EMERGENT MATH—STRENGTHENING A CONTINUUM OF LEARNING BETWEEN EARLY CHILDHOOD PROGRAMS AND PRIMARY GRADES

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Objectives

- Why a focus on early math is essential?
- How can we support early math skills in the context of ECD programs?
- Discuss promising results from piloting this program
- Implication for scalability
What is emergent math?

- Emergent, or early, math is concerned with the earliest phases of development of mathematical and spatial concepts. EM encompasses the skills and attitudes that a child develops in relation to math concepts throughout the early childhood period.

- Young children may not be able to add or subtract, but their interactions with a stimulating math–filled environment encourage them to construct a foundation / framework for what will eventually become mathematical concepts (Powell & Butterworth, 1971; Butterworth, 1999a, 1999b.).
Emergent math should be viewed as part of a broader process or continuum, rather than a period of acquisition of particular skills.

The roots of math and literacy begin in early childhood. The support we provide to children in the early years (in homes and ECD programs) is just as important as how we support them in primary school.
Emergent math skills are not optional

- The mastery of emergent math skills is not optional.
- On the contrary, EM skills are necessary as they pave the way to more complex math skills in early primary grades and beyond.
- If foundational EM skills are lacking, children will have to catch up substantially in early grades and will need remedial support.
### Key Emergent Math Skill Areas

*Don’t forget motivation and interest in numbers and math!*

<table>
<thead>
<tr>
<th>Numbers &amp; Counting</th>
<th>Patterns</th>
<th>Sorting &amp; Classification</th>
<th>Comparison &amp; Measurement</th>
<th>Geometry</th>
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- **Children’s ability to understand the concept of numbers and counting, order, ways of representing numbers, 1-to-1 correspondence, and quantity.**

- **Children’s ability to recognize, duplicate and create simple patterns (things that repeat).**

- **Children’s ability to distinguish between alike and different objects and to organize /sort objects according to their properties (size, color, shape, texture, etc.).**

- **Children’s ability to describe and compare measurable attributes, including time, length, weight and size using estimation as well as non-standard measures (such as hands, feet etc.).**

- **Children’s sense of space and position (under, over, beside, between, outside, next to) and child’s understanding of basic geometric shapes.**
Quality early childhood programs need to have a strong early math (and language) focus.
Save the Children’s Global ECCD Portfolio

Where we work in ECCD (75 countries)

Community based ECCD
Intensive Summer Camp
Home based ECCD
School based ECCD
Programmatic need to focus on emergent math in the preschool years

- Math talk /math activities are minimal
- Focus on rote memorization
- Misconception on what “emergent math skills are”
- Insufficient hands-on, active learning and activities
- High illiteracy
- Parents have little time and confidence to support learning at home
Foundational math skills are lacking even in strong early childhood programs

% of preschool children in India and Rwanda

- Cannot recognize a single number: India 62%, Rwanda 95%
- Cannot identify an object of circle shape: India 76%, Rwanda 80%
- Cannot complete a pattern: India 62%, Rwanda 76%
- Cannot complete a puzzle: India 60%, Rwanda 84%

Save the Children
ELM Toolkit-
Boosting the focus on early language and math

1. Support emergent math and literacy skills in ECD settings among young learners (ages 3-6 years)

2. Strengthen interactions between parents and younger children and increase parents’ confidence and capacity to support children’s learning at home

- Math talk & math print
- Open ended, play-based activities that introduce children to math constructs
- Opportunities to explore and interact with a variety of objects and “manipulatives” – such as rocks, beans, potatoes, leaves etc.
ELM in preschools

1. A flexible training package for early childhood teachers (early grades teachers can benefit from these modules as well)
   1. 3 training modules that can be integrated in pre or in-service teacher training
   2. Activity bank with over 50 early math games (+ 50 literacy games)
   3. Books and manipulatives
Nature Walk

Description: Children observe and recognize nature in their immediate surroundings.

