Workshop: Working With Patterns To Introduce Mathematics Concepts To Young Children

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Abstract

In a hands-on activity with crow beads, participants will learn about introducing very young children to patterns by means of number bracelets, and will extend this activity into creating growing and reflecting patterns for older children. Clock (modular) arithmetic will be introduced as a basis for other ways to create patterns for bead bracelets or necklaces. A discussion of modular arithmetic in loom weaving will conclude the workshop.

Introduction

I propose that an ability to recognize, manipulate and construct patterns is a key factor in young children's learning about the world generally and about conceptually-based disciplines like mathematics and science in particular. Following the research of Constance Kamii [1], Ian Stewart [2] and Elizabeth Warren [3], I define patterns as conceptual ordering principles about the ways things repeat. These principles may be represented in the natural and the human-created world by concrete objects or may remain abstract, e.g. as number or shape concepts.

A patterning activity at its most basic sets up the opportunity to group objects according to certain criteria. At the Textile Museum of Canada we use patterning activities with textile materials and techniques as tools for developing skills in both mathematics and textile art. For example, children up to 6 years of age select 8 millimetre plastic beads in different colours, create a simple four to six colour pattern by arranging the beads on a simple printed grid like the one in figure 1, glued to a Styrofoam plate, and then string the beads on an elastic cord, repeating the pattern to make a bracelet. Older children extend this activity by creating growing patterns and/or mirror patterns with the beads.

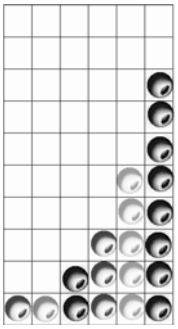

Figure 1: *Bead grid*

Figure 2 is an illustration of beads strung in the Fibonacci number sequence that begins as 0,1,1,2,3,5,8, with the beads starting at 1. The pattern rule is to add each of the last two numbers together to get the next number in the sequence. This sequence has some beautiful qualities that are revealed as the numbers progress from the first steps, easily understood by budding mathematicians, to larger numbers whose ratios, beginning with the ratio of 8 to 13, begin to approach 1.618034 (to six decimal places). This number, represented by the Greek letter phi (Φ) is known variously as the Golden Ratio, Angle, Section or Proportion [[2], 139]. Its principles are found in the growth patterns of many plants, for example the tightly packed arrangement of seeds in the head of a sunflower, and also in art and architecture as a principle of composition or structure.

Figure 2: *Number bracelet*

Make a Number Bracelet

Grade level: K-3

Summary: This activity investigates how numbers can be used to create visual patterns by organizing them on a grid, through the creative work of making jewelry.

Math Expectations: (Numeration) Classify whole numbers; compare and order whole numbers; (Patterning and algebra) explore patterns and pattern rules; (Data and probability) sort and classify concrete materials [[4], 31].

Visual Art Expectations: (Knowledge of elements) Recognize and name the primary colours; (Creative work) make colour choices in artistic work [5], 30]; (Critical thinking) describe how artists use the elements of design to communicate information [5], 31].

Materials: 1 x 1 cm grid printed on paper, with either 4 or 6 columns x 10 rows; a paper plate, 8 mm plastic crow beads, 41 cm piece of round elastic cord.

Description: 1) Tie a bead on one end of the elastic cord so the beads don't slip off as you string them. 2) Cut out a copy of the grid and glue it onto a paper plate. 3) Select a sequence of 4 or 6 numbers from 1 to 10. Numbers can be repeated if you wish. Our example uses the numbers 1,1,2,3,5,8. 4) Pick different colours of beads to correspond to the numbers in your pattern and put them on the grid so you can see the pattern as a chart. 5) Starting at the left of the grid, string the beads in order on the cord. When you have strung all the beads, repeat the pattern until the cord is almost full (about 50 beads). 6) Leave about 7 cm free for tying. Tie the ends of the cord together. Put on your bracelet. It will go twice around your wrist.

Extensions: Once you have strung all the beads on the grid, reverse the pattern when you repeat it.
(Grades 3-5) String all the beads in the sequence then grow it by doubling each number, then tripling them, and so on. Experiment with patterns that grow in different ways.

For older students the grid can also be expanded to numbers from 1-20 and the cord can be lengthened to make a necklace. The number sequence used in the bracelet can be graphed, using the grid and coloured pencils.

Number Bracelets and Clock Arithmetic

Grade level: 4-6

Summary: This activity explores computation, units of measure and creating patterns through the creative work of making jewelry.

Math Expectations: (Numeration) Solve number problems using addition; (Patterning and algebra) create and explore number patterns [[4], 64].

Visual Art Expectations: (Knowledge of elements) Recognize and name the primary colours; (Creative work) make colour choices in artistic work [5], 30].

Materials: 8 mm coloured plastic crow beads in 10 colours, 41 cm piece of round elastic cord.

