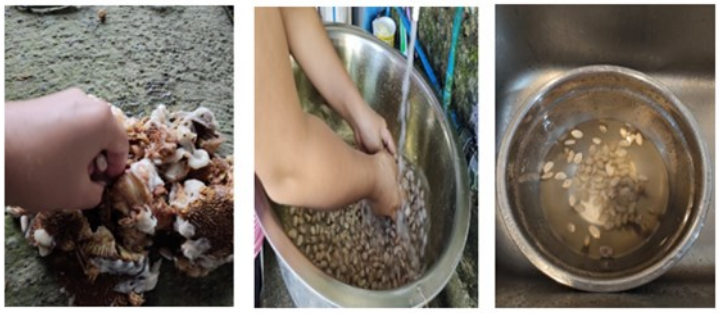

Fig. 2 preparation of antipolo seeds

Step 2: Drying. Drain the soaked seeds completely. Spread the seeds in a single layer on a food dehydrator tray. Dehydrate at 70°C (158°F) for approximately 5 hours, or until the seeds are completely dry and brittle. Check frequently to prevent burning.

Fig 3 drying process of antipolo seeds

Step 3: Peeling. Once the seeds are completely dry, carefully peel off the outer seed coat. This may require some effort depending on the seed's dryness. A small or paring knife may be helpful.

Fig. 4 peeling of the seeds

Step 4: Grinding. Place the peeled, dried seeds into a clean grinder. Grind the seeds into a fine powder. Pause and scrape down the sides of the grinder as needed to ensure even processing.

Fig. 5 grinding of seeds

Step 5: Packaging. Transfer the Antipolo fruit seed flour to an airtight, food-safe container.

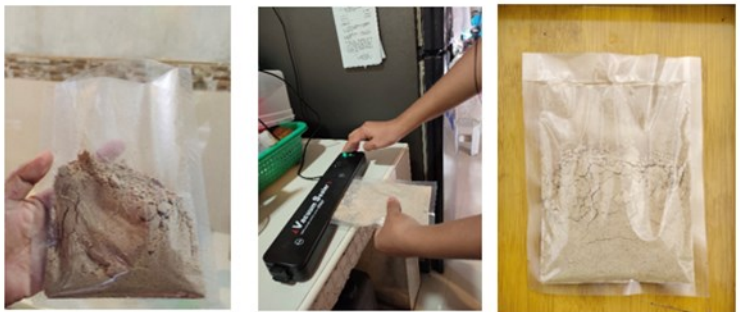

Fig. 6 Packaging of antipolo seed flour

Step 6: Storing. Store in a cool, dark, and dry place to maintain freshness and prevent spoilage.

Fig. 7 storing of antipolo seed flour

Formulation and Ingredients of the Antipolo Snack Bar

The following are the raw materials used in making the Antipolo Snack Bar including its step-by-step procedures and processes.

Raw Materials Used

1 1/3 cup Antipolo flour
2/3 cup All Purpose flour
1 ½ cup White Sugar
¾ cup Cocoa powder
1 ½ teaspoon Baking soda
1 ½ teaspoon Baking powder
1 teaspoon Iodized salt
½ cup Chocolate chips
¼ cup Ground peanut (for toppings)
2 pcs. Eggs
1 cup Milk
½ cup Oil
1 cup Boiled water

Procedures in making Antipolo Snack Bar.

Step 1: Preheat oven to 360°F (180°C). Line a baking pan with parchment paper for easy removal.

Fig. 8 pre heating of oven

Step 2: Prepare the ingredients and baking tools.

Fig. 9 preparation of ingredients and tools

Step 3: Sift the dry ingredients to remove lumps.

Fig. 10 sifting of ingredients

Step 4: Measure dry and wet ingredients.

Fig. 11 measuring of ingredients

Step 5: Combine all dry ingredients except chocolate chips and peanut. In a separate bowl, combine wet ingredients excluding the boiled water. Gradually add the dry ingredients to the wet ingredients, mixing until just combined. Avoid overmixing.

Fig. 12 combining all dry and wet ingredients

Step 6: Slowly pour in the boiled water, mixing gently until the batter is smooth and strain to make sure all dry ingredients are fully incorporated. Then, mix the chocolate chips in the batter.

Fig. 13 mixing of ingredients

Step 7: Pour the batter into the prepared pan. Sprinkle with ground peanuts, spreading evenly. Bake for 45 minutes in the preheated oven.

Fig. 14 pouring the batter into the pan and baking

Step 8: After 45 minutes, insert a toothpick into the center of the snack bar. If it comes out clean (or with just a few moist crumbs), it's done. If not, bake for a few more minutes and check again.

Fig. 15 monitoring the snack bar

Step 9: Remove the pan from the oven and let the snack bar cool completely in the pan on a wire rack.

Fig. 16 removing from the oven and cooling

Step 10: Once cool, carefully lift the snack bar out of the pan using the parchment paper. Cut into bars and pack in a container.

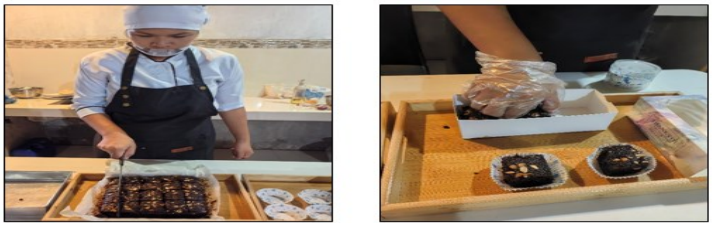

Fig. 17 cutting and packing in a container.

Physicochemical composition of the Antipolo fruit seed flour and the nutritional value of a snack bar

REPORT OF CHEMICAL ANALYSIS

Request Reference No. : R13-042025-CHE-0214
Location of Testing : In-house
Date Submitted : April 14, 2025
Date of Analysis : April 14, 2025 (Moisture, Ash Content, Total Fat)
April 14 – 15, 2025 (Crude Protein)
April 15 & 21, 2025 (Sodium)
Date of Issue : April 25, 2025
Sample Submitted : *Antipolo Snack Bar*
Submitted by : *Liza B. Valiente*
Address : *Surigao del Norte State University – Narciso Street, Surigao City, Surigao del Norte*
Contact Number : *09672569604*
Page : Page 1 of 2

Sample Code	Sample	Description	Parameter	Result
CHE – 0350	*Antipolo Snack Bar*	2x 158g sample in sealed PE bag	Moisture	**39.07 g/100g**
			Ash Content	**1.45 g/100g**
			Crude Protein	**5.45 g/100g***
			Total Fat	**7.56 g/100g***
			Sodium	**146.34 mg/100g***

* Test results which are outside the laboratory's scope of accreditation

Fig. 18 result on the physicochemical analysis of the developed snack bar

Figure 18 disclose the physicochemical analysis for develop Antipolo snack bar. The analysis presents quantitative measurements of major components in a 150g sample. The results indicate that Antipolo Snack Bar contains significant moisture (39.97 g/100g), substantial ash content (4.45 g/100g), moderate crude protein (8.44 g/100g), and remarkably high total fat content (148.34 mg/100g). The sequential testing dates listed (April 14-15 for crude protein, April 16 for ash content, April 17 for moisture and total fat) suggest a methodical analysis process. This quantitative data complements the previous reports by providing specific measurements of macronutrients, confirming that Antipolo Snack Bar are particularly fat-rich while containing modest amounts of protein and minerals (represented by ash content).

REPORT OF COMPUTATION OF NUTRITION FACTS

Request Reference No. : R13-042025-CHE-0215
Location of Testing : In-house
Date Submitted : April 14, 2025
Date of Computation : April 25, 2025
Date of Issue : April 25, 2025
Sample Submitted : *Antipolo Snack Bar*
Submitted by : *Liza B. Valiente*
Address : *Surigao del Norte State University / Narciso Street, Surigao City, Surigao del Norte*
Contact Number : *09672569604*
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Food Nutrient	Result of Chemical Analysis (per 100g)*	Amount of Food Nutrient per Serving Size (Rounded Value)	% Daily Value (based on 2000 Calorie Diet, Rounded Value)**	% RENI (based on FNRI reference adult requirement of males 19-29 years old)
Calories	275.72	140		5
Calories from Fat	68.04	35		
Total Fat (g)	7.56	4	5	
Sodium (mg)	146.34	75	3	
Total Carbohydrates (g)	46.47	23	8	
Protein (g)	5.45	3	6	4

*Based on the Report of Chemical Analysis
** The % Daily Value is based on the New Nutrition Facts Labeled finalized May 20, 2016

Fig. 19 result on nutritional facts testing for the developed snack bar

Figure 19 discloses the nutritional analysis provides detailed information per serving size, showing that Antipolo Snack Bar are highly caloric at 278.72 calories per serving (14% of daily value). They contain substantial fat with 30.14g total fat (46% daily value) and significant sodium at 146.34mg (7% daily value). The protein content is also notable at 16.35g per serving (33% daily value), while the carbohydrate content appears minimal with no percentage listed. This report complements the previous chemical analysis by translating the raw nutritional data into consumer-relevant daily value percentages based on a 2000 calorie diet, following the FNRI reference adult requirement for males 19-29 years. The footnote indicates this computation is based on previous chemical analysis results, providing a complete nutritional profile that would be relevant for food labeling or dietary assessment purposes.

RECOMMENDATIONS

1. Highlight the high protein and fat content of the Antipolo snack bar as a key nutritional benefit in marketing materials.
2. Consider investigating other parts of the Antipolo fruit for phytochemical content, since the seed showed no secondary metabolites.
3. Include carbohydrate values in the nutritional label to give a more complete dietary profile for consumers.
4. Explore flavor enhancements for the snack bar, as the absence of natural phytochemicals may result in a bland taste.
5. Standardize preparation and storage procedures to maintain the quality and shelf life of the Antipolo seed flour.

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PAGHAHANDA NG MGA LESSON SCRIPT PARA SA CATCH-UP FRIDAYS NG FILIPINO 7 AT ANTAS NG KASIYAHAN SA PAGKATUTO NG MGA MAG-AARAL

PREPARATION OF LESSON SCRIPTS FOR CATCH-UP FRIDAYS IN FILIPINO 7 AND THE LEVEL OF STUDENT SATISFACTION IN LEARNING

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ABSTRACT

This study aimed to develop and evaluate proposed lesson scripts for Catch-Up Fridays in Filipino 7 at Isabela National High School, using the ADDIE model. The level of students' satisfaction and its differences based on gender were examined, using surveys and statistical analyses such as ANOVA. It was found that students showed high levels of satisfaction with the lesson scripts, although there were differences in preferences based on gender, with females more valuing activities related to learning style and cultural context, while males more valuing skill acquisition. The use of proposed lesson scripts and the consideration of gender differences in lesson design, including the creation of an inclusive learning environment, were recommended.

Keywords: lesson scripts, Catch-Up Fridays, students' learning satisfaction

Ang pag-aaral na ito ay naglalayong bumuo at ebalwahin ang mga panukalang lesson scripts para sa Catch-Up Fridays sa Filipino 7 sa Isabela National High School, gamit ang ADDIE model. Sinuri ang antas ng kasiyahan ng mga mag-aaral at ang pagkakaiba nito batay sa kasarian, gamit ang mga sarbey at statistical analysis tulad ng ANOVA. Natuklasan na ang mga mag-aaral ay nagpakita ng mataas na antas ng kasiyahan sa mga lesson scripts, bagama't may mga pagkakaiba sa kagustuhan batay sa kasarian, kung saan ang mga babae ay mas pinahahalagahan ang mga aktibidad na may kaugnayan sa istilo ng pag-aaral at kontekstong kultural, habang ang mga lalaki ay mas pinahahalagahan ang pagtatamo ng kasanayan. Inirekomenda ang paggamit ng mga panukalang lesson scripts at ang pagsasaalang-alang sa pagkakaiba ng kasarian sa pagdidisenyo ng mga aralin, kasama ang paglikha ng inklusibong kapaligiran sa pag-aaral.

Mga susing salita: lesson scripts, Catch-Up Fridays, kasiyahan sa pagkatuto ng mga mag-aaral

PANIMULA

Ang pinakamahalagang bahagi o aspeto ng ating buhay ay ang edukasyon. Ito ang nagiging daan upang maabot ang ating pangarap sa buhay at upang maging handa sa mga hamon sa hinaharap. Ayon sa DepEd, ang kalidad ng edukasyon ay nagiging pundasyon ng isang progresibong lipunan. Sa pamamagitan ng pagtuturo at pagkatuto, nahuhubog ang mga indibidwal upang maging kapaki-pakinabang na miyembro ng komunidad, kaya't isang mahalagang aspeto ng personal at pambansang pag-unlad (Department of Education, 2021). Kaya't hindi maikakaila na ang edukasyon ang pundasyon tungo sa maunlad na lipunan. Sa bawat silid-aralan, sa bawat libro, sa bawat karanasan na ating natutututuhan, hinuhubog nito ang ating kinabukasan.

Sa pagpapatupad ng K-12 kurikulum sa batayang edukasyon, may mga kagamitan sa pagtuturo ng mga asignatura kabilang na ang asignaturang Filipino ang ipinanukala ng Kagawaran ng Edukasyon (DepED) sa hangaring matugunan ang mga pangangailangan sa pagkatuto ng mga mag-aaral. Ang mga kagamitang ginagamit ng mga mag-aaral sa sekundarya sa mga asignaturang Filipino ay naglalayong malinang ang iba't ibang kakayahan ng mga mag-aaral tulad na lamang ng kakayahang pangkomunikatibo, kasanayan sa pagsulat (sulating pampanitikan, ng mga pananaliksik) at iba pang kakayahang maaari nilang magamit sa buhay (Department of Education, 2017).

Ayon sa Department of Education (2020) ang mga guro ay dapat gumamit ng iba't ibang uri ng kagamitan sa pagtuturo, kabilang ang mga printed materials (textbooks, workbooks), digital resources (videos, online modules), at iba pang interactive tools (apps, websites). Sa pamamagitan ng mga ito, naisasama ng mga guro ang iba't ibang estilo ng pagkatuto, kaya mas naaabot ang mas malawak na hanay ng mga mag-aaral na may iba't ibang pangangailangan at kakayahan.

Ang mga learning resources ay dapat na direkta at angkop sa mga learning competencies na itinakda sa K to 12 curriculum. Ang mga guro ang may responsibilidad na tiyakin na ang mga kagamitan sa pagtuturo ay nakapokus sa mga itinakdang layunin at layunin ng kurikulum. Ang tamang paggamit ng mga resources ay nagbibigay ng mas epektibong paraan upang maabot ang mga inaasahang resulta ng pagkatuto.

Ayon sa DepEd Order No. 42, s. 2016, na kilala bilang "Policy Guidelines on Daily Lesson Preparation for the K to 12 Basic Education Program", ang mga guro mula sa Grades 4 hanggang 12 ay kailangang maghanda ng Daily Lesson Log (DLL) o Detailed Lesson Plan (DLP). Ito ang nagbibigay ng malinaw na patnubay sa paghahanda ng mga plano para sa pagtuturo ng mga guro upang matiyak ang epektibong pagtuturo at pagkatuto ng mga mag-aaral sa loob ng K to 12 Basic Education Program. Layunin ng patakarang ito na masigurado ang maayos na pagkatuto ng mga mag-aaral at mabigyan ng sapat na gabay ang mga guro sa kanilang pagtuturo. Itinatakda ng order na ang lesson preparation ay mahalaga para matugunan ang learning competencies na nakasaad sa curriculum.

Ayon kay Valencia (2019), habang ang lesson plan ay isang pangkalahatang plano na nagsasaad ng layunin, nilalaman, at mga materyales sa pagtuturo, ang lesson script naman ay mas detalyado, nagbibigay ito ng eksaktong linya o diyalogo na maaaring gamitin ng guro, lalo na sa mga kritikal na bahagi ng aralin, gaya ng pag-introduce ng mga bagong konsepto at paglilinaw sa mga mahihirap na ideya.

Ang lesson script ay maaaring ituring na bahagi ng mas detalyadong lesson plan o lesson guide, kung saan nakalista ang mga aktibidad, mga gagamiting tanong, at mga pamamaraan ng pagtuturo. Gayunpaman, ang "lesson script" bilang isang opisyal na dokumento ay maaaring maiangkop o maipaliwanag bilang bahagi ng isang detailed lesson plan (DLP) na itinatakda rin sa nasabing DepEd Order.

Ang MATATAG Curriculum, na bahagi ng mas malaking edukasyonal na reporma ng Department of Education (DepEd) sa Pilipinas, ay naglalayong mapabuti ang kalidad ng edukasyon sa pamamagitan ng pag-aayos ng kurikulum, pagpapalalim ng nilalaman ng mga aralin, at pagbigay-pansin sa mga pangunahing kasanayan. Isa sa mga estratehiya sa ilalim ng MATATAG Curriculum ay ang Catch-Up Friday, na may mga partikular na layunin sa pagtuturo. Sa pamamagitan ng epektibong lesson scripts para sa Catch-Up Fridays, nagkakaroon ng oportunidad ang mga guro na mas maayos na matugunan ang mga pangangailangan ng mga mag-aaral na nahuhuli sa pagkatuto. Ang mga nakalaang oras na ito ay nagbibigay ng espasyo para sa remediation, nagsusulong ng self-directed learning, at nagbibigay suporta sa mga guro, na nagiging mahalagang bahagi ng patuloy na ebalwasyon ng mga materyales sa pagtuturo. Sa ganitong paraan, ang pananaliksik na ito ay naglalayong hindi lamang mas mapalalim ang pag-unawa sa mga prinsipyo ng MATATAG Curriculum kundi pati na rin sa pagpapaunlad ng mga estratehiya sa pagtuturo na makikinabang sa lahat ng mag-aaral.

Ang Catch-Up Friday sa edukasyon ay ipinatupad alinsunod sa DepEd Memorandum No. 001, s. 2024. Layunin nitong bigyang-pokus ang pagbasa at pagbibigay ng kaukulang pansin sa values education, peace education, at health education tuwing Biyernes. Ayon sa DepEd, ang programa ay naglalayon na maitaguyod ang kasanayan sa pagbasa ng mga mag-aaral at matugunan ang learning gaps.

Isa pang mahalagang aspeto ng patnubay ay ang papel ng guro sa pagsubaybay at pagsusuri ng epekto ng mga learning resources sa pagkatuto ng mga mag-aaral. Dapat nilang tiyakin na ang mga materyales ay nagdudulot ng positibong epekto sa mga mag-aaral at sumusuporta sa kanilang akademikong paglago. Ang paghahanda at ebalwasyon ng lesson script ay mahalagang bahagi ng proseso ng pagtuturo, lalo na sa asignaturang Filipino 7. Sa yugtong ito ng edukasyon, kinakailangang magkaroon ng masusing pagpaplano ang mga guro upang epektibong maituro ang mga kasanayan sa wika, panitikan, at komunikasyon. Ang lesson script ay isang detalyadong gabay na tumutulong sa guro na magkaroon ng organisadong paraan ng pagtuturo. Nagbibigay ito ng malinaw na direksyon sa kung paano ituturo ang bawat paksa, mula sa pagbibigay ng instruksyon hanggang sa pagsasagawa ng mga interaktibong aktibidad na layong magpalalim ng pang-unawa ng mga mag-aaral.

Sa asignaturang Filipino 7, kung saan sakop ang masalimuot na aspeto ng wika at panitikan, ang isang mahusay na lesson script ay naglalaman ng mga estratehiyang magpapasigla sa interaksyon ng guro at mag-aaral. Kabilang dito ang mga teknik na magpapaunlad sa kakayahang mag-analisa ng mga teksto, magsuri ng mga konteksto, at makipagdiskusyon nang aktibo. Gayundin, mahalaga ang ebalwasyon ng lesson script upang matukoy kung epektibo ang mga ginamit na pamamaraan ng pagtuturo at kung paano ito maitutugma sa pangangailangan ng mga mag-aaral. Sa pamamagitan ng ebalwasyon, masusuri ng guro kung ang layunin ng aralin ay naabot at kung ang mga mag-aaral ay nagpakita ng progreso sa kanilang pagkatuto.

Dahil dito, ang paghahanda at ebalwasyon ng lesson script sa Filipino 7 ay isang mahalagang hakbang upang matiyak na ang mga aralin ay naiaangkop sa mga layuning pang-edukasyon, at ang mga mag-aaral ay nagkakaroon ng mas malalim na pag-unawa at kasanayan sa paggamit ng wikang Filipino. Kaya, ang mananaliksik na ito ay lubhang naniniwala sa masidhing pangangailangan ng mga kagamitang tulad nito kaya nga't ang pag-aaral na ito ay naglalayong makapaghanda ng mga lesson script para sa Catch-Up Friday sa Filipino 7. Naniniwala ang mananaliksik na ito na sa pamamagitan ng ihahandang mga lesson script ay makatutulong ito sa kanyang pagtugon sa pangangailangan sa pagkatuto ng mga mag-aaral at matutulungan silang makaangkop at makasabay sa bigla at mabilis na pagbabago ng sistema ng pagtuturo at pag-aaral.

