

Understanding Classical Mechanics in Early Filipino Culture

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Abstract: *This ethnography research focuses on the connection between the indigenous knowledge of Manuvu Erumanen of Cotabato Province, particularly in their crafts into the concepts of classical mechanics, a branch of Physical science. Through in-depth investigation, the author found out that these Indigenous Peoples(IP) lived mostly at Central Mindanao descendants of Mamanwa's (Dillo, 2021), as the first Filipino landed in the Philippines, vibrates their indigenous heritages particularly the bamboo weaving crafts and found out that there is a strong connection between the concepts of classical mechanics, particularly in volume and Newton's law of mechanics to their indigenous knowledge, system and traditions without formal training in physics education.*

Keywords: Manuvu Erumanen, Mamanwa, classical mechanics, Linikan, Indigenous People(IP's), Central Mindanao

1. Introduction

This COVID -19 pandemic has hampered the Filipinos all over the Philippines in terms of economic status queue particularly in their daily living, jobs, and productivity. According to Karl Chua (2021), as Secretary of the National Economic Development Authority (NEDA) concluded that the worker's productivity will be lower due to death, illness, and lack of schooling, impact on productivity is permanent. Further consumptions and investments will be lower in the next ten(10) years due to lower demand in sectors that require social distancing particularly in amusement, tourism, restaurants, and public transportation, consequently tax revenues will be lower. He reiterated that there were huge losses of incomes like in 2020 alone a 4.3 Trillion pesos and he anticipated a 37.0 trillion Pesos for the next 10 to 40 years. As this project started, the author amazes at this local heritage of some major IP groups, the Manuvo Erumanen lived on their thousands of acres ancestral domains in far-flung, mountainous areas in Central Mindanao, if the Philippine government support this basketry industry productions, this could help a lot in terms of income and promising emerging industry in this countryside. According to Power et. al(2020) that Indigenous Peoples experience a more significant burden of noncommunicable and infectious diseases generally, and this is related to social and health inequities stemming from invasion and subsequent colonization. This is also the reason they try to be in a remote area, which no one can dictate what they want to do. The modern invasions in terms of the ways and means of their daily living affect much on the preservation of their cultural heritage, as utter by their IPs chieftain, their basketry weaving is almost erased in the mind of the younger generations. Preservation is cant fully address without the help of the different agencies which cater to the improvement of the quality of life of Filipino Indigenous People, particularly in this area. However, the main issue here is the preservation and documentation of the Erumanen Manuvu basketry weaving which the Philippine government should intervene before and after the COVID-19 pandemic, realize to be one of the emerging industry because we have a lot of talented IPs who inherited from ancient Filipinos.

Further, the integration of this inherited heritage should be in equilibrium in Science, Mathematics, and technology concepts, so that acceptability could inject in the international arena. In Meneses-Navarro et.al (2020), some challenges need to be addressed by governments to guarantee the health and lives of those at the bottom of the social structure: the indigenous peoples in the region.

As a researcher, the writer was motivated in pursuing this study to connect the concepts of basket weaving as the cultural heritage of Erumanen Manuvu into emerging science-based indigenous crafts.

2. Related Literature

Basketry Crafts has been detected as the major cultural heritage that this ancient civilization pass in through this modern industrial civilization, according to Romero-Brugués, S., Huerta, R. P., & Herrero-Ortal, M. (2021) that they detected the early basketry techniques based on remains found at the site of La Draga (Banyoles, Spain). La Draga has yielded a series of basketry fragments dated to 5300–5000 cal. BC introduces novel information about the use of natural materials to make baskets and the techniques involved in their fabrication. In the study of Pazon, A. N. R., & Del Rio, J. M. P. (2018) emphasized that baskets serve as a national icon for Filipinos signifying agricultural, cultural relevance and are used as containers and traditional bags of the Filipino farmers for its products or a status symbol of the women amongst different indigenous groups. Further, the forms, style, usage, and economic relevance of the different indigenous baskets and transcend culture. In their study, the most common raw materials used in making baskets are rattan, abaca, nito, tikog, buri, bamboo, pandan, coconut leaves and sticks, palm leaves, and beeswax. Further the different materials, functions, weaving patterns, and cultural relevance of the different baskets in the Philippines particularly in Central Mindanao, where the Manobu Dulangan of Sultan Kudarat and Erumanen Manuvu of Cotabato province still practice this kind of basketry weaving. According to De Las Penas, M. L. A. N., Garciano, A. D., & Verzosa, D. M. (2021) that the art of

