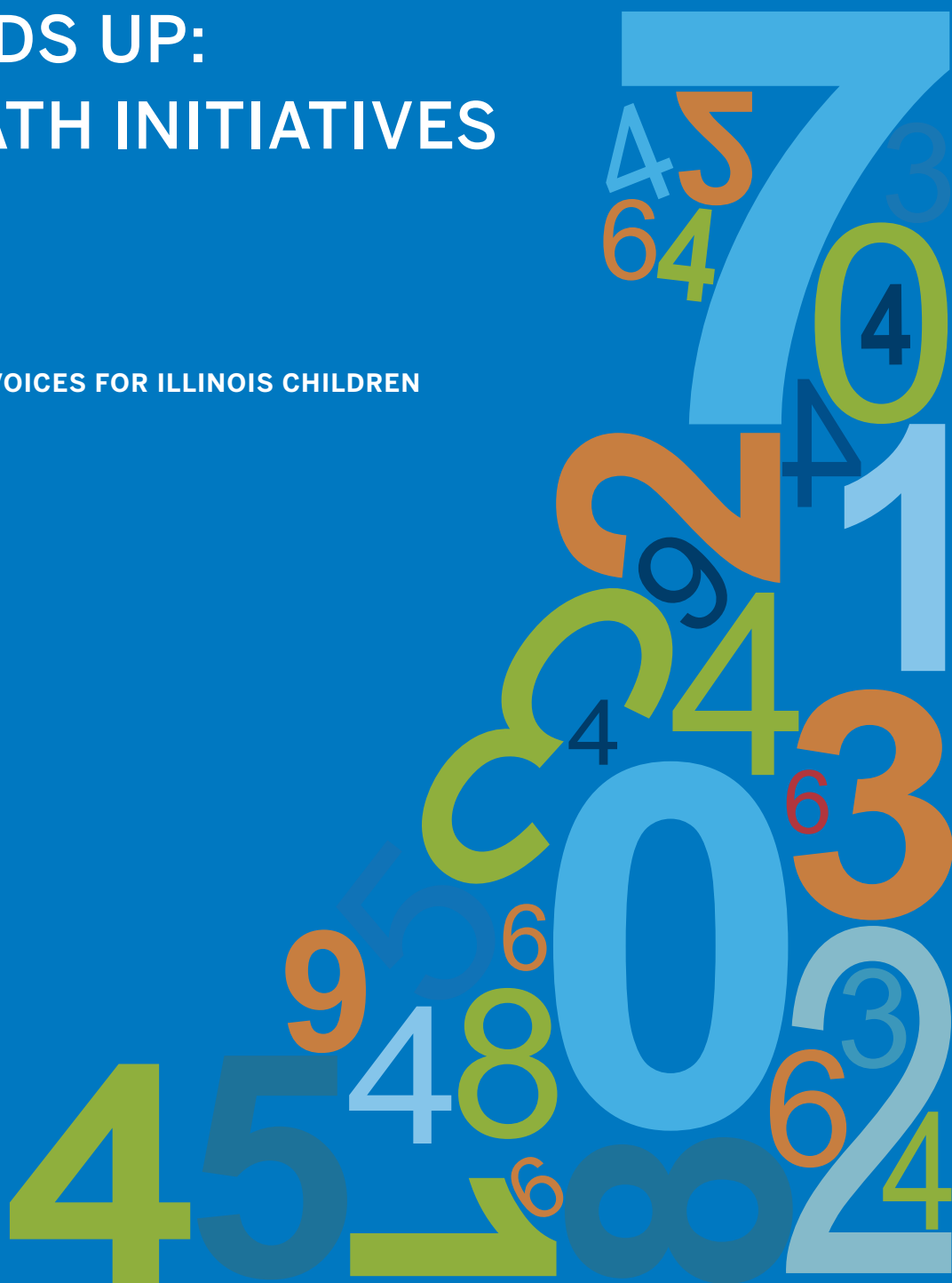


IT ALL ADDS UP: EARLY MATH INITIATIVES *in Illinois*

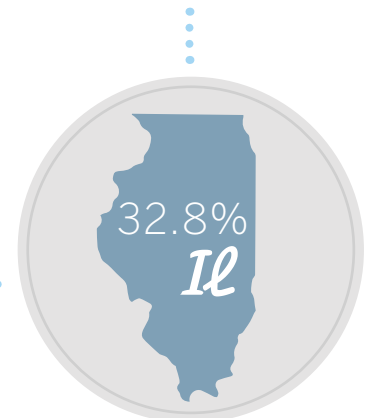
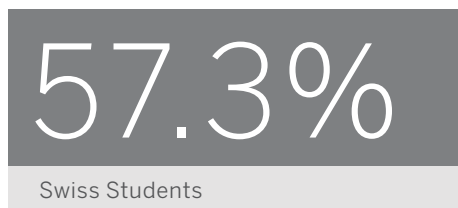
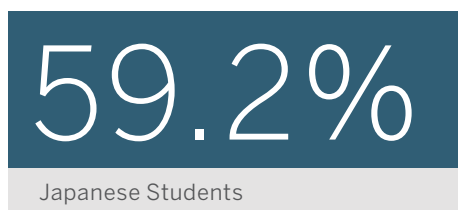
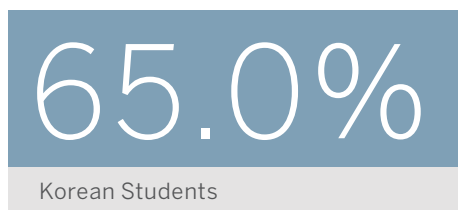
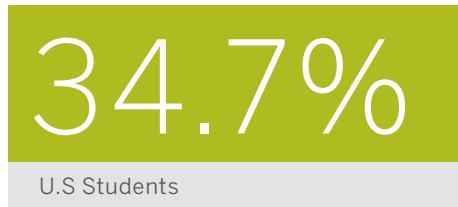
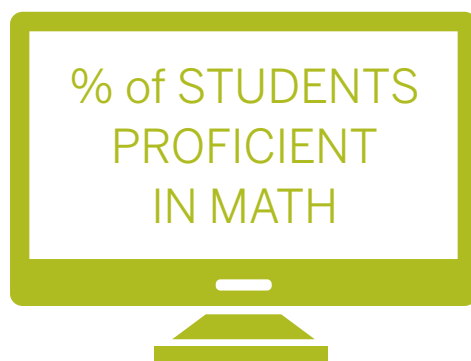
BY SUSAN B. MUNRO, VOICES FOR ILLINOIS CHILDREN



