Big Math for Little Kids Workshops: Background and Content

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What is Big Math for Little Kids?

History of Big math for Little Kids:

Big Math for Little Kids (BMLK) is a preK and kindergarten curriculum developed with funding from the National Science Foundation by Herbert Ginsburg, Carole Greenes and Robert Balfanz. This culmination of four years of work, extending from 1998-2002, was an attempt to provide children with a developmentally appropriate and research-based curriculum that would help prepare them for elementary school. The authors relied heavily on the extensive body of psychological and educational research to create the program (Ginsburg & Baron, 1993; Ginsburg, 1999; Copley, 1999; Balfanz, Ginsburg, & Greenes, 2003). This body of research showed that: (1) young children are ready and able to learn mathematics; (2) children need adult guidance to reach their full mathematics potential—playing is not enough; (3) low-income children benefit from rich math learning experiences; and (4) young children are capable of learning from a comprehensive and developmentally appropriate curriculum.

Once designed, the BMLK activities were field-tested in a variety of preschool settings. These settings included public schools, parochial schools, and early learning centers in New York, Massachusetts, Maryland, Texas, Wisconsin, and England. Authors worked with children from low-income families, children from middle-income families, and children who were just learning to speak English to ensure the curriculum's effectiveness with children from diverse backgrounds. In addition, authors collaborated very closely with teachers and used their feedback and suggestions to change, rearrange, delete, and add new activities to the curriculum.

Features of Big Math for Little Kids:

BMLK provides teachers with many different opportunities to help their children learn "Big Math" concepts. First, the curriculum offers teachers a sequenced, extensive and in-depth coverage of various mathematical concepts. Second, the curriculum gives teachers direct ways to connect literacy, language and mathematics. Finally, the curriculum presents opportunities for math learning to directly connect from the classroom to the home.

The BMLK curriculum covers six units: number, shape, patterns and logic, measurement, number operations, and space. Each of these math concepts is first introduced in the preK curriculum and then further developed in the kindergarten curriculum. Each unit differs in length and number of activities and teachers are meant to teach BMLK lessons on a daily basis for approximately 20 to 30 minutes. Lessons involve playing games, reading storybooks and engaging in activities with children. The curriculum also includes suggestions for different ways that teachers can assess their children's mathematical understanding.

- In the *Number unit* children learn to say the counting sequence, to use a number to tell how many (cardinality), and to use ordinal numbers to identify positions in a line (ordinality).
- In the *Shape unit* children learn the names and important attributes (e.g., sides, vertices, faces) of two- and three-dimensional shapes as well as the concept of symmetry.

- The *Patterns and Logic* unit gives children experience with repeating, growing and decreasing patterns by having them recognize, create, and extend various patterns involving sound, color, shape, letters, and numbers. Children also learn to reason logically through the use of clues.
- In the *Measurement* unit children develop basic measurement principles including comparison, standard measures, and ordering as they investigate length, weight, capacity, temperature, time and money.
- The *Number Operations* unit extends children's understanding of number by introducing addition, subtraction, multiplication and division concepts through manipulatives, stories and games.
- In the *Space* unit children learn to identify positions in space, navigate through space, and represent space using maps.

The curriculum also aids in deepening children's mathematical concepts by providing connections between language, literacy, and mathematics. Both the preK and kindergarten curriculum encourage children to learn mathematical vocabulary. Such vocabulary naturally flows from children and teachers' need to communicate mathematical ideas during the lessons. Every activity has a prepared list of mathematical terms that teachers should introduce to children. Additionally, each unit's storybook helps to link literacy and mathematics. The storybooks' narrative and illustrations allow children to explore mathematical concepts with characters in the story. Furthermore, each unit also provides suggestions for other storybooks, rhymes, or songs that can also be used to further develop mathematical language and concepts. The program also fosters language development by encouraging children to explain, justify, and communicate their mathematical ideas.

Lastly, Big Math provides for other math learning opportunities by actively involving the family in the children's mathematical development. Each of the six content units contains a take-home letter that teachers send to parents and caretakers to inform them of the units' mathematical content. Parents can use this information to continue math learning at home. Additionally, each unit also contains a take-home game that children can play with their parents or caretakers. These take-home games are normally related to an activity that children already did in class. Furthermore, after children finish reading the math storybooks in their classrooms they are given a black and white take-home storybook to read at home. All these opportunities allow parents and caretakers to explore "big math" concepts with their children at home.

