**Base 10 Abacus (Patent Pending) Background**
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The state of mathematics achievement in the Unites States especially among students of color will not be reiterated here. Nor is it necessary to elaborate on the fact that early childhood and early elementary grades mathematics knowledge is a critical foundation for long-term student success and is a strong predictor of academic achievement, high school graduation, and college attendance (National Governors' Association Paper, 2014). This paper will report on the challenge of numeracy as it relates to number sense and a proposed solution in the form of the Base 10 Abacus (Patent Pending).

The unique feature of this modified abacus is that a traditional abacus contains ten beads in each place value column, even though the maximum number in the place value of each column is nine. Eliminating one bead from each row transforms a traditional abacus in a teaching device that clearly and accurately presents Base 10 concepts.

"Numeracy" is a term that refers to all the mathematics that young students learn including number, operations, and geometry and measurement concepts (Learning Pathways in Numeracy: Addressing Early Numeracy Skills, 2014). Number sense, as presented in the diagram below, is to clearly understand the different ways numbers can be utilized in the real world (Booker, Bond, Sparrow & Swan, 2010).

Figure 1
Number Sense
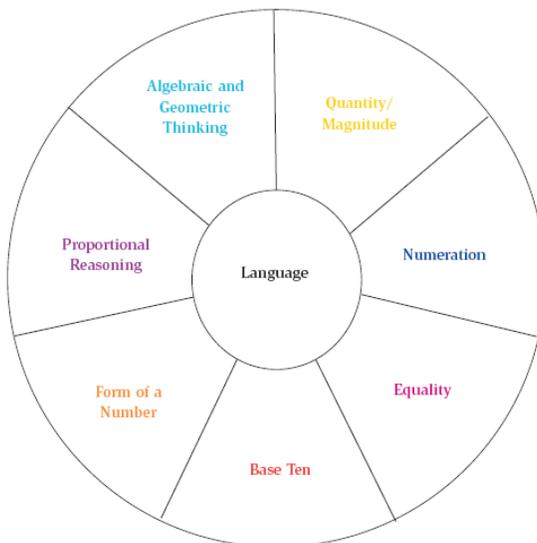
Note. From *The Components of Number Sense* by C. Cain, M. Doggett, V. Faulkner, and C. Hale. NC Math Foundations Training, Exceptional Children's Division of the NCDPI, Raleigh, NC. Copyright 2007. Reprinted with permission.

The Hindu-Arabic number system is a Base 10 number system that is used around the world because it allows mathematical operations to be made on arbitrarily large numbers (Wu, 2011).

As shown in Figure 1 above Base 10 is an integral component of number sense competency. In reviewing the Common Core State Standards for Math (CCSS Math) one finds that Base 10 is featured at every grade level K thru 5. As such the Base 10 Abacus could provide a much needed tool in students' attending to the Common Core Mathematical Practices of:

- <u>Modeling with Mathematics</u>

In the primary grades modeling with mathematics consists of using manipulatives to represent quantities and numbers. For a rich experience multiple representations of specific content standards are necessary for conceptual understanding. The Base 10 abacus provides alternative models for the decomposition of numbers that is necessary for conceptual understanding of the addition, subtraction and multiplication algorithms, and a consistent visual representation of place value.

- <u>Looking for and making use of structure</u>

Mathematically proficient students look closely to discern a pattern or structure. The Base 10 Abacus provides an authentic, unambiguous representation of the Base 10 number system that is manipulative and intuitive. The idea of structure is visible to users of the abacus. For example in the process of adding multi digit numbers students see the structure of the addition algorithm by the process of adding digits on the abacus that have the same place value.

- <u>Looking for and expressing regularity in repeated reasoning</u>

Expressing regularity is a byproduct of student use of the Base 10 Abacus. The visual nature of the Base 10 abacus allows for understanding of the powers of ten, and students self discovery of mathematical shortcuts through repeated calculations.

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