IT ALL ADDS UP: EARLY MATH INITIATIVES *in Illinois*

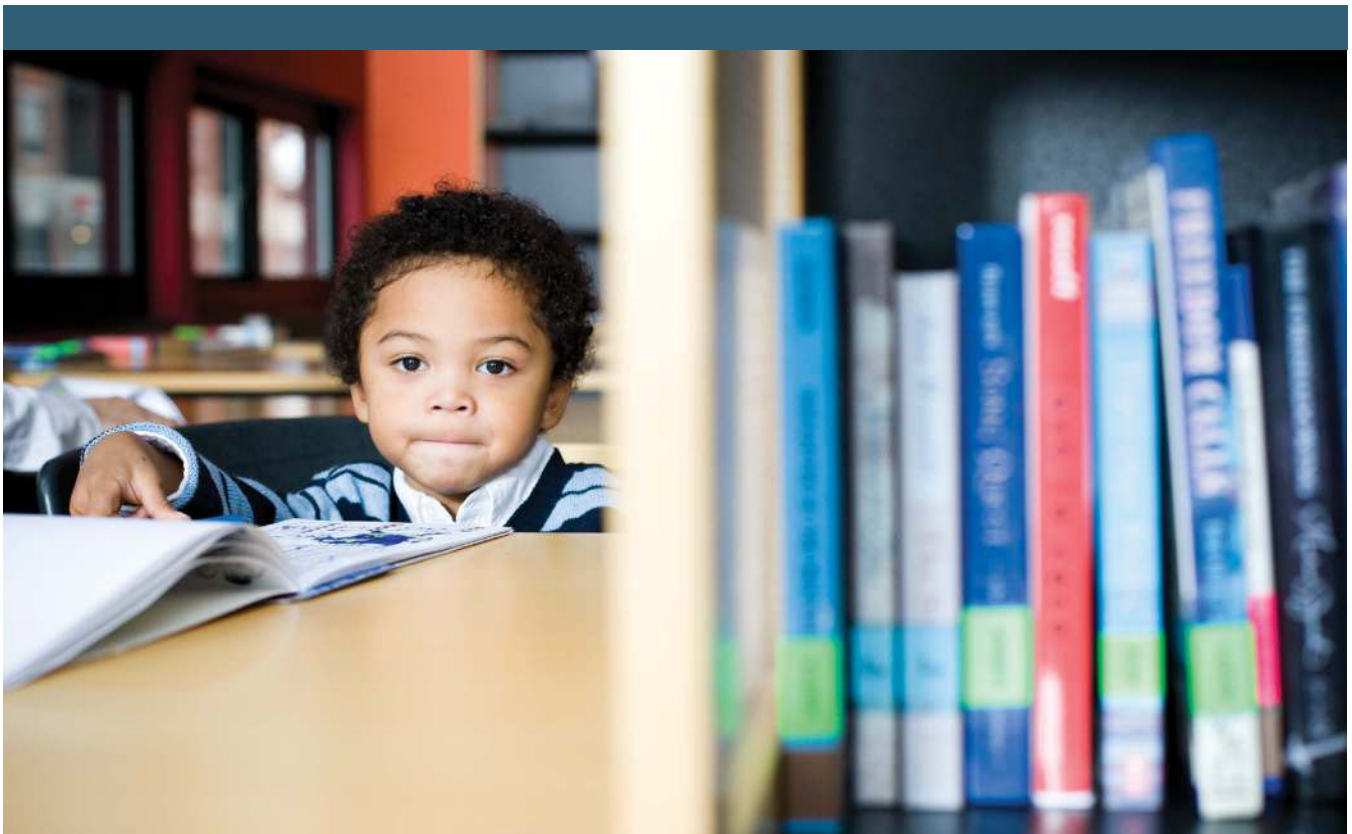
Math is all around us, and research suggests that children understand math concepts even before they can speak. Not only are they “born learning,” but they are also born learning math. So why does “math” seem so hard to so many and why are so many children failing math in school? When and why does math stop being fun for kids?

Addressing these questions is crucial to our success and future economic well-being as a nation and as a state. An analysis in *Education Next* shows that U.S. students, regardless of where they live, the color of their skin, or their family income, lag far behind students in other industrialized countries in their math proficiency. Only 34.7% of U.S. students and 32.8% of Illinois students are math proficient, compared to Korea (65%), Japan (59.2%), and Switzerland (57.3%), just to name a few of the countries that outrank the U.S.



