GEOMETRIC DESIGNS OF ILOCANO WOOD CARVINGS

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ABSTRACT: *Research on the promotion of wooden furniture objects is of historical and cultural value. This study explored the geometric designs of Ilocano wood carvings. The wood carvings were investigated on furniture products found in San Vicente, Ilocos Sur. Based on the findings, the wood carvings show fundamental geometric designs such as symmetry, parallelism, transformation, and proportionality. The concept of symmetry is mostly found in all furniture products like tables, doors, and chairs. The carving designs of doors made use of the concept of parallelism. On the other hand, the concept of transformation is used in carving designs on chairs to come up with congruent designs, and in the transformation of the design of the door of a cabinet. Furthermore, the carving of a miniature mirror and display products utilized the concept of proportionality. Generally, there is a combination of these geometric designs that make the products more attractive.*

Keywords: ethnomathematics, mathematical patterns, math-inspired products, Ilocano culture

1. INTRODUCTION

Wood carving design is the most tangible form of art and has a strong physical presence. Many carvers put aesthetic designs on their work to understand it at a more fundamental level. Geometric designs allow deeper interaction, which communicates mathematical concepts of pattern and structure in a tactile manner. When they produce furniture, they do not only gain a deeper understanding of the construction. They also personally invest in the final result, which leads them to take ownership of the work, to explain the process and ideas to others, and more specifically, to attract more clients and customers.

From the collection of quality wood carvings, the practice of wood carving by hand is an art as old as humankind itself. Originally, carved wood has practical uses. The wood carvings are formed into tools for protection, agriculture, and other domestic implements. However, it was shortly after that humans became aware of its importance for aesthetics. This interest and hunger for beauty anesthetics is a trait unique to the human experience; it is the attribute that fueled the art of ornamental wood carving. [1]. Because of this, man needs to upgrade his knowledge and skills to examine how Mathematics arises and is used in various cultures.

During the Spanish time, Ilocos Sur, particularly the municipality of San Vicente, was dubbed as the little Florence. The municipality produces beautiful furniture made from Narra and other tropical hardwoods, even from old wood previously used in wooden sugarcane crushers and old houses to make reproduction antiques. Furniture making has been so popular that it became their "one town one product" (OTOP).

Furniture and handicraft have been growing as one of the major livelihoods of Ilocanos. Aside from San Vicente, other municipalities are into wood carving such as Sta. Catalina, Bantay, San Vicente, and Tagudin. Hence, Ilocanos are skilled in wood carving, which is of the primary concern of this study.

Custom-made furniture like personalized doors, wardrove closets (*aparadors Ilk)*, rocking chairs, Cleopatra beds, lounging chair (*butaka and silyon* Ilk), picture frames, jewelry boxes, are made in honor of the leaders of the industry. Quality products are used locally as well as market abroad. Carving designs make the furniture attractive.

This study shows the importance of ethnomathematics in Ilocano culture, especially to the woodcarvers, who are the main subjects of this research. Findings of this study can provide awareness on the part of the community on the importance of mathematics in the development of wood carving. It can also provide knowledge on the part of the students on other application of mathematics. The students need to learn more than mere basic mathematical algorithms to be able to understand the importance of ethnomathematics. Also, they need to extend their understanding to include how mathematics connects to other disciplines, to problems to society and environment, and the Ilocano culture.

For the woodcarvers, the findings of the study can provide awareness of an essential method or discipline they are using in their daily wood carving activities. This method is related or somehow parallel to "ethnomathematics." Furthermore, the findings of the study may serve as a "breakthrough" in the woodcarvers' lifestyle, especially in carving, as their primary source of living. Future researchers may use the findings of the study as baseline data for their future research endeavors. The method used in the study may provide them with additional knowledge and insights and a better understanding of ethnomathematics as a discipline and its applications to every section of society.

Ethnomathematics is prevalent in our society. It is a growing research area. It is mathematics in the environment or mathematics in the community. It lies at the union of mathematics and cultural anthropology. [2] At another related level, it is a particular way that specific cultural groups go about the tasks of classifying, ordering, counting, and measuring.