PAGLALAHAD NG SULIRANIN

Ang pag-aaral na ito ay may layuning makapagpanukala ng mga lesson script para sa Catch-Up Fridays ng Filipino 7 sa Isabela National High School. Sasagutin sa pag-aaral na ito ang mga sumusunod na tiyak na tanong:

1. Ano ang profayl ng mga mag-aaral sa Grade 7 batay Sa kasarian?
2. Ano ang antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa mga sesyon ng Catch-Up Fridays gamit ang mga panukalang lesson scripts?
3. Ano ang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa mga sesyon ng Catch-Up Fridays?

METODO

Disenyo ng Pananaliksik

Ginamit sa pag-aaral na ito ang pagdidisenyo at debelopment na pamaraan ng pananaliksik. Gamit ang modelong Analysis, Design, Development, Implement, Evaluate (ADDIE). Sa paghahanda ng ipapanukalang mga lesson script sa Filipino para sa mga mag-aaral sa Grade 7 sa Junior High School. Ang modelong ito ay kinapapalooban ng apat na yugto sa pagdebelop ng mga kagamitang panturo: pagpaplano, pagdebelop ng mga modyul, pagbalideyt at pag-ebalweyt na batay sa modelong Analysis, Design, Development, Implement, Evaluate (ADDIE) sa pagdebelop ng kagamitang pampagtuturo.

Mga Kalahok sa Pag-aaral

Mayroong tatlo (3) na mga dalubhasa sa pagsulat ng script na mag-eebalweyt sa mga inihandang mga lesson script. Sila ay mga propesor/guro na may medyor sa Filipino at nagtuturo ng asignaturang Filipino sa Isabela National High School City of Ilagan, Isabela at Isabela State University-Echague Campus at higit sa tatlong taon ng nagtuturo sa paaralan.

Ang anim na seksyon ng mga mag-aaral na tinuturuan ng mananaliksik sa Isabela National High School na nasa Grade 7 ang gagamiting kalahok ng mananaliksik.

Talahanayan 1. Distribusyon ng Bilang ng mga Mag-aaral

Antas	Bilang ng Mag-aaral	Bilang ng Tagatugon	Bahagdan
SSS-Nepomuceno	20	13	9.26
BEC-Dalton	40	26	18.52
BEC-Darwin	37	24	17.13
BEC-Edison	40	26	18.52
BEC-Franklin	39	25	18.06
BRC-Roentgen	40	26	18.52
Kabuuan	**216**	**140**	**100.00**

Lokasyon ng Pag-aaral

Isasagawa ang pag-aaral sa Isabela National High School na matatagpuan sa Claravall St. San Vicente, City of Ilagan, Isabela.

Instrumentong Ginamit sa Pananaliksik

Sa pangangalap ng datos, ginamit ng mananaliksik ang mga 1) tseklist ng ebalwasyon ng eksperto tungkol sa lesson script na gagamitin; 2) tseklist ng ebalwasyon ng mga mag-aaral tungkol sa lesson script na gagamitin.

Ang tseklist ng ebalwasyon para sa mga guro ay ang Validation Tool for Lesson Scripts ng Deped na isinalin sa Filipino.

Ang tseklist ng ebalwasyong gagamitin ng mga mga mag-aaral upang makita ang kanilang fidbak sa kabisaan ng mga lesson script ay sariling likha na mananaliksik. Ipinabalideyt ang tseklist ng ebalwasyong gagamitin sa tatlong (3) gurong eksperto sa pagtuturo ng wikang Filipino.

Pamamaraan ng Pagkalap ng mga Datos

Ang pag-aaral ay dadaan sa apat na yugto upang maisagawa.

Unang Yugto: Pagpaplano

Tinukoy ng mananaliksik ang mga tiyak na layunin ng mga lesson script para sa Catch-Up Fridays batay sa MATATAG Curriculum Guide kabilang ang mga kasanayan at nilalaman na dapat matutunan ng mga mag-aaral. Gayundin sa pagtukoy ng mga partikular na kakulangan sa mga aralin sa Filipino 7.

Ikalawang Yugto: Pagdisenyo/Pagdebelop

Sa pagsulat ng mga lesson script, isaalang-alang at nabuo ng mananaliksik ang mga sumusunod:

1. Mga Layunin ng Aralin. Batay sa Batay sa mga kasanayan na nasa Matatag Curriculum Guide at nabuong paksa, at sa pangngailangan ng mga mag-aaral, gumawa ng mga tiyak na layunin.
2. Paksa, Batay sa mga kasanayan na nasa Matatag Curriculum Guide at nakalahad na tema, nabuo ang mga sumusunod na paksa.

   Unang Linggo - Ang Kwento ni Lolo Jose
   Ikalawang Linggo – Ang Mammangi Festival
   Ikatlong Linggo – Si Lino sa Queen Isabela Park
   Ikaapat na Linggo – Binnallay: Higit Pa sa Isang Kakanin, Isang Salamin ng Pananampalataya at Kasaysayan
   Ikalimang Linggo – Ang mga Kabataang Ilagueño
   Ikaanim na Linggo – Undas: Isang Pagsasama ng Paniniwala at Modernidad

3. Mga Kagamitang Panturo. Pumili ang mananaliksik ng kagamitang panturo na angkop sa paksa at kakayahan ng mga mag-aaral.
4. Integrasyon. Ang mga talakayan sa mga lesson script ay kailangang kaugnay, alinman sa Peace Education, Health Education, Values Education, at Reading
5. Gawaing Pamukaw-kaalaman. Ito ay ang bahagi ng lesson script na gaganyak sa mga mag-aaral.
6. Gawaing Paglalahad ng Layunin ng Aralin, Ito ay ang bahagi ng lesson script na maglilinaw sa mga mag-aaral ng mga inaasahang matamo ng mga ito.
7. Gawaing Pag-unawa sa mga Susing-Salita/Parirala o Mahahalagang Konsepto sa Aralin. Ito ay ang bahagi ng lesson script na magbibigay linaw sa katangian ng teksto at kahulugan ng mga salitang ginamit.
8. Pagbasa sa Susing Kaalaman/Ideya. Ang bahagi ng lesson script na nagpapakita sa paraan ng pagbabasa ng mga mag-aaral sa kabuuan ng teksto.
9. Pagpapaunlad ng Pag-unawa sa Susing Kaalaman/Ideya. Ang bahagi ng lesson script na nagtatalakay sa nilalaman ng teksto.
10. Pagpapalalim ng Pag-unawa sa Susing Kaalaman/Ideya, Ang bahagi ng lesson script na nagbibigay ng mga pangkatang gawaing hinggil sa paksa.
11. Paglalahat. Ang bahagi ng lesson script na nagbibigay ng panapos na katanungan sa mga mag-aaral.
12. Pagtataya. Ang bahagi ng lesson script na nagbibigay ng isang maikling pagsusulit sa mga mag-aaral.
13. Mga Dagdag na Gawain para sa Paglalapat o para sa Remediation. Ang bahagi ng lesson script na nagpapakita ng mga gawaing ibibigay sa mga mag-aaral bilang takdang-aralin kung kinakailangan lamang.

Ikatlong Yugto: Pagbalideyt

Upang maging balid ang nabuong mga lesson scripts ito dadaan sa masusing pagsusuri ng mga guro ng wika gamit ang Validation Tool for Lesson Script ng DepEd.

Ikaapat na Yugto: Implementasyon/Ebalwasyon

Para masuri ang dinebelop na lesson script, gagamitin ng mananaliksik ang mga nabuong lesson script. Pagkatapos ng talakayan sa bawat paggamit ng mga lesson script, kukunin ang fidbak ng mga mag-aaral ang kabisaan ng mga ito sa pamamagitan ng paggamit ng sarbey na talatanungan.

Instrumentong Pang-istadistika

1. Ang ebalwasyon ng mga guro sa bawat aspeto ng mga lesson script at ng ebalwasyon ng mga mag-aaral ay binigyan ng interpretasyon gamit ang mean ng kanilang ebalwasyon.
   Magiging gabay ang mga sumusunod na iskala at deskripsyon:

Mean	Pagpapakahulugan	Kaukulang Paglalarawan
3.50-4.0	Lubos na Sumasang-ayon	Napakahusay
2.50-3.49	Sumasang-ayon	Mahusay
1.50-2.49	Hindi sumasang-ayon	Medyo Mahusay
1.0-1.49	Lubos na Hindi Sumasang-ayon	Hindi nakatugon sa inaasahan

2. Ang inter-rater agreement sa resulta ng ebalwasyon ng mga guro sa lahat ng mga aspeto ng mga modyul ay tinuos gamit ang mean ng kanilang mga ebalwasyon at bahagdan ng konsistinsi ng mean ng kanilang ebalwasyon.
3. Ginamit ang ANOVA sa pagsusuri sa kung may mahalagang pagkakaiba sa ebalwasyon ng mga mag -aaral sa modyul kung mapapangkat sila sa kanilang strand na kinabibilangan.

RESULTA

Talahanayan 1. Profayl ng mga Mag-aaral

Profayl ng mga Mag-aaral	Frequency (n = 140)	Percent (100.0)
Kasarian		
Lalaki	75	53.6
Babae	65	46.4

Hinggil sa kasarian ng mga mag-aaral, makikita sa talahanayan na mas nakahihigit ang mga lalaki na may bilang na 75 (53.6%) kaysa sa mga babae na may bilang na 65 (46.4%).

Talahanayan 2. Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa mga Aralin ng Catch-Up Fridays Gamit ang mga Panukalang Lesson Scripts

Kasiyahan sa Pagkatuto sa mga Aralin ng Catch-Up Fridays Gamit ang mga Panukalang Lesson Scripts	Aralin 1		Aralin 2		Aralin 3		Aralin 4		Aralin 5		Aralin 6	
	Mean	DE	Mean	DE	Mean	DE	Mean	DE	Mean	DE	Mean	DE
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	3.48	N	3.52	LN	3.45	N	3.52	LN	3.50	LN	3.55	LN
Ang mga paksang sakop ay malalim at komprehensibo.	3.44	N	3.71	LN	3.57	LN	3.70	LN	3.64	LN	3.61	LN
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	3.62	LN	3.61	LN	3.62	LN	3.76	LN	3.55	LN	3.71	LN
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	3.63	LN	3.70	LN	3.65	LN	3.71	LN	3.71	LN	3.69	LN
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	3.57	LN	3.63	LN	3.63	LN	3.68	LN	3.61	LN	3.72	LN
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	3.63	LN	3.72	LN	3.67	LN	3.69	LN	3.72	LN	3.72	LN
Ang nilalaman ay napapanahon.	3.43	N	3.67	LN	3.66	LN	3.67	LN	3.58	LN	3.59	LN
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	3.60	LN	3.65	LN	3.67	LN	3.63	LN	3.66	LN	3.72	LN
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	3.65	LN	3.62	LN	3.65	LN	3.72	LN	3.62	LN	3.70	LN
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	3.52	LN	3.69	LN	3.66	LN	3.62	LN	3.70	LN	3.65	LN
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	3.50	LN	3.67	LN	3.70	LN	3.78	LN	3.64	LN	3.66	LN
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	3.62	LN	3.64	LN	3.69	LN	3.72	LN	3.72	LN	3.65	LN
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	3.57	LN	3.59	LN	3.63	LN	3.62	LN	3.65	LN	3.60	LN
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	3.66	LN	3.59	LN	3.69	LN	3.70	LN	3.64	LN	3.63	LN
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	3.55	LN	3.65	LN	3.65	LN	3.72	LN	3.67	LN	3.65	LN
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	3.56	LN	3.70	LN	3.65	LN	3.65	LN	3.72	LN	3.71	LN
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	3.60	LN	3.68	LN	3.70	LN	3.72	LN	3.66	LN	3.67	LN
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	3.58	LN	3.72	LN	3.70	LN	3.75	LN	3.79	LN	3.67	LN

Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN)

Ipinakikita sa talahanayan ang antas ng kasiyahan ng mga mag-aaral sa mga aralin ng Catch-Up Friday gamit ang mga panukalang Lesson Scripts na kung saan karamihan sa mga mean scores ay nasa saklaw ng "Lubos na Nasiyahan." Ipinapahiwatig nito na sa pangkalahatan, maganda ang naging karanasan ng mga mag-aaral sa mga aralin na ito. Makikitang walang pagkakaiba sa antas ng kasiyahan sa anim na aralin na nagpapakita ng pagkaroon ng pantay-pantay na positibong karanasan sa lahat ng sesyon. Sa kabilang banda, may mga ilang indikeytor partikular sa Aralin 1 at Aralin 3 na nasa antas “Nasiyahan” na may kaugnayan sa mga paksa ng kurikulum at ang kaugnayan ng nilalaman. Binibigyang-diin nito

ang pangangailangan para sa mas mahusay na pagsusuri hinggil sa mga aspetong ito. Gayunpaman, ipinahihiwatig nito na ang mga mag-aaral ay nakadarama ng mataas na antas ng kasiyahan sa pag-unawa, pagsusuri, pakikilahok, kaugnayan sa kultura, inclusivity, at suporta ng nilalamang nakaayon sa kanilang mga estilo ng pagkatuto. Bukod dito, itinuturing ng mga mag-aaral ang mga aktibidad at takdang-aralin na praktikal, mapanghamon, at kapaki-pakinabang sa pagpapaunlad ng mga pangunahing kasanayan. Samakatuwid, bagaman may mga aytem na nangangailangan ng pagpapabuti, ang mga panukalang Lesson Scripts ng mga aralin sa Catch-Up Fridays ay epektibo sa pagbibigay ng kasiya-siyang karanasan sa pagkatuto ng mga mag-aaral.

Talahanayan 3. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 1 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	-1.42 ns	.15
Ang mga paksang sakop ay malalim at komprehensibo.	1.22 ns	.22
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	-1.03 ns	.30
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	1.42 ns	.15
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	.04 ns	.96
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	-.91 ns	.36
Ang nilalaman ay napapanahon.	.42 ns	.67
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	-1.84 ns	.06
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	-.60 ns	.55
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	.29 ns	.77
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	.62 ns	.53
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	-.05 ns	.96
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	1.16 ns	.24
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	1.13 ns	.26
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	1.00 ns	.31
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	-.72 ns	.46
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	-.97 ns	.33
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	1.46 ns	.14

Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN); ns = not significant at 0.05 level

Makikita sa Talahanayan # na walang pagkakaiba sa antas ng kasiyahan ng mga lalaki at babae sa Catch-Up Friday Session para sa Aralin 1. Ang mga p-value ay mas mataas sa 0.05, na nagpapahiwatig na ang mga pagkakaibang ito ay hindi makabuluhan. Parehong ang mga lalaki at babae ay nagsasabi ng mataas na antas ng kasiyahan sa iba't ibang aspeto ng mga sesyon, kabilang ang kaugnayan ng paksa, nilalaman, mga aktibidad, at pagkatuto. Ipinapahiwatig nito na ang Catch-Up Friday Session ay epektibo sa pagbibigay ng kasiya-siyang karanasan sa pagkatuto para sa parehong kasarian, at walang kinakailangang mga pagbabago batay sa kasarian upang mapabuti ang sesyon.

Samakatuwid, ang haypotesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 1 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay tinatanggap. Ang mga natuklasan sa pag-aaral na ito ay nagpapakita na ang panukalang Lesson Script ay epektibo sa pagbibigay ng pantay na kasiyahan sa parehong lalaki at babae. Gayunpaman, mahalaga na isaalang-alang ang mga natuklasan mula sa mga pag-aaral tulad ng kay Dang et al. (2016), na nagpapakita ng pagkakaiba sa kung paano nararanasan ng mga lalaki at babae ang mga karanasan sa pag-aaral, lalo na sa mga kontekstong may kinalaman sa teknolohiya at blended learning. Bagamat sa pag-aaral na ito ay walang nakitang pagkakaiba, dapat pa rin na maging sensitibo sa mga potensyal na pagkakaiba sa pangangailangan at kagustuhan ng mga mag-aaral batay sa kasarian kapag naghahanda ng mga lesson script sa anumang asignatura.

Talahanayan 4. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 2 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	.30 ns	.76
Ang mga paksang sakop ay malalim at komprehensibo.	-.96 ns	.33
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	1.01 ns	.31
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	.17 ns	.85
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	-.93 ns	.34
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	.33 ns	.73
Ang nilalaman ay napapanahon.	1.11 ns	.26
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	-2.07*	.04
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	.29 ns	.76
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	-2.24*	.02
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	-.12 ns	.90
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	2.04*	.04
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	-1.19 ns	.23
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	-2.20*	.02
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	-.10 ns	.91
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	-.38 ns	.70
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	-.88 ns	.37
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	.68 ns	.49

*Legend: 3.50-4.00 = Lubhang Nasiyahan (LN); * = significant; ns = not significant at 0.05 level*

Makikita sa talahanayan na karamihan sa mga indikeytor ay walang pagkakaiba sa antas ng kasiyahan sa pagitan ng mga lalaki at babae. Gayunpaman, may ilang mga partikular na aspeto na nagpapakita ng makabuluhang pagkakaiba. Ang mga babae ay nagpakita ng mas mataas na antas ng kasiyahan pagdating sa kung paano sinusuportahan ng nilalaman ang kanilang istilo ng pag-aaral (p-value = 0.04,) kung gaano kapraktikal at naaangkop sa totoong sitwasyon ang mga aktibidad (p-value = 0.02,) at kung paano nakakatulong ang mga aktibidad sa pagbuo ng kritikal na pag-iisip (p-value = 0.02.) Sa kabilang banda, ang mga lalaki ay nagpakita ng mas mataas na antas ng kasiyahan sa kung gaano nila nakukuha ang mahahalagang kasanayan at kaalaman mula sa Catch-Up Fridays (p-value = 0.04.) Sa kabila ng mga pagkakaibang ito, ang parehong kasarian ay nagpakita ng mataas na antas ng kasiyahan sa pangkalahatan. Ipinapahiwatig nito na bagaman may mga partikular na aspeto ng aralin na mas nakakaakit sa bawat kasarian, ang Catch-Up Fridays Session ay epektibo sa pagbibigay ng kasiya-siyang karanasan sa pagkatuto para sa parehong mga lalaki at babae.

Samakatuwid, ang haypostesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 2 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay hindi tinatanggap. Ang mga resultang ito ay nagpapatunay na ang mga salik na nakakaapekto sa kasiyahan sa pag-aaral ay maaaring mag-iba depende sa kasarian, tulad ng ipinakita sa pag-aaral nina Dang et al. (2016) kung saan natuklasan nila ang mga pagkakaiba sa kung paano nararanasan ng mga lalaki at babae ang pag-aaral sa blended learning environment, lalo na sa mga salik tulad ng computer self-efficacy, perceived accomplishment, at perceived enjoyment.

Talahanayan 5. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 3 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	-.75 ns	.45
Ang mga paksang sakop ay malalim at komprehensibo.	-2.02*	.04
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	.83 ns	.40
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	-1.08 ns	.27
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	-.23 ns	.81
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	-.68 ns	.49
Ang nilalaman ay napapanahon.	.06 ns	.94
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	-2.53*	.01
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	-.09 ns	.92
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	-.93 ns	.35

Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	-.53 ns	.59
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	-.32 ns	.74
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	-.93 ns	.34
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	-1.06 ns	.29
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	-1.54 ns	.12
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	-.78 ns	.43
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	-.16 ns	.86
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	-1.54 ns	.12

*Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN); * = significant; ns = not significant at 0.05 level*

Makikita sa Talahanayan ang pagkakaiba sa antas ng kasiyahan ng mga mag-aaral sa Catch-Up Friday Session para sa Aralin 3 batay sa kasarian. Makikita na sa pangkalahatan, walang malaking pagkakaiba sa pagitan ng mga lalaki at babae. Karamihan sa mga mag-aaral, anuman ang kasarian, ay nagpahayag ng mataas na antas ng kasiyahan sa iba't ibang aspeto ng sesyon. Gayunpaman, kapansin-pansin na may dalawang aspeto kung saan nagkaiba ang kanilang pananaw: ang mga paksang sakop ay malalim at komprehensibo (p-value = 0.04) at ang paraan kung saan sinusuportahan ng nilalaman ang kanilang istilo ng pag-aaral (p-value = 0.01.) Mas positibo ang mga babae sa puntong ito, na nagpapahiwatig na maaaring mas nararamdaman nila na ang nilalaman ng aralin ay mas angkop sa kanilang paraan ng pag-aaral kumpara sa mga lalaki. Sa kabila ng pagkakaibang ito, ang pangkalahatang antas ng kasiyahan ay nananatiling mataas para sa parehong grupo.

Samakatuwid, ang haypostesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 3 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay hindi tinatanggap. Ang mga resultang ito ay nagpapatunay na ang mga salik na nakakaapekto sa kasiyahan sa pag-aaral ay maaaring mag-iba depende sa kasarian at edad, tulad ng ipinakita sa pag-aaral nina Yang, Hsu, at Chen (2016) kung saan natuklasan nila ang interaktibong epekto ng edad at kasarian sa kasiyahan sa pag-aaral ng mga nakatatandang mag-aaral.

