MATH IS FOR SPECIAL KIDS AND OTHER MYTHS IN EARLY CHILDHOOD MATH

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Memorable Math Moment

- Memorable math moment
- Turn and talk
- Turn and talk and share again

My background and how I came to do this presentation…

- Faculty
- Administrator
- Teacher
- Mom
- Math Expert?
- Faculty meeting – student's response to a survey

The Myths

- Let's look at some myths in early childhood education

Some Myths in EC Mathematics

- Math is for special kids
- Young children don't have the capacity to do very much math, and reading is really more important at this age anyway.
- Young children don't like math.
- An early childhood teacher really doesn't need to know much about math.
- Math is naturally learned through children's play.
- A teacher's attitude about math is irrelevant.

Nine Common Misconceptions about Mathematics Instruction with Young Children

1. Young children are not ready for mathematics education.
2. Mathematics is for some bright kids with mathematics genes.
3. Simple numbers and shapes are enough.
4. Language and literacy are more important than mathematics.
5. Teachers should provide an enriched physical environment, step back, and let the children play.
6. Mathematics should not be taught as stand-alone subject matter.
7. Assessment in mathematics is irrelevant when it comes to young children.
8. Children learn mathematics only by interacting with concrete objects.
9. Computers are inappropriate for the teaching and learning of mathematics.

(Lee & Ginsburg, 2009)

Facts

- Now, let's look at some facts about early childhood mathematics

Why is math important?

- Math is ***cumulative***
  - Later success depends on a good strong early foundation.
- ***Significant Achievement Gap***

Math & Literacy

- In general, there is more of a focus on literacy than math in early childhood.
  - While reading predicts only later reading ability, ***mathematics performance predicts*** not only later mathematics but ***overall later school achievement*** including reading ability (Duncan et al., 2007). In contrast, early reading skills are only related to later reading.
    - Preliminary results show that children's math skills in pattern recognition and measurement are the most predictive early academic skills for eighth grade reading, math, and science success. in preschool and kindergarten be devoted to number competence.
- Number Competence for Preschool and Kindergarten

Challenges at different levels

- Preschool children – lack of cohesive curriculum
- Kindergarten children – diversity of needs
- Primary Grades – scripted or prepared curriculum

Teachers at all Levels Need to Know

- Teaching-Learning Paths or Learning Trajectories
  - Content of the discipline (i.e. skills and knowledge)
  - What is appropriate for achievement and understandable for children at certain ages (NRC, 2009)
- To support children's mathematical proficiency, every early childhood teacher's professional preparation should include:
  1. Knowledge of ***mathematical content and concepts*** most relevant to young children
  2. Knowledge of ***young children's learning and development*** in all areas
  3. Knowledge of ***effective ways of teaching mathematics*** to all young learners
  4. Knowledge and ***skill in observing and documenting*** young children's mathematical activities and understanding
  5. Knowledge of ***resources and tools*** that promote mathematical competence and enjoyment (NAEYC & NCTM, 2002).

Intentional Teaching in Mathematics

- Math learning must not be left to chance:
  - Prepared environment
  - Long blocks of playtime with math materials
  - Integrated Curriculum
- The teacher has an important role in teaching mathematics, not simply to watch, but to intentionally instruct. This includes:
  - Guiding, extending, helping children reflect, predict and process;
  - Asking thoughtful questions about the process the child uses to come up with answers; and
  - Helping children make connections to generalize their learning.

Intentional Teaching Strategy: Reviewing &Changing Behaviors

- Teacher Behaviors relating to children's improved math knowledge
  1. How much time the teacher is actively engaged in math activities
  2. Whether the teacher builds on and elaborates children's mathematical ideas and strategies
  3. How much the teacher facilitates children's responding to math questions and situations
  4. Teachers' curiosity and enthusiasm for mathematics
  5. Teachers' ability to set high but realistic expectations
  6. Teachers observations of children, note taking to record their observations, and use of learning trajectories to individualize instruction

  (Clemens & Sarama, 2007a, 2007b, 2008 as cited in Bredekamp, 2010)

Intentional Teaching Strategy: Math Talk

- Language plays a critical role in learning math.
  - Consider words like more, less, under, inside, bigger, smaller, first.
  - Language is necessary to explain and express mathematical thinking.
  - Children should be learning mathematics vocabulary through their exploration.
- Math talk is using language to ask children to observe, question children, extend knowledge or ideas, and point out to children that they are doing math in everyday situations.
- Helps teacher assess
- Enormous variation

Intentional Teaching Strategy: Grouping

- Small group activities
- Diversify math experiences
- One study suggests that when working in whole groups, there should be only brief teacher-led discussions following by problem-solving with a partner and then some physical activity coming out of the ideas (Clements & Sarama, 2007a, 2008).