Mathematics educators studied the cultural influences of mathematical knowledge. Mathematical skills that the child learns in school are not logically constructed based on the abstract cognitive structure, but rather it is inherited knowledge and skills. [3] Teachers also suggest the use of varied and appropriate teaching strategies that make mathematics learning more effective and meaningful. [4]

Geometric sculpture showcases the beauty of mathematics in a permanent way. It captures the essence of math as a creative art form and makes it inviting and accessible to the general public. [5] Creating and displaying beautiful mathematical objects inspires viewers to enjoy and appreciate various topics in math. By placing visually engaging constructions prominently in our everyday surroundings, mathematical thinking and discussion will become normalized. [6]

The mathematical activity of people in a variety of work situations. One study involved mathematical activities in the work of insurance agents. It was found that these practices do not involve only arithmetic computations but also estimating, using heuristics, explaining the complicated relationship between quantities, and describing diagrams. [7] Appreciation of mathematics may also be attained by reflective thinking.

The findings of the study on journal writing may help provide valuable sources of information to teachers to adopt more effective strategies in teaching students how to solve worded math problems. [8]

There were some studies conducted on geometrical patterns such as combining mathematics and visual arts by utilizing Islamic geometric patterns [9], exploring the impact of emergence on a design space with consideration of different methods in generating designs in a particular style [10], and studying geometrical patterns and computer-controlled carving which provide precise information to guide the paths of cutting tool and to carve patterns with a laser cutter that would previously have only been possible for skilled artisans. [11]

The importance of Ethnomathematics was recognized in the whole world, especially by the researchers who seek information on how mathematical ideas relate to the real world, specifically on wood carving. Since ethnomathematics is essential, it brought diversified studies to improve our quality of education and in particular, our way of living.

2. METHODS

This ethnographic study used the descriptive method of research. The study explored the furniture products with wood carvings, which are found in 26 registered and unregistered furniture shops in San Vicente, Ilocos Sur. These furniture products include chairs, doors, beds, dining tables, and cabinets. The researchers sought permission from the municipal mayor to conduct the study. Participation of the furniture owners and wood carvers was voluntary as supported by a signed consent form. The researchers conducted interviews with the wood carvers and ocular inspection of the carved products in exploring the geometric designs.

3. RESULTS AND DISCUSSION

Regarding geometric designs; symmetry, parallelism, transformation, and proportionality are the fundamental concerns found on the furniture products investigated.

Symmetry. The study considered the balance of the parts of a figure relative to a central point, line, or plane. A figure possesses symmetry if and only if there is a line, such that the reflection through each point of the set is also a point of the set. In other words, a figure has symmetry if there is an isometry that maps the figure onto itself. A figure has reflectional symmetry or line symmetry if the isometry is the reflection of a plane figure. On the other hand, a figure has line symmetry if there is a line at the point where the figure is folded making the two parts of the figure coincide.

Almost of the designs found in the different furniture products has line symmetry. For instance, Figure 1 shows the pieces of wood with carvings that serve as moldings at the circumference of a round table.

Fig. 1. Carving designs for a round table

Figure 2 illustrates line of symmetry on the design of the carved wood. A figure has line symmetry if there is a line that divides the figure into mirror images. [12] One half of the design is a mirror image of its other half. In coming up with the design, a woodcarver uses a pattern which is the half of the design to make sure that the other half is the same as the other.

Figure 2. Line of symmetry

Furthermore, most wood carving designs on chairs possess symmetry are shown in Figure 3.

Figure 3. Carving designs on chairs

It shows that on the chairs produced, the carving is commonly done on “cleopatras”. Floral designs are usually presently embedded with curves and lines. These curves and lines are symmetric about the vertical axis. These masterpieces have shown symmetrical designs. There is a balanced posture between the sides of the figure. The points on the left side are the same as the right side. What is on one

side is a reflection of the other side. These masterpieces provide an astonishing accuracy of geometric form using a simple Cartesian grid.

Parallelism. Designs showing parallelism make use of lines. Moreover, in parallelism, the appearance in a figure makes striking use of geometric principles as reflected in their fractal shapes and designs.

Figure 4 . Carving designs on doors

The wood carving present on the doors in Figure 4 varies from simple to intricate designs. Based on an interview with the woodcarvers, the designs of the products are based on the choice of their clients and customers. The first door starting from the left shows a simple design of a door that divides it into eight rectangular parts with engraved convex figures in every portion. Each design is congruent with one another by accurate measurements. Parallelism exist since each rectangle is parallel to one other. The second door shows a complex design equipped with fractal shapes and designs. Parallelism concerning the directions of the curves is cautiously carved to show also the symmetry of the designs.

