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The mathematical ideas involved in Maranao Weaving

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Abstract :
Weaving is an art. It portrays the unique identity of the maker. It allures everyone seeing it. It is rich of mathematical ideas that reveal the creativity and critical thinking of the maker. This is what the teachers, school administrators, and curriculum planners want to develop to the students. Why not integrating it in the mathematics curriculum? Students of different levels of skills will have interest and fun in doing the activity like Maranao Kararawhile they are learning. They will be challenged to explore those concepts. Weaving activity will help solve many of the existing educational problems among students like valuing different cultures and application of concepts in reality.

This qualitative study presents the mathematical ideas explored in Karara designs of Maranao. There were 5 participants involved who were native Maranaos and whose ages ranges from 40 to 55 years old. Purposive sampling was employed for selecting the participants while interviews and observations were used to gather the data. These were recorded in audio. The mathematical concepts discovered by the researcher in the preparation, process, and designs of Karara are symmetries, congruency, patterns, counting, and estimation. The different geometric shapes contained in Karara designs are triangles, squares, rectangles, and other quadrilaterals. The results of the study illustrated equal computations of perimeters and areas of the involved shapes using the traditional estimation and the mathematical formulas taught in school. This study recommended that mathematics teachers, educators, and curriculum makers should use lessons with ethnomathematics activities because it provides rich and interesting concepts that can be discovered by the learners.

Keywords :
Weaving, mathematical ideas, creativity, mathematical curriculum

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Introduction

A subject containing hands – on activities such as, an art, poster making, weaving, and other artistic skills is the favorite subject of students usually those slow performers in the academic subjects. It let them express their own feelings that their individual art may convey. On other hand, mathematics is considered as difficult subject among students. Why not thinking the teaching methods and strategies that address all diverse skills of students?

Maranao people are acclaimed throughout the world for their aesthetic and elegant artworks in weaving. Such designs in weaving can be seen in tribal materials such as "Landap", "Langkit", "Okir", and other tribal materials (Pimping, 2010). It involves intricate strands of different unique designs and symbols containing patterns and symmetries provided with different colors. The designs also consists of geometric and algebraic structures and show craftsmanship and cultural richness of the tribe. Other researchers (Ablaza & Diaz, 2011; , Alangui, Aquino, Bacaoto, & Rapanut, 2011; De Guzman, Masa, Ortiz, & Sambile, 2011; Penas, 2011; Pimping, 2010; Suyam, 2011; Yebron & Eballe, 2011; Yu, Fonacier, & Latonio, 2011) found the use of patterns, triangles, right angles, body parts, weights, heights, width, ratio and proportion, and counting numbers in their respective ethnomathematics researches and they claimed it effective in teaching and learning process. According to Ascher (1991) ethnomathematics provides linkages between the students and the different cultures around the world. Thus, this study aimed of recommending for the inclusion of Maranao cultures in the revision of the curriculum because it will help elevate both educational and economic status of the locality.

Statement of the Problem

The main purpose of this study is to explore the mathematical concepts involved in Maranao weaving called, "Karara". Specifically, it sought to answer each of the following questions:

1. What are the algebraic concepts applied in Karara?
2. What geometric concepts are used in Karara?
3. How are formal mathematics conceprs applied in Karara?
4. What are the different perceptions of the participants on the importance of mathematics?

Significance of the Study

One of the significances of this study is that it enables students to comprehend, relate, respond, and discover the mathematical concepts involved in Maranao weaving. They will appreciate and value Maranao cultures. Mathematics teachers can use Maranao weaving as a good supplemental to instructions, especially in the applications of mathematical concepts in word problems that elevates the higher level thinking skills of students. Also, the curriculum makers will see the importance of including Maranao weaving in the educational curriculum especially in the locality of Lanao del Sur because it contains abstract mathematical concepts that develop the levels of thinking of students.