basket weaving of the Batak indigenous community in Palawan, Philippines, discloses the depth of mathematics present in the weaves of the baskets. Using white and black one-sided bamboo strips, Batak weavers can construct a basket of a given size that displays highly symmetric patterns. The presence of elaborate patterns in the baskets indicates masterful planning by the weaver and an inherent knowledge of algebraic and geometric principles even without formal training in mathematics. This is the reason why the author wants to interconnect the concepts of physics, particularly in mechanics without formal schooling in science still the architecture of the Erumanen Manuvu of Central Mindanao possess a law of physics without knowing it.

3. Method

Syahrin, et. al (2016) emphasized that qualitative methods with the principles of ethnography such as studies in ethnomathematics i.e. observation, interviews, documentation, and field notes were used in this research. The researcher gathered the data through on-field observation, triangulate it into the contents of indigenous knowledge and physical views which describe simple computations of keen analysis in Newton's law and Volumes of solid objects. First the author strictly comply the Certificate of Compliance(CC) from the National Commission in Indigenous People (NCIP), which is done through a Memorandum of Agreement(MOA) between the SKSU, IP leaders, and NCIP –Region XII legal team representatives in two key areas – Sultan Kudarat and Cotabato province. Second, the author gathered the indigenous data from the selected *Erumanen Manuvu* particularly their basketry weaving in the perspective of the author in terms of the concept of volume and Newton's law. Lastly the interweaving of the indigenous culture, traditions, and customs in the subject of the study in the science and mathematics perspective.



Figure 3 (a)



Figure 4-a



Figure 4-b



Figure 4-c



Figure 3 (b)

Figure 2.a. The author and its *Erumanen manuvu* crafts, where the *Linikan* is bigger compare to others while the figure 2. b is the *Linikan* weaver.

4. Results and Discussion

4.1 Understanding classical mechanics in Manuvu Erumanen way

Most of the basket that the *Erumanen Manuvu* do is for a container in their agricultural products like the harvested rice, corns, and other fruits which is very important in their daily living. The uniqueness of this *Linikan* basket as shown in Figure 1 below as one of the basket crafts made by the *Erumanen Manuvu* weaver can carry a large amount of volume of agricultural products and also their measurement in terms of the consumptions that they already used as they fill-in inside the container particularly in *Linikan*. Further, the author noticed that the *Linikan* craft has irregular shapes, which the topmost part is not equal in the surface bottom of the said object, particularly the shapes, which the top has a circular shape while the bottom is a rectangle. As the *Erumanen Manuvu* revealed that this kind of appearance is suited in their way of living in the ancient time, particularly that the craft is put at the head of their IP member who carries over the said craft with a fill-in agricultural products and walked in a long-distance manner. So as the author investigate thoroughly the *Linikan* craft, the author found out that there is physics on it, particularly the center mass of the *Linikan*, the person carrying the *Linikan* using his head at the center, the gravitational force of the fill-in objects inside the *Linikan* and automatically towards the four surface corner of the said object. Further, there is balancing weight carried inside the *Linikan* so, ancient Filipinos already used the science in their crafts without knowing it.

In Figure 4. Shown a *Linikan* basket weaved by *Erumanen Manuvu* weaver. The side view of *Linikan* with a height value = 28cm (Figure 4-a). A circular top view with a diameter of 35 cm (Fig.4-b) and surface area in rectangular shape with dimension of 26cm x 27 cm(Fig.4-c).