Materials
Primary Skill: Sorting & Classification
Secondary Skills: Patterns

Directions
1. Tell the children, “We are going to go talk a walk outside and see what we can find!”
2. Take the children outside and help them all collect leaves from trees or from the ground.
3. Once every child has at least one leaf, bring the group back inside the classroom.
4. Start a conversation with the group by holding up a leaf and saying what it looks like: the color, the shape, the texture (how it feels), how it smells, whether it is dry or has been on the ground for a long time.
5. After you have described your leaf, invite a few children to describe their leaves to the whole group.
6. Then invite all of the children to tell a friend about his or her leaf.
7. After they half all talked about their leaf for a few minutes, invite the children to make piles of leaves. If there is a large group of children, they can make several piles of leaves.
8. Then say, “Now we are going to sort the leaves by color!” Invite the children to sort their piles by color. Help the children if they need help.
9. After sorting the leaves by color, put them all in a pile again, and say “Now we are going to sort the leaves by size!” Invite the children to sort their piles by size. Help the children if they need help.
10. After sorting the leaves by size, put them all in a pile again, and say “Now we are going to sort the leaves by shape!” Invite the children to sort their piles by shape. Help the children if they need help.
11. After doing this, tell the children that they did a great job sorting leaves.

Extensions and Variations
- Other things to collect and sort: seeds, stones, flowers, insects, etc.
- Objects can also be sorted by texture, weight, and any other criteria you or the children choose.
**Measure with Your Feet**

**Description:** Children draw shapes that they have just seen from memory.

**Materials**
- Chalk, chalkboard

**Primary Skill**
- Comparison & Measurement

**Secondary Skills**
- 123 Numbers & Counting

**Instructions**
1. Say, “We are going to measure how long something is by using our feet!!!”
2. Children think of a list of things they would like to measure in length. For example, they could measure a rug, a table, and a path.
3. Once they have agreed on what things they are going to measure (at least two), ask “Which do you think is longer, [object one] or [object two]?”
4. After they have answered, say “Let’s find out!”
5. Show the children how to measure the first object with their feet (by putting their heel at the start of the object and stepping along, putting their next heel to their toes, counting how many steps they need to take). They may find it easier if they do this in partners, one child stepping, and the other child helping the stepping child to line up their heels and toes well and count the number of steps they are taking. Then they can make a record of the measurement on a piece of paper. Let all of the children try it.
6. Then, have the children measure the second object (if they are working in pairs they should swap roles)
7. Then say “Let’s see if we were right! How many of you found that [object one] is more feet than [object two]? Is that what we thought?”
8. Finish by saying, “Now we know that [longer object] is longer than [shorter object]! Great job!”

**Extensions and Variations**
- This activity can be done with things other than feet. The children can measure using 2 blocks, a pencil, their hands, or something else.
- This activity can be done with outdoor objects as well as indoor objects. For example, it can be done with distance: “What is farther? The distance from the school door to the tree, or from the tree to the fence?”
# Stick Shapes

**Description:** Children make shapes using sticks, pebbles, beads, or some other material

<table>
<thead>
<tr>
<th>Materials</th>
<th>Shape cards, sticks (or toothpicks, beads, pebbles, bottle caps, shells etc.)</th>
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</thead>
<tbody>
<tr>
<td>Primary Skill</td>
<td>△ Geometry</td>
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<tr>
<td>Secondary Skills</td>
<td>123 Numbers &amp; Counting, ■■■ ■■■ Patterns</td>
</tr>
<tr>
<td>Directions</td>
<td>1. Give each child a shape card of the shape that the class is focusing on that day.</td>
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<td>2. Next, draw the shape on the board and say its name.</td>
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<td>3. Show the children how to trace the shape with their fingers. Describe the shape, making note if it has straight lines, curves, or angles.</td>
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<td>4. Next, give each child several sticks (or toothpicks, beads, pebbles, etc.) and show them how to trace the shape with the sticks by laying them on the outline of the shape.</td>
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<td>5. Let them try to do this with different types of materials. For example, if they make a square out of sticks first, let them make a square out of pebbles or rocks next.</td>
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<td>6. After they have done this a few times, congratulate them on learning about that shape.</td>
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**Extensions and Variations**
- For an outside activity, trace a very large version of the shape in the ground using a stick. Have the children trace the shape using rocks, big sticks, or their own bodies (everyone stands on the line to make the shape).
Parent Outreach - ELM at Home