Talahanayan 6. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 4 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	1.13 ns	.25
Ang mga paksang sakop ay malalim at komprehensibo.	-.01 ns	.98
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	1.05 ns	.29
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	-.21 ns	.83
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	.51 ns	.60
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	-1.09 ns	.27
Ang nilalaman ay napapanahon.	1.27 ns	.20
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	.11 ns	.91
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	-.97 ns	.32
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	-1.68 ns	.09
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	-1.65 ns	.10
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	.49 ns	.62
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	-.05 ns	.96
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	-.75 ns	.45
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	-.62 ns	.53
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	.44 ns	.66
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	-1.79 ns	.07
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	-.87 ns	.38

Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN); ns = not significant at 0.05 level

Makikita sa talahanayan ang pagkakaiba sa antas ng kasiyahan ng mga mag-aaral sa Aralin 4 ng Catch-Up Fridays gamit ang panukalang lesson script batay sa kasarian. Sa pangkalahatan, walang makabuluhang pagkakaiba sa antas ng kasiyahan sa pagitan ng mga lalaki at babae sa araling ito. Parehong ipinahiwatig ng mga lalaki at babae na sila ay "Lubhang Nasiyahan" sa iba't ibang aspeto ng

aralin. Walang p-value na mas mababa sa 0.05, na nagpapakita na ang anumang maliit na pagkakaiba sa mean scores ay hindi estadistikang makabuluhan. Ito ay nagpapahiwatig na ang panukalang lesson script para sa Aralin 4 ay epektibo sa pagtugon sa mga pangangailangan at inaasahan ng parehong lalaki at babaeng mag-aaral.

Sa kabuuan, ang haypotesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 4 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay tinatanggap. Ang mga natuklasan sa pag-aaral na ito ay nagpapakita na ang panukalang Lesson Script ay epektibo sa pagbibigay ng pantay na mataas na antas ng kasiyahan sa parehong lalaki at babae para sa araling ito. Gayunpaman, mahalaga na isaalang-alang ang mga natuklasan mula sa mga pag-aaral tulad ng kay Leong et al. (2021), na nagpapakita ng potensyal na pagkakaiba sa kung paano nararanasan ng mga lalaki at babae ang mga karanasan sa pag-aaral, lalo na sa mga kontekstong may kinalaman sa internet self-efficacy. Bagamat sa pag-aaral na ito ay isang indikeytor lamang mayroong pagkakaiba, dapat pa ring maging sensitibo sa mga potensyal na pagkakaiba sa pangangailangan at kagustuhan ng mga mag-aaral batay sa kasarian sa paghahanda ng mga lesson script.

Talahanayan 7. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 5 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	-.99 ns	.32
Ang mga paksang sakop ay malalim at komprehensibo.	-1.08 ns	.28
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	-1.89 ns	.06
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	-.48 ns	.63
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	-.69 ns	.48
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	-2.01*	.04
Ang nilalaman ay napapanahon.	.02 ns	.98
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	-.63 ns	.53
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	-.47 ns	.63
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	-.48 ns	.62
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	-1.61 ns	.10
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	-.90 ns	.36
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	-.70 ns	.48
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	-.06 ns	.94
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	-1.42 ns	.15
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	-1.90 ns	.06
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	-1.24 ns	.21
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	-.99 ns	.32

*Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN); * = significant; ns = not significant at 0.05 level*

Makikita sa talahanayan ang antas ng kasiyahan ng mga mag-aaral sa Aralin 5 ng Catch-Up Fridays gamit ang panukalang lesson script. Bagaman mayroong maliit na pagkakaiba sa antas ng kasiyahan sa pagitan ng mga lalaki at babae, partikular sa indikeytor na ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral (p-value = 0.04) kung saan mas mataas ang antas ng kasiyahan ng mga babae. Ang parehong grupo ay nagpakita ng mataas na antas ng kasiyahan sa halos lahat ng aspeto ng aralin. Ito ay nagpapahiwatig na ang panukalang lesson script ay epektibo sa paghahatid ng mga aralin na may kaugnayan, nakakaengganyo, at sumusuporta sa pagkatuto ng mga mag-aaral, anuman ang kanilang kasarian.

Ang haypotesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 5 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay hindi tinatanggap. Ang resultang ito ay sumusuporta sa mga natuklasan sa mga naunang pag-aaral, tulad ng kay Chen et al. (2011), na nagpapakita ng makabuluhang pagkakaiba sa kasiyahan sa pag-aaral batay sa kasarian. Partikular, ipinakita ng kanilang pananaliksik na ang kasiyahan sa pag-aaral ng mga lalaki sa mga larangang dominante ang babae ay positibong nauugnay sa kanilang akademikong identidad at pagpapahalaga sa sarili. Samakatuwid, ang pag-unawa sa mga pagkakaiba sa kasiyahan sa pag-aaral batay sa ka-

sarian ay mahalaga sa pagbuo ng mga epektibong estratehiya sa pagtuturo at pagkatuto, lalo na sa konteksto ng mga programang tulad ng Catch-Up Fridays.

Talahanayan 8. Pagkakaiba sa Antas ng Kasiyahan sa Pagkatuto ng mga Mag-aaral sa Aralin 6 ng Catch-Up Fridays Gamit ang Panukalang Lesson Script batay sa Kanilang Kasarian

Kasiyahan sa Pagkatuto sa Aralin ng Catch-Up Fridays Gamit ang Panukalang Lesson Script	t-value	p-value
Ang mga paksang sakop sa Catch-Up Fridays ay may kaugnayan sa paksang pinag-aaralan.	-1.96 ns	.06
Ang mga paksang sakop ay malalim at komprehensibo.	-1.33 ns	.18
Ang nilalaman ay ipinakita sa paraang madaling maunawaan.	1.23 ns	.21
Ang nilalaman ay ipinakita sa paraang nakakaengganyo at kawili-wili.	-.68 ns	.49
Ang nilalaman ay ipinakita sa paraang may kaugnayan sa kultura.	-2.01*	.04
Ang nilalaman ay ipinakita sa paraang kasama ang lahat ng mga mag-aaral.	-.74 ns	.46
Ang nilalaman ay napapanahon.	-.74 ns	.45
Ang nilalaman ay ipinakita sa paraang sumusuporta sa aking istilo ng pag-aaral.	-.60 ns	.54
Ang mga paksang sakop ay may kaugnayan sa aking mga layunin sa karera o pangarap.	.17 ns	.85
Ang mga aktibidad at takdang-aralin ay praktikal at naaangkop sa mga totoong sitwasyon.	-.09 ns	.92
Ang mga aktibidad at takdang-aralin ay mapanghamon at nakapupukaw ng pag-iisip.	.06 ns	.94
Pakiramdam ko ay nakakakuha ako ng mahahalagang kasanayan at kaalaman sa pamamagitan ng Catch-p Fridays.	-.76 ns	.44
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong hubugin ang kasanayan sa komunikasyon.	-.85 ns	.39
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa kritikal na pag-iisip.	-.58 ns	.55
Ang mga aktibidad at takdang-aralin ay idinisenyo upang tulungan akong bumuo ng mga kasanayan sa paglutas ng problema."	.60 ns	.54
Pakiramdam ko ay epektibo akong natututo tuwing Catch-Up Fridays.	.51 ns	.60
Pakiramdam ko ay lalong tumataas ang aking pag-unawa sa paksa.	.03 ns	.97
Pakiramdam ko ay naa-apply ko ang natutuhan ko sa Catch-Up Fridays sa ibang mga kurso."	-.31 ns	.75

*Legend: 2.50-3.49 = Nasiyahan (N); 3.50-4.00 = Lubhang Nasiyahan (LN); * = significant; ns = not significant at 0.05 level*

Makikita sa Talahanayan 9 ang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 6 ng Catch-Up Fridays gamit ang panukalang lesson script batay sa kanilang kasarian. Ipinapakita ng talahanayan sa pangkalahatan na parehong mataas antas ng kasiyahan ng mga mag-aaral anuman ang kanilang kasarian. Gayunpaman, may isang makabuluhang pagkakaiba partikular sa ikalimang indikeytor na kung saan mas mataas ang antas ng kasiyahan ng mga babae sa kung paano ipinakita ang nilalaman na may kaugnayan sa kultura (p-value = 0.04.) Ipinahihwatig na ang panukalang lesson script ay epektibo sa pangkalahatan, ngunit maaaring may mga pagkakataon kung saan ang kontekstong kultural ay mas nagiging mahalaga sa mga babaeng mag-aaral.

Samakatuwid, ang haypotesis na walang pagkakaiba sa antas ng kasiyahan sa pagkatuto ng mga mag-aaral sa Aralin 6 ng Catch-Up Fridays gamit ang panukalang Lesson Script batay sa kanilang kasarian ay hindi tinatanggap. Ang resulta ng pag-aaral ay nagpapakita ng mga pagkakatulad at pagkakaiba sa mga natuklasan ng mga naunang pananaliksik. Bagaman ang pangkalahatang antas ng kasiyahan ay mataas para sa parehong kasarian, ang makabuluhang pagkakaiba sa kasiyahan na may kaugnayan sa kontekstong kultural, kung saan mas mataas ang antas ng kasiyahan ng mga babae, ay nagpapahiwatig ng mga natatanging pangangailangan at kagustuhan ng mga mag-aaral batay sa kasarian. Ito ay sumasang-ayon sa mga natuklasan nina Yang, Hsu, at Chen (2016) na nagpapakita ng interaktibong epekto ng kasarian sa kasiyahan sa pag-aaral, lalo na sa mga kontekstong may kaugnayan sa kultura. Kaya naman, mahalaga na ang mga lesson script ay sensitibo sa kontekstong kultural at nagtataguyod ng inklusibong kapaligiran sa pag-aaral.

KONKLUSYON

Batay sa mga resulta, ang mga sumusunod na pangunahing konklusyon ay nabuo:

1. Sa pangkalahatan, nagpakita ang mga mag-aaral ng mataas na antas ng kasiyahan sa mga aralin ng Catch-Up Friday, na nagpapahiwatig na ang mga panukalang Lesson Scripts ay epektibo sa paghahatid ng kasiya-siyang karanasan sa pagkatuto.
2. Ang mga babae ay kadalasang nagpapakita ng mas mataas na antas ng kasiyahan sa mga aspetong may kinalaman sa istilo ng pag-aaral, pagiging praktikal ng mga aktibidad, at kontekstong kultural.
3. Ang mga lalaki naman ay nagpapakita ng mas mataas na antas ng kasiyahan sa mga aspetong may kinalaman sa pagtatamo ng mahahalagang kasanayan at kaalaman.
4. Ang mga resulta ay nagpapakita na mahalaga ang pagsasaalang-alang sa mga potensyal na pagkakaiba sa mga pangangailangan at kagustuhan ng mga mag-aaral batay sa kasarian sa paghahanda ng mga lesson scripts.
5. Bagama't mataas ang pangkalahatang antas ng kasiyahan, may mga ilang tiyak na mga indicator na nangangailangan ng pagpapabuti, lalo na sa mga aspetong may kinalaman sa kurikulum at kaugnayan ng nilalaman.
6. Ang mga araling may malinaw na ugnayan sa kultura at kontekstong local ng mga mag-aaral ay higit na nagpapataas sa antas ng kanilang kasiyahan at pag-unawa sa mga paksang tinalakay.

REKOMENDASYON

Batay sa mga resulta, ang mga sumusunod ay iminumungkahi:

1. Gamitin ang mga panukalang lesson script para sa ikatlong kwarter sa Grade 7 bilang pantulong na kagamitan.
2. Dahil napatunayang epektibo ang mga panukalang lesson scripts sa pagpapataas ng kasiyahan at pagkatuto ng mag-aaral, iminungkahi na ipagpatuloy at palawakin pa ang pagbuo at implementasyon ng mga lesson script sa iba pang aralin at baitang upang mapalalim ang kanilang pag-unawa at kasanayan sa asignaturang Filipino.
3. Batay sa natukoy na pagkakaiba sa kasiyahan sa ilang aspeto , inirerekomenda na isaalang-alang ng mga guro ang tagadisenyo ng modyul ang iba’t ibang istilo ng pagkatuto ng mga mag-aaral (visual, auditory, kinesthetic at collaborative) upang maging mas inklusibo at mas epektibo ang bawat lesson script.
4. Ang mga lesson scripts ay maaaring idisenyo upang tugunan ang natatanging pangangailangan ng bawat kasarian, na nagbibigay ng mga aktibidad na nagpapahalaga sa kanilang mga istilo ng pag-aaral.
5. Lumikha ng isang inklusibong kapaligiran sa pag-aaral na nagpapahalaga sa pagkakaiba-iba at nagtataguyod ng kultural na pagiging sensitibo, na naghihikayat sa pakikilahok ng lahat ng mag-aaral.
6. Iminumungkahi na higit pang pag-ibayuhin ang pagsasama ng mga kontekstuwalisadong aktibidad sa mga aralin, lalo na iyong may kaugnayan sa lokal na kultura at karanasan ng mga mag-aaral, upang maging mas makahulugan at kapaki-pakinabang ang pagkatuto.

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ANALYSIS OF STUDENTS' ERRORS IN MAKING DEFINITIONS:BASIS FOR LEARNING INTERVENTION

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ABSTRACT

The study investigated the frequency and the types of errors found in the definitions made by the Junior High School Grade 10 students in Nansiakan National High School. Descriptive research was utilized using quantitative and qualitative data through frequency count and describing errors particularly grammatical error, omission, misinformation, and misordering. The study revealed that the most common errors made by the respondents in writing along grammatical errors were on prepositions, along omission on "be" verbs, along misinformation on the use of verb tenses, and along misordering on noun phrases. Generally, the respondents had most common errors in making definitions mostly on omission, second was on misinformation, third was on grammatical error, and fourth was on misordering. Hence, a contextualized Learning Activity Sheet along this area was developed to help the students enhance their skills in making definitions.

Keywords: Error analysis, learning intervention, making definitions

INTRODUCTION

Ensuring that students acquire the required knowledge and skills is essential in education, particularly when dealing with difficulties in the delivery of instruction. The Department of Education in the Philippines has implemented the Most Essential Learning Competencies as these are most essential and indispensable competencies to guide the curriculum and instruction in all public schools.

However, there are several subjects covered in the Most Essential Learning Competencies that students find most difficult to understand, find incomprehensible, and would rather skip. These competencies are the least mastered and are characterized as the most basic level of knowledge and applied abilities that should allow learners to function well in learning environments and other spheres of life. Least mastered competencies refer to any skill from the competencies of a given subject of which learners show most of the difficulty in performing.

To develop effective solutions, teachers need to be very perceptive to identify the underlying causes of their students' difficulties grasping a subject's concepts. Teachers need to be proficient in a wide range of competencies to enhance student learning (Jackson, 1990, as cited in Saidovna, 2021). In fact, the researcher is one of the teachers who is currently working in Nansiakan National High School found out that the least mastered competency in English 10 is "making definitions" by administering a pretest to Grade 10 students. Making definitions is an essential learning skill since it helps students grasp vocabulary, communicate more effectively, and get ready for more challenging coursework.

Slife (2016) suggests that every definition use should incorporate best practices for the three conceptual duties of justification, specification, and clarification. If readers can understand some terms that are used by writers, this means that writers are successful in communicating their concepts or terms to readers (Nirwanto, 2015). Commonly, defining terms is an important part of scholar work for students. Making definitions is one of the competencies that Grade 10 students should master as this will be used in their Senior High School research subject.

Students can develop and expand on their knowledge, abilities, and ways of thinking with the support of competencies. However, in practice, students struggle to meet the necessary learning abilities in

certain English subjects. This is supported by the Program for International Student Assessment (PISA) result which shows that the students in the country are five to six years behind in terms of learning competencies. Likewise, the results of Southeast Asia Primary Learning Metrics (SEA-PLM) year 2019 reveal that many Filipino students lack the reading, writing, and math skills necessary to advance to secondary school. In the Philippines, most Senior High School students struggle with adopting academic writing rules, including formality, coherence, grammar, and other associated abilities involved in writing conventions of a research paper (Martinez, 2019).

In Nansiakan National High School, the researcher assessed that the Grade 10 students were unfamiliar of the rules in using articles and prepositions. They used incorrect articles like using "a" before words that start with a vowel sound and using "an" before words that start with a consonant sound. Most of the time, they interchanged the articles "the" and "a." They were also confused of prepositions like "in" and "on", "at" and "in." In using verbs, students commit incorrect use of verb forms like "go" instead of "went." They also forgot to include subjects like "It," "They," "He," and "She" when asked to answer in a complete sentence. Moreover, Saavedra and Barredo (2020) records that many students have poor writing skills in English and Filipino due to a variety of factors, including a lack of vocabulary in the target language, difficulty organizing and communicating ideas, a perception that writing is a difficult task, a lack of motivation and interest in writing, and difficulties with spelling, grammar, and sentence construction. The findings of the given studies especially the least mastered competency, 'making definitions,' assessed by the researcher on the writing performance of the Grade 10 students in English subject can be addressed appropriately using error analysis.

The process of identifying, describing, and explaining students' errors is known as error analysis (Ellis & Barkhuizen, 2005, as quoted in Amiri & Puteh, 2017). To execute this, Ellis proposes four main steps which are identification, description, explanation, and evaluation of errors. The researcher followed the first two steps which are identifying and describing errors. To easily identify the errors, the researcher familiarized herself with the term "error" and "mistake." Corder (1981, as cited in Al-Sobhi, 2019) clearly distinguished between 'errors' and 'mistakes.' Errors matter in the language acquisition process, but mistakes do not, hence errors committed by second or foreign language learners require more consideration and research than mistakes. Thus, errors are manifested in formal scenario and technical writing whereas mistakes are in speaking and informal scenario.

Upon describing the errors through error analysis, a specific intervention is needed. This study aimed to develop a Learning Activity Sheet as a learning resource in English 10 based on the errors made by the Grade 10 students from the identified least mastered competency to help minimize the writing errors of students along grammatical errors, omission, misinformation and misordering and master the competency. Learning Activity Sheet is an additional learning tool that students can use, such as customized learning tasks that help them advance the knowledge and abilities they are gaining from various lessons.

The Localized Policy Guideline on Contextualizing Learning Resources as stipulated in Regional Memorandum No. 22, 2019 supports this intervention. This guideline defines learning resource as any text-based material or non-text-based material that is utilized as the main foundation for or addition to the teaching and learning process aligned with the K–12 curriculum. It covers the provision of contextualized learning resources across the region based on the needs analysis of the students. The Learning Activity Sheet must undergo quality assurance anchored on DepEd order No.001 s.2021 to better support and mentor students as they acquire the abilities, information, and experiences that will help them in both school and in life. Teachers can also benefit from Learning Activity Sheet in planning and preparing a good lesson plan exemplar.

Further, the present study chose to promote continually and strengthen the culture of research in DepEd basic education as stipulated in Division Memorandum No. 33, s. 2020. Also, in the activity of College of Teacher Education Graduate Studies in catering K to 12 Basic Education Program and educational trends, issues and challenges included in their agenda. Additionally, the study would be in support to the ultimate pursuit of National Research Agenda for Teacher Education (NRATE) which is quality teacher education through research. This was premised on the requirement that teacher education should be relevant, sustainable, and innovative to effectively deliver the K–12 curriculum; can engage community in the educative process; is a dedicated and resilient lifelong learner; and skillful in research. On top of that, the Sustainable Development Goal (SDG) 4 specifically advances the discourse of quality education further by stating that attaining high-quality, inclusive education for all reaffirms the belief that one of the most effective and well-established means of promoting sustainable development is education.

The study would contribute to one of the universal targets of Sustainable Development Goal (SDG) 4 which is, every student gains the information and abilities required to advance sustainable development, particularly through education for sustainable development and healthy lifestyles, gender equality, human rights, fostering a culture of nonviolence and peace, global citizenship, and an understanding of cultural variety and how it contributes to sustainable development.

Statement of the Problem

The following questions framed this study, serving as a compass for the conduct of the inquiry:

1. What are the errors in making definitions made by Grade 10 students along grammatical errors, omission, misinformation, and misordering?
2. What learning intervention could be developed to address the findings of the study?

METHODOLOGY

This concerns the research design, methods and procedure employed in conducting the study.

Research Design

Quantitative descriptive and qualitative content analysis were employed in this study. It is quantitative descriptive because it involved the use of frequency count to describe the errors in making definitions along grammatical errors, omission, misinformation and misordering made by the Grade 10 students in their English subject. The qualitative aspect is, after frequency count, the sample errors were tabulated and described. Describing errors is involved firstly with the categorization of errors according to error taxonomy, and secondly, it is concerned with the recording of the error frequencies in the individual error categories. Thus, content analysis was employed in this study.

Sampling Procedure

This research study made use of non-probability sampling, specifically purposive sampling. From the population of Junior High School students, the researcher only selected those who enrolled in English 10, those who answered the written task, and those who were willing to join the study as respondents. For the quantification of the errors that were gathered, it made use of simple frequency count. For the analysis of errors, the researcher described the errors in the steps indicated in Error Analysis model of Rod Ellis.