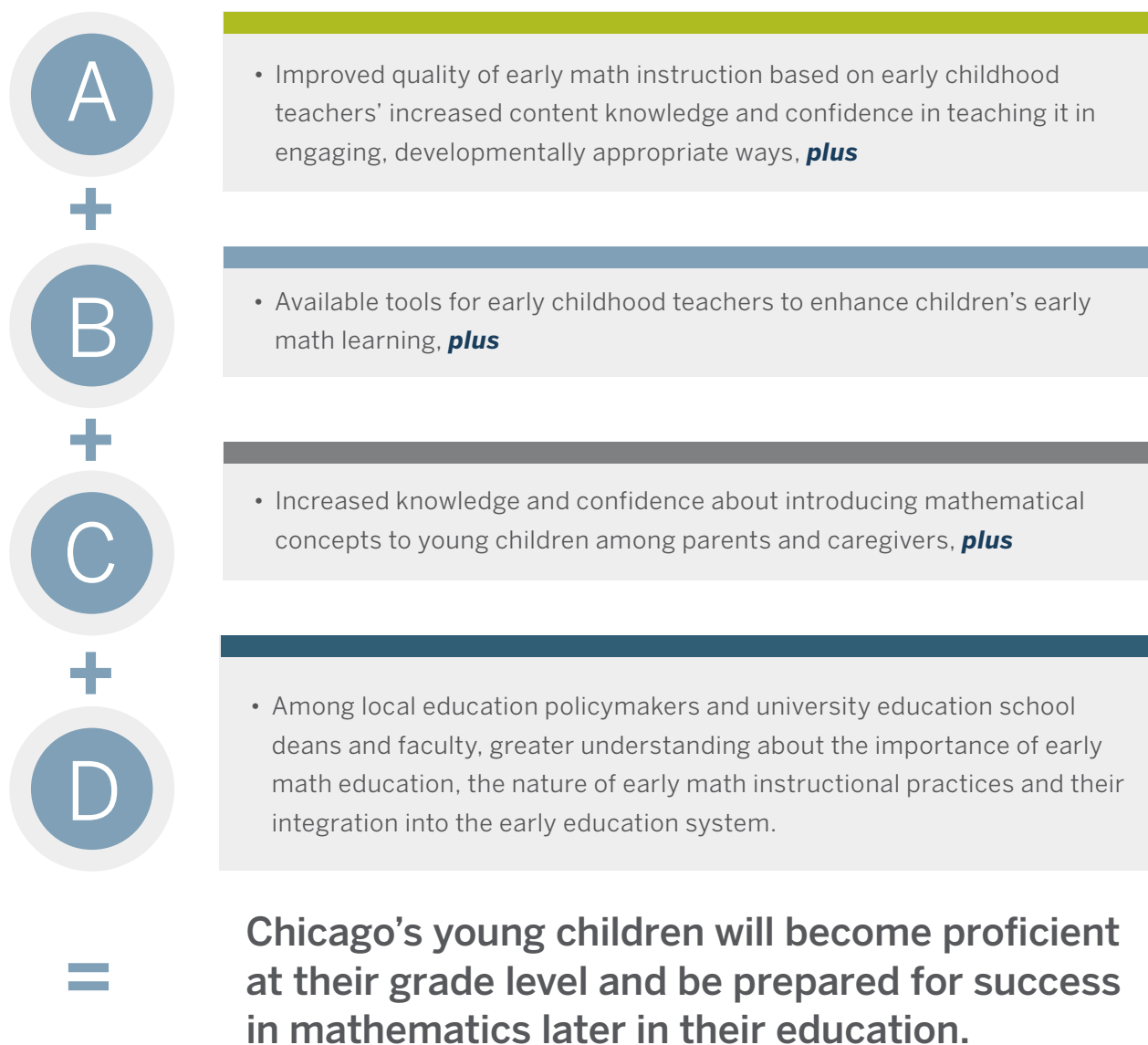
The problem starts early. Aside from counting, recognizing numbers, and naming some shapes, development of math concepts during the crucial years from birth to kindergarten has until recently been largely ignored. Childcare providers and preschool teachers who are grounded in literacy instruction never miss a chance to identify letters, sounds, and words in a context-rich environment. However, many feel much less confident about math concepts or about how to embed math talk and experiences into their early childhood classroom.

CME Group Foundation (the Foundation), through its focus over time on early math, has not only stimulated research and practice but also created a learning community of early math practitioners who are learning from one another in Chicago and increasingly in other sites in Illinois. The seeds planted by the Foundation, along with its partners at the Robert R. McCormick Foundation, are having a tremendous impact on early math instruction. The lessons learned from this effort should inform further research and practice, as well as the preparation of early childhood educators.



In launching its early math education initiative in 2010, CME Group Foundation developed a theory of change with one big goal: Chicago's young children will become proficient at their grade level and be prepared for success in mathematics later in their education.

Leading up to the goal were **FOUR** elements:





Over the first four years of the project, the Foundation has made significant and strategic investments in early math research, practice, and professional development, with measurable effects on the quality of early math instruction. It has supported, stimulated, and influenced the development of tools, from one-page math museum guides to textbooks and websites packed with content and resources for early childhood math educators. Some of its projects are reaching out intentionally to caregivers and parents of the very youngest children, so that even daily routines of infant and toddler care become times for learning about math.

With this foundation, which continues to grow, it is possible to offer some recommendations to local and state education policymakers and higher education school deans and faculty that will greatly expand the impact of this work and move the field closer to the goal of having all children be proficient in math by third grade.



HOW CHILDREN LEARN MATH

Children arrive at preschool with wide variations in their mathematical knowledge, and these variations are predictive of their later success in math. In order for early childhood teachers to design effective math instruction, they need to know not only where children are in terms of understanding math concepts but also how children in general learn those concepts. The process of learning math concepts has not been as fully mapped as language acquisition. Children learn math through experience, using all of their senses, at variable rates, and incrementally but with some sudden jumps when a concept clicks for them.

Researchers at the University of Chicago have taken on the challenge of designing formative assessments that can be used to determine preschool children's math knowledge. They are also mapping the trajectory of children's understanding of number and spatial/geometric knowledge. Along with this work, they are developing and testing instructional strategies in an iterative process they call "from the classroom to the lab and back."



