LAUNCHING KINDERGARTEN MATH CLUBS

The Implementation of High 5s in New York City

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Overview

Early math has been shown to predict not only longer-term math achievement, but also future reading achievement, high school completion, and college attendance. Yet effects from early math programs often fade out as children move into more varied instructional contexts in elementary school. This fade-out suggests the need for an alignment of math instruction across the early years to support children's earlier math gains.

In 2011, the Robin Hood Foundation began a collaboration with MDRC to rigorously test an approach aimed at boosting early math skills. High 5s, a supplemental small-group math club program for children in kindergarten, was designed specifically as a follow-on to the Making Pre-K Count study, in which preschools implemented an enriched, evidence-based math curriculum (Building Blocks) supported by professional development for teachers. High 5s aligned with Building Blocks by focusing on children's developmental progression, encouraging hands-on learning, supporting student reflection about mathematical thinking, and using formative assessment (which helps teachers modify their approaches) and instruction differentiated by children's ability levels. As described in more detail in a companion report, children who were offered two years of enhanced math instruction (High 5s and Making Pre-K Count) had stronger math skills than those who had no enhanced math in pre-K or kindergarten — an impact equivalent to more than four months of growth — as well as more positive attitudes toward math. Given these encouraging findings, this report describes what was needed to implement the High 5s program successfully.

Key Findings

When the project team set out to design a math enrichment program, there were uncertainties about its feasibility: Would schools be receptive? Could an appropriate time and place to hold the clubs be identified? Would children attend regularly and be engaged? Could enough facilitators be hired at a paraprofessional level salary and retained for an entire year? With the support of a strong training and supervision model, all these issues were addressed and the High 5s program met all the benchmarks identified at the outset. Throughout the year, attendance and engagement were high, sessions were held regularly, and activities were implemented as intended by a team of committed facilitators.

All students who were part of the High 5s study also received typical math instruction in their kindergarten classrooms. Classroom instruction was found to differ in a number of ways from the instruction in High 5s: Students participating in High 5s were presented with a wider range and somewhat more advanced instructional content than was observed in classrooms, that content was delivered in a small-group format as opposed to the whole-class format in which most classroom mathematics was delivered, and facilitators engaged in more open-ended questions and more differentiation of material than was observed in classrooms.

These findings suggest that small-group enrichment may be one way to provide kindergarten instruction that is more closely aligned with the pre-K experience, which typically involves a substantial amount of small-group instruction with many hands-on learning opportunities. The math club model may help ensure that children get more individualized instruction, and its alignment with the preschool experience may be one way to help mitigate fade-out of math gains after preschool.

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Preface

In 2011, MDRC entered into a collaboration with the Robin Hood Foundation to identify early childhood interventions that had the potential to change the life trajectories of New York City children experiencing poverty. The effort began with a focus on improving early math skills, an area shown to be among the most important predictors of a young child's later academic achievement. In a rigorous test, prekindergarten classrooms in New York City were provided with a high-quality, evidence-based math curriculum (Building Blocks) and ongoing teacher training and coaching over two years. The program was named Making Pre-K Count.

Though few studies of pre-K math curricula follow children over the long term, those that do often show a fade-out of math impacts as children move into elementary school. Various theories exist as to why fade-out occurs. If shifting educational contexts as children progress from preschool through high school are a factor, aligning children's instructional experiences across school years may help maintain pre-K gains. With this in mind, the study team set out to explore whether a kindergarten enrichment program that was aligned with the pre-K experience in terms of both content and pedagogy could provide a critical boost that would lead to more sustained long-term achievement gains. That initiative, a small-group math club program for kindergartners called High 5s, which was developed and piloted in 2014 and implemented in 2015, is the focus of this report.

The project faced a number of uncertainties: Would schools be receptive? Would it be possible to successfully recruit a team of facilitators to implement the program? Would scheduling and space issues stymie the effort? And if those issues were resolved, would kindergartners come regularly and be engaged in a supplemental math club? But the High 5s program met its implementation goals. Throughout the year, attendance and engagement were both high, sessions were held on a regular basis, and a team of committed facilitators delivered the activities as designed. The results show promise: As described in more detail in a companion report, students who participated in both Making Pre-K Count in pre-K and High 5s in kindergarten had stronger math skills at the end of kindergarten than students who had received no enhanced math instruction, an effect equivalent to more than four months of math learning.

This report provides detailed information about the implementation of the High 5s program: what went well, what barriers existed, and the factors that may have contributed to its success.

Gordon L. Berlin
President, MDRC

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The Authors

Executive Summary

Early math is a strong predictor not only of longer-term math achievement, but also of later reading achievement and even high school completion and college attendance.[1] Thus, boosting children's early math skills is thought to be a way to improve long-term outcomes across a wide range of domains. Working from this notion, MDRC and the Robin Hood Foundation, one of New York City's leading antipoverty organizations, began a joint effort to rigorously test promising early childhood interventions that might make a lasting difference for children growing up in poverty. The early part of the initiative was focused on trying to boost that potential "linchpin" outcome — early math skills.