Figure 5 below also shows parallelism in the designs of a "park bench" chair.

Figure 5. Design on a "park bench" chair

Transformation. This is a rule by which a given mathematical object is changed into another of the same kind. The idea of transformation has its roots in the fact that the same object is seen from different points of view with its appearance depending on the viewpoint. There is a transformation law that indicates how to predict the apparent shape from the new viewpoint, given the shape from the old point of view.

Most mathematical **transformations** are geometric or algebraic. A geometric transformation is a mapping of a geometrical object into itself. Adding scaling as a symmetry transformation opens a lot of indigenous patterns to mathematical analysis. As to the masterpieces of the woodcarvers, there are different sizes made per figure. For instance, there are big and small carvings but with similar designs such as the product shown in Figure 6.

Figure 6. Transformation of design on a chair

The carving shown on the chair applies the concept of transformation to come up with not only similar designs but with congruent designs.

Figure 7 also shows the transformation of the wood carving design on the door of the cabinet. The figure shows a door that has a parabolic design, placed at the upper portion of both doors of the cabinet. It shows the transformation of the fractal shapes and design by a rotation of 90 degrees.

Figure 7. Geometric designs of a cabinet

Figure 8. Geometric designs in a miniature mirror frame

Furthermore, mathematical properties can be observed on the designs of the furniture products illustrated in Figures 7 and 8. In Figure 7, the carvings at the upper portion of the parabola which is popularly known as the graph of a quadratic function in the form $ax^2 + bx + c = 0$. In most physical situations, the parabola serves as a common mathematical model. Meanwhile, in Figure 8, the carvings are found at the outer portion of the mirror frame which is in the form of ellipse. In analytic geometry, an ellipse is a locus of a point which moves such that the sum of its distances from two fixed points (foci) is constant. The general form of the equation of an ellipse is given as a $ax^2 + bx^2 + cx + dy + e = 0$, where a ≠ b, but have the same sign. The wood carvers may just simply call it oval or oblong. But the way they form the mirror frame applies mathematical aspects to form a more accurate design.

Proportionality. Every part of the figure is proportional to each other. Proportionality is the comparative relation between things or magnitude as to size, quantity, and number.

Figure 9. Proportionality in a trophy and displays

The woodcarvers also produced trophies for special events. In Figure 9, the upper body of the trophy is proportional to its lower body. The figure on the right showing a wood-carved product in the form of dolphin also possesses proportionality so that it could be more realistic.

Figures 10 shows the artistic design of the woodcarvers to produce the top of a table. It shows symmetry, transformation, and proportionality of the wood carving designs. Meanwhile, figure 11 shows a combination of symmetry, transformation, and parallelism on the design of a headboard of a double-sized bed. Through these geometric designs, anyone who waits in a dining room and who takes a rest in a bedroom would feel relaxed upon seeing these wonderful works of art.

Figure 10. Wood carving designs on a table

Figure 11. Wood Carving designs on the headboard of a bed

Combinations of these aspects of geometric designs are found in other various furniture products investigated.

4. CONCLUSIONS AND RECOMMENDATIONS

It was concluded that the Ilocano woodcarvings portray the use of varied fundamental geometric designs such as symmetry, parallelism, transformation, and proportionality. These generally use a combination of these geometric designs to make the product more aesthetic and appealing.

The research is a form of promotion of wooden furniture objects which are of cultural value. Math teachers may use the findings in the different furniture products in teaching mathematics subjects to make the students more aware of the concrete applications of the subject in society in teaching geometry-related subjects at any educational level. In addition, through this method the students will become more knowledgeable about the importance of ethnomathematics in Ilocano culture. Hence, the integration of culture into the mathematics curriculum makes it more relevant to the students. [13]

The findings of the study should be adequately disseminated to the woodcarvers for them to be aware of the geometric designs they are using. This may inspire them to explore more designs in making math-inspired furniture, which may reduce cost but ensure quality and durability. The researchers also recommend that training on furniture-making program that incorporates concepts behind math-inspired furniture be conducted by the local government agencies to help the furniture industry in the province. This training program may aim to capacitate the furniture owners and woodcarvers in developing pieces of furniture that minimize materials but not sacrificing the strength and quality.

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