FROM THE CLASSROOM *to* THE LAB AND BACK

1

- **Preschool teachers describe instructional dilemmas, perhaps spots where children stumble in learning a concept.**
- **Then the researchers devise promising ways to address these dilemmas and assess whether they are effective in promoting students' learning.**

2

- **They work one-on-one with children in their learning lab and then share their findings with teachers, who adapt these solutions in the classroom. Working with the developers of Everyday Math, the widely used pre-k – grade 6 mathematics curriculum, they modify existing lessons to scale up lab findings about best practices.**

3

- **These lessons are then field tested by the researchers and classroom teachers. Often, these observations and results lead to further refinements and new ideas for research aimed at improving children's math learning.**

When teachers have a map of children's developmental math trajectory, they are in a better position to design instructional challenges just beyond the child's current competence, setting up exercises and experiences to advance his or her math knowledge. However, most teachers will need professional development, coaching, practice, and reflection to build their knowledge, confidence, and early math instructional skills.

CONTENT AND PEDAGOGY: THE WHAT AND HOW OF EARLY MATH INSTRUCTION

The Early Math Collaborative at Erikson Institute has been the professional development hub for most of the early math projects funded by the Foundation. Erikson built its "big ideas" approach not only on the trajectory of children's understanding of math concepts but also on the whole-child approach and deep understanding of how children learn and experience the world. Those involved with Erikson's professional development have high praise for their combination of content (the what) and pedagogy (the how).

The big ideas – the central, coherent, developmentally appropriate content that teachers must grasp – are outlined on the facing page. The pedagogy – Erikson's key strategic teaching practices, described on pp. 7-9 of *Big Ideas of Early Mathematics* — includes:

- Mathematize the world around us. That is, help children engage with mathematics everywhere, whether in the block corner or on the bus.
- Make mathematics more than manipulatives (objects used to teach concepts). Math is abstract. While young children need concrete learning experiences, they must be helped to make connections between objects and symbols, pictures, and language.
- Recognize receptive understanding. Especially with very young children, whose language skills are just developing, teachers need to be alert to nonverbal indications of what a child is thinking.
- Get mathematics into children's eyes, ears, hands, and feet. Multimodal learning – engaging multiple sensory and action systems of the learner – deepens learning. When new ideas are presented in different ways, learners' brains form more connections between new ideas and familiar concepts.
- Scaffold children to construct their own understanding. Young children are curious and competent learners who can – and will – solve many of the problems that abound in daily life. The teacher's role is to frame and guide problem situations in ways that take into account the remarkable developmental trajectory they can traverse.

Everyday life presents a multitude of opportunities to combine content and pedagogy into meaningful learning experiences. However, many teachers lack the skills and knowledge to fully exploit these opportunities.



Big Ideas of early mathematics

One of the most important contributions of this project has been to map the “big ideas of early mathematics,” essential ideas about math topics that teachers of early math need to know. The Erikson Institute Early Math Collaborative has summarized and illustrated these concepts in the *Big Ideas* book. Although the book was not published until 2014, the big ideas have guided much of the early math professional development done in Chicago by Erikson faculty in collaboration with other CME Group Foundation grantees. These are the essential ideas that early childhood educators need to know and be able to put into practice.

Topic	Big Ideas
Sets	<ul style="list-style-type: none"> • Attributes can be used to sort collections into sets. • The same collection can be sorted in different ways. • Sets can be compared and ordered.
Number Sense	<ul style="list-style-type: none"> • Numbers are used in many ways, some more mathematical than others. • Quantity is an attribute of a set of objects and we use numbers to name specific quantities. • The quantity of a small collection can be intuitively perceived without counting.
Counting	<ul style="list-style-type: none"> • Counting can be used to find out “how many” in a collection. • Counting has rules that apply to any collection.
Number Operations	<ul style="list-style-type: none"> • Sets can be changed by adding items (joining) or by taking some away (separating). • Sets can be compared using the attribute of numerosity, and ordered by more than, less than, and equal to. • A quantity (whole) can be decomposed into equal or unequal parts; the parts can be composed to form the whole.
Pattern	<ul style="list-style-type: none"> • Patterns are sequences (repeating or growing) governed by a rule; they exist both in the world and in mathematics • Identifying the rule of a pattern brings predictability and allows us to make generalizations. • The same pattern can be found in many different forms.
Measurement	<ul style="list-style-type: none"> • Many different attributes can be measured, even when measuring a single object. • All measurement involves a “fair” comparison. • Quantifying a measurement helps us describe and compare more precisely.
Data Analysis	<ul style="list-style-type: none"> • The purpose of collecting data is to answer questions when the answers are not immediately obvious. • Data must be represented in order to be interpreted, and how data are gathered and organized depends on the question. • It is useful to compare parts of the data and to draw conclusions about the data as a whole.

HOW TEACHERS LEARN AND CHANGE

Erikson researchers found that the cognitive research about how children learn math has not migrated to or influenced the practice of early math instructions. Since they wanted to learn more about pre-k teachers' knowledge of how to teach math and how their abilities impact children's mathematical performance, they surveyed Chicago Public Schools (CPS) pre-k teachers in 2007. One finding that stood out was teachers' hunger for professional development in math instruction. Many expressed a lack of confidence in their own math knowledge and competence, even though they didn't think that this hindered their ability to teach early math.



Early childhood teachers' lack of confidence about teaching math can cause them to avoid the subject and inadvertently continue the cycle of low math achievement. The whole-teacher professional development model developed, tested, and refined by the Early Mathematics Collaborative at Erikson is a content-focused approach that addresses not only skills and knowledge but also attitudes and affect around early math.