Data Gathering Procedure

The researcher developed the questionnaire from the pre-assessed least mastered competency, "making definitions," by including words the students usually encountered and were unfamiliar to them arranged randomly. The Office of the Schools Division of Nueva Vizcaya was informed through a letter request permission to conduct the study in Nansiakan National High School with the attachment of completed Request to Conduct Research Activity, Chapters 1-3 and research instrument as mentioned in the guidelines stated in Division Memorandum No. 33, s.2020. Conduct of any research activities shall follow the guidelines and shall adhere to the observance of Data Privacy Act and research ethical standards as set in DepEd Order No. 16, s. 2017.

Statistical Treatment of Data

There were no complicated statistical tools needed for the analysis of the data in this research because it was mainly quantitative and qualitative in nature. Only simple frequency count was employed in the study to get the exact count of the number of errors found in the definitions.

FINDINGS

The data were collected using the research instrument, along with their analysis and interpretation, are presented here.

Problem 1. What are the errors in making definitions made by Grade 10 students along grammatical errors, omission, misinformation, and misordering?

Grammatical errors are a deviation in certain rules. This includes articles and prepositions that are found in the students' definitions.

Grammatical Errors	Frequency
Articles	5
Prepositions	9
Total	**14**

The number of grammatical errors made by the Grade 10 students in making definitions along the articles was with a frequency error of 5; followed by preposition with a frequency error of 9.

These were the grammatical errors in articles and in prepositions committed by the Grade 10 students in making definitions.

Grammatical Errors	Erroneous	Correct
Articles	Elaboration is where you give an proper explanation to other people and explain every reason in any situation you are facing.	Elaboration is where you give a proper explanation to other people and explain every reason in any situation you are facing.
Prepositions	Showcase is when performers give an excitement to the audience of what they are going to perform into the theater.	Showcase is when performers give an excitement to the audience of what they are going to perform in the theater.

In the given sentence of grammatical error on the articles, 'an' was used rather than 'a'. The rule states that only single count nouns whose precise identification was unknown to the reader should be used with the indefinite articles "a" or "an." Before nouns that start with a consonant, use "a," while before nouns that start with a vowel, use "an."

"Pre-Position," as the name suggests, comes before something. In the given sentence, the preposition 'into' was changed to 'in'. The prepositions "in" and "into" can be confusing to some people. According to this prepositional rule, reserve the preposition "in" for indicating a location and use "into" to convey motion toward something. In the sentence, 'into' was used to express location instead of using the preposition 'in' to indicate that the performers perform in a specific theater.

Omission is omitting a word or grammatical element needed in an expression. This is classified into five categories: "be" verbs, prepositions, possessive adjectives, elimination of suffixes for multiple nouns and subject abolition.

Omission	Frequency
"be" verbs	37
Prepositions	25
Possessive Adjectives	2
Elimination of Suffixes for Multiple Nouns	28
Subject Abolition	21
Total	**113**

The errors made by the Grade 10 students in making definitions along omission of the "be" verbs was with frequency error of 37, followed by elimination of suffixes for multiple nouns with 28; prepositions with 25; subject abolition with 21; and possessive adjectives with 2.

These were the errors on omission of "be" verbs, prepositions, possessive adjectives, and elimination of suffixes for multiple nouns committed by the Grade 10 students in making definitions.

Omission	Erroneous	Correct
"be" verbs	1. A menu is a piece of paper where you will find a list of food that offered in a restaurant.	A menu is a piece of paper where you will find a list of food that is offered in a restaurant.
	2. It a mutual trust and friendship among people who spend a lot of time together.	It is a mutual trust and friendship among people who spend a lot of time together.
Prepositions	1. Peculiar is showing uniqueness style and character.	Peculiar is showing uniqueness of style and character.
	2. Vapid is people who love isolating themselves and reading books like introverts.	Vapid is for people who love isolating themselves and reading books like introverts.
Possessive Adjectives	1. Conference is a women's meeting to inform and empower women to take responsibility of health and well-being.	1. Conference is a women's meeting to inform and empower women to take responsibility of their health and well-being.
	2. Showcase is when my friend invited me to see the beautiful spots in province.	Showcase is when my friend invited me to see the beautiful spots in her province.
Elimination of Suffixes for Multiple Nouns	1. Elaboration is the way to understand what you want to learn like how teachers elaborate the lessons to their students to learn more thing.	Elaboration is the way to understand what you want to learn, like how teachers elaborate the lessons to their students to learn more things.
	2. Menu is a list of the different food, drinks, dessert, and other food that they are offering so you can choose whatever you want to eat and order in restaurant.	The menu is a list of the different food, drinks, desserts, and other food that they are offering, so you can choose whatever you want to eat and order in a restaurant.
Subject Abolition	1. Is having a face-to-face talk to discuss and make something clear or make someone interested on what you are talking about for him to agree.	It is having a face-to-face talk to discuss and make something clear or make someone interested on what you are talking about for him to agree.

In error on the omission of "be" verbs, 'is' was omitted. The word 'list' acted as a collective noun, so it took a singular verb 'is' because they were singular in construction. Food is an uncountable noun, so it did not have to take a plural verb. In sentence 2, 'is' was omitted. Use "is" if the noun is singular, and "are" if it is plural or there are many nouns.

In sentence 1 of an error on the omission of prepositions, 'of' was omitted. In the erroneous sentence, "Peculiar is showing uniqueness style and character." The meaning of peculiar was unclear. To repair the sentence, the preposition 'of' was added. In the sentence 2, "Vapid is people who love isolating their selves and reading books like introverts." The preposition 'for' was missing. The word vapid was directly referring to people when in fact, vapid is an adjective that should be used to describe.

In sentence 1 of an error on the omission of possessive adjectives, 'their' was omitted. 'Their' was the possessive pronoun that means "belonging to them." In this case, 'their' pertained to the health and well-being of the women. In sentence 2 of an error on the omission of possessive adjectives, the possessive adjective 'her' was omitted. If added, it modified the word friend in the context of the given situation.

In omission of elimination of suffixes for multiple nouns, there is an omission of -s or -es when single form becomes a plural noun. In sentence 1, -s was omitted. More means greater in number, size, and amount. It was used before nouns, so it should be preceded by plural nouns like 'more things.' In sentence 2, -s was also omitted. Since the word 'list' functioned as a collective noun in the sentence, it referred to a number of things, so -s should be added to the word 'dessert' on the phrase "a list of the different food, drinks, dessert."

To be complete, a sentence should have a subject and a predicate. In the given sentence of error omission on subject abolition, 'it' was omitted, like the errors omitted by most of the students. 'It' is a pronoun that can function as a subject that refers to an object, animal, or other thing that has already been mentioned.

Misinformation is the use of an incorrect grammatical form. This is classified into four categories: possessive adjectives, "be" verbs, use of singular plural, and use of verbs.

Misinformation	Frequency
Possessive adjectives	1
"be" verbs	2
Use of singular plural form	1
Use of verb tense	60
Total	**64**

Most of the respondents had errors in writing and misinformation in using verb tense. This was supported by the frequency error of 60. Further, the same Table showed that the respondents have errors on misinformation of the "be" verb with a frequency error of 2 and of possessive adjectives like the use of singular plural form with 1.

These were the errors on misinformation of possessive adjectives, “be” verbs, use of singular plural and use of verbs committed by Grade 10 students in making definitions.

Misinformation	Erroneous	Correct
Possessive adjectives	1. Vapid is boring and the conversation is not going well on it’s own.	Vapid is boring and the conversation is not going well on its own.
“be” verbs	1. Menu means a thing where a bunch of food are listed such as chicken, menudo and more.	Menu means a thing where a bunch of food is listed, such as chicken, menudo, and more.
	2. Misconstrued is when a person misunderstood decisions that are already done.	Misconstrued is when a person misunderstood decisions that were already done.
Use of singular plural form	1. A menu is a kind of paper filled with pictures of food and their names and informations that the server or waiter gives.	A menu is a kind of paper filled with pictures of food and their names and information that the server or waiter gives.
Use of verb tense	1. Base on the sentence, Belle thought it was peculiar that she saw no children on the street during her drive to work.	Based on the sentence, Belle thought it was peculiar that she saw no children on the street while driving to work.
	2. Peculiar is feeling unusual because what you are see right now is different compare to the past.	Peculiar is feeling unusual because what you are see right now is different compared to the past.

In the given sentence using the possessive adjective form, ‘it’s’ should be replaced by ‘its.’ An apostrophe is frequently added to the possessive adjective "its." It is simple to mistake "its" for the contraction of "it is" or "it's," which does contain an apostrophe. Apostrophes are never used in possessive adjectives.

In sentence 1 of the error on misinformation of the “be” verbs, the phrase ‘a bunch of food’ was used as an answer. This was correct and usable in written English; however, if used in a sentence, ‘bunch’ is a collective noun, so it must take the singular verb ‘is.’ In sentence 2, ‘are’ was replaced by ‘were’ because the action was completed in the past and was represented by the phrase ‘already done.’ ‘Are’ was used in the present tense, while ‘were’ was used in the past tense. ‘Were’ was the past tense of the verb ‘are.’ In the given sentence of error on misinformation in using singular plural form, “informations” was used. The word “information” is a non-count noun, so it should take a singular verb.

In sentence 1, given in the error on misinformation in the use of verb tense, “base on” is changed to “based on,” which was correct and acceptable. In sentence 2, the past tense of the verb ‘compare’ was ‘compared.’ ‘Compared to’ was used to measure or judge something in relation of now to an earlier time. The simple past tense was used to describe an action that occurred at a specific time and was completed.

Misordering is the placement of wrong words in one expression. This is classified into two: noun phrases and verb phrases committed by Grade 10 students in making definitions.

Misordering	Frequency
Noun Phrases	3
Verb Phrases	2
Total	**5**

Most of the respondents had errors in writing, along with misordering of noun phrases, as supported by the frequency of errors of 3. Also, the respondents had errors in writing along with misordering of verb phrases. This was supported by the frequency of 2.

These were the errors on misordering of noun phrases and verb phrases committed by Grade 10 students in making definitions.

Misordering	Erroneous	Correct
Noun Phrases	1. Vapid is supposed to connect levels to conversations over text or calls tiring.	Vapid is supposed to connect levels to conversations over text or tiring calls.
	2. Showcase means showing or demonstrating what he saw in the festival of Ammungan.	Showcase means showing or demonstrating what he saw in the Ammungan festival.
	3. For example, when you go to another place and you see a person with good-hearted.	For example, when you go to another place and you see a good-hearted person.
Verb Phrases	1. Negotiate is to a formal discussion have with someone.	Negotiate is to have a formal discussion with someone.
	2. Elaboration is to over get a topic through explanation.	Elaboration is to get over a topic through explanation.

In sentence 1 of misordering of noun phrases, the phrase "calls tiring" was used rather than "tiring calls." "tiring" describes or modifies the noun "calls." In sentence 2, "in the festival of Ammungan" was used, which made the sentence vague because it might produce two meanings. In sentence 3, the student wrote "a person with good-hearted" instead of using "a good-hearted person."

A verb phrase is a group of words that consists of a verb and any auxiliary or modal verbs that accompany it. In sentence 1 of the misordering of verb phrases, "to" and "have" were misordered which made the definition unclear. "To have" is considered an infinitive phrase. It is the basic form of the verb "have" preceded by the word "to" which is the standard way to form an infinitive in English. In sentence 2, "over get" was changed to "get over." The phrase "over get" is not a common phrase in English and does not have a meaningful usage. "Get over" is considered a phrasal verb which is the combination of a verb and a preposition to create a new meaning, typically signifying the act of recovering from something unpleasant or overcoming a difficulty.

This summarized the errors which included grammatical errors, omission, misinformation, and misordering in making definitions made by Grade 10 students.

Describing Errors	Frequency
Grammatical Errors	14
Omission	113
Misinformation	64
Misordering	5
Total	**196**

The table exhibits that most of the respondents had errors in writing along with omission, misinformation, grammatical errors, and misordering, as shown by the numbers 113, 64, 14, and 5.

Among the error descriptions, such data implied that the Grade 10 students in Nansiakan National High School commonly committed errors in writing particularly in omission. This implied that the students usually had errors in omitting the "be" verbs, prepositions, possessive adjectives, elimination of suffixes for multiple nouns, and subject abolition. It also implies that the respondents also had errors while writing on misinformation, grammatical errors, and misordering.

Problem 2. What learning intervention was developed to address the finding of the study?

Based on the findings of the study, it was found out that the Grade 10 students quite had errors in their writing along with omissions.

Hence, an enhancement activity in the form of a Learning Activity Sheet was developed as a learning intervention that would cater not only to errors in omission but also to misinformation, grammatical errors, and misordering since there were also errors committed in each type of error under describing errors.

Learning Activity Sheet, as defined by the Department of Education, is an additional learning tool that students can use, including customized learning activities that deepen the required understanding and abilities they are learning from various lessons.

The Learning Activity Sheet was developed to help the Grade 10 students of Nansiakan National High School master the identified least mastered competency, "making definitions," and enhanced their writing skills in general. As a result, the teachers could use the Learning Activity Sheet during classes in English as a supplementary material for the students.

This was in consonance with the finding of Naval (2014) in his study, showing that the developed modules were found acceptable for the 10th grade Physics students. Similar with the findings of the study of Tindugan (2023), the created intervention material was deemed very acceptable by the two respondent groups based on the following standards: appropriateness, authenticity, technicality, utility, significance, and comprehensibility. Similarly, the participants characterized the created resources as significant, engaging, and appropriate for these could help students master the skills they haven't learnt the most.

Furthermore, how the objectives were met at the conclusion of the lesson determined how well the teaching-learning process went (Dayagbil et al., 2021). Therefore, achieving these objectives depended on the teacher selecting the appropriate approach and plan, pertinent teaching resources, and reliable and trustworthy evaluation instruments (Dayagbil et al., 2021). It was shown that integrating various ap-

proaches or procedures into a single lesson was more successful, particularly when targeting multiple intelligences (Yavich & Rotnitsky, 2020). However, the instructor is also in charge of deciding which instructional learning resources will be employed, in addition to selecting the appropriate methodology or plan (Choppin et al., 2020).

CONCLUSIONS

As an efficient and effective way to figure out students' mastery of English, error analysis has gained popularity in the process of teaching English writing, much the same as how the present study has contributed to identifying the errors in making definitions made by Grade 10 students along the grammatical errors, omission, misinformation, and misordering. Also, the study helped educators trace out and address language errors systematically through an intervention.

With the significant findings as bases, the following conclusions were drawn.

1. According to the error analysis, the most prevalent writing errors made by Grade 10 students were the incorrect use of rules on prepositions, omission of "be" verbs, incorrect verb tenses, and improper arrangement of noun phrases. The respondents described writing errors mostly as omissions, second was misinformation, third was grammatical error, and the fourth was misordering.
2. The noteworthy conclusions of the study indicated that most of the errors were omissions. Therefore, to assist the Grade 10 students at Nansiakan National High School, an enhancement activity, specifically a contextualized Learning Activity Sheet along omission with greater number of items, misinformation, grammatical errors, and misordering might be devised. At the same time, this can help the students to master the identified least mastered competency, "making definitions," and enhanced their writing skills in general.

RECOMMENDATIONS

The following suggestions were made considering the facts and conclusions drawn:

1. In as much as the Grade 10 students at Nansiakan National High School commit errors in writing, the students are recommended to be given more lessons on "be" verbs, prepositions, use of verb tense and noun phrases. The teachers may devise ways to integrate these lessons in their daily lessons in English 10, especially since there are only a few lessons of these in the K to 12 Curriculum.
2. The contextualized Learning Activity Sheet that has been generated is recommended to be validated and given to the Grade 10 students as an additional English language resource in Nansiakan National High School. The contextualized Learning Activity Sheet is recommended for language teachers to use and may be used or adopted by other classes in the Division of Nueva Vizcaya.
3. This study is recommended for validation of its effectiveness. It may focus on in-depth analysis of many variables not considered in the current analysis. Future studies may delve into other areas of error analysis. The improvement efforts could also be filed for an ISBN to provide a more widely accessible and reputable source of error analysis information.

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ATTITUDE TOWARD TECHNOLOGY AND LIVELIHOOD EDUCATION AND MOTIVATION OF GRADE 7 STUDENTS OF ARITAO

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ABSTRACT

The study aimed to determine the attitude toward Technology and Livelihood Education and motivation of Grade 7 students of Aritao for the School Year 2024-2025. The study used descriptive correlational method. It utilized simple random sampling including the Grade 7 students in public secondary schools in Aritao, Nueva Vizcaya like Aritao National High School, Sta. Clara High School, and Bone North Integrated School. The attitude and motivation of the respondents were measured using the adapted and adopted questionnaire from Aguilana (2019), respectively. The study found that the respondents had a favorable level of attitude toward Technology and Livelihood Education (TLE) along with resources, teacher, learning environment, and professional opportunities. The respondents had high level of motivation along with family situation, personal achievement/satisfaction, life skills application, and achievement of skills in Technology & Livelihood Education. It was also found that there is a significant relationship between the attitude toward TLE and motivation of the respondents. An intervention entitled Project AIMS was developed. It concluded that a positive attitude toward TLE is likely to enhance students' motivation to engage with the subject matter, leading to increased participation and effort in their learning activities. Hence, the study recommended that Project AIMS be implemented in order to improve the attitude and motivation of the respondents.

Keywords: Attitude toward Technology and Livelihood Education, motivation, Grade 7 TLE students

INTRODUCTION

In the classroom, it has been a perennial problem of the teachers about the motivation and attitude of the students particularly in Technology and Livelihood Education. The motivation and attitude of the students towards the Technology and Livelihood Education is the main subject of this study. Along with attitude toward the subject, the impact of motivation is assessed based on how the students really behave in the classroom by evaluating their overall performance.

The trend in education includes standard-based learning and popular techniques for teachers. Understanding educational trends enables educators and learners to remain up to date on the most recent best practices implemented by the Department of Education. This assists the students in discovering what is currently working or not working for them in terms of attitude and learning motivation. Internalization, international collaborations, outcomes-based standards, and Information and Communication Technology (ICT) use are some of the current trends in Philippine education. Additionally, students' attention spans are getting shorter. With the aid of Technology and Livelihood Education, students can investigate concepts, acquire real-world experience, and process ideas in a secure and encouraging setting. All young learners who are pursuing new vocations and lifestyles must possess the ability to adjust to a technologically changing society and accept social responsibility. In addition to reflecting the quick changes in the industry, it enables learners to assess their interests and strengths while choosing a job, enabling them to make well-informed decisions about their future. Technology and Livelihood Education is a skill - and decision-oriented subject that focuses on preparing people for family life via education and strength-building. Some see it as a way to give the kids the academic and practical preparation they need to succeed in their future occupations. Some have thought about studying the subject in order to pursue

entrepreneurship and/or employment opportunities. It enables students to gain practical skills that will lead to a variety of employment options (Acordon, 2016) and it enables students to recognize the value of studying technology as a subject and the relevance of technology education (Ingal, 2015).

Knowledge and information, entrepreneurial ideas, delivery and process, work ethics, and life skills serve as its pillars. This indicates that a Technology and Livelihood Education that is effective is one that is based on sufficient mastery of information and knowledge, skills and procedures, as well as the development of appropriate work values and life skills. It must be useful in order to give students the tools they need for lifetime learning. Technology and Livelihood Education is based on the effective, behavioral, or psychomotor aspects of human development. Thus, teaching this subject entails imparting all knowledge, ideas, abilities, and morals since Technology and Livelihood Education is primarily a skill-based subject by nature that the teacher must aid students in competing globally. Students have the opportunity to solve problems and address current concerns and trends through technology education. Students learn technology to solve problems in real-world contexts, either individually or in groups. They also acquire technical know-how, attitudes, and abilities, as well as life skills like empathy and efficiency in the workplace.

In relation to this, the issues in education faced by the country at present include quality which is manifested by the low National Achievement Test (NAT) results, cost, budget, lack of resources, increased of dropouts, more out-of-school youth and bureaucratic inefficiencies. Further, compared to other subjects, Technology and Livelihood Education is seen as less important in the Philippines. Okocha, referenced by Azodo (2014), shown that while parents understand the career potential of technical degrees, despite receiving technical or vocational education, parents are nonetheless willing to concede that white-collar, socially elite vocations are preferable to those in technical fields. It is unusual for high school students to have aspirations in this area. There are issues on students' lack of attitude and motivation in learning Technology and Livelihood Education while learning the subject.

Students' attitudes toward learning may have an impact on their NAT results, according to a study on junior high school students that found that motivations and attitudes have a significant impact on academic performance. Positive attitudes increase motivation, which in turn leads to better academic outcomes (Capuno et al., 2019).

Research has indicated that students' attitudes have a considerable impact on their academic performance in the subject. Since the NAT includes mathematics, having a favorable attitude toward the subject may help students do better on the test (Laranang & Bondoc, 2020). Hence, low performance is attributes to attitude and motivation (Capuno et al, 2019; Laranang & Bondoc, 2020).