Description: 1) Choose any two numbers from 1 to 10. 2) Follow this rule: add the two numbers on the right and record just the digit in the ones place in the sum. Add the numbers with the help of the 10-hour clock to see why this works.

2+6=8
6+8=4
8+4=2
4+2=6
2+6=8

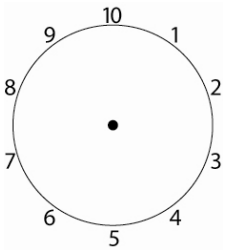

Figure 3: *10-hour clock*

This number pattern repeats after line 4 so you have a pattern of 4 numbers, 8-4-2-6. 3) Select four colours of beads; for example, 8 yellow, 4 blue, 2 orange and 6 green. This is where the artistic creativity comes in. 4) When you are happy with your colour choices for the four numbers in your sequence, string them in repeat to make a bracelet. You may also try mirror or growing patterns with your sequence.

If you think of the numbers as being on a 10-hour analogue clock, which repeats just as a 12-hour clock repeats, you can imagine another kind of clock, for instance a 4-hour clock, and choose a pair of numbers. Here is an example using a 4-hour clock. For any sums over 4, subtract 4. Add the numbers with the help of the 4-hour clock to see why this works.

1+2=3
2+3=1
3+1=4
4+1=1
1+1=2
1+2=3

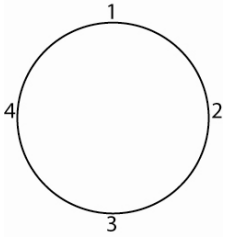

Figure 4: *4-hour clock*

This number pattern repeats after line 5 so you have a pattern of 5 numbers, 3-1-4-1-2. Select five colours of beads as before and use this pattern to make a necklace.

Weaving and Clock Arithmetic

How does clock arithmetic relate to the technology of weaving? A loom is a device for keeping tension on one set of threads, called the warp, so a second set of threads, called the weft, can be inserted in an over – under interlacement, for example the over one – under one pattern called tabby. A foot powered floor loom usually has 4 shafts. Each warp thread is passed through the eye of a needle, or heddle, in a repeated sequence, so the warp thread can be raised to make a space, or shed, for the weft to pass through. The patterns created are usually based on the twill weaves of the familiar blue jeans.

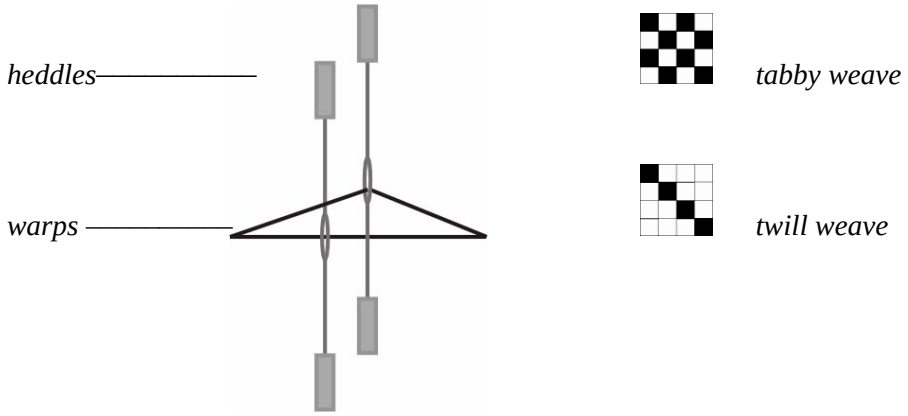

Figure 5: *How a loom works*

On a grid with 4 columns x 24 rows, try filling in cells to discover some of the patterns you can make on a 4 shaft loom. (Any combination of cells will work on a loom except for all blank or all filled - why?) Every 4 columns change the pattern and see what happens. Then cut strips of paper in two colours and interlace them to see how your pattern works.

References

[1] Kamii, Constance. "The Development of Logico-Mathematical Knowledge in a Block-Building Activity at Ages 1-4." *Journal of Research in Childhood Education* 19.1 (2004): 44.

[2] Stewart, Ian. *Nature's Numbers: The Unreal Reality of Mathematics*. New York: Basic Books, 1995.

[3] Warren, Elizabeth. "Generalizing the Pattern Rule for Visual Growth Patterns: Actions that Support 8 Year Olds' Thinking." *Educational Studies in Mathematics* 67.2 (2008): 171.

[4] *Ontario Ministry of Education Mathematics Curriculum, Grades 1-8.* Queen's Printer for Ontario, 2005. Also available online at http://www.edu.gov.on.ca.

[5] *Ontario Ministry of Education Arts Curriculum, Grades 1-8.* Queen's Printer for Ontario, 1998. Also available online at http://www.edu.gov.on.ca.