<u>Principles underlying Professional development workshops:</u>

When signing up for the Big Math curriculum, teachers can also receive yearlong training to help them understand "Big Math" concepts and implement the curriculum in their classrooms. This series of professional development workshops were designed around four research-supported principles.

The first principle is that professional development should offer teachers sustained opportunities for learning (Cwikla, 2004; Garet et al., 2001). According to teachers' responses in Garet et al.'s (2001) study, teachers were more likely to benefit from participating in professional development programs that occurred over a lengthy span of time rather than a one-shot experience. Many of our preschool and kindergarten

teachers have never before taught mathematics using a coherent and sequenced math curriculum. Plunging into unchartered mathematical waters may prove to be daunting for some. In addition, each unit's content area brings unique content and pedagogical challenges. Big Math teachers need continued and intensive support as they tackle the curriculum and all the possible issues that may arise. We believe that yearlong workshops will help provide that needed support.

The second principle is that understanding children's thinking can better inform and positively change teachers' teaching. The Cognitively Guided Instruction (CGI) program researchers noted that when teachers were presented with knowledge about children's mathematical thinking, they were better able to predict their students' performance, and they spent more time listening to and interacting with students (Carpenter & Fennema, 1992; Carpenter et al., 1996; Franke & Kazemi, 2001). Their students also performed better in using a problem solving approach to recall of number facts than did students from control classrooms. Similarly, BMLK workshops attempt to also improve teachers' understanding of young children's mathematical thinking. This is done by showing videotapes of young children engaging in everyday mathematics behavior (e.g., children playing in the block area), showing a videotape of a clinical interview (e.g., an interviewer asks children to count different objects), or by helping the teacher to experience children's thinking (e.g., letting teachers listen to the counting sequence in another language and having them become confused.)

Related to the second principle, the third principle is that case-based learning provides teachers richer opportunities for learning. Cases are examples shown either through narrative or videotape that serve to bring "forth a variety of issues, teaching strategies and philosophies… highlighting…complexity, rationality and flaws" (Barnett, 1998). Cases can be used to examine student's mathematical thinking. However, cases can also have a broader purpose when acting as springboards for discussions relating to all types of issues, problems, and concerns that accompany teaching. Cases provide an opportunity for teachers to work out their own beliefs and thoughts while also hearing other points of view. Within every BMLK workshop teachers have the opportunity to watch video clip cases of other teachers teaching a selected activity. After watching such videotapes teachers discuss a variety of different topics including what problems their children might encounter with the activity, how they would adapt the activity for their classroom, or how to provide materials that can be best used to teach the mathematics. Such conversation builds a great community for learning.

The fourth principle is that like students, teachers benefit when they actively learn in real contexts (Bransford, Brown, & Cocking, 2000; Garet, et. al, 2001). In BMLK workshops teachers are given the opportunity to teach specific activities to small groups of teachers or to the entire group. As one teacher teaches, others act as students. By role-playing what a lesson might look like and what children might say or do, important discussions relating to various topics from material preparation to pedagogy also occur.

Content of workshops

A series of seven workshops were developed in the 2002-2003 academic calendar (Ginsburg, Galanter, & Morgenlander, 2004). Piloted with early childhood educators working in low-income communities in New York and New Jersey, these initial workshops taught us how to structure them in ways that the literature could never

provide; in other words, we have learned the most from trying out different techniques used in workshops ourselves. For example, since there are six units to the Big Math for Little Kids curriculum, it originally seemed logical to follow the approach that we should have a workshop once a month for every unit. However, as previous experience has shown us, it does not make sense to have only one workshop for the first unit, which is the longest and densest of them all, and then move on to the next unit a month later, even though teachers would not even be close to finishing the first. Therefore, we established three workshops for this first unit: two filled with content, and one as a kind of "debriefing" workshop, where the teachers have an opportunity to ask questions, share their insights, and explore the mathematical ideas further.