This study focused on the attitude toward Technology and Livelihood Education of the students. An individual's prepared cognitive, affective, and behavioral response to events in their environment is shaped by their knowledge, experiences, and feelings about those events. This is known as their attitude. Both internal and external motivational elements play a significant role in the acquisition, modification, or maintenance of behavior in both daily life and education. The learning-teaching process depends heavily on motivation since it encourages students to participate in the behavior Palmer (2005) referenced in Ince (2023). Another factor for the student to excel in one subject is their motivation. Academic achievement declines and students who lack motivation are often unproductive, according to literature (Analoui, 2010), which is quoted in Aguilana (2019). Other detrimental behaviors like procrastination, bad study habits, and even a negative attitude toward learning are also brought on by a lack of motivation. This disdainful mindset toward education. In turn, this pessimistic mindset leads students to fall short of their academic objectives. Contextual elements could, nevertheless, have an impact on how students think about their Technology and Livelihood Education subject. Different attitudes may be sparked by home and school surroundings, which could have an impact on students' motivation, attitude and general performance. These can obstruct in many ways. These may also make it more difficult for the student to reconcile these concerns with their academic obligations, leading to problems with homework in particular and prompting scholars to recognize the significance of contextual factors at home and at school in the study of motives in education. According to Schutz (2010), referenced in Aguilana (2019), motivation play a crucial role in almost every facet of the learning process; as such, comprehending the motivational landscape within the educational setting is vital.

The indicators of attitude include resources, learning environment, professional opportunities, and teacher while the level of motivation of the Junior High School students include improving family situa-

tions, personal achievement/satisfaction, life skills application, and achievement of skills in Technology and Livelihood Education of Aritao.

The research gaps of the present study show that most of the studies conducted along TLE focus more on study habits and other areas. Few studies are conducted along levels of motivation and attitudes of students particularly in Technology and Livelihood Education. In Junior High School, Technology and Livelihood Education is one of the most difficult subjects a secondary school teacher teaches (TLE). In addition to having four parts, it actually concentrates on the students' overall growth. The teacher must find future artists and skilled workers in addition to future business owners, bakers, chefs, and designers. For this reason, in order to bring out the best in their students, these teachers must carry out a variety of tasks.

The conduct of the study is based on the pre-test conducted by the researcher that the majority of Aritao Grade 7 students struggle to understand the subject matter and applications that are a part of the teaching and learning process. The majority of students find it easy to become bored in class since they have little interest in learning about Technology and Livelihood Education. According to the teacher's perspective, the element that finds it difficult to promote learning is the students' motivational potential and attitude towards the subject. The teacher also noted that the students' attitudes and motivation for the subject were lacking which often led to Students At Risk of Dropping Out (SARDOs) and even dropping from their studies. These are just some of the sentiments of the students: “Makapasadot met ti TLE”; “Aglinlinis la ngaruden ti maar-aramid idiay garden! Aglinis manen ditoy!”; Makauma met ti aglinis linis!”. These reasons motivated the researcher to conduct a study on levels of attitude and motivation of students and teachers in TLE of Junior High School of Aritao, Nueva Vizcaya.

STATEMENT OF THE PROBLEM

The main focus of this study was to determine the attitude toward Technology and Livelihood Education and motivation of Grade 7 Students of Aritao.

Guiding the research process are the following questions:

1. What is the respondents’ level of attitude toward Technology and Livelihood Education in terms of resources, learning environment, professional opportunities and teacher?
2. What is the respondents’ level of motivation along with improving family situations, personal achievement and satisfaction, life skills application, and achievement of skills in TLE?
3. Is there a significant relationship between the attitude toward TLE and motivation of the respondents?
4. What learning intervention may be developed from the findings of the study?

METHODOLOGY

The research design that was used in this study was quantitative. The study is quantitative with in employing the analysis of the attitude and motivation of the students in their Technology and Livelihood Education. In particular, the descriptive section will ascertain the attitudes and motivation of Aritao, Nueva Vizcaya students enrolled in Technology and Livelihood Education. In order to ascertain the relationship between Technology and Livelihood Education and students' motives and attitudes, the study generally studied these data.

Further, descriptive correlational method was used in this study. This blends aspects of correlational and descriptive research. Without changing any of the variables, it seeks to characterize their current states and evaluate their correlations. Although this approach is useful for identifying correlations between variables, it must be interpreted carefully to prevent incorrectly attributing causality (Bhandari, 2021).

The selected participants of this research study were the Grade 7 students who are taking Technology and Livelihood Education of Aritao, Nueva Vizcaya. The respondents of the study included those students with low performance in Technology and Livelihood Education.

Simple random sampling procedure was used, the respondents only included the Grade 7 students who are presently taking up Technology and Livelihood Education among the secondary schools in Aritao, Nueva Vizcaya.

To gather the substantial information that answered the research questions, the researcher used two research instruments: questionnaire for attitude and questionnaire for motivation.

Attitude Toward Technology and Livelihood Education Questionnaire. This measured the attitude of the students towards their Technology and Livelihood Education subject. This was adapted from Aguilana (2019). It comprised resources, learning environment, professional opportunities, and teacher.

Questionnaire on Motivation. This measured the motivation of the students to learn in their Technology and Livelihood Education subject. This comprised improving family situations, personal achievement, satisfaction, life skills application, and achievement of skills in Technology and Livelihood Education. This was adopted from Aguilana (2019).

With the assistance of the researcher's thesis adviser, the questionnaire was reviewed, edited, and revised. After that, the panel members verified the final draft. A week before the administration takes place, this was be completed with the assistance of several Technology and Livelihood Education teachers. The intended responses were then received a final copy that has been created. The instrument was validated and had pilot testing before processing to the data gathering. Content validation was done by 3 to 5 experts such as psychologist, TLE major, and language expert.

The study made used of the following statistical treatment in order to arrive at the most appropriate interpretations and analyses of the data.

Mean. The mean computation was employed as to measure the attitude and motivation of the respondents in Technology and Livelihood Education.

Pearson Product-Moment Correlation Coefficient (Pearson-r). This was used to establish the relationship existing between the respondents' attitude and motivation in Technology and Livelihood Education. All inferences were made using the at 0.5 level of significance.

FINDINGS

This chapter presents the findings of the study. The presentation begins with a description of the problem and proceeds to the identification of the data management tools, the findings and their discussion, tables, and pertinent supporting documentation in order to organize the study's findings.

Table 2. Respondents' Level of Attitude towards Technology and Livelihood Education

Attitude towards Technology and Livelihood Education	Mean	Standard Deviation	Qualitative Description
Resources	3.26	0.44	Favorable
Learning Environment	3.11	0.42	Favorable
Professional Opportunities	2.97	0.51	Favorable
Teacher	3.24	0.53	Favorable
Overall Mean	**3.14**	**0.39**	**Favorable**

It can be seen on Table 2 that the respondents' level of attitude towards Technology and Livelihood Education has an overall mean of 3.14 with SD of 0.39. This is qualitatively described as favorable.

The overall mean comprises the components of the attitude towards Technology and Livelihood Education such as resources with the mean 3.26 with SD (0.44); teacher with 3.14 with SD 0.39; learning environment with 3.11 and SD (0.51); and professional opportunities with 2.97 with SD (0.51) which are all qualitatively described as favorable.

Resources. The findings on the respondents' level of attitude toward Technology and Livelihood Education (TLE) reveal a generally favorable perception across various dimensions. The highest average score was observed in the area of resources (3.26), indicating that students feel positively about the availability and adequacy of materials and tools necessary for their learning. This suggests that well-resourced educational environments can significantly enhance student engagement and motivation in TLE.

A favorable attitude indicates that students perceive the resources available for TLE—such as instructional materials, equipment, and facilities—as adequate or beneficial. This perception can enhance

their engagement and willingness to participate actively in the subject. This suggests that pupils may become more motivated if they have a good attitude regarding resources. Students are more likely to interact with the content and improve their learning outcomes and TLE skill acquisition when they believe they have access to high-quality resources.

Additionally, TLE is a practical subject that frequently calls for the use of abilities in real-world situations. Students who have a positive attitude about resources are likely to understand how important they are to their educational process, especially when it comes to subjects like cooking, electrical installation, or other vocational skills.

In conclusion, Grade 7 students' positive attitudes regarding TLE resources demonstrate their interest in and likelihood of succeeding in the subject, underscoring the vital role that sufficient resources play in creating a positive learning environment.

Dela Cruz (2019), which examines Grade 7 students' favorable attitudes toward TLE, particularly in electrical installation and maintenance, supports the findings of this study by emphasizing the role that instructional resources have in influencing students' attitudes and performance.

Learning Environment. This specifically means that favorable attitude indicates that students perceive their learning environment as supportive and conducive to their educational experience in TLE. This can include aspects such as classroom setup, availability of resources, and the overall atmosphere created by teachers and peers.

The second highest score was related to teachers (3.14), reflecting students' appreciation for their educators' competence and support in facilitating learning. This finding underscores the critical role that effective teaching plays in shaping positive attitudes toward the subject, highlighting the importance of teacher training and development.

This suggests that students are more likely to participate fully in class activities when they have a good attitude regarding their learning environment. This involvement may result in increased involvement, peer collaboration, and a readiness to learn new TLE-related ideas and techniques. For pupils to develop intrinsic drive, a supportive learning environment is essential. Good attitudes can increase students' interest in the material, which will improve their academic performance and help them develop their skills in the real-world applications of TLE.

The results also demonstrate how well TLE instructors foster a supportive learning environment. Students' attitudes can be greatly impacted by knowledgeable and encouraging professors who inspire them to learn and feel appreciated. A positive outlook on the classroom might be the starting point for lifelong learning. Pupils are more likely to continue their education and acquire skills that will be crucial for their future employment if they feel encouraged and at ease in their learning environments.

In conclusion, Grade 7 students' positive attitudes regarding the TLE learning environment show that they feel interested and supported, both of which are critical for their academic achievement and personal development in the subject. Their motivation and openness to learning may be increased by this favorable view, which will ultimately improve their performance in Technology and Livelihood Education.

Dela Cruz (2019) supports the current study's findings by emphasizing the favorable effects of a supportive learning environment on student engagement and performance.

Agluba (2024) discovered that academic performance is impacted by students' motivation in the TLE learning environment, suggesting that a supportive atmosphere promotes positive attitudes and improves learning outcomes.

A positive learning environment affects student engagement and skill acquisition, according to Daguno-Bersamina and Relativo's (2024) investigation of Grade 7 students' performance in cooking inside TLE.

Additionally, Abang and Alonzo (2024) discovered that a nurturing classroom atmosphere established by qualified teachers plays a part in cultivating favorable attitudes in students.

The aggregate findings of these research support the notion that student attitude, engagement, motivation, and overall performance in the field are strongly influenced by a positive attitude toward the learning environment in Technology and Livelihood Education.

Professional Opportunities. The dimension of professional opportunities (2.97) scored the lowest among the four categories. This finding suggests that students may not fully recognize or feel motivated by the potential career paths associated with TLE. Addressing this gap could involve integrating more career-oriented discussions and practical applications into the curriculum to enhance students' understanding of how TLE skills can translate into future job opportunities.

However, generally, the attitude of the respondent toward professional opportunities is favorable which indicates that students recognize the potential career opportunities associated with TLE. This awareness can motivate them to engage more deeply with the subject, as they see its relevance to their future job prospects.

Students are more likely to be motivated to learn and acquire the required abilities when they have a good attitude about the professional opportunities that TLE offers. Their desire to investigate different TLE specializations and their level of participation in class may both be improved by this incentive.

Additionally, this means that a positive outlook on professional opportunities can be a reflection of students' assurance in their capacity to use the TLE-taught abilities in practical settings. Increased participation in hands-on activities and a higher willingness to take on problems can result from this confidence. The optimistic outlook on career chances indicates that the TLE curriculum successfully reflects students' interests and goals for the future. Teachers and legislators can learn from this alignment how crucial it is to preserve and improve TLE programs in order to guarantee that they satisfy the needs of students.

It also implies that the positive outlook of the respondents on TLE professional opportunities can help them be prepared for the long run. The Garde 7 students in Aritao are more likely to put effort into their studies if they see their education as a means of obtaining job in the future, which will improve their academic and professional results.

In summary, the finding implies that the Grade 7 students' positive attitudes toward professional opportunities in Technology and Livelihood Education show that they are aware of and inspired by the possible career routes related to the topic. Their engagement, confidence, and general performance in TLE can all be improved by this favorable perception, which will ultimately set them up for success in a variety of professional domains.

Casiño and Tantiado (2024) emphasized in their study how TLE exposes students to a variety of job routes and options, highlighting the subject's value in preparing learners for future employment, which supports the findings of the current study. It talks about how students are motivated and have a positive outlook on professional opportunities when they are exposed to technical skills and certificates (such as the National Certificates from TESDA).

Cooking, which is marketed as a lifelong skill and a feasible job alternative both domestically and internationally, is one area where Perez & Briones (2022) discovered that the TLE curriculum aligns with professional options. The report emphasizes how these specializations encourage students to see TLE as a means of advancing their careers.

In their phenomenological study, Pamor et al. (2024) discovered that TLE teachers use practical skills into their teaching strategies to help students comprehend the career options related to the subject. It emphasizes how instructors' work influences students' positive perceptions of pursuing jobs in TLE-related professions.

Together, these studies show that TLE gives students insightful knowledge about career options, encouraging a favorable attitude toward the subject as a means of acquiring new skills and finding work or professional opportunities in the future.

Teacher. The second highest score was related to teachers (3.14), reflecting students' appreciation for their teachers' competence and support in facilitating learning. This finding underscores the critical role that effective teaching plays in shaping positive attitudes toward the subject, highlighting the importance of teacher training and development.

In particular, the positive attitude toward the teachers of the Grade 7 students in Aritao suggests that pupils think their TLE teachers are capable and efficient at teaching the material. Students may become more engaged and eager to participate fully in class as a result of this perception, which can also strengthen their faith in their teachers. Additionally, positive attitudes toward teachers are often associated with increased academic accomplishment. When teachers assist and encourage their students, they are more inclined to work hard in their studies, which can lead to improved TLE knowledge and abilities.

Students' willingness to learn can be greatly increased by having a positive attitude toward their teachers. Students are more inclined to interact with the curriculum, look into real-world TLE applications, and become more interested in the subject when they respect and value their teachers. Additionally, this data implies that TLE teachers' classroom environments are seen as encouraging and learning-friendly. Students can feel free to express themselves, ask questions, and take chances in their education when they have a good relationship with their teacher.

In addition, the finding implies that the foundation for lifelong learning can be established by having a positive attitude toward teachers. Positive interactions between students and their teachers increase the likelihood that they will continue their education and acquire skills necessary for their future employment.

In conclusion, Grade 7 students in Aritao have a positive attitude toward Technology and Livelihood Education along with the teachers' dimension. This indicates that the Grade 7 students in Aritao believe that their TLE teachers are competent, which is important for improving student motivation, attitude, engagement, and learning outcomes in general. Their academic path and career goals in a variety of vocational domains may be greatly impacted by this perspective.

Daguno-Bersamina and Relativo (2024), who focus on how teacher effectiveness impacts student engagement and attitudes toward learning, and Dela Cruz (2019), who emphasizes how effective teaching strategies and teacher support contribute to positive student perceptions of the subject, both support the study's findings and emphasize the significance of teachers' roles in fostering positive student experiences in TLE subjects.

Table 3. Respondents' Level of Motivation along with Improving Family Situations, Personal Achievement/Satisfaction, Life Skills Application, and Achievement of Skills in TLE

Motivation	Mean	Standard Deviation	Qualitative Description
Improving Family Situations	3.26	0.45	High
Personal Achievement/Satisfaction	3.23	0.49	High
Life Skills Application	3.28	0.47	High
Achievement of Skills in Technology & Livelihood Education	3.22	0.47	High
Overall Mean	**3.25**	**0.42**	**High**

Table 3 shows that the respondents' level of motivation in Technology and Livelihood Education has overall mean of 3.25 with SD (0.42) which is qualitatively described as high.

Improving family situation (3.26) with SD (0.45); personal achievement/satisfaction (3.32 with SD (0.47); life skills application (3.28) with SD (0.47); and Achievement of Skills in Technology & Livelihood Education 3.22 with SD (0.47) were all assessed with high as the qualitative description.

Improving Family Situations. In particular, the results indicate that seventh-grade children have a strong desire to better their home circumstances. This indicates that these kids are organically driven and that the responders want to improve their family's situation. They probably consider the importance of their education as a way to improve their family's well-being in addition to for their own benefit. Increased participation in academic pursuits and perseverance in conquering obstacles might result from this internal drive.

The results suggest that the respondents are very motivated to better their family circumstances, which frequently results in higher levels of academic engagement. Students who are motivated to improve their families' lives are more likely to take their education seriously, which will improve their attendance, involvement, and academic effort. The students that are driven to help their families may have specific goals for their schooling and careers. They are more motivated to concentrate on their education and seek skills related to future work when they realize that their efforts may result in improved possibilities for their family.

This implies that a supportive home environment where family members support academic endeavors is reflected in the motivation of the Grade 7 pupils in Aritao. Support like this can boost students' self -esteem and reaffirm the value of education as a means of enhancing family situations.

In conclusion, the high degree of motivation among Aritao Grade 7 students to enhance family situation points to a close relationship between academic endeavors and personal goals. This drive not only aids in their academic endeavors but also holds promise for promoting constructive transformations in their communities and families.

This finding is supported by Wang and Sheikh (2022) found that a supportive family environment positively influences students' academic motivation and achievement. It emphasizes the role of family dynamics in fostering a desire for improvement in students, which aligns with the motivation to enhance family situations. Motivated students often receive substantial support from their families, which can drive their desire to improve their family's situation (Flores, 2023).

Family dynamics have an impact on children's ambition to achieve academically, according to Jabbari and Rouster's (2021) similar findings. This suggests that a positive family environment can increase students' goals to change their circumstances, especially those connected in improving family situations.

Personal Achievement/Satisfaction. The respondents have high level of motivation on their personal achievement and/satisfaction. This means that the high level of motivation of the Grade 7 students in Aritao towards personal achievement suggests that individuals are driven by intrinsic factors, such as the desire for self-improvement and fulfillment. This intrinsic motivation can lead to greater engagement in activities that promote personal growth and satisfaction.

The findings also suggest that the respondents probably set clear, attainable objectives for themselves, which they are driven to achieve. This goal-oriented mindset is typical of people who are committed to their own growth and success, which is consistent with ideas from accomplishment motivation theory, which holds that people thrive on achieving difficult but reachable goals. Positive self-efficacy and self-image are frequently linked to a strong drive for personal success. People who have confidence in their talents are more inclined to pursue possibilities that fit with their own objectives and take on new challenges.

Furthermore, this result suggests that the Grade 7 students in Aritao can greatly improve their general well-being by becoming more motivated to pursue their own goals. They frequently feel happier and more satisfied when they are driven to accomplish their goals, which benefits their mental health. People who are highly motivated to succeed personally can be role models in their peer groups or communities. Their motivation on their personal achievement/satisfaction can encourage a culture of success and self-improvement and motivate others to follow their own dreams.

In summary, the finding that respondents exhibit a high level of motivation toward personal achievement and satisfaction reflects a strong intrinsic drive, goal orientation, resilience, positive self-perception, enhanced well-being, and potential influence on others. This motivation is crucial for personal development and success in various aspects of life of the Grade 7 students in Aritao.

Life Skills Application. It was revealed in the table that the Grade 7 students in Aritao have high life skills application level of motivation which means that the respondents have high level of motivation to apply life skills suggests that students are eager to develop essential competencies such as critical thinking, communication, and problem-solving. This motivation can lead to improved self-awareness and personal growth, as students actively seek to enhance their abilities.

It also suggests that the Grade 7 students in Aritao are driven learners who are inclined to participate in activities that let them practice and use their life skills in practical settings. Their understanding of the value of these abilities in daily life can be strengthened by this hands-on TLE application. Students who are highly motivated to practice life skills are better prepared for the challenges of maturity. Making wise judgments, pursuing lifelong learning, and overcoming obstacles in both the personal and professional spheres all depend on these abilities.

To sum it up, a dedication to personal development, the practical application of information, enhanced academic achievement, resilience, constructive social interactions, readiness for future difficulties, and a sense of empowerment are all indicated by the high level of motivation among Grade 7 students in Aritao to apply life skills. This drive is essential to their general growth and achievement in a variety of spheres of life.

Parker et al. (2019) discovered that students' academic growth and competences are improved when they are motivated to apply life skills, which supports the findings of the current study.

Student success requires the use of essential life skills application, with a focus on how desire to cultivate these abilities can result in enhanced academic accomplishment and personal development in a variety of spheres of life (The Asian School, 2024).

Achievement of Skills in Technology & Livelihood Education. The same table shows that the respondents have high achievement of skills in Technology and Livelihood Education. This simply means that respondents believe that they learn and achieve more in learning Technology and Livelihood Education. Also, it means that the high achievement in TLE indicates that students have effectively developed practical skills across various components of the curriculum, such as Home Economics, Agri-Fishery Arts, Industrial Arts, and Information and Communication Technology (ICT). This competence prepares them for real-world applications and potential career paths.

The result specifically means that mastery of skills taught in TLE equips students with the necessary tools to pursue further education or vocational training. This foundation can lead to better job prospects

or entrepreneurial opportunities in the future, as TLE emphasizes skills that are relevant to the job market.