Changing teachers' knowledge, attitudes, and classroom practices in a major subject area is challenging. While Erikson has developed variations of its model, in general effective early math professional development must:

- **Be focused on content**
- **Be sustained over time (at least one year)**
- **Incorporate learning labs that address both content and affect**
- **Include practical ways to introduce and integrate math content**
- **Include ongoing, regular coaching in the teacher's settings**
- **Be shared in a community of practice**
- **Recognize that all learning is contextual**

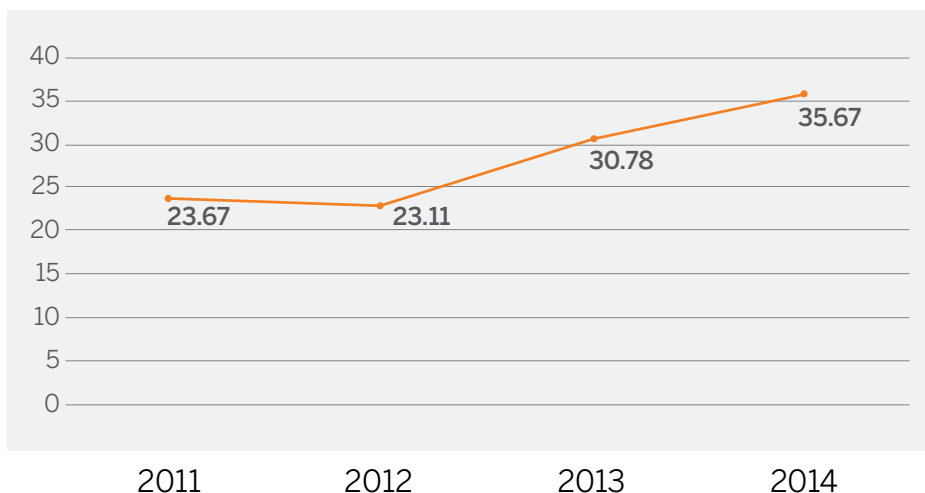
It is not enough to work with individual teachers. For teachers to be both intentional and successful in their early math instruction, they need learning communities where they can share ideas, reflect on classroom practices, and learn from one another. Then, the school as a whole must change. Erikson has now developed administrator/ leadership academies for groups of principals and assistant principals where they get a taste of the professional development experience and develop their own learning communities around early math instruction.

With funding from a range of sources, Erikson has engaged approximately 500 pre-k and kindergarten CPS teachers in yearlong early math professional development and over 2,000

teachers in short-term early math professional development. The approach is having positive effects. Preschool children whose teachers were in yearlong programs demonstrated achievement equivalent to three months more math during a single school year than those whose teachers were not in the program. For children who were already behind the national norm, the gain was five months compared to the contrast group.

Erikson has leveraged the opportunities presented first by CME Group Foundation and Robert R. McCormick Foundation to win a federal Investing in Innovation (i3) grant to expand the project from pre-k and kindergarten to grade 3. With additional funds from the Foundation and Chicago Community Trust, they are including fourth and fifth grade teachers.

Results - Overall HIS-EM



Teachers significantly improved their math teaching practice over the three years

INFUSING MATH IN EARLY CHILDHOOD ENVIRONMENTS

Math at Home

Even very young children understand concepts like more, bigger and smaller, and fair (equal). Toddlers line their toy cars up by size and count “one, two!” as they touch two shoes on two feet. They are natural mathematicians.

Most children younger than three spend their days with a parent or caregiver in home child care settings. These adults rarely have the time or opportunity for professional development, and math instruction for babies and toddlers may not even be on their radar. Many three- and four-year-old children are also at home or in family childcare settings. How can the early math experiences of these children be enriched?

Math at Home (mathathome.org), originally based at National Louis University and now at the University of Illinois at Chicago (UIC), is a web-based resource designed for these caregivers. Here they can watch short videos about math concepts and how to set up their environment to encourage math exploration. They will find close to 100 lessons that integrate math into daily routines, from mealtime and dressing to playtime outdoors and inside. So far, up to 12,000 users per month are accessing Math at Home. Through the blog on the site they are sharing their experiences in a virtual early math learning community.

The Math at Home developers are exploring multiple avenues for providing opportunities for professional development to family childcare providers, who work long hours in their homes with few chances for interaction and enrichment. They have learned that parents, students, university programs, and center-based teachers are also using the Math at Home site.

Educare

Erikson’s initial early math project focused on pre-k and kindergarten teachers. In partnership with Erikson, the Ounce of Prevention Fund has extended this approach to infant-toddler teachers and to families of children birth to age 5. The Ounce’s Educare school in Grand Boulevard on Chicago’s South Side serves as the laboratory for the initiative.





At Educare, everyone – teachers, administrators, family support specialists, and parents – has a chance to learn the big ideas in mathematics. Educare teachers take part in intensive professional development through cycles of training, practice, individualized coaching, and peer learning to strengthen their own math content knowledge and skills and enhance their ability to instill these concepts in children. The halls are filled with examples of children, even babies and toddlers, playing with sorting, patterns, measurement, and other math concepts. Parents take part in several family math events each year and are encouraged to use everyday opportunities to explore math with their children.

