Running Head: COMMUNITIES OF MATHEMATICAL PRACTICE

Creating Communities of Mathematical Practice:

Increasing the Viability of the Mathematics Classroom

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Abstract

The communities within which we live and work influence what we recognize as mathematics and how we understand and interpret mathematical concepts. In this session, we will share several mathematical perspectives that inform classroom teaching and offer evidence of mathematical excellence for teachers and students in a variety of non-traditional contexts.

CREATING COMMUNITIES OF MATHEMATICAL PRACTICE: INCREASING THE VIABILITY OF THE MATHEMATICS CLASSROOM

The communities within which we live and work shape our visions of the world. These different communities – cultural, professional, vocational, and avocational – influence both what we recognize as mathematics and how we understand and interpret mathematical concepts. These communities contribute a variety of mathematical ideas that influence how the world is recognized and described. Many of these mathematical perspectives could inform classroom teaching and we offer evidence of mathematical excellence for teachers and students in several typical classroom contexts.

Recent research by Garii and Burrell (2007) was based on the insights that K-8 classroom generalists struggle with making mathematics meaningful, understanding mathematics as only that which is taught in schools and failing to recognize the natural mathematical practices that thrive beyond their classroom walls. Teachers' self-reflections reveal their own limitations in mathematical understanding, and teachers' limitations are often projected upon their students. Ultimately, the viability of mathematics education for both teachers and students of mathematics is enhanced when we incorporate contributions from allied practices into the mathematics classroom. This paper offers opportunities to deepen one's understanding of mathematics as a community practice and learn about the mathematics of non-western cultures.

Middle School Students Investigate Inupiaq Mathematics

In the land of snow, ice and polar bears sits Barter Island off the north shore of Alaska close to Canada. Nestled in the island is the tiny village of Kaktovik where 300 Inupiaq people live. In the center is Harold Kaveolook School with 84 students and 10 teachers.

From 1996 to 1999, William Clark Bartley was the middle school teacher there. He was responsible for teaching all subjects for 6th, 7th, and 8th grade students. While doing place value during a math lesson, his students were fascinated by the fact that the Inupiaq numbering system is base 20 and Bartley encouraged them to think about how they could write the numerals for the numbers. The class explored ways to write the numerals for the following numbers:

Inupiaq numbers

Atausiq	Akimiaq malguk
Malguk	Akimiaq pinasut
Pinasut	Inuinnaqutailaq
Sisamat	inuinnaq
Tallimat	
Itchaksrat	
Talimat malguk	
Talimat pinasut	
Qulinnugutailaq	
Qulit	
Qulit atausiq	
Qulit malguk	
Qulit pinasut	
Akimiagutailaq	
Akimiaq	
Akimiaq atausiq	

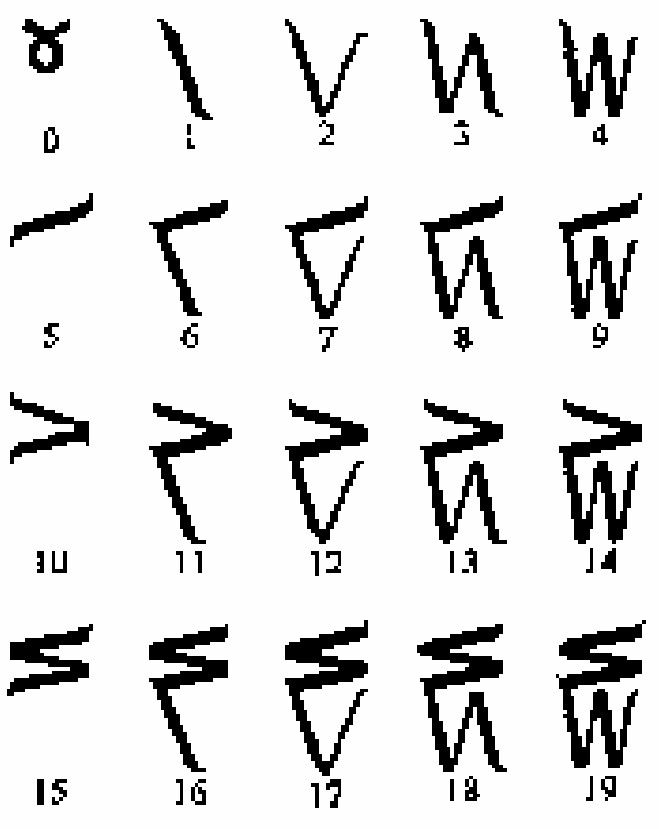
Tallimat means “hand”, Qulit means “above”, and Inuinnaq mean “whole person”. Thus once can see the human body as a mathematical metaphor for the Inupiaq speaker.

