Mortensen Instead
Judith Townsend on Why She Replaced Montessori Math Material
By Judith Townsend

Maria Montessori never taught in an elementary school setting.

Her primary writings and observations are of the child under seven years old. She developed elementary materials but had limited personal experience working with these materials with the older child. Mario Montessori, her son, developed many of the works in geometry and cubing, for example. Many of these materials were then taught to teachers, without extensive "field testing" with students.

Public School Montessorian asked me to share my insights on two types of math manipulatives, Montessori and Mortensen, based on my personal experiences with children and educational training of both materials.

Recently, I heard Nancy Rambusch speak at the Public School Montessori Conference in Washington D.C. One of her assertions is that when bringing a "message" to indigenous people, the natives may, and often do, reinterpret the message to make it fit their culture. I believe that Nancy did this when she "reinterpreted the message" from "Montessori International" and created the American Montessori Society. I believe that this is also necessary in the Montessori mathematics' curriculum. A good measure of what our goals could be for each year is set forth in the National Council of Teachers of Mathematics Standards. You may want to consider this the minimum for each child and teach more than what's recommended in the Standards. These standards are our current cultural expectations in mathematics for children in America in the 1900s. The book is readable, enjoyable and informative, and it sets reasonable mathematic standards for the children in American elementary schools.

Discovering the Standards gave me permission to look at the Montessori math curriculum through new eyes: as a "native" receiving a message from another culture and time, and reinterpreting this curriculum as it relates to our own culture and time. For example, I no longer teach the negative snake game or division to first-year children. I do not consider myself either a bad teacher or poor Montessori teacher for this decision.

Having adopted the curriculum, I saw the Montessori math materials with new eyes.

- Are they the most versatile and are they the "best" materials currently available?
- Are they inexpensive and durable?
- Are the golden beads that children used in their 3-6 programs the best choice for elementary age students and the math concepts they have to master?

Montessori lived near the glass manufacturing city of Venice--hence the stringing glass beads on wire if, instead, she had lived in Silicon Valley, perhaps she would have used extruded plastics! Plastic math materials are attractive and much cheaper than their glass counterparts, and for the goals of the elementary math curriculum, have one significant feature not possible in the glass beads: the plastic ones are uniform in size. The golden beads themselves come varying in sizes, and the turned up wires on the ends both contribute to one "six"-bead bar being bigger than another. For children who have learned a one-to-one corresponce in their 3-6 education, the manufacturing differences in the golden beads make using them to teach math in the elementary school more difficult than necessary. How?

Trying to show a first-year student working on her addition and subtraction facts with the Montessori materials that "6+3=9," or that "6+3=3+6" is frustrating because the materials don't show that accurately. If the child takes the 6 and the 3 to the 9 for a proof of an equality, there is often a visible inequality instead. It's not that arithmetic is wrong; it's that the materials aren't precise.

Mathematics is an exact science, based on proofs. A child deserves material that supports the hypothesis, and not a material that is based of approximation and faith.

When I discovered the "Mortensen more than Math" materials, I was surprised that they were not being used in the Montessori elementary training program. Since many Montessori schools, both public and private, are now using the Mortensen materials and this more simplified and unified approach, why aren't they recognized by much of the Montessori community?

Jerry Mortensen took AMI elementary teacher training in Bergamo, Italy. He has acknowledged repeatedly that his materials and directly descended from Maria Montessori's golden beads, and that the Montessori approach to mathematics was a wellspring for many of his insights.

Perhaps the problem with these materials in the Montessori community is that both Maria Montessori and Jerry Mortensen with the pride of geniuses, the joy of discovering mathematics as child's play, and the desire to be entrepreneurs, have their named attached to their materials. Does that mean that you have to choose one set of materials or the other because one is "Montessori" and the other is a plastic innovation?

Adaptation and innovation are what has made the American Montessori method successful. It is intrinsic in how we define ourselves, and as basic as Nancy Rambusch's initial insistence, when she brought Montessori education to this country, they were not a copy of anything.

Shouldn't we give the same permission to math materials as we do to other areas of the Montessori curriculum? A plurality is possible because both kinds of materials can be used to teach "Montessori math". I simply suggest using the material that best illuminates—clearly, simply, and accurately---what you are trying to teach, regardless of the name it wears. We are not teaching a name; we are teaching math.