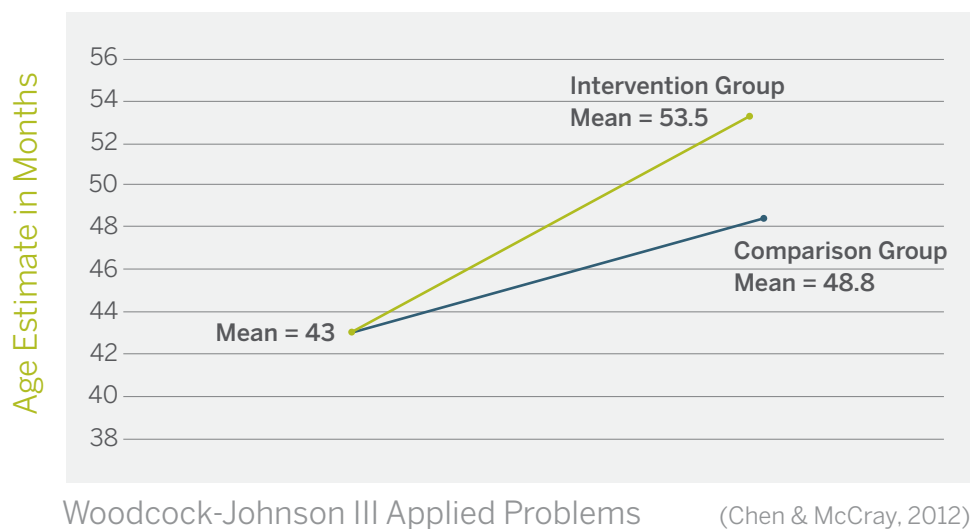
As with several other projects, Educare professional development staff found that they needed to slow down and focus on a few topics at

greater depth, rather than trying to cover all of the big ideas in one year. They now offer fewer learning labs but build in time for team planning and reflection, along with group coaching. Their efforts are paying off. When five-year-old Educare children are assessed using several measures, there is no “achievement gap” between these low-income children and their higher-income peers.

Educare teachers have also dramatically improved their math teaching practice, realizing a 51% increase in their overall score over three years on Erikson’s observational assessment, High Impact Strategies for Early Mathematics (HI-SEM).

The Ounce and Erikson are working to create early math tools on the “big ideas” that use written material and video to provide infant-toddler teachers and home visitors with the content knowledge needed to promote early math

Effects on Pre-K Children



awareness in very young children. They are also working to develop and implement professional development experiences for birth-to-three professionals in the greater Chicago area to ensure that the tools have maximum impact. In addition, they are exploring strategies to share what they have learned with the 20 other Educare Schools in the Ounce's national network, such as webinars for the Educare master teachers.

INFORMAL CONTEXTS FOR PLAYING WITH MATH

Two children's museums – Chicago Children's Museum (CCM) and Kohl Children's Museum (KCM) – have provided opportunities for pre-k, kindergarten, and first grade teachers to deepen their knowledge of math concepts and develop new strategies for teaching math whether in their classrooms, at the museum, or in other informal education settings.

Both museums have rich math environments and are popular field trip sites for children in Chicago Public Schools and the Chicagoland area. As part of the Early Math Education Initiative, CCM has developed and implemented a series of professional development workshops about math content and methods for school-based teacher teams from Chicago International Charter Schools (CICS). This Playing with Numbers program emphasizes integrating children's literature into

math lessons and using math workstations. CCM has also facilitated peer reflective groups, field trips to the museum, and opportunities to plan, practice, and refine hands-on lessons.

CCM's program allows teachers to remember that it is through authentic play opportunities that children naturally encounter math concepts and begin connecting classroom learning with the real world. With additional funding from other foundations, CCM has been able to replicate this model with a cohort of CPS teachers.

Kohl Children's Museum has worked with CPS teachers who have participated in Erikson's professional development program. KCM's approach combines workshops about math content and pedagogy, peer reflective groups, field trips to the museum, and opportunities to plan and practice hands-on lessons in other settings. As with the other programs, KCM found that they were more successful when they focused on one big idea or math station at a time, enabling teachers to build confidence in their ability to create and implement developmentally appropriate, playful lessons in that area.

KCM staff say that the project has transformed the museum, leading to greater intentionality about integrating math concepts. While continuing to work with teachers, they are also conducting early math training for childcare providers and developing math activity guides for parents to use in the museum and at home.

**EARLY ELEMENTARY SCHOOL CLASSROOMS:
AUSL (ACADEMY FOR URBAN SCHOOL
LEADERSHIP) AND BIG SHOULDERS FUND/
SAINT XAVIER UNIVERSITY**

The Foundation has supported early math projects at five AUSL schools and five Chicago parochial schools supported by the Big Shoulders Fund. The elements of teacher professional development are similar: learning labs, classroom coaching, time for peer reflection in a cohort, all sustained and supported over time. Both projects involve school principals in workshops.

It is hard to miss the uproar about the Common Core State Standards – Math (CCSS-M). Assignments to teach basic math concepts have been mocked by comedians and fiercely debated by politicians and parents. Many teachers are frustrated or struggling with the task of implementing this new instructional approach with outdated textbooks.

The approach taken by the AUSL and Big Shoulders Fund schools supports implementation of the Common Core in the early elementary school years and beyond. The big ideas are aligned with CCSS-M, and, like the standards, they address the problem of a curriculum that is “a mile wide and an inch deep.”

Teachers who lack conceptual understanding of key math ideas are hardly in a position to teach a Common Core curriculum. They need deep content knowledge, which is exactly what professional development based on the big ideas provides. They need a range of instructional

strategies that are coherent, sequenced, and developmentally appropriate.

High-quality math textbooks have not yet caught up with the Common Core or are too expensive for inner-city schools to replace. AUSL has developed planning guides for each grade level that are aligned with the Common Core and cover the scope and sequence of instruction. Even without adequate instructional texts, schools where early math professional development is a priority have a leg-up when it comes to implementing the Common Core. And as more children experience high-quality math instruction in pre-k and their teachers become more confident in their own math knowledge and skills, those conceptually based math problems will look less foreign and forbidding to their parents.



GOING TO SCALE

Grantees say that math instruction has been transformed at their schools and institutions by this project. Along with the Foundation, they are eager to see more teachers and children affected by high-quality early math professional development for teachers. However, certain parameters constrain “going to scale.”