Our workshops began in the summer with a one-day "intensive" introduction, which we refer to as the "Summer Institute." This meeting was crucial for several reasons: First and foremost, it described the overall structure of the program. We included an overview of the whole curriculum, including such details as how to read the teacher's guide, the planning chart for the year, and the assessment materials. Secondly, some actual activities from each unit were covered, giving them an idea of the kind of learning and teaching involved. Finally, it gave all the workshop attendees an introduction to us, all the people involved with creating and organizing the workshops, the evaluation study, and of course, Herb Ginsburg, one of the curriculum's authors.

For the most part, the eight workshops that followed the Summer Institute are all conducted in a similar structure (with the exception of the third workshop, which had a different format altogether). When the workshop participants enter the room, they sign in, and take a folder containing all the materials that they will need for the day, including a photocopy of the particular teacher's guide that we will be focusing on for that day, as well as a copy of the PowerPoint slides to be presented. In addition, there is always a Pre-Questionnaire for them to fill out. So after they have a chance to grab a cup of coffee and Danish (food, we have found, is a good motivational technique for on-time attendance), the teachers sit down to answer questions about which activities from the last workshop they've done, and give us written feedback on how the previous unit's activities have been going, and any suggestions on how to enhance the last workshop.

Besides the coffee and pastries, we offer many other incentives for coming to the workshops. The first one appears right away – we've come to call these the "on-time prizes." When the workshop is ready to begin, we close the doors and start passing around a bag of gift-wrapped goodies. These are small items, mostly school supplies (such as colored pencils, play dough, or glitter-glue) that have an amazing ability to make teachers feel good. We are sure to mention the on-time prizes again at the end of the workshop, so that those who came in late know that they have missed something and thus feel motivated to arrive earlier to the next workshop. While we are not very proud of this obvious form of bribery, we have found that it works wonders for our attendance.

Workshops begin with a short conversation about the previous month's workshop, to find out how the teachers fared with the curriculum thus far. These conversations, always somewhat improvised by the workshop leaders, offer a kind of "warm-up" for the conversations intended for the rest of the workshop. Indeed, this part of the workshop functions as a subtle yet very important part of developing the kind of atmosphere we hope to engender. In our experience, we find that treating these workshops less as lectures, and more as "conversations among colleagues," we make the experience more

worthwhile and memorable for everyone involved. Not only do the teachers get a sense of self-importance from these interactions (which is so rare for most inner-city preschool teachers), but we, the researchers, get a sense of their understanding of the content. In addition, this stylistic choice reflects the Big Math for Little Kids curriculum itself; Workshop Leaders, in a sense, model for the teachers the kind of respect, group-learning, and open-ended questions in which we hope that they will engage their own students.

What follows this "debriefing," is a new part of our workshops, called the "challenge question." Initiated originally as a simple form of evaluation of the teachers' content knowledge, it is now a regular part of the workshop structure. The development of this feature goes like this: For the first unit about Numbers, we gave both the control and treatment group teachers the same worksheet, containing possible examples of student work after the "Bag It" activity was taught. "Bag It" is an activity where teachers hand out clear plastic bags labeled with numbers 0, 1, 2, or 3 and a variety of objects. Children put in the corresponding amount of objects into the bag and then take filled bags and place them in a correspondingly marked bin. This is a great activity to learn about number cardinality. The goal of the "challenge question" was for teachers to evaluate if the student work being presented reflected a sense of understanding about cardinal number. On the worksheet, several different hypothetical examples of filled "bags" were presented, with a number printed on each bag and items inserted clearly visible. This challenge had an open-ended nature to it, as there could be many interpretations of the student work.

For the control group teachers, the "challenge question" was filled out during a school visitation. For the treatment group teachers, it was filled out during the workshop, and then discussed once the results were collected. Surprisingly, this exercise left a great impression on the workshop attendees. As an unintended learning experience, we received such strong positive feedback from the teachers that we decided to continue giving them similar "challenge questions" followed by discussion, regardless of whether or not we would use their responses as data.