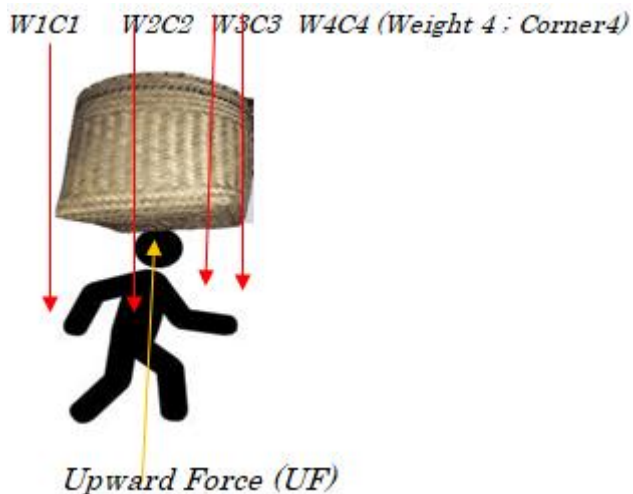


Illustration 1: Mechanics of Linikan

In Illustration 1, where the physical appearance of the *Linikan* interconnected into the concept of classical mechanics particularly in the concept of center of gravity, weight, mass, and volume. The author analyzes why the *Linikan* has a rectangular surface area compare to the topmost part of it. As the author used the concept of weight of the objects inside the *Linikan*, and the person carrying it, based on the interview, they put this in their head as to balance the container-*Linikan* and can't fall easily in the ground including the objects inside the container and they can travel in a long distance without hesitating to fall in the ground. Therefore our ancient Filipinos already have a concept of Center of gravity, center mass, weight, and volume.

The mathematical concepts using the Newtons law behind the Illustration 2 is shown below;

$$\sum \{Weight_1; Corner_1(W_1C_1) + \dots + Weight_4; Corner_4(W_4C_4)\} = Upward Force$$

Equation 1: Third Newton's law equation

In equation 1 demonstrate how the third law of motion equation is used to understand how the mechanics of *Linikan* works. The summation of four(4) corners of the *Linikan* surface with the equivalent value of weight object fill inside the *Linikan*, go directly in every four corners of *Linikan*. Weight is considered as the force which directly towards the ground, and against the Upward force applied by man, who carrying the said *Linikan*. Further, there is a strong application of the law of mechanics in carrying a *Linikan*, which in their culture served as a container of agricultural goods and was very important in their daily living. The *Erumanen Manuvu* weaver understands how to create the *Linikan* in such a way that the main purpose will be used as a container of agricultural products and most importantly to carry and transport with no hassle and comfort.

How about the physical appearance as describe to be an irregular shape?

The *Linikan* craft is very unique in terms of the main parts like the top part is circular while the surface perimeter is rectangular. As shown in Illustration 2.0.

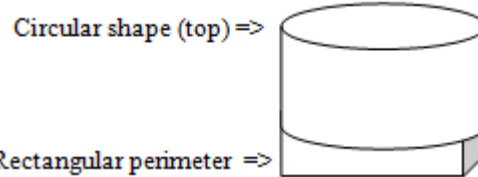


Illustration 2: The irregular shape perspective of Linikan

The irregular shape of the *Linikan*, make the author to combine the two(2) equations of a volume, as shown in the equation 2.0. Further using the formula of a circular cylinder $V = (\pi r^2)(height/2)$, where the height of the *Linikan* divided into 2, then the other half is using the rectangular area like Area = Length x width; Volume = A*(height/2). Therefore the main equation used is shown below.

$$Volume\ of\ the\ Likinan(V_l) = Circular\ Volume(V_c) + Surface\ Volume(V_s)$$

Equation 2: The Volume of Linikan

Let's solved the Volume of Linikan based on the actual size gathered by the author

$$Circular\ cylinder\ V = (\pi r^2) (height/2) = (3.1416)(35cm/2)^2(28cm/2) \\ V = 12,704.4\ cm^3 = 12.7\ L$$

$$Surface\ Volume = (Surface\ area-rectangular) (height/2) = (26cm \times 27\ cm)(28\ cm/2) \\ V = 9,828\ cm^3 = 9.83\ L$$

$$Volume\ of\ the\ likinan = Circular\ Volume + Surface\ Volume$$



$$V = 12.4\ L + 9.83\ L = 27.33\ Liter = 22\ kilograms\ or\ almost\ 1/2\ sack\ of\ ric$$

As equation 2.0, revealed that the actual size of the container is almost the same weight as a 1/2 sack of rice, so it is shown among the crafts of *Erumanen manuvu* that the *Linikan* has important rules in their daily living. The interweaving of the *Linikan* designs down to the *Linikan* mechanics are shown that ancient Filipinos have science and mathematics knowledge without proper pieces of training.

5. Conclusion

The presence of physics and math knowledge in basket crafts, as one of the oldest Filipino cultural heritage, remind us that ancient Filipinos have strong concepts in the said disciplines, remarks that there is an intersection point between science, math, and culture. There is a new way of

finding and integrating science and mathematics in everyday life of being a Filipino and how to understand even in this pre and post Covid-19 pandemic era then technology is next to uplift this emerging basket industry.