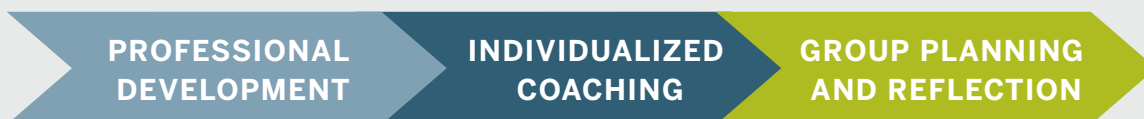
Professional development needs to be relationship-based and sustained over time. Regardless of the setting, grantees reported that they needed to go slower than they had originally planned. They couldn’t introduce seven big math concepts and send teachers back to their classrooms to devise effective lessons. Rather, they had to introduce one concept, such as measurement, and then give teachers time to learn the content, design lessons, work with their coach, reflect with their team – and cycle through that process more than once before moving on to another concept.

Learning within a cohort – for instance, all of the first grade teachers in a school or the principals and assistant principals in five schools – is hugely beneficial. It not only provides an excellent context for learning and reflection but also starts to change the school environment. However, the learning community can’t be too large or it loses its effectiveness.

Turnover among early childhood teachers presents challenges. Since new teachers rarely arrive with the appropriate deep math content and instructional skills, professional development is never completed at a school.

Finally, professional development incorporating coaching and/or master teachers, as well as time for learning labs and reflective groups, is expensive. Big Shoulders Fund mentioned that some schools might have to abandon in-person coaching because it is so expensive, even though they had identified this as a key lever of change.

Most teachers will need professional development, coaching, peer learning and planning, opportunities to practice, and time to share and reflect to build their early math knowledge, confidence, and instructional skills.



There are some promising angles for expanding or scaling up that do not compromise the basic model:

- **High-quality texts and materials.** The Foundation's early math initiative has stimulated development of *Big Ideas of Early Mathematics*, Ounce-Erikson manuals for infant-toddler teachers and home visitors, research publications that are influencing textbooks, planning guides for teachers, museum guides for teachers and parents –

and more. By themselves, these resources aren't enough to change teachers' content knowledge, attitudes, and classroom practices, but they are a major step in that direction.

- **Partnerships.** Grantees who partnered with Erikson got the benefit of Erikson's year of early math study. These partnerships kept them from reinventing the wheel and helped them to move forward. Partnerships can also be leveraged to bring in more funds to a school for professional development.



- **Training the trainers.** With Erikson training, master-teachers and coaches within Chicago Public Schools are taking on some professional development functions.
- **Teaching the teachers.** Erikson has started to train community college teachers to use the *Big Ideas* book to train pre-service teachers.
- **Using technology.** As reinforcement for coaching and to reach a broader geographic area, Erikson has produced webinars and online video demonstrations. Two video series – Focus on the Child and Focus on the Lesson – provide rich illustrations of how teachers can facilitate children's acquisition of math concepts.

RECOMMENDATIONS FOR FOUNDATIONS

When asked whether and how the experience with the Foundation had been valuable, grantees used words like “phenomenal,” “extraordinary,” and “tremendous.” The Foundation has made substantial, long-term commitments, based on a philosophy that embraces a continuum of practice from birth through third grade. It gave Erikson a year to learn, test ideas, and develop “collaborative wisdom.” It let projects make adjustments and refinements to improve effectiveness, even if that meant slowing down to help teachers truly absorb content.

Foundation Executive Director Kassie Davis encouraged grantees by sharing ideas, asking questions, making connections, and treating them as trusted and respected partners. Most significantly, Davis convened the grantees on a regular basis so that they could form their own learning community. Grantees described this as the “best kind of collaboration.” Fruitful partnerships evolved in this natural setting, where ideas – and even missteps – could be discussed freely. New grantees stand to benefit from the work that has already been done to nurture this spirit of collaboration.

RECOMMENDATIONS FOR THE ILLINOIS STATE BOARD OF EDUCATION (ISBE)

ISBE could increase attention to early math competency through the Early Childhood Block Grant (ECBG) process, for instance, by requiring programs to create a math professional development plan. It could also provide programs with resources, such as *Big Ideas of Early Mathematics* and guidelines for best practices in professional development.

ISBE can draw attention to the math goals in the recently revised early childhood learning standards. The Illinois Early Learning Standards (2013) include math goals, learning standards, and performance descriptors that align with the research and Common Core, as well as the “big ideas” of early math. The Illinois Early Learning



Guidelines for Children Birth to Age Three (2012) include several pages on infant/toddler math. As these standards become more widely used, it is likely that they will influence early childhood instructional practices and increase the demand for early math professional development.

Working with partners in early childhood and higher education, ISBE could contribute to creation of a tiered professional development approach that funds statewide introductory and ongoing training for teachers and administrators, as well as professional development coaching and coaching.

RECOMMENDATIONS FOR HIGHER EDUCATION

In addition to Erikson's work with community college teachers, AUSL coaches have taught courses at National Louis University, in order to create a direct feedback loop from lessons learned in the classroom with in-service teachers to pre-service teachers in AUSL's residency-based training program. For the most part, however, pre-service teacher math education is too generalist.

Requiring students to take more math courses will not solve the problem. They need specific courses in basic math content and methods taught by faculty with deep knowledge of math concepts. At this point there is a shortage of early childhood faculty with these competencies. Appropriate coursework will not eliminate the need for professional development, but it will give pre-service teachers the background they need before entering the classroom – and help to alleviate some of their anxiety about math.

The Illinois Professional Teaching Standards (IPTTS) require that teachers have in-depth understanding of content area knowledge. The knowledge and performance indicators include examples related to language development and literacy strategies, but none for mathematics knowledge and performance. These standards could be updated to include more criteria related to early math conceptual knowledge and instructional practices, which would spur improvements in pre-service early math courses, as well as professional development.