Theoretical Framework

The theories utilized in this study are Van Hiele, constructivism, experiential, cognitive apprenticeship, educational progressivism, epistemology, and conceptual theories guided this research. Van Hiele theory greatly emphasized that students need to visualize geometric objects first before identifying its properties, relate properties, and prove

theorems used in the research concerning the objects. These characteristics of students in learning correspond to their individual levels of understanding geometry. As part of developing their cognitive skills progressively, they need to learn best in their own real – life activities. Epistemology established the ability of students to connect with the concept and explores the culture of a group to have depth understanding and value of it. In this case, thinking skills eventually develop and this can be evaluated on how the words are constructed, criticize things, and think creatively. This is what the ultimate goal of education to learners.

Conceptual Framework

With the continuing degradation of the performances of Filipino students in mathematics in the successive Trends International Mathematics and Science Study (TIMSS), a new teaching method that addresses the economic status and diverse skills of learners of the third country like Philippines must be introduced. This is being supported the prior to assumption of ethnomathematicians in 1980 that a curriculum should be reformed without the use of technology. Slow learners have the ability to relate with the culture – based teaching because the mathematical ideas involved are basic. According to Solaiman (2013), learning geometrical shapes, which are always missed by the teachers, is very important because topics in mathematics are interrelated.

Furthermore, International Study Group on Ethnomathematician (ISGEM, 1985) believed that mathematics is cultural product and its different forms are necessary to reflect and understand the relationship among nature, culture, and development of mathematical thinking.

Methodology

This qualitative study aimed of exploring the mathematical ideas in Maranao Karara weaving. It was conducted in Lanao del Sur with five (5) Maranao women served as the participants of the study for a period of 1 month. The sampling techniques used were purposive and snowball sampling and the instruments used to gather the data are semi-structured interviews and observations. The questionnaires, which was used for the interview, was composed of 10 questions about personal lives, on preparing, and on the process of weaving a Riyaraan. It was reviewed and validated by the 3 experts.

Procedure

Before conducting the interviews, the researcher asked permissions from the local leaders and participants from 5 different communities in Lanao del Sur in accordance with the ethical values. The interview was audio – taped by the researcher aside from the field notes she used. The research together with her assistant personally asked each of the participants. She even went to the store here the Riyaraan (mat) is being sold to take some photos of the different designs of the mat. The data gathered were analyzed using textual analysis using both inductive and deductive coding style.

Findings

On the Algebraic Concepts

Countingby twos is used for separating the longer dried Susud leaves from the shorter ones. The leaves were separated with respect to their lengths. For each 40 leaves, it was tied as 1 set. There must be 12 sets of tied leaves that would constitute as 1 sadair. The

riyara contains 3 to 4 sadairs. When the border of the Riyaraan has been woven, its width must be measured as 12 lakad (steps).

It is also used in either of the two styles of weaving, that is, two versus two (ginidowa) or one versus three (pisoradan). Two versus two means there are two leaves folded down and two leaves folded up. Similarly, one versus three means that there are one leaf folded down but three leaves are folded up. Within this process of weaving, only one leaf folded down is exchanged with another leaf folded up. Note that, counting style of weaving varies when a particular design like butterfly, lettering, or any design is applied on the woven mat.

Counting is also used for a cross – section of diagonal directions of the leaves. Each layer in a diagonal direction has 6 sorad. Thus, there are 12 sorads in 1 sadair (first 1/3 of the mat).

Estimation is used for separating the leaves with respect to their heights. It was also used for applying 12 packs or equivalently 4 teaspoons of a particular color (e. g., maroon, dark green, or yellow) to the leaves being cooked on 3/4 full of large biscuit can with water.

Division was used for dividing the leaves with respect to their lengths into 12 sets. Hence, a basic operation in arithmetic is applied in the process of preparing the leaves to weave. Time is used for cooling the cooked leaves, for smoothen the dried leaves, and for weaving. Usually, to initiate weaving it must be at dawn until 9 am to 10 am. Then, weaving should be stopped at noon and resume doing it by 3 pm or 4 pm until night.