The high achievement levels reflect the effectiveness of the TLE curriculum in meeting educational goals outlined by the Department of Education in the Philippines. It demonstrates that the curriculum is successfully imparting essential skills that align with industry standards and competencies set by the Technical Education and Skills Development Authority (TESDA).

In addition, the emphasis on skill acquisition in TLE contributes to the holistic development of students. It not only focuses on academic knowledge but also on practical life skills that are crucial for personal and professional success.

Generally, the high achievement of skills among Grade 7 students in Aritao within Technology and Livelihood Education signifies their readiness for future opportunities, increased confidence, alignment with educational goals, potential for entrepreneurship, community contributions, and overall holistic development. This finding underscores the importance of TLE in preparing students for both immediate and long-term success.

The finding of the present study is similar with the finding of Demapendan et al. (2024) who emphasized the importance of effective teaching tools in improving students' skill acquisition and overall performance in TLE subjects.

The study cited in Instabright Gazette (2023) discussed the importance of enhancing technical skills among secondary teachers in TLE, which directly impacts student learning outcomes and skill achievement in grades 7 and 8. It highlights how effective teaching practices contribute to higher levels of skill acquisition among students in exploratory courses like TLE.

Dela Cruz (2024) indicated that motivated learners achieve higher skill levels due to effective instructional strategies and supportive learning environments provided by teachers.

Table 4. Summary of Relationship between the Attitude and Motivation of the Respondents in Technology Livelihood Education

Variables Correlated	*r*-value	*p*-value	Qualitative Description	Decision
Attitude and Motivation	0.80	0.00	Significant	Reject Null Hypothesis

The table reveals that relationship between the attitude and motivation of the respondents in Technology and Livelihood Education has a computed r-value of 0.80 with the corresponding p-value of 0.00 which is lesser than 0.0f level of significance with qualitative description of significant. There is a significant relationship between the attitude and motivation of the respondents in Technology Livelihood Education. Hence, the null hypothesis is rejected. The result specifically means that the attitude of the Grade 7 students in Aritao significantly relate with their motivation to learn Technology and Livelihood Education. The Pearson correlation coefficient (r) of 0.80 indicates a strong positive relationship between students' attitudes toward TLE and their motivation. This means students with more positive attitudes toward TLE are also more likely to exhibit higher motivation in the subject. The p-value of 0.00 (statistically significant at $\alpha = 0.05$) confirms that this relationship is not due to random chance. The correlation is robust and meaningful in the population studied.

In like manner, students' positive attitudes (e.g., perceiving TLE as enjoyable, relevant, or beneficial) directly enhance their motivation to engage with the subject. This aligns with studies showing that intrinsic motivators like personal satisfaction and family improvement correlate with higher motivation in TLE.

Also, the significant correlation rejects the notion that attitude and motivation are unrelated. This contradicts earlier findings where motivations/attitudes showed no relationship with performance, but reinforces their interdependence in driving engagement. This finding underscores the need to prioritize attitude enhancement in TLE curricula to maximize student motivation and engagement.

The finding of the study is supported by Aguilana (2021) which discusses how students' attitudes toward TLE significantly correlate with their motivation to study the subject. It emphasizes that a favorable attitude leads to higher motivation levels, which in turn affects academic performance in TLE.

Another study that supports the finding is the study of Abang and Alonzo (2024) which investigated the motivations and attitudes of TLE students and their relationship with performance, finding significant

correlations between positive attitudes and high levels of motivation, which enhance student engagement in TLE subjects.

In as much that this study found that attitude significantly relate with the motivation of the Grade 7 students in Aritao, a learning intervention is developed in order to improve the attitude and motivation of the respondents which can eventually improve their overall performance in Technology and Livelihood Education.

Based on the findings of this study, a learning and development is now being developed that emphasizes contemporary educational concerns, like enhancing the students' motivation in Grade 7 in Aritao and their attitude toward Technology and Livelihood Education.

The purpose of this learning and development is to orient the students on how to improve their attitude and motivation toward Technology and Livelihood Education.

CONCLUSION

The following conclusions were made in light of the study's findings:

1. The finding that the respondents have a favorable level of attitude toward Technology and Livelihood Education (TLE) indicates that students generally perceive the subject positively. This favorable attitude suggests that they recognize the value and importance of TLE in their education and future endeavors which can lead to several beneficial outcomes, including increased engagement in learning activities, greater motivation to acquire practical skills, and a stronger appreciation for the relevance of TLE in preparing them for real-life applications and career opportunities.
2. The high level of motivation suggests that students are not only interested in TLE but are also likely to actively participate in learning activities, which can enhance their educational experience and skill development. The results imply that students recognize the relevance and importance of TLE in their personal and professional lives, fostering a sense of purpose in their studies.
3. It underscores the interconnectedness of attitude toward Technology and Livelihood Education and motivation in the educational experience. A positive attitude toward TLE is likely to enhance students' motivation to engage with the subject matter, leading to increased participation and effort in their learning activities.
4. A learning intervention is developed in order to improve the attitude and motivation of the respondents which can eventually improve their over-all performance in Technology and Livelihood Education.

RECOMMENDATION

Based from the significant findings and conclusions of the study, the following are highly recommended:

1. Implement more hands-on activities, such as workshops, simulations, and practical projects that allow students to apply their skills in a tangible way. This experiential learning approach can reinforce their positive attitudes and increase their motivation to engage with TLE.
2. Organize career talks, job fairs, and workshops to help students understand how TLE skills can lead to various career opportunities. Highlighting real-life applications of TLE skills will deepen their appreciation for the subject. Incorporate more project-based activities where students can apply their TLE knowledge to solve real-world problems or create marketable products. This approach can increase engagement and motivation while demonstrating the practical value of TLE.
3. Implement recognition programs that celebrate students' positive attitudes and achievements in TLE. Acknowledging their efforts can further motivate them to engage actively with the subject matter.
4. Implement the proposed Learning and Development in order to improve the attitude and motivation of the respondents toward Technology and Livelihood Education.
5. Other researchers could do a similar study with other characteristics not covered in order to improve respondents' motivation and attitude toward Technology and Livelihood Education.

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ENHANCING MASTERY LEVEL OF GRADE 12 STUDENTS IN MOTION CONCEPTS THROUGH COLLABORATIVE PROBLEM-SOLVING APPROACH

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ABSTRACT

This study aimed to enhance the mastery level of Grade 12 learners at Aritao National High School in motion concepts, focusing on Aristotelian, Galilean, and Newtonian perspectives by implementing the Collaborative Problem-Solving Approach (CPSA). Using a convergent-parallel mixed-methods design, the research evaluated students' mastery levels before and after the intervention through pre-tests and post-tests and qualitative insights from guided interviews. The results indicated a significant improvement in students' understanding, with average pre-test scores for motion concepts increasing from 38.97 to 73.02 after the intervention. This change reflected a shift from "No Mastery" to "Partial Mastery." Students reported positive experiences, particularly enjoying hands-on activities and collaborative work, which fostered richer discussions. However, some challenges arose, including difficulties with certain concepts and issues related to group dynamics, such as unequal participation among group members. The findings highlight the effectiveness of CPSA in enhancing students' comprehension of complex scientific principles. At the same time, they emphasize the need for more explicit guidance and additional resources to support learners. Thus, this study offers insights into the impact of collaborative learning strategies on high school science education. It suggests that while CPSA is beneficial, careful structuring is essential to maximize its effectiveness.

Keywords: Assessment, collaboration, learning, mastery levels, motion Concepts

Imagine a nation where every student possesses the knowledge and skills to succeed in an increasingly complex world. This vision aligns with the United Nations Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education for all. In response to this global agenda, countries worldwide are working to improve their educational systems to meet the challenges of the 21st century.

The Philippines recognized its essential role in this initiative and enacted the Enhanced Basic Education Act of 2013 (Republic Act No. 10533). This law aims to create a functional education system that develops responsible citizens capable of acquiring essential skills for lifelong learning and employment (Department of Education, 2013). Despite these efforts, the Philippine education system faces significant challenges, particularly in science education.

Recent results from the Programme for International Student Assessment(PISA) 2022 indicate that Filipino students ranked 77th out of 81 countries, achieving a mean score of 373 in science. This score is significantly lower than the OECD average of 487 (OECD, 2023). This result suggests that Filipino students are approximately five to six years behind their peers globally in learning competencies. Physical Science (PS), an essential part of the Senior High School curriculum, requires special attention because it provides students with the scientific knowledge and skills necessary for their future careers (Smith & Jones, 2020).

At the local level, Aritao National High School reflects these national challenges. In 2019, the school's National Career Assessment Examination (NCAE) results showed a mean percentile rank of 52 in Scientific Ability, placing it in the average range. Grade 12 learners at this school particularly struggle with mastering essential concepts related to motion, such as comparing Aristotelian and Galilean ideas

(Garcia, 2021), understanding uniform acceleration in a vacuum, and distinguishing between Newton's First Law and Galileo's views on force (Department of Education, 2013).

Educators need to address several key gaps in the educational landscape.

First, there is an Empirical Research Gap: Despite some promising findings from previous studies, there is limited empirical research on the effectiveness of new teaching strategies in the Philippine context. Second, the Performance Gap indicates that students often struggle to visualize two-dimensional motion, understand how horizontal and vertical motions are independent, and apply kinematic equations (Lee, 2022). Finally, the Implementation Gap highlights the urgent need for targeted interventions to help Grade 12 learners overcome challenges with motion-related concepts.

To tackle these challenges, this study recommends implementing the Collaborative Problem-Solving Approach (CPSA), which prioritizes teamwork in problem-solving while encouraging clear communication and creative thinking (Johnson & Johnson, 2018). This approach aligns with various institutional frameworks, including the DepEd Research Agenda, which aims to improve educational outcomes through evidence-based practices; the Nueva Vizcaya State University (NVSU) Research Agenda, which promotes innovation and empowers students; and the MATATAG Agenda, which supports initiatives to enhance science education (Department of Education, 2023).

Thus, this research aspires to transform challenges related to scientific concepts into a path of exploration and empowerment. By implementing the Collaborative Problem-Solving Approach (CPSA), the study aims to enhance students' comprehension of motion concepts, strengthen their problem-solving and critical thinking abilities, and contribute to the overarching objective of developing globally competitive graduates. These initiatives address pressing educational requirements and support the vision of cultivating a skilled and capable workforce in the Philippines, in line with the objectives of SDG 4 for quality education and lifelong learning opportunities for everyone.

STATEMENT OF THE OBJECTIVES

The objectives of this study were to enhance the mastery level of Grade 12 learners at Aritao National High School for the school year 2023-2024 in motion concepts, explicitly focusing on Aristotelian, Galilean, and Newtonian perspectives. The study aimed to evaluate the effectiveness of the Collaborative Problem-Solving Approach (CPSA) as an intervention to improve students' understanding and application of these concepts.

This study specifically sought to address the following questions:

1. To assess the level of mastery of Grade 12 students regarding motion concepts before and after the implementation of the Collaborative Problem-Solving Approach (CPSA).
2. To determine whether there is a significant difference in the mastery levels of the respondents concerning motion concepts before and after the implementation of the CPSA.
3. To explore the experiences of the respondents during the implementation of the CPSA.
4. To evaluate how the experiences of the respondents correlate with the results of the study.

METHODOLOGY

Research Methods

The research methods employed in this study encompassed both quantitative and qualitative techniques. The quantitative aspect involved administering a pre-test and post-test to evaluate students' mastery levels before and after the intervention. This approach provided numerical data that could be statistically analyzed to assess the effectiveness of the educational strategies implemented.

On the other hand, the qualitative methods included guided interviews aimed at gathering in-depth insights into the learners' experiences and perceptions. These interviews allowed participants to articulate their thoughts and feelings regarding the instructional approaches, thereby enriching the context of the quantitative findings.

Research Environment

Aritao National High School (ANHS) is a public educational institution in the Municipality of Aritao, a 2nd class municipality in Nueva Vizcaya, Philippines. Established as Aritao High School, it was renamed Aritao National High School in 2015. Built in 1993, the school boasts a history of 26 years dedicated to providing quality education. Currently, ANHS serves approximately 3,000 students and employs around 100 teachers, continuing to grow. The institution has multiple buildings that adequately accommodate its student and teacher population. ANHS has consistently demonstrated a commitment to excellence, achieving numerous accolades over the years, which reflect its dedication to fostering a culture of achievement among its students. It is recognized as a nature-vibrant and client-friendly institution, committed to providing quality, accessible, relevant, and liberating K to 12 education by-laws, policies, and procedures. This commitment is anchored in the principles of customer satisfaction and continual improvement. The current study focuses on Grade 12 non-STEM learners at ANHS, assessing their mastery levels in motion concepts through a collaborative problem-solving approach, thereby contributing valuable insights to the field of education.

Respondents of the Study

The researcher employed purposive sampling to select participants, specifically targeting Grade 12 learners enrolled in the ICT, HUMMS, and GAS sections at Aritao National High School.

Sampling Procedure

Inclusion and Exclusion Criteria

For the qualitative component of the study, the researcher established specific inclusion and exclusion criteria to ensure that selected respondents could offer relevant insights:

1. **Open-ended Questions**: All respondents who completed the survey and answered all open-ended questions were included in the analysis. This approach captured a wide range of perspectives, enriching the qualitative data.

2. **Focus Group Discussions**: Inclusion in focus group discussions was based on participants' responses to the open-ended questions. Only those who clearly understood the subject and offered thoughtful responses were included, while those who did not meet these criteria were excluded. This selective process aimed to enhance the quality of the discussions and ensure meaningful contributions from participants.

Furthermore, only learners who completed the intervention process with no absences during the implementation of the Collaborative Problem-Solving Approach (CPSA) were considered for inclusion. This criterion was crucial to ensure that participants had fully engaged with the intervention and could provide informed feedback.

The purposive sampling method allowed the researcher to select participants based on specific characteristics aligned with the research objectives, such as academic performance, interest in the subject, and consistent attendance throughout the study.

Before participation, the researcher approached potential respondents from the ICT, HUMMS, and GAS sections to explain the purpose and significance of their involvement in the study. It was essential to obtain informed consent from all participants, ensuring their voluntary participation and the confidentiality of their responses throughout the research process.

Table 1. Frequency and Percentage Distribution of the Grade 12 learners of Aritao National School for School Year 2023-2024

Section	Population	Respondents	Percentage
Grade 12 ICT	30	22	25.29 %
Grade 12 GAS	40	21	24.14%
Grade 12 HUMMS	60	44	50.57%
Total	**130**	**87**	**100%**

The data presented in Table 1 shows the frequency and percentage distribution of Grade 12 learners at Aritao National School for the school year 2023-2024. The total population of Grade 12 students is 130, with 87 responding to the survey, resulting in a total response rate of 100%. Among the different sections, the Grade 12 HUMMS (Humanities and Social Sciences) section has the highest number of

respondents, with 44 out of 60 students participating, which accounts for 50.57% of the total respondents. The Grade 12 ICT (Information and Communications Technology) section follows with 22 respondents out of 30, representing 25.29%. Lastly, the Grade 12 GAS (General Academic Strand) section has 21 respondents from a population of 40, making up 24.14% of the total. Overall, the data indicates a strong engagement from the HUMMS section, while the ICT and GAS sections have similar participation rates. This distribution highlights the varying response levels across different academic strands within the Grade 12 population.

Research Instrument

Pre-Posttest

To collect the necessary data for this study, the researcher utilized a 60-item pre-test and post-test designed to evaluate the learners' mastery levels in horizontal, vertical, and projectile motion, which are the key focus areas of the study. The assessment tool emphasized higher-order thinking skills (HOTS), ensuring that the questions required critical thinking and problem-solving abilities. This teacher-made pre-posttest questionnaire included simplified questions and was administered to Grade 12 learners in the ICT, HUMMS, and GAS sections at Aritao National High School. To validate the assessment tool, it was presented to the School Basic Education Research and Quality Assurance Committee (SRC), chaired by the school principal and including a master teacher, the Senior High School (SHS) Subject Group Head, and the subject coordinator. This presentation aimed to seek validation and approval of the assessment tool. Additionally, the pre-test and post-test were validated by three personnel: the School Principal IV, the Master Teacher in Key Stage 4, the SHS Subject Group Head, and the Science Department Head. The validation process utilized the quality assurance tool of the Nueva Vizcaya State University (NVSU) and the Department of Education, Schools Division of Nueva Vizcaya, and was conducted before the intervention.

To determine the mastery level of the learners before and after the utilization of the intervention, scores on their pre-test and posttest were interpreted based on the following mastery level descriptions:

Table 2. Mastery Level Descriptions

Traditional Grading Scale		Standards-based Grading Scale	
Letter Grade	**%**	**Points**	**Notes**
A	90-100%	4	Advanced
z	80-89%	3	Meets Expectations for Target
C	70-79%	2	Partial mastery of Target. Demonstrates partial understanding or can perform portions of the target with assistance.
D	60-69%	1	Little or No Mastery. Cannot demonstrate mastery, even with instructor assistance.
F	0-59%		

Standard-based rating (2019).

This pre-posttest was pilot-tested, and reliability analysis was carried out, yielding a reliability index (Cronbach alpha) of 0.92, which is qualitatively described as excellent internal consistency.

Data Gathering Procedure

To gather vital data for the action research, several key procedures were followed.

Development of Assessment Tool. The first key procedure in the data collection for the action research involved developing an assessment tool. A 60-item teacher-developed test was created specifically to measure the respondents' mastery levels. This test was designed to comprehensively evaluate the student's understanding of the subject matter, ensuring that it aligned with the educational objectives of the study. By focusing on a range of competencies, the assessment aimed to provide a clear picture of the learners' knowledge and skills prior to the intervention.

Validation Process. Following the development of the assessment tool, a rigorous validation process was undertaken to ensure its reliability and effectiveness—this involved validation by selected Master Teachers, Science Coordinators, and the school's quality assurance team. The assessment tool was then presented to the School Basic Education Research and Quality Assurance Committee (SRC) for formal validation and approval. This step was crucial in confirming that the assessment met the necessary educational standards and was suitable for use in the research. To further enhance the credibility of

the assessment, the pre-test and post-test were validated by several key personnel, including the School Principal IV and the Master Teacher in Key Stage 4. The validation process utilized quality assurance tools from the Nueva Vizcaya State University and the Department of Education. This collaborative effort ensured that the assessment was reliable and aligned with broader educational standards and expectations.

Pilot Testing. To ensure the reliability of the assessment instrument, pilot testing was conducted. This involved administering the pre-test and post-test to another section of Grade 12 learners. The pilot testing phase was instrumental in identifying necessary adjustments to the test items, allowing for refinements that would enhance the clarity and effectiveness of the assessment. Before conducting the pilot testing, the researcher obtained the required permit from the SRC, ensuring that all procedures followed institutional guidelines.

Pre-test and Post-test Administration

The administration of the pre-test and post-test was strategically planned to align with implementing the CPSA. The pre-test was administered in a printed format one week before the CPSA was implemented, allowing for a baseline measurement of student mastery. The post-test was scheduled for the end of the fourth quarter, providing a comparative measure of student learning outcomes after the intervention.

Distribution of Materials

In preparation for the study, the researcher distributed the exam and the Table of Specifications prior to the commencement of the research. This ensured that all participants were well-informed about the assessment structure and expectations, facilitating a smoother testing process. Clear communication of the materials was essential for maintaining consistency and clarity throughout the assessment phase.

Review of Daily Lesson Log (DLL)

The Subject Group Head, Assistant Principal, and School Head thoroughly reviewed the Teacher-Made Daily Lesson Log (DLL) in Motion Concepts. This review process was critical in ensuring that the instructional materials were effective and aligned with the study's learning objectives. By involving key educational leaders in the review, the researcher aimed to enhance the quality of the teaching materials used during the intervention.

Implementation of CPSA

The CPSA was implemented by the existing class schedules, allowing for seamless integration into the learners' academic routines. This strategic implementation aimed to enhance the overall learning experience by providing students with opportunities to engage in meaningful problem-solving activities relevant to their studies.

Group Formation. They were divided into teams of seven to promote active participation and collaboration among students. This group structure was designed to encourage teamwork and facilitate effective engagement, allowing learners to work on separate tasks while contributing to a common goal—the research aimed to enhance the learning experience and encourage peer-to-peer interaction by fostering a collaborative environment.

Selection of Group Leaders. Group leaders were selected based on their academic performance during the first semester. This selection process aimed to ensure that the leaders could facilitate effective communication and coordination within their teams. By choosing academically proficient students as leaders, the research sought to enhance the overall effectiveness of group dynamics and decision-making processes.

Role Assignment within Groups. Within each group, specific roles were assigned to each member, including primary facilitator, timekeeper, recorder, researcher, and presenter. This structured approach to role assignment fostered a sense of shared responsibility among group members, enhancing their engagement and accountability. By clearly defining roles, the research aimed to promote collaboration and ensure that all students contributed meaningfully to the group's efforts.

CPSA Process Implementation. The CPSA process began with presenting the first competency to the groups, where the primary facilitator encouraged all members to share their initial thoughts and ideas. This initial discussion was designed to stimulate engagement and ensure that every group member actively participated in the problem-solving session—the research aimed to enhance the collaborative learning experience by fostering an inclusive environment.