The Early Math Advisory Committee recommends that college programs hold early math symposia that emphasize content and methods for effective early math instruction. Pilot projects could evolve from collaborations among symposium participants, leading to innovative models for enhancing pre-service teachers' math competency.

Principal leadership is key to change in any school. Since principals come to their role with their own experiences as classroom teachers and their own perceptions of how math should be taught, it is important that their administrative coursework include exposure to early math concepts, methods, and evaluation. This is especially important for future administrators of pre-k through elementary schools.

RECOMMENDATIONS FOR EARLY LEARNING SETTINGS AND SCHOOL SYSTEMS

Effective curricula and professional development to support early childhood educators' knowledge and instructional practices is essential to closing the achievement gap. Especially for children birth to 5, this should include enrichment not only for the preschool classroom but also for the home environment.

The message to “read to your child” is drummed into parents' heads – and it is an important message. But the idea of doing math with one's child may evoke images of drills and worksheets, rather than the fun of playing in sand with measuring cups or sorting autumn leaves by color or shape. Parents may not think of math as counting the unoccupied seats on the bus, noticing the shapes of traffic signs, or deciding how many forks to put on the table at dinnertime.

Parents can be introduced to math concepts in everyday life during parent meetings and through suggestions of activities to do at home. The lesson from the various projects is to introduce one concept at a time, with a fun activity that can be integrated into the family's day and doesn't require special materials. There are an enormous number of fun, beautiful, and engaging children's books about numbers, shapes, and sorting. Parents can be encouraged to make these books part of their daily reading routine.

Within early childhood settings, there needs to be recognition that teaching math concepts requires some expertise. If we want children to “go deep” into math concepts and become good problem solvers, then schools have to invest in professional development that goes deep with teachers over a sustained period of time. Systems need to acknowledge that early math is specialized knowledge that is best learned in relationship for both children and teachers. Teachers need time to plan, reflect, and assess in teams or cohorts. They need to use multiple strategies, including observational tools, to monitor children's progress and evaluate their early math comprehension.

The system needs to change, too. Principals and other administrators need to know what good math instruction looks like, so that they will support teachers' development and know how to assess teachers in the classroom. That means providing opportunities for principals to be exposed to early math concepts, methods, and evaluation, perhaps through continuing education or leadership academies. Systems need to make a long-term commitment to excellent math instruction that starts in pre-k (or before) and that is coherent and aligned with the Common Core standards.

RECOMMENDATIONS FOR POLICYMAKERS

Investments by CME Group Foundation and Robert R. McCormick Foundation have stimulated development of highly effective early math professional development models. They have encouraged innovative strategies to involve families and caregivers in early math and to integrate math into early learning environments. They have also made recent investments, including some outside of Chicago, that are not discussed here.

Private foundation investments are still very much needed to expand outstanding early math experiences for all children, and the findings from these projects can inform public investments in early math. However, all of the models require a significant investment of time and resources for ongoing professional development, coaching, joint planning and reflection – the elements that have been found to be levers of change in teachers' knowledge and practice. In the current fiscal climate, it will be challenging for ISBE, school districts, community-based agencies, and higher education to make the financial commitment required for systemic change.



One step that can be taken is to start building a plan for widespread transformation of the way early math is taught. The Early Math Advisory Committee recommends that policymakers create a math steering committee that could take on this role. As outlined in “Early Math in Illinois: Recognizing and Raising the Profile,” the advisory committee’s 2013 report, this new committee would support and coordinate early math initiatives in higher education, professional development, and systems building.

Overall, more attention needs to be paid to how teachers are trained, in colleges and ongoing professional development, to support children’s early math development. Public policies and investments need to support coaching, reflective practice, and professional learning communities. With support from informed principals, teachers can create developmentally appropriate learning environments where every young child has a chance to explore and absorb the big ideas of early mathematics. They can help parents nurture the joy of discovering math concepts in daily life. In the long run, this will all add up to increased math proficiency among Illinois children and improved competitiveness on the world stage.



ACKNOWLEDGMENTS

Many thanks to the following individuals who were interviewed for this project:

Rosemary Baker, Shana Hayes, and Ryan Eggert, AUSL; Rebecca Ryan, Big Shoulders Fund; Nancy Plaskett and Lauren Putze, Chicago Children's Museum; Jennifer McCray and Jie-Qi Chen, Erikson Institute; Stephanie Bynum and Erika Gray, Kohl Children's Museum; Kathleen Sheridan, Math at Home (UIC); Elizabeth Rothkopf, Ounce of Prevention (Educare); Raedy Ping, University of Chicago; Madelyn James and Gaylord Gieseke, Voices for Illinois Children. Special thanks to Kassie Davis of CME Group Foundation for her facilitation.

RESOURCES

The Early Math Collaborative, Erikson Institute (2014). *Big ideas of early mathematics: What teachers of young children need to know*. Pearson Education, Inc.

Hanushek, Eric A., Peterson, Paul E., & Woessmann, Ludger (2014). U.S. students from educated families lag in international tests, *Education Next*, fall, Vol. 14, No. 4. Available at <http://educationnext.org/us-students-educated-families-lag-international-tests/>

Illinois Early Learning Standards (revised 2013):
http://www.isbe.state.il.us/earlychi/pdf/early_learning_standards.pdf

Illinois Early Learning Guidelines for Children Birth to Age Three (revised 2012):
<http://www.isbe.state.il.us/earlychi/pdf/el-guidelines-0-3.pdf>

Illinois Early Math Advisory Committee (2013). *Early math in Illinois: Recognizing and raising the profile*. Illinois Network of Child Care Resource & Referral Agencies (INCCRRA).