Geometric Concepts on the Designs

Some of the geometric shapes that can be identified in the different designs of Riyara gathered by the researcher are:

1. Congruent right isosceles triangles in pisoradan pattern
2. Congruent right isosceles triangles in ginodowa pattern
3. Squares inscribed in a right triangle
4. Symmetric lines
5. Symmetric diagonal lines forming squares
6. Butterfly design containing 8 congruent equilateral triangles and parallel lines with equal lengths.
7. Batik designs serve as the border line after the butterflies' designs.
8. Woven round table mat consists of spherical congruent lines of equal length and a width with a red circle at its center

Application of Formal Mathematics Concepts in Karara

On Batik

The square consists of 2 congruent vertical triangles facing each other. Considering the steps in weaving as the unit of measurement, the first triangle has 6 steps while the second one has 3 steps totaling to 9 steps. Since each side of a square has 3 steps then, we have, area = 3 sides x 3 = 9 steps. Thus, traditional counting of steps is similar to the formula of the area of a square in formal mathematics.

For perimeter, each side of the square has 3 steps, so we have, 4 sides x 3 steps = 12 steps.

Symmetric Diagonal Lines Forming Squares

Cross sections of red, green, and white leaves producing a large white square design has 21 leaves on each side, four identical small squares, and parallelograms. Enclosed in a large square are cross sections of six green leaves between each of the three red leaves. If the steps in weaving are used as the unit of measurement, then the areas and perimeters of squares and parallelograms coincide with the formulas in algebra. For example, if there are n leaves on a side of a square then each leaf has steps in the square. So, we have a total of n^2 total steps similar to the formula, area = n steps x n steps = n^2 total steps.

Congruent Squares Inscribed in a Triangle

The areas and the perimeters of congruent squares inscribed in a triangle, as a result of cross sections of leaves, coincide with the number of steps of the leaves in weaving. It was discussed previously. For the large right triangle, the number of steps of the leaves on the two adjacent sides of the triangle is equal because the other side was done by just flipping the leaves from the adjacent side. Thus, in algebra, the triangle is isosceles. Actually, the shape is not intended to be like triangle unlike the other designs like squares, Batik, butterfly, and others in which counting designs is being used to ensure the exactness of its shape.

Symmetrical Lines

The symmetrical lines which look like striped lines have 12 leaves for each color. Thus, they have equal lengths, perimeters, and area measurements both in using the formulas in algebra and considering the number of steps produced by the leaves in the design.

Congruent Right Isosceles Triangles

In a Riyaraan, there are three identical right isosceles triangles. Clearly, they have equal perimeters and areas using formulas in algebra. It was discussed previously that the triangle is a result of the cross sections of leaves. The numbers of steps of the leaves on the two adjacent sides of the triangle are equal because the other side is just flipped of the leaves from the adjacent side so, it is isosceles triangle.

Woven Round Table Mat

Symmetrical striped colored lines of woven round mat have equal measures except for red leaves. In order to add the diameter of the mat while weaving, there is a constant additional of red leaves for each red line of leaves. Thus, the radius on any side of the woven round mat is constant and the person who is doing this activity is knowledgeable about the constant radius style. This material provides critical thinking to the students. The symmetrical curved lines have equal measures.

Perceptions of the Participants on the Importance of Mathematics

All participants agreed counting of numbers and its basic operations should be taught to the child because it is important in our daily lives.

Conclusions of the Study

The study confirmed the significance of exploring the symmetries, congruencies, patterns, estimation, and other mathematical concept in an ethnic cultural activity done by the other researchers (Alangui, et. Al 2011; Asher & Asher, 1981; Delas Penas, 2011; Gerdes,

2007; Mangulabnan, 2011; Yu, et. Al., 2001). The use of footstep in measuring the width of the mat, counting principle are applied in weaving designs, and coincidence of measuring the areas and perimeters of different geometric shapes using both traditional and formal mathematics were accurate. Thus, Maranao wooven material such as Karara is rich source for illustrating mathematical concepts both algebraic and geometric.

Implications of the Study

Based on the findings of the study, there are lots of abstract algebraic and geometric concepts found in Maranao Karara weaving. Indeed, both mathematics teachers and curriculum planners should find ways of incorporating Maranao weaving, designs, or culture as art of mathematics curriculum. It is very helpful as a supplemental resource of the subject that motivates and challenges students of different abilities.

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