Both the Montessori and Mortensen materials and methodology provide a mathematical highway for the development of the “mathematical mind”. However the Mortensen materials are much less expensive, often more efficient in demonstrating numerous mathematical concepts than traditional Montessori materials, less frustrating to manipulate and can lead more easily into abstraction.

The Montessori geometry and cubing materials are wonderful. I haven’t found any other materials that are better.

The math curriculum should be like the rest of a Montessori school’s curriculum: buy or make the best you can for the concept that you are teaching.

To introduce you to the accuracy, ease, and simplicity of the Mortensen math materials, I have selected 4 areas for comparison:

- The addition strip boards
- The snake (and negative snake) game
- Multiplication using the checkerboard
- Square roots using the pegboard.

Strip Boards

It was an enormous relief to me when I removed all those strip boards on addition and subtraction from my shelves. It happened quite simply: one day as I was looking through my math albums on teaching addition concepts and memorization of addition facts, I realized that I needed only one piece of Mortensen materials to do almost all of it. Then I realized that the same piece of material could be used with subtraction!

The fingerboards and charts are designed to help a child with the memorization of math facts. They are extensions of the golden beads. The golden beads are materials designed to illuminate concepts for children who are in a sensitive period for touching and weighing. Little fingers feel the bead and the child learns a one-to-one corresponce. I have observed that the beads are not the most appropriate material for the elementary child who wants to get on with things and “do some math”.

One piece of Mortensen material called the combination kit, can be used for both concepts and memorization. It was a built-in control of error. Not only can I walk away while the children do the work, but I know that the materials will assist them in getting the answer.

The small beads were originally intended for the small fingers of a preschool child. The older children like these new materials. The colors appeal to them, but more important, the children like how quickly and accurately they can get out and manipulate quantities. I have found that the combination kit not only facilitates the children’s understanding of math concepts but also speeds their memorization of math facts.

Snake Game

The snake game lines up accurately with the Mortensen materials. I have seldom seen a child become frustrated, want to quit, or consider herself not as bright as another child when using these materials to do this work. I remember 11 years ago, when my oldest son was in the second year of our elementary school. He had a Bergamo-trained, certified AMI teacher. My son would lay out the multi-colored snake---and he rarely got the right answer. It was the lack of uniformity in bead size and those twirly metal ends again. The beads were not a consistent size. He learned very little except how to perfect his fine-motor coordination laying out the beads, and how to wait in line for the teacher to "help" him. The underlying message was that he could not "do math" or get the correct answer by himself. He was credited with having "experienced and completed the snake game".

With the Mortensen materials, there us conformity with the sizes of each number. There are no pesky little ends. Consequently, my students have changed the snake game into the fun math game that it was intended to be. They do it in one step. My students have easily seen the combinations that make ten and have transformed the game into "child's play" where it is no longer necessary to trade the beads in the ritualized sequence as originally outlined my Montessori.

Does that make it "less Montessori"? Students lay out various bars and write the answer. I have tried to make them exchange the colored bars for bars of ten but they found that this was an unnecessary step. They were doing the addition in their heads! By simply changing to the plastic materials, the goals of loving math and seeing it's simple logic become visible to more children. Or are we pursuing a more labyrinthine process that stresses where various bead bars are placed and by its ritualized sequence eliminates some children from the fun and joy of math?

The negative snake game became just as easy, whenever I choose to teach it, because the plastic band of extruded plastics is hollow on the opposite side. What a mathematical boon that is! The hollow side can be defined as a negative. Combining (+1) and (-1) equals 0, mathematically, but now it can be demonstrated too! So, using the same materials, all the negative numbers have been added to my math tool kit, because each plastic piece has a hollow back. Add a (+2) and, (turning a two over), a (-2) makes zero. I no longer need grey bars, black and white bars, black bars, nor do I need to worry about what goes where. The child lays out some positive numbers and some hollow negative numbers, makes zeros, and what's left is the answer.

Without fanfare, lots more children are now "talented" in math. Thanks to simplicity, accuracy and plastics, many more are. Mathematical concepts become clearer, simpler, and more available to more students. The math hasn't changed. The tools for understanding it just got better.