6. Funding

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7. Acknowledgements

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8. Disclaimer

The author declares no conflict of interest

9. Ethical values

This research is under the process of the NCIP (National Commission and Indigenous People) and get the Certificate of Compliance (see the attached in appendix A) without violating any IP (Indigenous People) laws.

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Appendix A-Certificate of Compliance from NCIP-R012



Office of the President

NATIONAL COMMISSION ON INDIGENOUS PEOPLES

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Website: www.ncip12.wordpress.com/Facebook: www.facebook.com/ncipregion12

Control No. RXII-CC-19-09-0042

COMPLIANCE CERTIFICATE

**Certificate of Compliance with the IKSP Guidelines on
Academic Research and Research in Aid of Policy Development
and
Certification that the Concerned ICCs/IPs Have Given Their Consent**

THIS IS TO CERTIFY THAT:

- A. SULTAN KUDARAT STATE UNIVERSITY (SKSU)**, with principal address at ACCESS, EJC Montilla, Tacurong City represented by **ROLANDO F. HECHANOVA, RPAE, PhD**, SKSU President, has obtained the consent of the **Erumanen ne Menuvu Indigenous Cultural Communities/ Indigenous Peoples (ICCs/IPs)** in the Province of Cotabato to conduct a study/research by **Mr. Ramil M. Arciosa**, Faculty/Researcher of SKSU entitled **“Preservation and Documentation of the Erumanen ne Menuvu Weaving and their Mathematical and Cultural Implications”** in accordance to procedure and process required for the issuance of Certification Precondition under National Commission on Indigenous Peoples (NCIP) Administrative Order No. 1 series of 2012;
- B. THIS COMPLIANCE CERTIFICATE** is granted to SKSU, subject to the stipulations in the Memorandum of Agreement (MOA) executed by and between the Erumanen ne Menuvu ICCs/IPs, SKSU and NCIP, and to the following conditions, to wit:

1. This Compliance Certificate is issued solely for the purpose of conducting a research on **“Preservation and Documentation of the Erumanen ne Menuvu Weaving and their Mathematical and Cultural Implications”** as defined in the MOA, and at no instance shall the conduct thereof deviate from the methodology and the purposes outlined in the MOA.

That SKSU, commits to the following:

- 1.1 To recognize and allow the full participation and involvement of the Erumanen Menuvu Indigenous Political Structure (IPS) of the Province of Cotabato in the research activities if they choose so;
- 1.2 To respect the rights of the FIRST PARTY to preserve and develop their culture, tradition and institution;

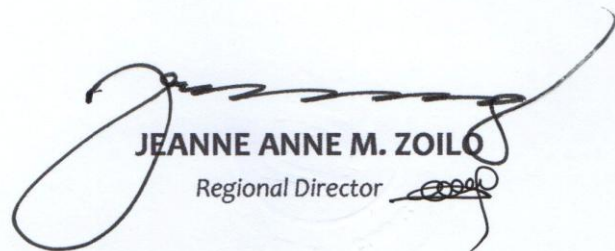
Page 1 of 2

- 1.3 To strictly adhere to the policy of respect of the Erumanen ne Menuvu culture, tradition and institutions and avoid to do acts that will offend or insult the identity, customary laws, traditions and practices of the FIRST PARTY;
- 1.4 To conduct research activities only in the agreed/designated venue;
- 1.5 To strictly follow the extent of information that the FIRST PARTY agreed to disclose; and that research activities be conducted within One (1) year and shall commence right after Certification Precondition is received from NCIP;
- 1.6 To present the research output to the FIRST PARTY for validation before publication;
- 1.7 To provide the FIRST PARTY a translation of the major findings and recommendations as well as pertinent research documentations;
- 1.8 To provide the FIRST PARTY and the THIRD PARTY one (1) hardbound and soft copies of the research output;
- 1.9 To recognize the FIRST PARTY that has exclusive rights to market interventions in their weaving products; and
- 1.10 To ensure that the output of this research study shall not be used for commercial purposes.

C. THIS CERTIFICATION is issued in accordance with NCIP Administrative Order No. 1 s. 2012, upon the request of SKSU and upon the favorable resolution of the concerned ICCs/IPs.

D. THIS OFFICE, however, reserves whatever action needed to be undertaken to protect the rights and interests of the Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) concerned, including the cancellation/revocation of this certification, as the case may be.

September 30, 2019. Koronadal City, Philippines.


JEANNE ANNE M. ZOILO
Regional Director