



University of Colorado at Colorado Springs

College of Education

Executive Summary
Multi-sensory Materials in K-3
Mathematics: Theory and Practice

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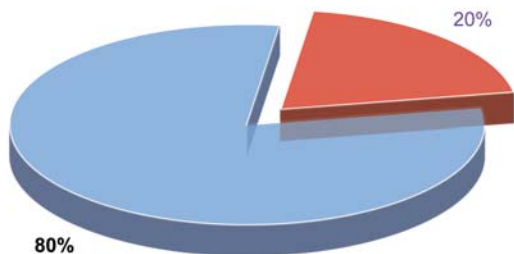
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Executive Summary

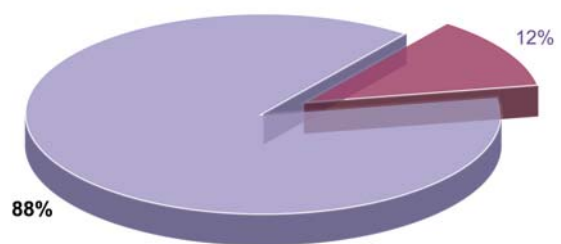
Multi-sensory Materials in K-3 Mathematics: Theory and Practice

- In recent years there has been an increase in the demand for accountability in elementary education. This is evidenced by the No Child Left Behind (2002) legislative initiative. Schools are asked to actively report their performance in comparison with other schools in their area and state on State mandated tests. All students must be able to meet minimal standards or schools will lose funding.
- Mathematics education for children in grades K-3 is no exception. Under funding from the National Science Foundation, The National Council of the Teachers of Mathematics (NCTM) has set standards for the curricula being used in today's classrooms. However, in order for all children to advance together, that curricula is often not enough. Examples of the NCTM curricular formats include: Everyday Mathematics, Investigations in Number, Data, and Space®, and Math Trailblazers. These approaches all advocate stressing children's thinking and understanding (Marshall, 2003). In addition, many schools stress a more traditional approach like Saxon, a more procedural style of learning.
- The teaching of mathematics to children (and their learning) is founded in a long history of developmental theory in educational psychology. The primary theorists (Piaget, Bruner, and Vygotsky) stress that children pass through stages of development. All children will pass through all the stages, but they do not all move from stage to stage at the same age. Piaget notes that these stages include: sensorimotor, pre-operational, concrete operational, and formal operational. Of importance to the present review and the middle two stages. The first occurs somewhere between the ages of two and seven (or so) and the second between seven and eleven. Students are not yet ready to assimilate material if they have not progressed through these stages of development. Teachers are, therefore, challenged to make sure that all children, regardless of their stage of development, are not “left behind”.
- One way to assist teachers in this task is the utilization of educational aids from outside the domains of the core curricula. Such aids are referred to as “Supplemental Learning Materials”, which assist the teacher in reaching more students. One family of approaches, developed from the perspectives of Piaget, Bruner and Vygotsky, involves multi-sensory approaches to the presentation of subject matter. Multi-sensory approaches (involving visual, auditory, and tactile-kinesthetic techniques simultaneously) have been shown to be effective in many settings (e.g., reading [Dev, Doyle, & Valente, 2002], spelling [Kuhn & Schroeder, 1971], and foreign language learning [Kalivoda, 1978]). Of obvious importance to the present review are approaches to early mathematics learning.

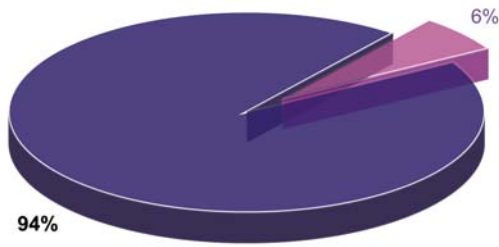
- Termed “manipulative” approaches, early mathematics students learn by interacting with new material with all of their senses. Reys (1971) indicates these are things students can feel, touch, and handle; they appeal to multiple senses, either physically or mentally (Chester, Davis, & Reglin, 1991); and may be concrete or pictorial (Sowell, 1989). Using concrete materials in class enhances students understanding. Suydam (1984) reports that teachers believe manipulatives should be used in mathematics lessons however they are implemented most often with younger students (Suydam; Gilbert, & Bush, 1988).
- In ascertaining the efficacy of employing these approaches to enhance student performance, attitudes and practices of teachers need to be addressed. While there needs to be, additionally, empirical research on the various multi-sensory approaches to teaching mathematics, the readiness of teachers to embrace these approaches needs to be determined. To this end, we examined the rather meager literature which as attempted to survey elementary teachers’ attitudes, practices, and demographics to determine what already exists and which methodologies have been successful in provoking an acceptable response rate.
- One of the common threads throughout this literature review is the impact of demographics, specifically teacher demographics, on teacher attitudes and behavior. These variables (i.e., experience, background, and grade level of teaching) influence the teachers’ style of teaching, including the use of manipulatives in general and TouchMath® in particular.
- Consequently, the investigation into the demographic relationships with teacher attitudes and behaviors is warranted to determine the place of multi-sensory materials in the early mathematic experience of children.
- In the current investigation executed by our research team at the University of Colorado at Colorado Springs, kindergarten through third grade teachers were randomly selected from the pool of all elementary schools in the United States. The survey taken by these teachers generated the following results in regards to supplemental, multi-sensory materials (TouchMath® in specific). The teachers’ classrooms varied from no special ed students to only special ed students in make up. Selected results are as follows:



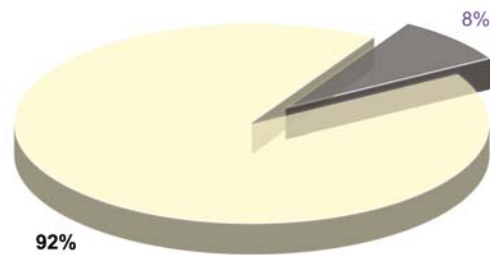
80% of teachers agree with the Piagetian concept that children must be mentally ready in order to learn certain mathematical concepts



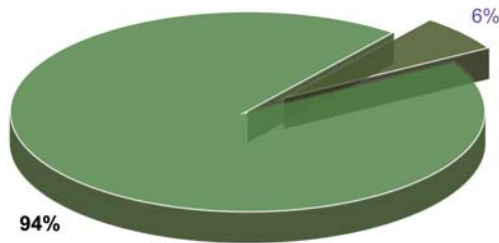
88% of teachers surveyed are using supplemental materials in their classrooms either often or very often.



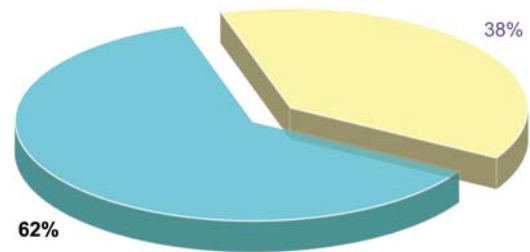
94% of teachers incorporate multi-sensory techniques into their math lessons often or very often.



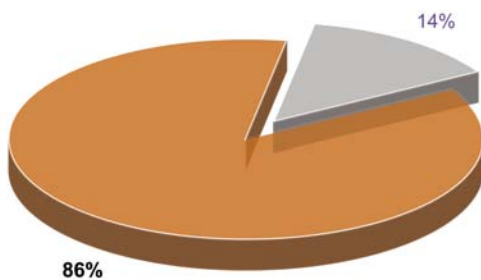
92% of teachers agree that multi-sensory materials are necessary to enhance all young children's understanding of mathematical concepts.



94% of teachers say that manipulative materials are appropriate for all grades K-3.



62% of teachers surveyed, who have TouchMath® available for their use say they use it in their classrooms.



86% of teachers surveyed who have used TouchMath® have or will use it again.

- The number of teachers familiar with TouchMath® decreases as grade level teaching increases.
- Lower grades are using significantly more supplemental materials, multi-sensory techniques, and manipulative materials than are higher grades.
- Teachers with more exposure to supplemental math materials as part of their training are significantly more likely to use them more often in their classrooms.

- Although the use of supplemental, multi-sensory products differs across certain demographics (grade level and background of exposure), the results of this study suggest that elementary teachers are aware of the benefits of incorporating multi-sensory techniques, such as the use of manipulative type products, into their mathematics lessons. Most teachers, regardless of the type of curriculum they are employing in class, are utilizing multi-sensory techniques; however, use of these does diminish as grade level increases. Teachers perceive supplemental materials and multi-sensory materials to be appropriate for both regular ed as well as special ed children.
- The survey findings indicate that the majority of teachers who are familiar with and have access to TouchMath® are using it in their K-3 classrooms. But, this familiarity decreases with grade level teaching. The current research supports the importance of exposing teachers to supplemental materials as part of their training, either in college or in continuing education seminars, as a means of increasing their use of them.

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