After discussing the "challenge question," we turn to the content of the current unit; this is directed with a PowerPoint presentation. Although each workshop is unique, each begins with a look at what the children already know and understand about the math topic being presented. Video clips of children in naturalistic play are most commonly used to demonstrate this idea, but sometimes an exercise is conducted to exemplify these ideas. For example, to demonstrate how difficult it is to memorize the counting numbers from 1 to 20 in English, we ask the workshop attendees to attempt to learn these counting words in a language such as Tagalog, from the Philippines. These kinds of exercises offer a profound sense of perspective from the preschoolers' point of view.

After considering what kind of knowledge the children might already have in this topic, we look at the mathematical content of the unit. This is where goals for the unit are covered, and we discuss the mathematical ideas involved. While most who are unfamiliar with preschool math might assume that this part of the workshop seems simplistic, it often has profound revelations for the teachers, many of whom have never considered the complexity of what is being taught. For example, many of the workshop attendees had never before considered that a square was actually a special type of rectangle. It is common for teachers coming to the Shape workshop to have always considered squares as separate shapes entirely different from rectangles, unlike the subset

that they really are. Content knowledge like this is debunked and debated. It is important to note that this is the kind of conversation that early childhood educators rarely have the opportunity to engage in. Yet, some of these conversations have even forced us, the Researchers, to turn to mathematics experts for actual definitions of "point" (the geometrical term), "kite," or "pattern". Indeed, it appears as though occasionally the Workshop Leaders gain as much as the workshop attendees!

After looking at the content, the unit activities are discussed. The planning chart is always considered, so as to keep all the Workshop Attendees understand the pacing involved. While not all of the activities are covered in every workshop, the key, most important activities are always considered. We do these in a variety of ways: through role playing, discussions about various aspects of the activity, and video clip examples. Throughout these activities, we discuss issues of pedagogy, methods of assessment, grouping of children, and construction of materials. This is the longest part of all the workshops, allowing teachers to get a real sense of the key activities, so that they leave with the confidence to return to their classrooms and teach it.

We have found that teachers appreciate being able to walk away with the workshop with a tool that they can use in their classrooms. Therefore, we have instituted a "take-away" item for each workshop session. This item may be as simple as one of the black-line masters photocopied onto cardstock for their class or a simple tool. For example, packs of drinking straws were provided for the measurement unit, as there are many materials needed for this part of the curriculum. Whatever the item is, we find that this both encourages the teacher to implement that particular activity, as well as look forward to attending the next workshop.

At the conclusion of every workshop we have yet another questionnaire. This Post-workshop questionnaire gives us feedback on what they have just experienced. It is one of the many tools used to help us evaluate the effectiveness of the workshops, which will be discussed in the next section.

Effectiveness of Workshops

As mentioned already, workshops are evaluated by questionnaires given both at the beginning of the workshop (the "Pre-Questionnaire") and the end of the workshop (the "Post-Questionnaire"). The Pre-Questionnaire concerns issues that the teachers may have faced – both positive and negative – about the curriculum since the workshop group last met. It specifically addresses the effectiveness of the previous workshop now that the teacher has actually implemented the unit. In the Post-Questionnaire, the current workshop is evaluated, giving us immediate feedback to what was just presented.

In addition to these formal measures, the workshops are evaluated in another way. One researcher sits in the back of each workshop and takes notes. This way, we have a record of the kind of impromptu conversations we hope to include in each session. These notes include the note-taker's personal reaction to the discussions in the workshops. The notes are then passed on to the Workshop Leader, who in turn adds her own personal notes to this document. These notes are circulated among the group of researchers, with various comments discussed at length on occasion. The result is a very rich conversation about the effectiveness of the workshops, as an on-going process.

Together, the workshop attendees' feedback on questionnaires and our own observations have led us to improve the workshops as we go. As mentioned in the

previous section, the "challenge question" was a new aspect of the workshops created this year; this would not have evolved were it not for this kind of qualitative evaluation of the workshops that we have continued to pursue. The workshops continue to grow and improve as this feedback persists.

Implications for Early Childhood Professional Development

As we go through workshop series, we have discovered several guiding principles that influence what we present and how we present workshops.

Principle 1: Teachers are professionals and should be treated as such.