Intentional Teaching Strategy: Integrating Play

- Block Building – Does not automatically result in math learning!
  - Use math talk and discuss mathematical ideas
  - Introduce new math vocabulary or raise problems.
  - Implications
- Games
  - Board games where children count spaces along a number list develops number knowledge.
  - Adapting board games
  - Games can also be helpful in assessing children's knowledge (Moomaw, Carr, Boat, & Barnett, 2010).
- Using Table Toys - Does not automatically result in math learning!
  - Puzzles and manipulatives enhance math knowledge as they provide concrete materials.
  - Scaffolding knowledge

Intentional Teaching Strategy: Integrating Play

- Book Reading
  - Math concepts can be found in many storybooks.
  - We can also choose books explicitly made to help children learn math.
- Sociodramatic Play
  - Self-regulation and executive function
  - Context
- Exploration & Practice during Other Play
  - Play for practice

Building Effective Math Curriculum

- Aligned with the standards
- Compatible with child development
- Compatible with sequences of important mathematical ideas
- Should be broad and deep and follow a logical sequence

Planning for Math Instruction

- Prior Knowledge
- Practice

Numbers And Operations: Prek-Grade 2

- Basic understanding of numbers and their relationships
- Be able to read and write numbers
- Understand the meanings of operations
- Be able to compute fluently and make reasonable estimates

(NAEYC & NCTM, 2002)

Enumeration & Cardinality

- What might it look like?
  - Children point to items as you count without one-to-one correspondence. They make an utterance (da da da) with you when you count but do not say numbers.
  - Children point to items as you count. They begin to try to use the number words or more sophisticated utterances (some number words but not always in the right order). While they do achieve a one-to-one correspondence, they don't achieve cardinality and keep counting and touching the items or picture until they feel done.
  - Children get a good grasp of the number words and counting and are able to count in order accurately. However, they still are not able to achieve cardinality and don't always come to the correct conclusion about the number of items. They start to identify some numbers.
  - Children achieve cardinality and are able to accurately count items up to a certain number. They start to identify a few more numbers.
  - Children continue to grow in their ability to count items and identify numbers and begin to write numbers.
- How do we differentiate for a group of children at 2-3 of these levels in our classroom?

Children need everyday practice

- Outside Play
- Snack Time
- Block Area
- Transitions.
- Morning Routine
- Center Time
- Work Time

Children need everyday practice

- Outside Play: Counting the number of pushes on a swing or times back-and-forth on the playground.
- Snack Time: Counting the number of items needed for snack and achieving one-to-one correspondence (napkins, cups, plates). Counting how many snack items they have left after eating one and comparing with their friend.
- Block Area: Sorting and counting the number of different color of shape blocks in the block area before beginning to build. Estimating if there will be enough to make what the child wants to make.
- Transitions: Counting off when lining up to make sure all present children are ready to go.
- Morning Routine: Counting days in school or how many children are in attendance and how many absent. If able, adding up how many children have been in attendance all week. Keeping track of the days of school.
- Center Time: Counting how many children are currently at a center to see if one more can join. Knowing the number of children in the class and the number of centers, figuring out how many children can be in each.
- Work Time: Figuring out how many pencils or papers are needed at each table for the number of children at each table and how many are needed in total.

Geometry: Prek-2nd Grade

- Engage in analyzing characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Describe spatial relationships using coordinate geometry and other representational systems
- Apply transformations (i.e. slides, flips, and turns) and use symmetry to analyze mathematical situations
- Use visualization, spatial reasoning, and geometric modeling to solve problems

(NAEYC & NCTM, 2002)

Shapes

- Infants and young toddlers explore shapes through touch and by using their mouths (balls, soft blocks, books)
- Toddlers use simple shape sorters to begin to match a 3D shape with the corresponding hole. They may able to match shapes in puzzles as well and may be able to start naming simple shapes.
- Preschoolers are able to match shapes in puzzles and use play dough to make shapes by forming shapes or using cookie cutters to cut out shapes. They are also able to identify shapes. They begin to close the circle in their drawing and are able to draw lines eventually leading to their ability to draw shapes. They start to notice the shapes of things in their environment – their cookie is a circle, their pizza is a rectangle. They notice that the building blocks have different shapes and with reinforcement start to learn the names for 3D shapes.
- Many Kindergarteners already know basic shapes, but they are more aware of the shapes that appear in their environment and are ready to learn even more advanced shapes. They notice that the building blocks have different shapes and with reinforcement start to learn the names for 3D shapes.
- Primary grade children use pattern blocks make a design and start to understand the relationship among shapes and how many of the shapes combined become another shape.