Role Rotation. To further enrich the learning experience, a role rotation process was implemented after each competency. This approach allowed students to experience different group responsibilities, promoting well-rounded development and preventing role fatigue. The research aimed to enhance students' skills and adaptability by rotating roles, contributing to a more dynamic learning environment.

Post-Evaluation. Scoring, Analysis, and Interpretation of Data. The data gathered from respondents' responses were meticulously tabulated for further analysis and interpretation, ensuring a structured and efficient approach to data management. The findings were used as a basis to provide conclusions and recommendations.

Statistical Tools Used

After retrieving the research instruments, the researcher organized the collected data, created tables, and conducted statistical analysis and interpretation.

The following statistical tools were employed:

Mean Percentage Score and Standard Deviation. These measures were used to assess the mastery level of respondents utilizing the Classroom Performance Standard Assessment (CPSA).

Paired t-test. This was utilized to determine whether there is a significant difference in the mastery levels of Grade 12 learners concerning the concepts of motion from the Aristotelian, Galilean, and Newtonian perspectives before and after the implementation of the CPSA. The paired t-test was conducted at a 5% level of significance. Change scores were calculated from the pre-test, and post-test scores and the importance of these changes was assessed using a paired sample t-test, with a threshold of $t > 30\%$ as the comparison value.

Thematic Analysis. This was conducted through open and axial coding systems to describe the learners' experiences with the intervention. Open coding served as the initial step, focusing on distinct concepts and categories within the data, breaking it into first- and second-level categories. Axial coding was then employed to confirm that the identified concepts and categories accurately represented the gathered responses and to explain how these concepts and categories were related (Creswell, 2007).

FINDINGS

This discusses the relevant findings of the study based on the collected data that were subjected to appropriate statistical treatment based on the specified problem.

***Objective 1*. To assess the level of mastery of Grade 12 students regarding motion concepts before and after the implementation of the Collaborative Problem-Solving Approach (CPSA).**

The test results show improved students' understanding of motion concepts from the pre-test to the post-test. Initially, students scored an average of 38.97 (SD = 17.97) on Aristotelian and Galilean concepts, indicating No Mastery. After the intervention, this average increased to 73.02 (SD = 14.19), reflecting Partial Mastery. For Galileo's conclusion about objects in a vacuum, the pre-test average was 35.26 (SD = 16.67), also showing No Mastery. The post-test score rose to 77.53 (SD = 12.00), indicating Partial Mastery. Similarly, the distinction between Newton's First Law and Galileo's assertions improved from a pre-test average of 41.02 (SD = 13.01) to 72.17 (SD = 11.74) post-intervention.

Hence, the pre-test average for all competencies was 42.36 (SD = 17.97), while the post-test average rose to 74.25 (SD = 11.74), indicating a clear transition from No Mastery to Partial Mastery. This substantial improvement highlights the effectiveness of the instructional intervention in enhancing students' understanding of motion concepts.

Research supports this, showing that cooperative learning improves understanding and retention of concepts through peer interactions. For instance, Johnson and Johnson (2009) emphasize that collaborative problem-solving enhances mastery of complex concepts, including physics, as students benefit from discussing and clarifying doubts with each other. Similarly, Hattie and Donoghue (2016) found that collaborative efforts lead to higher mastery levels, reinforcing the idea that students learn better when they work together. In the Philippines, studies by Alonzo and Tiongson (2020) and Bautista and Santiago (2021) have shown that students who engage in collaborative activities achieve significantly higher mastery levels than those in traditional learning settings.

Thus, the results show the effectiveness of collaborative problem-solving in increasing students' engagement and understanding. However, while the results are promising, the mastery levels still indicate that students have not fully mastered the concepts, suggesting a need for continued support and refinement of teaching strategies.

Objective 2. **To determine whether there is a significant difference in the mastery levels of the respondents concerning motion concepts before and after the implementation of the CPSA.**

The data for Problem 2 investigates whether there is a significant difference in the mastery levels of Grade 12 students at Aritao National High School regarding motion concepts before and after implementing the Collaborative Problem-Solving Approach. The data was collected through a structured assessment process.

Initially, a pre-test was administered to evaluate the student's understanding of motion concepts before the intervention, yielding a mean score of 38.37. This score indicated the students' level of mastery at that time. After implementing the Collaborative Problem-Solving Approach, a post-test was conducted to assess any changes in the student's mastery levels.

The post-test results showed a significant increase in the mean score to 74.25. To analyze the data statistically, we calculated the mean difference between the pre-test and post-test scores, resulting in a mean difference of 35.88. A t-test was performed to determine the significance of this difference, yielding a t-statistic of -19.02 with a corresponding p-value of 0.000. Since this p-value is less than the alpha level of 0.05, it indicates that the difference in mastery levels before and after the intervention is statistically significant.

Table 3. Comparison of the Pre and Posttest Results of the Respondents

Indicator	Mean N=130	Mean Difference	df	t stat	P value
Pre-test	38.37	35.88	86	-19.02	0.000*
Posttest	74.25				

α= 0.05

The comparison of the pre-test and post-test results shows a significant improvement in students' understanding of motion concepts. The mean score for the pre-test was 38.37, with a mean difference of 35.88 and a t-statistic of -19.02, resulting in a p-value of 0.000. This p-value is well below the alpha level of 0.05, indicating that the difference in scores is statistically significant.

Initially, students demonstrated "No Mastery," meaning they could not effectively show understanding even with teacher assistance. However, the post-test results indicate a shift toward "Partial Mastery," where learners displayed some understanding or could perform parts of the target concepts with assistance. This transition suggests that the Collaborative Problem-Solving Approach (CPSA) effectively enhanced students' comprehension of the material. The data highlights the positive impact of this intervention on students' learning outcomes and emphasizes the importance of targeted teaching methods in improving mastery of complex concepts.

Supporting this idea, Hattie (2009) synthesized over 800 meta-analyses demonstrating how collaborative learning strategies boost student achievement. His findings reveal that collaborative problem-solving approaches lead to higher mastery levels in physics, as students benefit from peer support and diverse perspectives, particularly in understanding motion concepts.

Objective 3. **To explore the experiences of the respondents during the implementation of the CPSA.**

In analyzing the qualitative data regarding positive learning experiences, several themes aligned with Creswell's (2014) practical teaching and learning principles. The primary themes identified include Positive Learning Experiences, Challenges and Difficulties, Impact of Collaborative Problem-Solving Approach, and Suggestions for Improvement.

Table 4. Experiences of the learners after the implementation of CPSA

Themes	Sub-Theme
Positive Learning Experiences	Enjoyable Aspects of Motion Concepts
	Collaborative Engagement
Challenges and Difficulties	Conceptual Difficulties
	Group Dynamics
Impact of Collaborative Problem-Solving Approach	Enhanced Understanding
	Application of Knowledge
Suggestions for Improvement	Need for More Structured Guidance
	Additional Resources and Support

Table 4 presents the themes and sub-themes derived from the learners' experiences following the implementation of the Collaborative Problem-Solving Approach (CPSA) in their study of motion concepts. The responses shows both positive learning experiences and challenges faced by the students, as well as suggestions for improvement.

Positive Learning Experiences

Enjoyable Aspects of Motion Concepts

Students expressed enthusiasm for the hands-on activities associated with learning motion concepts.

Respondent 2 noted, *"Talagang nag-enjoy ako sa pag-aaral tungkol sa iba't ibang uri ng motion, lalo na sa mga hands-on na activities kung saan nakita namin ang mga concepts in actual. These activities really helped me to better understand the ideas and principles of motion."*

Another highlighted the effectiveness of using toy cars to demonstrate speed and distance,

Respondent 18 stated, *"The part where we used toy cars to demonstrate speed and distance was my favorite because it made the lesson fun and easy to understand*."

Hence, the experiments conducted were well-received, with students feeling that they made the lessons more interesting and helped them visualize the concepts better.

Respondent 20, *"Learning about projectile motion was exciting! I loved how we could calculate the angles and see the results in real-time."*

Thus, students' enthusiasm for hands-on activities in learning motion concepts indicates that interactive and experiential learning significantly enhances engagement and understanding. Incorporating more practical demonstrations, such as using toy cars, can make lessons not only enjoyable but also more effective in helping students visualize and grasp complex ideas.

Collaborative Engagement

The collaborative aspect of the CPSA was also positively received. Students appreciated the opportunity to work in groups.

Respondent 28 stated, "*Working in groups made the lessons more enjoyable kasi nakakapag-share kami ng ideas at natutulungan ang isa't isa*.."

The teamwork showcased a richer learning experience, as noted by Respondent 20: " *Group discussions allowed us to explore different viewpoints, which made the learning experience richer. Sa mga usapan, nakapag-share kami ng iba't ibang ideas namin kaya mas naging makulay at masaya ang aming pagkatuto.."*

Many students felt more engaged when collaborating, indicating that peer support enhanced their learning.

The positive reception of the collaborative aspect of the Collaborative Problem-Solving Approach (CPSA) suggests that group work fosters a richer learning experience. By encouraging teamwork and idea-sharing, educators can enhance student engagement and support, leading to a more dynamic and inclusive classroom environment.

Challenges and Difficulties

Conceptual Difficulties

Despite the positive experiences, students encountered challenges, particularly with conceptual understanding.

Respondent 41 admitted, *"Nahihirapan ako sa pag-intindi ng mga formula na may kinalaman sa motion; nakakalito sila sa simula.."*

Respondent 55 echoed similar sentiments regarding specific concepts, such as acceleration and inertia, indicating a need for more time and clarity in these areas. For instance, one student stated, *"Some concepts, like acceleration, were hard for me to grasp, kailangan ko ng mas maraming oras para maunawaan ang mga ito."*

Students' struggles with conceptual understanding of motion-related formulas and concepts like acceleration and inertia highlight the need for more time and clarity in instruction. This suggests that learner should consider implementing targeted teaching strategies and additional resources to help students grasp these challenging concepts more effectively.

Group Dynamics

Group dynamics also posed challenges. Some students expressed frustration over unequal participation,

Respondent 1 noting, *"Sometimes, not everyone in the group contributed equally, which made it frustrating for those of us who wanted to work hard."*

Disagreements within groups were mentioned as a barrier to effective collaboration.

Respondent 75 stated , *"We had some disagreements in our group, which made it hard to focus on the task at hand."*

Additionally, some students felt overshadowed in discussions, which hindered their ability to contribute.

The challenges related to group dynamics, such as unequal participation and disagreements, indicate a need for strategies to foster equitable collaboration.

Impact of Collaborative Problem-Solving Approach

Enhanced Understanding

The CPSA significantly impacted students' understanding of motion concepts.

Respondent 6 remarked, *"The Collaborative Problem-Solving Approach really helped me understand motion concepts better; discussing with my peers clarified a lot of my doubts."*

Many students reported increased confidence in their understanding after collaborative work,

Respondent 11, *"I felt more confident in my understanding after working together with my classmates on the problems."*

Hence, (CPSA) has proven effective in enhancing students' understanding of motion concepts. By facilitating peer discussions, this method not only clarifies doubts but also boosts students' confidence in their knowledge. The opportunity to explore various problem-solving strategies deepens comprehension, suggesting that incorporating collaborative techniques in teaching can significantly enrich the learning experience and foster a more profound grasp of complex concepts

Application of Knowledge

Students also noted that the group activities facilitated the application of knowledge to real-world situations.

Respondent 5 shared, *"The group activities helped me apply what I learned in class to real-world situations, mas naiintindihan ko na ang mga pangyayari sa paligid ko."* This connection between theory and practice was emphasized by Respondent 70, who stated, *"I felt that the collaborative tasks helped me connect the dots between theory and practice, ito ay nakatulong sa aking pagkatuto at mas ma appreciate pa ang science lalo na sa motion."*

The positive feedback from students regarding group activities highlights the importance of connecting theoretical knowledge to real-world applications.

Suggestions for Improvement

Need for More Structured Guidance

Students suggested that more structured guidance could enhance their collaborative learning experience.

Respondent 28 stated, *"I think we could benefit from clearer instructions during group activities; minsan kasi magulo lalo kung maraming ideas ang mga kagrupo."*

Others echoed this sentiment, advocating for step-by-step guides and additional checkpoints during group activities to ensure everyone remained on track.

Respondent 8 stated, *" Having a step-by-step guide for our collaborative tasks would help us stay focused and organized. Mas magiging maganda kung lahat ng members ay may printed copy ng instructions, hindi lang yung leader."*

The feedback from students indicates that structured guidance is essential for enhancing their collaborative learning experiences. Clearer instructions and step-by-step guides can help reduce confusion and chaos during group activities, allowing students to focus better and stay organized.

Additional Resources and Support

Finally, students expressed a desire for additional resources to support their learning. Suggestions included supplementary materials such as videos and worksheets.

Respondent 58 stated, *"It would be helpful to have more supplementary materials, like videos or worksheets, to reinforce what we learn in class."*

Access to online resources and hands-on simulations was also recommended to help visualize complex concepts better.

Respondent 83 mentioned, *"I think extra practice problems would help us solidify our understanding of motion concepts."*

Additionally, Respondent 17 noted, *"I would like to see more hands-on resources, like simulations, to help visualize the concepts better."*

Hence, students' requests for additional resources shows the necessity of providing diverse instructional materials, such as videos, worksheets, and hands-on simulations. These resources can enhance understanding and retention of complex concepts, catering to various learning styles.

The results support the study of Dela Cruz and Ramos (2022), which highlights the effectiveness of collaborative problem-solving activities in improving students' mastery of motion concepts. Their findings show that students who engaged in group problem-solving exhibited enhanced understanding and application of motion principles, demonstrating the value of collaboration in physics education.

Additionally, Gonzales and Mendoza (2023) conducted a case study that reinforces the importance of collaborative strategies, showing significant improvements in students' understanding of motion concepts through collaborative activities in a senior high school setting.

***Objective 4*. To evaluate how the experiences of the respondents correlate with the results of the study.**

To determine whether the respondents' experiences support the study's results, a mixed-methods approach was employed, integrating both quantitative and qualitative data. Quantitative data were collected through a structured assessment that measured the Mean Percentage Score (MPS) for various themes related to the student's learning experiences in motion concepts. Each theme, such as "Positive Learning Experiences" and "Challenges and Difficulties," was assigned an MPS that reflected the students' mastery levels. For instance, the MPS for "Enjoyable Aspects of Motion Concepts" was recorded as 73.02, indicating Partial Mastery. This quantitative data provided a numerical basis for understanding the overall effectiveness of the instructional approach.

In addition to the quantitative data, qualitative data were gathered through open-ended student responses. These responses offered more profound insights into their personal experiences and perceptions regarding the learning process. For example, students enjoyed hands-on activities and collaborative discussions, which aligned with the quantitative findings of positive learning experiences. However, some qualitative responses also highlighted challenges, such as difficulties in understanding certain concepts, contrasting with the overall positive MPS—the integration of these two data types allowed for a comprehensive analysis of the student's experiences.

The consistent results between the quantitative MPS and qualitative feedback reinforced the effectiveness of the Collaborative Problem-Solving Approach. At the same time, the discrepancies in some areas highlighted the need for further support in specific concepts. This mixed-methods design enriched the understanding of the student's learning experiences, providing a more nuanced view of their mastery levels and the impact of the instructional strategies employed.

Table 5. Joint Display Integration of Quantitative and Qualitative Findings on the Learners' Experiences in the Implementation of CPSA.

Themes	Sub-Themes	Quantitative Data	Qualitative Data	Difference Between themes and Statistical Results
Positive Learning Experiences	Enjoyable Aspects of Motion Concepts	MPS: 73.02 Mastery Level: Partial Mastery	Respondent 2: *"Talagang nag-enjoy ako sa pag-aaral tungkol sa iba't ibang uri ng motion, lalo na sa mga hands-on na activities..."*	Consistent quantitative and qualitative results
			Respondent 18: *"The part where we used toy cars to demonstrate speed and distance was my favorite..."*	Consistent quantitative and qualitative results
			Respondent 20: *"Learning about projectile motion was exciting!"*	Consistent quantitative and qualitative results
			Respondent 28: *"Working in groups made the lessons more"*	Consistent quantitative and qualitative results
	Collaborative Engagement	MPS: 74.25 Mastery Level: Partial Mastery	Respondent 20: *"Group discussions allowed us to explore different viewpoints..."*	Consistent quantitative and qualitative results
Challenges and Difficulties	Conceptual Difficulties	MPS: 72.17, Mastery Level: Partial Mastery	Respondent 41: *"Nahihirapan ako sa pag-intindi ng mga formula na may kinalaman sa motion..."*	Respondent measures contradict qualitative themes
			Respondent 55: *"Some concepts, like acceleration, were hard for me to grasp..."*	Respondent measures contradict qualitative themes
	Group Dynamics	MPS: 72.17, Mastery Level: Partial Mastery	Respondent 1: *"Sometimes, not everyone in the group contributed..."*	Respondent measures contradict qualitative themes
			Respondent 75: *"We had some disagreements in our group..."*	Respondent measures contradict qualitative themes
Impact of Collaborative Problem-Solving Approach	Enhanced Understanding	MPS: 74.25 Mastery Level: Partial Mastery	Respondent 6: *"The Collaborative Problem-Solving Approach really helped me understand motion concepts better..."*	Consistent quantitative and qualitative results
			Respondent 11: "I felt more confident in my understanding after working together..."	Consistent quantitative and qualitative results
	Application of Knowledge	MPS: 74.25 Mastery Level: Partial Mastery	*Respondent 5: "The group activities helped me apply what I learned in class to real-world situations..."*	Consistent quantitative and qualitative results
			Respondent 70: *"I felt that the collaborative tasks helped me connect the dots between theory and practice..."*	Consistent quantitative and qualitative results
Suggestions for Improvement	Need for More Structured Guidance	MPS: 72.17 Mastery Level: Partial Mastery	Respondent 28: "*I think we could benefit from clearer instructions during group activities..."*	Consistent quantitative and qualitative results
			Respondent 8: *"Having a step-by-step guide for our collaborative tasks would help us stay focused..."*	Respondent measures contradict qualitative themes
	Additional Resources and Support	MPS: 72.17 Mastery Level: Partial Mastery	Respondent 58: *"It would be helpful to have more supplementary materials, like videos or worksheets..."*	Respondent measures contradict qualitative themes
			Respondent 83: *"I think extra practice problems would help us solidify our understanding..."*	Respondent measures contradict qualitative themes
			Respondent 17: *"I would like to see more hands-on resources, like simulations..."*	Respondent measures contradict qualitative themes

The integration of quantitative and qualitative data reveals several insights into learners' experiences after implementing the Collaborative Problem-Solving Approach (CPSA). Regarding Positive Learning Experiences, the sub-theme of Enjoyable Aspects of Motion Concepts shows a mean percentage score (MPS) of 73.02, indicating a level of Partial Mastery. Respondents enjoyed hands-on activities and group work, highlighting a consistent positive sentiment towards the learning experience. This alignment between quantitative results and qualitative feedback suggests that learners found the activities engaging and beneficial. Similarly, in Collaborative Engagement, the MPS of 74.25 indicates Partial Mastery, with respondents noting the value of group discussions in exploring different viewpoints, reinforcing the idea that collaboration enhanced learning.

Moreover, the sub-theme of Conceptual Difficulties presents an MPS of 72.17 under Challenges and Difficulties, indicating Partial Mastery. However, qualitative data reveals that respondents struggled with understanding formulas and concepts like acceleration, suggesting a more significant challenge than the quantitative data reflects. This discrepancy indicates that while some mastery is achieved, deeper conceptual understanding remains an issue. The Group Dynamics sub-theme also shows an MPS of 72.17, with qualitative insights revealing issues with group contributions and disagreements, further indicating that group dynamics may hinder learning more than the quantitative data suggests.

In terms of the Impact of the Collaborative Problem-Solving Approach, the sub-theme of Enhanced Understanding shows an MPS of 74.25, indicating Partial Mastery. Respondents felt more confident and understood motion concepts better through collaboration, with the data being consistent and showing that CPSA positively impacted understanding. The Application of Knowledge sub-theme also reflects an MPS of 74.25, with respondents feeling they could apply classroom learning to real-world situations, indicating the effective application of knowledge gained.

Hence, regarding Suggestions for Improvement, the sub-theme of the Need for More Structured Guidance has an MPS of 72.17, indicating Partial Mastery. Respondents expressed a need for more precise instructions and structured guidance, suggesting a stronger need for improvement than the quantitative data reflects. Similarly, the Additional Resources and Support sub-theme with an MPS of 72.17 indicates a demand for more supplementary materials and hands-on resources, further highlighting that qualitative insights indicate a greater need for resources than the quantitative data suggests.

Thus, the respondents' experiences largely support the study's results. While there is a general alignment between quantitative and qualitative data in areas of positive learning experiences and the impact of CPSA, discrepancies arise in challenges and suggestions for improvement. The qualitative data often highlights deeper issues and needs that the quantitative measures do not fully capture, suggesting areas for further attention and enhancement in the learning process.