The Physical Model of the Emerging Symbol Set

A symbol set for the Inupiaq numerals did not exist until the Kaktovik middle school students pursued the idea. The students wanted a symbol set that reflected the meaning of the words for the numbers; they wanted to write the numbers without the need to lift their pencils from the paper. They began by exploring a physical model of the numbers that they organized into groups. They then abstracted this physical representation to form their symbol set.

Using popsicle sticks to represent the numbers, they began with a bundle of 5 sticks held together by an elastic band. The abstraction of the elastic band would come to represent the number 5.Similarly, 13 was represented as two elastic bands and three vertical popsicle sticks. Four bundles of five Popsicle sticks, again held together with elastic bands, was used to represent 20 (Inuinnaq).

The numerals from 1 to 19 were created with vertical and horizontal slants, which the students called “straight” and “side”. The numerals are elegant and can easily be written without lifting the pencil. The Inupiaq words for the numbers readily correlate with the symbol for the number. Having completed creating the symbols for the first 19 numbers, they found they needed a symbol for zero but did not want to use the oval as in the Arabic Numerals. One of the students suggested they write a bow tie to represent “folding our arms above our head”. The results of their efforts are shown in the following chart.



$128_{20}=1(400)+2(20)+8(1)$

Inuinnaq Inuinnat (1-400's)

Malguk Inuinnat (2-20's)

Talimat Punasut (8-1's)

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Bartley encouraged the students to explore addition, subtraction, multiplication and division with numerals. Students found all operations with the Kaktovik numerals easier and faster than doing the same operations with the Arabic numerals because of the visual flow. Bartley had the shop teacher help the students make a wooden pentavigesimal abacus and the students created abacus vs. calculator competitions. The calculator team vs. the Kaktovik abacus team. Both teams were given the same computation problem simultaneously. The team

using the Kaktovik numerals would win, solving the computation problem faster than the calculator team. Bartley encouraged the students to explore fractions with the numerals.

The community was excited about the numerals and wanted all the children to learn them. The parents insisted that the students should learn math with the Kaktovik numerals, so the principal agreed and invited the middle school students to tutor the elementary and high school students. They created worksheets using familiar illustrations, for example, pictures of Ullus (Inupiat knives), skin boats, and mukluks and using Inupiat words where appropriate. They also developed a simple board game that include dice that had the Kaktovik numerals. The worksheets and games evolved into a workbook for students to learn about mathematics using the Kaktovik numerals.

At the end of the first year of this pedagogy, the math test scores of the middle school students rose significantly. By the end of the year the entire student body in Harold Kavelook School had explored math with the Kavelook numerals. Math test scores continued to be elevated for the three years of Bartley's teaching appointment in Kavelook School.

In 2000 No Child Left Behind (NCLB) entered the public school arena. By 2000 the middle school students of 1997 were high school students and the elementary students of 1997 were upper elementary and middle school students. With elevated math scores Harold Kavelook school achieved "Adequate Yearly Progress" for NCLB in four consecutive years from 2001 to 2005. Only one other school in the North Slope School District of 8 Inupiat villages was able to achieve "Adequate Yearly Progress" for one year.

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