Data Analysis and Probability: Pre-k - 2nd Grade

- Engage in formulating questions that can be addressed with data and in collecting, organizing, and displaying relevant data to answer those questions
- Be able to select and use appropriate statistical methods to analyze data
- Develop and evaluate inferences and predictions that are based on data, and understand and apply basic concepts of probability.

(NAEYC & NCTM, 2002)

Graphing – Bar Graph

- What should we name our new class pet? After generating and writing up answers, write children's names after the name of their choice. Alternatively have the child put a picture of themselves next to it. Alternatively use a SmartBoard to put their name or their picture up after their choice. Have them think about which one has the most votes…how did they come to that conclusion? Count with them to find the answer.
- What should we name our new class pet? Take down the names on the bottom, ask children to bring a post-it note up and put their post-it above their choice (alternatively, color in a square). Which one has more votes? How do we know?
- What should we name our new class pet? Ask children for suggestions and write them at the bottom. Ask children to come up one by one and add a tally mark to their choice making sure they recall that every 5^{th} tally mark must be crossed over. Add up the tallies for each section and write down the total. From there ask them which has the most? How do we know?
- What should we name our new class pet? Ask children for suggestions and write them down. Have children vote. Have a child count up the votes for each animal and write the number. Which has the most? How do we know?

Algebra: Content Pre-k through 2nd Grade

- Be able to sort, classify and order by size and other properties
- Recognize, describe, extend, and analyze patterns
- Use algebraic symbols to represent and analyze mathematical situations
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts (e.g. growing taller over a specified period of time)

(NAEYC & NCTM, 2002)

Patterning

- Children learn a simple A/B pattern through a clapping rhythm, dividing into 2 groups while in a circle (eg. blue team, green team, blue team, green team), finding borders on books or around the room with this simple pattern. They share why it is a pattern. The teacher points out these simple patterns throughout the space and day.
- Children learn a simple A/B/C pattern through a clapping rhythm, counting off by 3s to divide into groups, creating this type of pattern with colored squares, snap cubes, or stringing beads. OR Children create their own clapping pattern sequence. Children share their work and explain what their pattern is. Teachers continue to point out any ABC patterns throughout the space and day.
- Children create a more complex pattern on a worksheet or with manipulatives. As they have a broader knowledge of patterns, they are given more autonomy in making their pattern. They continue to share and describe their work.

Measurement: Pre-k through 2nd Grade

- Understand measurable attributes of objects and the units, systems, and processes of measurement
- Be able to apply appropriate techniques, tools, and formulas to determine measurement

(NAEYC & NCTM, 2002)

Measuring

- Children's bodies or hands are traced. Children look at the difference in size and try to order them. OR Children line up in size order or hand-size order. OR Children decide which item is bigger or smaller.
- Children decide which item is biggest and smallest and which is in the middle or put multiple items in size order. OR Children measure how long their leg is by using their hand as a nonstandard measurement. OR Children can measure the classroom table with snap cubes.
- Children use a pencil to measure their table and note it. Then they use a ruler. They compare how many rulers and how many pencils they need for the whole table.
- Children read the numbers on a ruler to measure an item. They note it. Then they look for other items in their classroom that are of similar length and measure them and compare on a worksheet.