Qualitative data analysis on positive learning experiences revealed several key themes that align with Creswell's (2014) teaching principles. These themes include Positive Learning Experiences, Challenges and Difficulties, the Impact of the Collaborative Problem-Solving Approach (CPSA), and Suggestions for Improvement.

Within Positive Learning Experiences, sub-themes highlighted the Enjoyable Aspects of Motion Concepts and Collaborative Engagement, with students enjoying the learning process and valuing teamwork. In contrast, the Challenges and Difficulties theme presented sub-themes of Conceptual Difficulties and Group Dynamics, where learners faced obstacles in understanding complex concepts and navigating group interactions.

The CPSA theme emphasized Enhanced Understanding and the Application of Knowledge, showing that this approach improved students' comprehension and practical application of motion concepts. Lastly, Suggestions for Improvement included the need for More Structured Guidance and Additional Resources, indicating a desire for frameworks to facilitate collaborative efforts better and enhance understanding.

CONCLUSIONS

Based on the significant findings presented, the following conclusions were drawn:

1. The findings indicate that implementing the CPSA enhanced the mastery of motion concepts among Grade 12 students at Aritao National High School. The transition from No Mastery to Partial Mastery across various competencies demonstrates the positive impact of collaborative learning strategies on students' understanding and application of complex scientific principles.
2. CPSA significantly improved the mastery level of motion concepts among Grade 12 students. The substantial increase in scores from pre-test to post-test reflects the effectiveness of this instructional strategy in fostering a better understanding of complex scientific principles.
3. Implementing the Collaborative Problem-Solving Approach significantly enhanced students' understanding of motion concepts while highlighting areas for improvement. The positive feedback regarding hands-on activities and collaborative engagement indicates that these methods effectively support student learning. However, the challenges related to conceptual understanding and group dynamics suggest that while CPSA is beneficial, it requires careful structuring to maximize its effectiveness.
4. The findings suggest that the CPSA significantly enhances learners' understanding and engagement with motion concepts, as evidenced by improved scores in both quantitative and qualitative measures. While students express enjoyment and recognize the benefits of collaboration, challenges related to conceptual understanding and group dynamics indicate areas that require further attention.

RECOMMENDATIONS

After careful handling of the data and coming up with the significant findings and conclusions, the following are recommended:

1. Based on the findings, it is recommended that educators continue to utilize the CPSA in teaching motion concepts, as it has proven effective in improving student mastery.
2. Based on the results, it is recommended that educators continue to implement the Collaborative Problem-Solving Approach in teaching motion concepts, as it has proven to be effective in enhancing student mastery. Additionally, further research should explore the long-term effects of CPSA on student learning and consider integrating supplementary resources and structured guidance to address any remaining conceptual difficulties and support students in achieving higher mastery levels
3. To improve the learning experience further, it is recommended that educators provide more structured guidance during collaborative activities. This could include more explicit instructions and step-by-step guides to help students stay organized and focused. Additionally, supplementary resources such as videos, worksheets, and hands-on simulations can address conceptual difficulties and cater to diverse learning styles, ultimately enhancing students' grasp of complex motion concepts.
4. To build on the positive outcomes of the CPSA, it is recommended that educators provide more explicit instructions and structured guidance during collaborative activities to address the identified conceptual difficulties.

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DEVELOPMENT AND EVALUATION OF DUALLY OPERATED METAL BENDING (DOMB) MACHINE

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ABSTRACT

This study focused on the development and evaluation of a dually operated metal bending (DOMB) machine, based on the needs of the Metal Trade Department, College of Industrial Technology, Nueva Vizcaya State University, Bambang, Nueva Vizcaya. It specifically sought to determine the specifications and requirements for constructing a DOMB machine; identify a suitable design; assess the level of evaluation of the respondents on the acceptability of the DOMB machine in terms of design, functionality and safety; and examine the significant differences that may exists in the assessments among the three group of respondents. This study used a quantitative design, particularly the descriptive method, utilizing a questionnaire to evaluate the developed machine. The respondents were twenty (20) students, ten (10) faculty members, and ten (10) industry partners. The DOMB machine was assessed as very much acceptable by most of respondents with a grand mean of 4.69. Students qualitatively described the machine as much acceptable in all areas, while faculty members and industry partners described it as very much acceptable. A significant difference was found in the assessments of the three groups of respondents on the acceptability of DOMB machine in terms of design as attested by the computed F-value of 8.87 and p-value of 0.001; functionality, with a computed F-value of 6.88 and p -value of 0.003; and safety, with a computed F-value of 4.81 and p-value of 0.014. Overall, the acceptability level of DOMB machine was assessed as very much acceptable, though to varying degrees among the different groups of respondents.

Keywords: acceptability, descriptive method, development, dually operated metal bending machine, evaluation

INTRODUCTION

Education is the starting point of every individual to learn basic knowledge and skills, which can later be applied in their chosen field of work. Schools should provide students with both abstract and practical life skills that meet the demands of advancing technology.

The United Nations crafted the seventeen (17) Sustainable Development Goals (SDGs) which aimed to address global problems. One of these goals is Quality Education. SDG 4 aims to ensure inclusive and high-quality education for everyone, while fostering opportunities for lifelong learning and advocating for the reduction of inequalities. The key targets of SDG 4 are to ensure that all learners regardless of gender, complete free, inclusive, and high-quality education at the elementary and secondary levels, thereby improving the number of competitive worker with relevant skills for employment (National Economic and Development Authority).

In educational settings, the development of instructional materials is considered one of the key factors in upholding and enhancing student learning and the achievement of academic goals and objectives. Educators need to prioritize developing beneficial teaching-learning materials to cater the needs of increasing number of students (Kapur, 2019). Along with the new discoveries of advanced skills and scientific ideas, materials, tools and equipment help people work conveniently and efficiently, improving quality of product and services.

On this note, higher education institutions particularly those offering technology programs, are tasked with developing in students the essential knowledge and competencies to contribute to a productive, effective, and competent workforce. They must provide students with high-quality education that

equips them with critical competencies to meet and overcome the widespread and difficult challenges they encounter.

It is sad to note, however, that many schools could hardly deliver quality instruction because of several factors, one of which is the inadequacy of tools and equipment in the workshops. Considering the increasing enrollment in technical courses, instructors find difficulty in transmitting and facilitating learning, especially because technical courses require hand-on activities or practicum.

School may develop and innovate. Some tools and equipment may be improvised out of locally available materials. With a dearth of resources, one important thing to remember is that improvised equipment or tools will aid in developing or harnessing the necessary skills needed for the work (Bantasan, 2001).

Metal Arts and Crafts is one of the courses in the Bachelor of Science in Industrial Technology at the Nueva Vizcaya State University (NVSU), Bambang, Nueva Vizcaya. It is not spared from the problem of scarcity of instructional materials, especially in the subject MT1-Fundamentals of Metal Works and Processes. There are existing materials, tools, and equipment but they are found to be obsolete due to rapid advancement in technology and there are machines that are still usable but does not meet the standard ratio between equipment and student.

Premised on this, the researcher was prompted to develop a dually operated metal bending machine. It is a machine that can either be electrically or manually operated to bend metals such as flat bars, square bars, round bars and tubulars. The machine can be used even if there is no electric power or when cost cutting is considered when small materials can be bend manually. The machine is eventually a practical application in teaching a lesson in fundamentals of metals works and processes. The teacher can practically impart essential technical knowledge and skills to the learners on the procedure in bending metals into different shapes and forms through this machine.

STATEMENT OF THE PROBLEMS/OBJECTIVES

This study focused on the development and evaluation of a dually operated metal bending (DOMB) machine to be used as instructional material (IM) based on the need of the Metal Trade Department, College of Industrial Technology, Nueva Vizcaya State University (NVSU), Bambang, Nueva Vizcaya. The main objective of this study was to determine the level of acceptability of the developed IM.

Specifically, the study aimed to:

1. Determine the specifications and requirements needed in designing the DOMB machine;
2. Develop a DOMB machine based on the determined specifications, requirements, and design;
3. Determine the level of evaluation of the students, faculty, and industry partner respondents on the acceptability of the finished projects in terms of design, functionality and safety; and
4. Unveil if there is a significant difference in the evaluation of the three groups of respondents on the acceptability of the finished project.

METHODOLOGY

The study made use of the descriptive-evaluative and comparative method of research involving the Product Development (PD) method. The researcher conceptualized the design, developed, and evaluated the finished DOMB machine.

Product Development (PD) method involves either developing new or improving an existing product and its presentation. PD method aims to guide the researchers by providing theoretical and practical knowledge on how to developed and innovate a product by following appropriate steps. The Stage-Gate type of PD method which generally follows a sequential process to develop and to launch a product was adapted in this study. One stage is generally executed only if its prior process is accomplished and passed established criteria between processes. Product Development method use in research usually start with planning process, then development process, testing and evaluation process to discover or to contribute to a creation product. "In general, the need-based PD methods suggest a development start making benchmarking, reversed or backward engineering of existing products and solutions followed by us-

ing and improving the best solutions to be new solutions and products" (Ottoson & Kolla, 2017, "Introduction" section).

The dually operated metal bending machine was developed and the parts were assembled in conformity to the PD method (Figure 1), it consists of four main stages as follows:

Planning Stage. In this stage, the researcher conceptualized the design of the dually operated metal bending machine by considering the needed specification, requirement and plan of the parts to be followed in assembling the project. Reviews from related literatures and study, solicited students' ideas on their priority needs, together with the recommendations and suggestions of experts are parts in determining specification and requirements.

Development Stage. At this stage, the fabrication of the DOMB machine is carried out. Materials are sourced out, purchased and assembled. The necessary procedures or steps to be followed in fabricating the project is supervised by the researcher to ensure that design purpose of each part is not compromised.

Testing and Revision Stage. After the DOMB machine is fabricated, it undergoes an actual testing. In this stage the project is tested into its intended purpose. This is considered as the initial evaluation as all requirements or criteria in the instruments are observed. Experts are invited to participate in the testing of the project. When the result is satisfactory, it is subjected for final evaluation. If it seems not satisfactory or experts have recommendations, a revision is made considering experts' recommendations and observations.

Evaluation Stage. This stage is the final evaluation of respondents; a questionnaire is administered using five-point Likert scale. Acceptability of the project in terms of design, functionality, and safety are considered as criteria. There were twenty (20) students, ten (10) faculty members who were randomly selected all from the Bachelor of Science in Industrial Technology program of the College of Industrial Technology, Nueva Vizcaya State University, Bambang, Nueva Vizcaya and ten (10) local industry partners, took part in the evaluation of the project. Respondents' recommendation is considered for revision of the final project.

Comparative method of research involves a two question or objectives in a study, "what to compare" and "how to compare". "What to compare involves deciding on the general class of cases and how to compare is a choice about the comparative logics that drive the selection of specific cases" (Bloemraad, 2013). In this study, the significant differences in the evaluation of the three groups of respondents on the acceptability of the DOMB machine is determined using a comparative approach. A null hypothesis was developed and used ANOVA/F-test as statistic tool. Data where tallied and the three mean scores of respondents were determined. Results of the p-value from F-test computation was compared to the 0.05 significance level used in the study to determine the significant differences between the evaluation of the three groups of respondents.

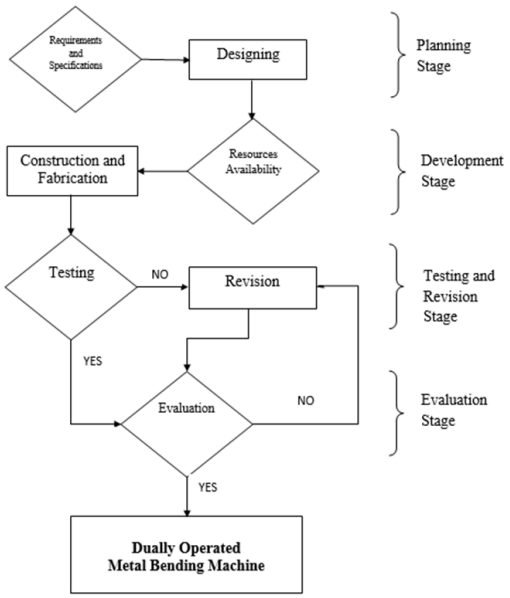

Figure 1. Product Development (PD) Method

FINDINGS

To come up with a well conceptualized design of dually operated metal bending machine, specifications and requirements were determined. The following are the specifications and requirements for the dually operated metal bending (DOMB) machine:

1. The machine should be heavy duty and durable to withstand the work it is intended for;
2. The machine is easy to operate;
3. It can be manually and electrically operated;
4. The machine is easy to maintain and its wearable parts are replaceable and repairable;
5. The material parts to be used in the construction of the DOMB machine are locally available;
6. It should be installed with overload switch, emergency stop, cover guard and label with safety precautions;
7. The DOMB machine should be able to bend round bar and square bar of sizes up to one-half (1/2) inch diameter, bend flat bar of sizes up to one (1) inch width by one-fourth (1/4) inch thickness, bend square/round tubular/pipes of sizes up to one (1) inch diameter/width;
8. The machine can bend the specific round bar, square bar, flat bar, square and round tubulars into quarter circle, half circle, full circle and spiral shape; and
9. It can be both used in shops and as instructional equipment.

The design of the DOMB machine, based on the determined specifications and requirements, is shown in figure 2, and the developed DOMB machine is shown in figure 3.

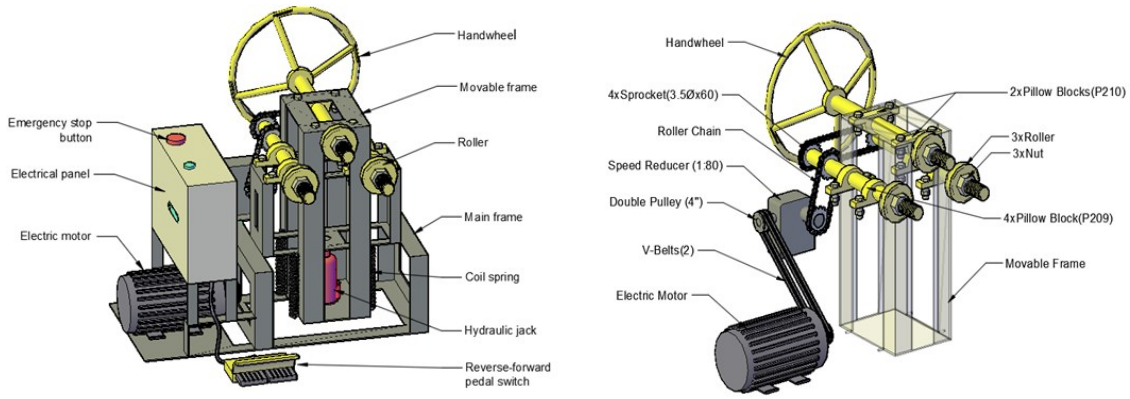

Figure 2. Parts of the DOMB machine

Figure 2 shows the parts of the DOMB machine. The electrical panel houses the contactors, circuit breaker, emergency stop and overload switches are installed and keep. Rollers guides the insertion of metal to be bend. Pillow block bearings are used to hold the shafting in place and a handwheel is provided for manual operation of the machine.

A hydraulic jack is positioned beneath the movable frame. The movable frame is held by a coil spring, purposely to retract it, pressing back the hydraulic jack after used. This mechanism enables the machine to achieve the desired curvature of a bent metal. The machine is operated electrically using a reverse-forward pedal switch, allowing a single operator to control it while keeping both hands and foot working in synchronize. The emergency stop button is strategically positioned for quick access in case of an emergency. The motor speed is reduced at a ratio of 1:80 using a speed reducer to ensure smooth and safe bending.

A V-belts are used to transmit power from the electric motor to the speed reducer, allowing for slippage when bending load is excessive. After the speed reducer, power is efficiently transmitted to the rollers via chain and sprockets connected to the shafting. Pillow block bearings were chosen to hold in place the shafting for their ease of mounting, minimal maintenance, stability and self-aligning capability. All parts are positioned in accessible area to facilitate easy repair and maintenance.

Figure 3. The developed DOMB machine

The developed DOMB machine was evaluated using a five-point Likert scale questionnaire. The mean scores and qualitative descriptions of respondents' evaluations of the DOMB machine in terms of design, functionality and safety are shown in table 1.

Table 1. Level of Evaluation of the Respondents on the DOMB Machine

	Student		Faculty		Industry Expert		Overall Mean	
	Mean	Qualitative Description	Mean	Qualitative Description	Mean	Qualitative Description	Mean	Qualitative Description
Design	4.29	Much Acceptable	4.86	Very Much Acceptable	4.85	Very Much Acceptable	4.67	Very Much Acceptable
Functionality	4.37	Much Acceptable	4.89	Very Much Acceptable	4.89	Very Much Acceptable	4.72	Very Much Acceptable
Safety	4.41	Much Acceptable	4.85	Very Much Acceptable	4.77	Very Much Acceptable	4.68	Very Much Acceptable
Grand Mean	4.36	Much Acceptable	4.87	Very Much Acceptable	4.83	Very Much Acceptable	4.69	Very Much Acceptable

The DOMB machine along design is evaluated by students with a mean of 4.29 which is qualitatively described as much acceptable. Meanwhile faculty and industry expert rate the machine with a mean of 4.86 and 4.85 respectively which both are very much acceptable. These imply that the respondents agreed that the design of the DOMB machine is heavy duty but simple, manually and electrically operated, it is operated by a single operator when electrically operated and equipped with a safety device; every material part of the machine is locally available; component parts of the machine are retainable and easy to maintain; and stressed parts are repairable and replaceable.

The students also assessed functionality as much acceptable as indicated by the mean of 4.37. While faculty and industry experts rated the machine very much acceptable with a same mean rating of 4.89. This suggests that they agreed that the DOMB machine can bend round bar of up to one half (1/2") inch of material diameter, square bar up to fourteen (14) millimeter output diameter, flat bar with maximum size of one (1") inch wide by one-fourth (1/4") thickness, pipes of up to one (1") inch diameter, and square pipes of up to one (1") inch in size. They also agreed that the DOMB machine can be used in teaching or demonstrating bending activities such as: quarter arc bending, half circle bending, full circular bending, and spiral bending; and agreed that the DOMB machine is serviceable and easy to operate.

Likewise, the students rated the machine in terms of safety with a mean of 4.41 with the qualitative description of "much acceptable" and "very much acceptable" by faculty and industry expert with mean of 4.85 and 4.77 respectively. It can be construed that they agree that the DOMB machine is stable and the materials used are durable, is installed with overload switch and emergency stop; high speed rotating parts of the machine are installed with cover guard; safety labels are attached to warn the operator of possible danger; and the DOMB machine is provided with an instructional manual.

It appears that the group of students rated the DOMB machine much acceptable while faculty and industry partners rated it very much acceptable. The result implies that students less likely appreciated the design, functionality and safety of the machine. These could be because students are not yet exposed in real manufacturing and in practical industry. They are cautious because they have less experi-

ence to perceive practicality in designing. They expect easier or spoon-feed machine, and they have no exposure in assessing the risk level of danger in operating a certain machine.

In a nutshell, the DOMB machine is "very much acceptable" as marked by the grand mean of 4.69 of the respondents' evaluation. Most of the respondents strongly agreed with the acceptability of the developed machine in terms of design ($\bar{x}$=4.67); functionality ($\bar{x}$=4.72); and safety ($\bar{x}$=4.69). Majority of them strongly agree that the design is aligned with the purpose for which the machine was constructed making it function properly as intended and ensuring that it does not put the operator at risk when used.

The overall assessment of the respondents on the DOMB machine differs significantly. This clearly imply that students' assessment has shown a space to review on the betterment of the device. In comparison, the difference on the assessment on the device between faculty and industry partners shows no significant difference. This would imply that both respondents almost have the same appreciation on the machine. These implications would suggest that the DOMB machine can be enhanced more by considering if possible the students' level of appreciation but not compromising the purpose of the machine.

CONCLUSIONS

Premised on the aforementioned findings of this study, the following conclusions were drawn:

1. The dually operated metal bending (DOMB) machine was conceptualized based from specifications and requirements needed for its development.
2. The DOMB machine was developed guided by a design and flow chart.
3. The DOMB machine was developed following a conceptualized design.
4. The DOMB machine was very much acceptable in terms of design, functionality, and safety.
5. Significant difference existed in the assessment of the three sets of respondents on the acceptability of the DOMB machine.
6. The DOMB machine can be enhance based on the level of appreciation of the student but not compromising its main purpose.

RECOMMENDATIONS

Based on the foregoing significant findings and conclusions of the study, the following are recommended for the enhancement of the project:

1. Since the DOMB machine is very much acceptable, its use as an instructional material may be maximized.
2. The school administrators may consider the production of more DOMB machine for greater chance to engage in more hands-on activities.
3. Other criteria of acceptability besides design, functionality, and safety may be explored in future studies.
4. Developers of technological machines or equipment may collaborate with industry partners for the enhancement of the DOMB machine and even other trainers and tools.
5. This study may be replicated involving other machines and equipment and based on NC II standards.
6. For enhancement of future product, it may be installed with a roller to transportable, a guide holder of the bended materials, casing for aesthetic purpose, safety precaution and foot operated jack.

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