We have a profound sense of respect for who these teachers are and what they do on a daily basis. Teachers have a great deal of knowledge regarding general pedagogy, their own classrooms, and their own children. We try to show this sense of respect in our workshop environment. By providing teachers small things like breakfast in the morning or folders to hold their handouts, we show them professional courtesy. By purposefully setting up time for teachers to have conversations with one another regarding how to connect ideas from the presentation and actual classroom practice, we step back as experts and allow the teachers' expertise to come to play. These workshops provide tips and tools for teachers to use. As "experts of their own classrooms" teachers need time to think about and reflect on how they are going to use the given tools in their own teaching contexts.

Principle 2: Teachers may have a fear of math.

This is a re-occurring theme that we've dealt with every year while leading these workshops. At the end of each workshop cycle, many teachers confessed to us that previous negative math experiences made them scared to teach math in their own classrooms. One teacher was so afraid of math that she made her aide teach all the math activities to the children. We're happy to report that by the end of the workshop cycle our workshops helped this teacher, and others, to overcome their math phobias. It is important for us to always consider a fear of math when we design our workshops. Our hope is that the workshops give teachers a comfort zone by showing examples on video, by explaining and discussing math concepts, and by having them try out math activities in a peer-group setting.

Principle 3: Teacher Incentives help. (a.k.a.- The Bribery Principle.)

The types of teacher incentives that we offer in our workshops include: breakfast, "on-time prizes," and "take-away" items. All "on-time prizes" and "take-away" items are either for general classroom use or specially selected for teaching the mathematics content of the unit. Offering such teacher incentives primarily serves to boost attendance and help initially engage teachers in extended professional development. Such teacher incentives also help to bolster relationships between workshop presenters and teachers. Workshop presenters acknowledge the real world environment that teachers have to operate in. For example, the BMLK Measurement unit is particularly material intensive. To help teachers out with some of the materials, our "on-time prizes" and "take-away" items were materials that certain activities required. In addition, these incentives help to alleviate workshop attrition rates. While this outward form of bribery might seem silly to

some, it is important to ensure that a long-term professional development series such as this continues to have full attendance.

Principle 4: Allowing time for thoughtful discussions is important.

Teachers often remark that one of the most helpful portions of each workshop was the discussion they had with other teachers. Our general philosophy as workshop leaders is to not lecture teachers. Instead we try to provide an environment where conversations about mathematics, children's thinking, and the BMLK curriculum can occur. Teachers discuss topics ranging from issues involving classroom management, which are indirectly related to math learning, to pedagogical problems, like how certain materials are better for teaching a math concept or how certain questions can elicit mathematical thinking. These discussions are helpful for working out connections between workshop topics and the realities of the classroom.

In addition, discussions can also serve to encourage teachers who are hesitant to implement change. For example, one teacher may express the belief that the concept of pattern is too difficult for her children to comprehend. She may be resigned to not even try to teach certain pattern activities. Hearing other teachers talk about their positive experiences with patterns or offer suggestions for teaching patterns may encourage the reluctant teacher to change her mind and try out the activities.

Principle 5: Thoughtful discussions result from constant facilitation.

Admittedly, opening up the floor for discussion can be quite frightening for workshop presenters. It is never easy to relinquish control and the question of what the teachers will actually discuss always looms in the back of the presenter's mind. There is a lot riding on the teachers' discussions and the quality and direction of conversation can quickly change depending on what is said or how long a certain topic is discussed. For example, a presenter once posed the question of whether it was better to teach a certain activity in a small or a large group setting. Several teachers mentioned that they would teach that particular activity in a small group. One teacher then mentioned that she had difficulties with small groups because all the students wanted to work with her. She asked the group for questions on how to make sure that children stay in their work groups. Several teachers offered different behavior management suggestions and a lengthy discussion about behavior management occurred. The entire discussion changed from group size to behavior management. Although behavior management is important, the mathematical point of the conversation had been lost.

This example shows how difficult it is for the workshop presenter to act as a facilitator of discussion. On one hand, teachers bring a lot to the discussion table and have great advice, insight, and knowledge to offer both the workshop presenter and other teachers. As mentioned above, it's important to create an environment that is open to discussion. However, on the other hand, the overall quality of the interaction in the workshops depends on the depth and content of the discussion. Though teachers may want to discuss many different topics, it is up to the workshop presenter to set up and direct the conversation so that deep and meaningful conversation related to the workshop's goals occurs.

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