# PURPOSE

In using realistic models (photographs) that reference mathematical ideas (my own, not the child's) and represent a potential model for the mathematization process, this study:

- Explores a child's construction of number as it relates to multiple addition in reference to arrays;
- Develops insights into how children make sense of visual media;
- Provides children opportunities to build a bridge between media and emergent mathematical ideas.
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Within Realistic Mathematics Education (RME), models are not seen as literal representations but are representative of aspects of mathematical concepts (Van Den-Heuval-Panhuizen, 2003). The photographs chosen represent both real and imaginable contexts in reference to mathematics. These images will help create a mental model to serve as a bridge between the formal concepts of the classroom with the learner's emergent mathematical understanding (Van Den Heuval-Panhuizen, 2003).

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# METHOD

**CAN THE USE OF PHOTOGRAPHS AS A MATHEMATICAL MODEL SUPPORT THE GROWTH OF MATHEMATICAL UNDERSTANDING IN CHILDREN?**

Photographs of multiplicative arrays were presented in a sequence that would provide and support opportunities to reason multiplicatively to children in 2nd – 5th grades. Images were used as a referent object in a semiotic sequence and were chosen to represent one sequence of inferential understanding (based upon the interviewer's model of multiplication). Using their signs (words and symbols) I identify and analyze a students developing mental model of multiplication through a process of "semiotic chaining" (Presmeg, 2006). Semiotics is the negotiation of meanings and signs as defined by Peirce (in Presmeg, 2006) and both supports and defines the study of language and its structure.

# USING PHOTOGRAPHS TO SUPPORT STUDENT'S DEVELOPING UNDERSTANDING OF MULTIPLICATION

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## FINDINGS

Analysis for a student's developing mental model *of* multiplication to a model *for* multiplication, with the use of photographs as object (referential) models, will be done through the process of "semiotic chaining" (Presmeg, 2006).

In the chaining model, each new signifier *stands for* everything that precedes it in the chain (Presmeg, 2002). Semiotic chaining enables us to describe the process of progressive mathematization in that semiotics, as defined by Charles S. Peirce (in Presmeg, 2006), is the negotiation of meanings and signs (Freudenthal, 1968).

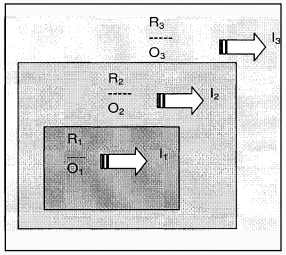
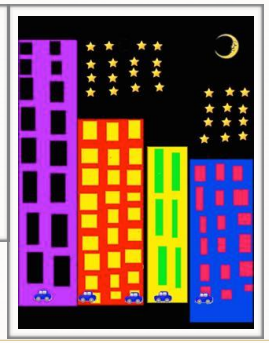



*Figure 3: A representation of a nested chaining of three signs (Presmeg, 2005, p.107)*
*0 = Object (signified) R = Representamen (signifier) I = Interpretant*

Results indicate that photographs are an effective model in the mathematization process, revealing the growth of mathematical understanding in children. Student's abilities to demonstrate development in a progression of signs from the additive to the multiplicative are shown.

### MENTAL MODELS

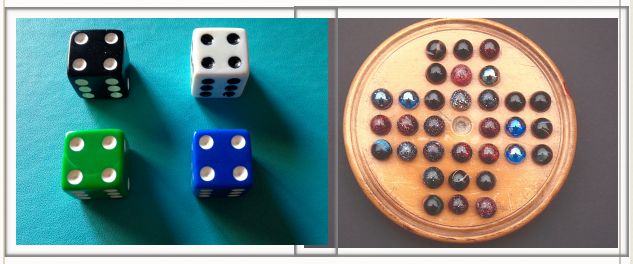
Modeling takes many forms in the classroom. The most common form is a picture. Pictures from textbooks, teacher-made drawings, photographic images, and other images created through the use of computer programs or apps, are typical models of mathematics used in the facilitation of *connected knowledge* in the classroom (NCTM, 2000). When teachers implement the use of these

*Photographs of arrays are used to enable students to connect a model **of** an array to one **for** multiplication.*

### SPATIAL STRUCTURING

Photographs aid in the construction of an organization or form for an object or a set of objects. Research has found this to be a foundational mental process for student's quantitative development (Battista, Clements, Arnoff, Battista, VanAuken Borrow, 1998). Photographs aid in the abstraction process of coordinating rows and columns into meaningful spatial components (Battista, et al, 1998)



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### METHOD

The arrays provided each student the opportunity to share their strategies. By recording their strategies or algorithms, students were afforded the opportunity to contextualize their thinking, through the analysis of the referent objects, the photographs. Their representations, along with their explanations to me, created the mathematical practice necessary for reflective construction (Kamii, 2000, p. 9).

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