Integrating Process Skills Throughout

- *Problem Solving*
  - Be guided to build new mathematical knowledge through problem solving, apply and adapt a variety of appropriate strategies to solve problems in math and other contexts and reflect on those processes
- *Reasoning and Proof*
  - Be able to recognize reasoning and proof as fundamental to mathematics
  - Develop, investigate, use, and evaluate appropriate conjectures, arguments and proofs
- *Communication Standard*
  - Organize and consolidate their mathematical thinking and to communicate that thinking coherently, clearly, and precisely to peers, teachers, and others
  - Analyze and evaluate the mathematical thinking and strategies of others
- *Connections*
  - Recognize and use connections among mathematical ideas
  - Understand how those ideas interconnect and build on one another to produce a coherent whole
  - Recognize and apply mathematics in other contexts
- *Representation*
  - Create and use representations to organize, record, and communicate mathematical ideas; and then select and apply those representations to solve problems and to model and interpret physical, social, and mathematical phenomena

(NAEYC & NCTM, 2002)

How can we become more intentional? Beliefs

- Examine our beliefs
  - Lack of appropriate preparation may cause both preservice and experienced teachers to fail to see mathematics as a priority for young children and to lack confidence in their ability to teach mathematics effectively (NAEYC & NCTM, 2002).
- We must believe that:
  - All children can learn math and that math is important
  - Math is for all children, not just for special children or children of a particular background.
    - Many teachers believe, either explicitly or implicitly, that some children may be born with mathematical aptitudes or mathematics genes, and others are not (Lee & Ginsburg, 2009). This is not the case.
- Teachers must also reflect on their beliefs about their own ability and experience with math and how that affects their teaching. Many early childhood teachers have been found to believe that math is hard to teach (NRC, 2009).

How can we develop more intentional EC math teachers?

- Higher Education: Review preservice training to find ways to include more math information, ideas, and opportunities for teachers to practice appropriate skills
- Teachers & Administrators: Review curriculum materials along with standards and if inadequate consider changing or supplementing. Look for ways to supplement during daily activities.
- Administrators: Ensure that teachers are adequately trained to use any set curriculum and that this training is ongoing. If there is no set curriculum, take time to ensure there is a method of capturing the intentional and chance math occurring each day.

Recommended Practices

- Find/research/pass out/make available good resources for math education including standards, position papers, books, podcasts, and appropriate journal articles.

Recommended Practices

- When developing curriculum consider:
  - Identifying what prior knowledge students need to be successful in the lesson.
  - Listing 2-3 questions that they might ask students to help them reflect, reason, process or connect material.
  - Identifying an extension for the lesson or the next sequential step.
  - Including a space to provide a solid rationale for the activity for not only how it connects to any theme if applicable, but how it relates to child development, content and process skills and standards.

Recommended Practices

- In order to link math with other subject areas consider:
  - Identifying similarities between making predictions in literacy as well as in math.
  - Identifying how charting or graphing done in literacy or science relate to mathematics. Science and math are easily connected and can be very effectively integrated (Brenneman, Stevenson-Boyd & Frede, 2009).
  - Identifying how problem solving skills can be strengthened through different subject areas

Recommended Practices

- Consider taking time in meetings and professional development to:
  - Find appropriate ways to build on the block building that is occurring during center time.
  - Identify materials that can be used in each of the different centers in the classroom to further student's mathematical learning and development.
  - Identify how computers might be utilized for math learning.
  - Identify how math journals might be utilized in their classroom for math learning.
  - Identify what "real life" situations can be utilized to illustrate math principles (i.e. money, shopping, directions).
  - Have teachers describe ideas and scenarios planning for math talk and helping children mathematize

Recommended Practices

- Consider planning carefully for comprehensive assessment of mathematics in the classroom by:
  - Diversifying assessment methods using both informal and formal assessments
  - Identifying what math behaviors indicate in terms of the content and skills required at any given age.
  - Understanding how different assessments can be used to best understand what children know, especially those at risk because of SES, disability, or necessity of learning a second language (Moomaw, Carr, Boat, & Barnett, 2010).

Myths Debunked

- ✓ Math is for special kids: some young children have the ability and skills while others do not
- ✓ Young children don't have the capacity to do very much math, and reading is really more important at this age anyway.
- ✓ Young children don't like math: math should be hidden within other content so children don't even know they are doing math.
- ✓ An early childhood teacher really doesn't need to know much about math.
- ✓ Math is naturally learned through children's play by building with blocks or working with manipulatives.
- ✓ A teacher's attitude about math is irrelevant to how young children learn math as long as they teach the math they are supposed to.

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Podcasts:

- NAEYC Radio: What is Developmentally Appropriate Math for Very Young Children with Jaunita Copley: http://www.naeyc.org/newsroom/NAEYCradio

- Easy as 1, 2, 3: Mathematics Learning in Early Childhood http://www.nap.edu/audioplayer.php?record_id=12519&n=0

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