- Family outreach modules extending opportunities to develop foundational skills at home, especially for those children with no access to preschool education.

1. 8 x 1.5 hour modules
2. 25+ games that parents can play with children at home
3. Book borrowing library

- Promote ELM skills while taking care of daily chores
Let’s Sort & Organize

Sort the Food
- Mix together 2-3 different ingredients of your choice (like onions, tomatoes and corn example).
- Say: “Help me sort these vegetables into piles?”
- Try sorting them by size.

Let’s organize leaves
- Go on a quick walk with your child to collect leaves.
- Try to order them by size from smallest to biggest.
- Now organize them by color.
- Now, try to organize them by shape.
- Try the same game with sticks and rocks.

Can you think of something similar?
- Say: We are going to think of some things that are similar or different from what I tell you. So listen carefully!"
- Here is a tomato. Can you think of something else that is red like a tomato?
- Can you think something else that is round like a tomato?
Shapes & Measurement

Circles, Circles Everywhere

- Draw circles in the sand or dirt. Make some bigger and some smaller.
- Tell your child, “this is a circle.”
- Ask your child to try to draw a circle. Hold your child’s hand to help if this is hard.
- Look for things around the home or outdoors that are the same shape.

Which is longer?

- Go outside with your child and select a stick.
- Ask your child to take the stick and find another that is either LONGER or SHORTER than that stick.
- Ask your child how they know which is longer.
- Show how you can put the sticks next to each other with the ends lined up and compare.

Measuring your feet and hands

- Ask your child, “How many steps are there from where you are sitting to that tree?”
- Walk to the tree with your child and count the steps together.
- Then, measure the length of a stick with your child using the child’s hands.
The Evidence
Ethiopia RCT Pilot - Gains in Math Skills in Regular ECD program vs. improved ECD model

Figure 5. Math Domain: average baseline and gain by group (% of 68 correct)
An added bonus from interactive learning and teaching – socio-personal gains

Figure 3: Socio-personal Development: average baseline and gain by group (% of 38 correct)
Bangladesh - School readiness outcomes (effect sizes $d=1.67$, $1.91$)

Average endline school readiness scores by group controlling for age, height-for-age, mother’s education, family assets and baseline score.
Two years after the intervention, students who attended preschool obtained numeracy scores that are significantly better than scores of comparison children ($p<.001$). Effect size: .33 SD.

Results account for clustering at village level, and controls for school readiness baseline scores, age, gender, SES and districts.
ELM Toolkit Process

- Pilot in Bangladesh 2011
- Pilot in Ethiopia and Rwanda in 2012-2013
- Roll out in Asia in 2013 Nepal, Indonesia, Afghanistan, Bangladesh, Pakistan, China
- Roll out in Africa - TOT scheduled for July 2014
Scalability and Next steps

- The ELM boost is highly scalable and relevant across programs and providers
- Training modules are flexible and easily adaptable to different teacher training schedules
- Strong links to programs for early primary grades
- Cost of starting up an ECD program vs. quality improvement
- ELM boost- $4 per school – roughly 11 cents per child per year
The way forward

1. Focusing only on early grades literacy and math support is not enough to move the needle on learning outcomes.

2. We must recognize that the early years have a crucial role in building foundational skills in both math and literacy that pave the way for success in primary school.

3. We have to invest in quality preschool education and parent support programs to ensure that children have adequate early learning opportunities.
Let’s see what it looks like

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Thank you