Pegboard

When using the pegboard to take the square root of a number in the thousands, the visual impression may show the area of the units to be much bigger than the area of the thousands. This is conceptually incorrect. Children see this right away, but may be reluctant to mention it, kind of like the “emperor’s new clothes” phenomenon.

It seems essential to continue demonstrating to children the conceptual reality of a problem before we present the abstract version. The Mortensen materials are scaled according to their size so the visual impression is correct. Mortensen materials show units as 1/10 of a 10, 1/100 of a 100, 1/1000 of a 1000, and 1/10,000 of 10,000. The Montessori material, which is an abstraction designed to facilitate calculation, cannot show the conceptual reality.

Checkerboard

The checkerboard is also geometrically not accurate and therefore does not lead as easily to abstraction as Mortensen materials do. When doing the abstraction of a problem with a two-or-more-digit multiplier, the first partial product of units is entered in the upper right-hand corner. The abstraction with pencil or paper never begins by putting units in the lower right-hand corner.

Now we must choose: do we want to use this material because it is Montessori even though it is mathematically incorrect? Why not replace it with a material and a presentation that consistently places all the partial products where they belong, where the geometric formation is correct, and easily leads to the mathematical convention as well?

You may notice the similarity of the square root layout and the multiplication layout. The Mortensen methodology has a unified approach to the teaching of arithmetic. The mathematical constructions for division, problem solving, fractions, algebra and calculus all have a related geometry which make the learning of a new concept easy. The “rules” are consistent. I have seen children develop great self-confidence and ability in math using the Mortensen materials.

It may be hard to imagine fractions taught by using squares. The children and I enjoy the fraction materials the most. I suspect this because of the love of secret codes exhibited by the elementary age child and the joy of understanding the secret code that fractions represent. The presentations lead easily to the understanding of the abstraction and the materials are easy for a child to draw. Squares facilitate the demonstration of concepts in fractions that are convoluted or impossible with circles and, as I mentioned, use the same mathematical similarity of layout as the rest of the Mortensen methodology.

There are three parts to a fraction kit:

- 9 squares evenly divided into halves, thirds, fourths, etc.
- 2 halves, 3 thirds, 4 fourths, etc., which can be used to make each whole
- The same size squares marked evenly in halves, thirds, fourths, etc., but this time made from clear acrylic

Equivalencies, addition and subtraction with like and unlike denominators, addition and subtraction of mixed numbers and, (the toughest of all those skittles) multiplication and division, which can be easily demonstrated.

Final Notes

I was asked to write about only two types of math manipulatives currently in use by Montessori teachers. There are other good materials available.

The more you explore mathematics using the Mortensen Math materials and methodology as tools, the more you discover its simplicity and geometry.

Montessori started its mathematics discovery process using manipulatives. I believe that Jerry Mortensen has contributed to it, too. Multiplication, division, squaring, and taking the square root of numbers can be shown without purchasing any additional processes like bead frames, checkerboards, or pegboards. With the Mortensen materials these operations can be shown using the same combination kit. The brilliance of these mathematical demonstrations for these arithmetic processes is confirmed by their simplicity.

The purpose of teaching mathematics is to foster logic and analytical thinking skills. The Mortensen materials have been constructed and arranged so that it is logical to apply the same arithmetic rules using base ten to algebra. The same combination kit can be used for arithmetic and algebra, whenever you decide to teach it.

Imagine having young children adding, subtracting, multiplying and dividing in base ten and then having them discover that the same principles apply to algebra. Adding and subtracting polynomials, and factoring quadratic expressions become logical extensions of the work and require no additional manipulatives.

I have discussed and illustrated a few areas in the Montessori Math curriculum that I think make teaching and the children's understanding easier. While I think these materials are better than the traditional ones, I am not advocating that you discard what works for you. However, I do feel that the Mortensen materials and methodology will allow you to discover and communicate the joy and simplicity of arithmetic.

Also, if you have a limited budget and goals for your students, that are similar to those in the Standards, I invite you to look beyond the materials labeled Montessori.

Judith Townsend is an AMS certified elementary teacher and has trained extensively in the use of the Mortensen math manipulatives and methodology. She lectures and provides seminars for teachers and parents in the US and Canada. She is an elementary teacher at the Princeton Montessori School and a teacher trainer at PCTE in Princeton, NJ.