A two-pronged approach to boosting early math skills was planned. The first part, called Making Pre-K Count, provided prekindergarten classrooms in New York City with a high-quality math curriculum (Building Blocks) and ongoing teacher training and coaching over two years. Building Blocks is a 30-week, evidence-based curriculum designed to take into account and build on children's natural developmental progression in math skills; it also encourages instructional practices such as hands-on learning, student reflection about mathematical thinking, formative assessment to measure student progress and inform teaching decisions, instruction differentiated by the skill level of individual children, and a mix of small- and whole-group activities.

The second part, a math club program called High 5s, is the focus of this report. The High 5s math clubs were designed specifically as a follow-on to the larger Making Pre-K Count study and were developed using the learning trajectories research on which the Building Blocks curriculum is based. The program was intended to provide a small-group math enrichment experience that was aligned with both the content and approach of the Building Blocks curriculum, for kindergarten students who had experienced Making Pre-K Count in pre-K.

The High 5s program was developed by staff members at the University of Michigan with input from Doug Clements and Julie Sarama, the developers of the Building Blocks curriculum, and was implemented by Bank Street College of Education, which hired, trained, and supervised the club facilitators. The implementation included a number of key components:

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[1] Greg J. Duncan, Chantelle J. Dowsett, Amy Claessens, Katherine Magnuson, Aletha C. Huston, Pamela Klebanov, Linda S. Pagani, Leon Feinstein, Mimi Engel, and Jeanne Brooks-Gunn, "School Readiness and Later Achievement," *Developmental Psychology* 43, no. 6 (2007): 1428-1446; Greg J. Duncan and Katherine Magnuson, "The Nature and Impact of Early Skills, Attention, and Behavior" (paper presentation, Russell Sage Foundation Conference on Social Inequality and Educational Outcomes, New York City, 2009).

- A total of 24 paraprofessional-level facilitators (mostly recent college graduates with limited formal teaching experience) administered the program to over 300 children in 24 New York City public schools during the 2015-2016 school year. The clubs typically included four children and one facilitator.

- Facilitators received substantial training on the curriculum and instructional approach before the start of the program as well as weekly coaching and supervision from the Bank Street supervisors and program director that was designed to be responsive to their individual needs.

- Clubs took place during noninstructional time (before school, after school, or during lunch). They were designed to meet three times a week for approximately 28 weeks starting in the fall of 2015, with each club session lasting approximately 30 minutes.

- Activities in the clubs were designed to move children along key mathematical learning trajectories and were delivered in a game-like format that was intended to be fun, engaging, and developmentally appropriate.

As described in more detail in a companion report, students who had two years of enhanced math instruction (both Making Pre-K Count in pre-K and High 5s in kindergarten) had stronger math skills (on the REMA-K,[2] one of two measures of math achievement in the study) at the end of kindergarten than students who had received no enhanced math instruction in either pre-K or kindergarten, an effect equivalent to 4.2 months of additional growth in math skills. Students in High 5s also had stronger math skills as measured on the REMA-K than those who had received only one year of enhanced math instruction as part of the Making Pre-K Count project, an impact equivalent to approximately 2.5 months of growth.[3]

With these positive findings as a backdrop, this report describes the High 5s program in detail, noting what was needed to implement the program with fidelity to the model. The program set out to achieve a number of goals — it was designed to build on the content of the Building Blocks curriculum; to deliver hands-on, engaging instruction in a game-like format; and to provide opportunities for both differentiated instruction and for children to delve deeply into mathematical concepts by explaining their mathematical thinking to others. Because the High 5s program was new and developed specifically for this project, and because it aimed to

[2]The Research-Based Early Math Assessment–Kindergarten (REMA-K) is a version of the full REMA. For more information on the impact measurement, see Shira K. Mattera, Robin Jacob, and Pamela A. Morris, *Strengthening Children's Math Skills with Enhanced Instruction: The Impacts of Making Pre-K Count and High 5s on Kindergarten Outcomes* (New York: MDRC, 2018).

[3]Mattera, Jacob, and Morris, *Strengthening Children's Math Skills*.

achieve an ambitious set of logistical and educational objectives, it was not clear at the outset whether High 5s could be implemented successfully.

Despite these uncertainties, the High 5s program met all the benchmarks identified for the program at the outset of the study, and with the support of a strong, ongoing training and supervision model, it was implemented with fidelity. Findings from an analysis of implementation data indicate the following:

- **Student attendance was high, with an average attendance rate of 87 percent across the year.** The majority of students attended most of their club sessions, with more than 90 percent of the students having attendance rates over 70 percent. Over 80 percent of students had attendance rates over 80 percent.

- **Club sessions were completed as scheduled and the curriculum was delivered as intended.** Ninety-two percent of scheduled sessions were completed and club observations indicated that 96 percent of the activities were implemented as intended.

- **Students spent an average of 25 minutes in each club on mathematics.** The goal was to spend at least 20 minutes of the math club on math. Students spent about 75 minutes a week on math in addition to the time they spent on math in the kindergarten classroom.

- **Facilitators created a positive instructional climate in clubs.** All facilitators met expectations for having a good rapport with students. Over 80 percent met expectations for making math learning fun and using positive strategies to manage behavior. This was true even though a number of facilitators cited managing student behavior as one of the most challenging aspects of the job.

- **Student engagement was also high (as reported by both facilitators and observers).** Engagement was rated on a scale of 1 (all students are disengaged) to 5 (all students are engaged). Average facilitator-rated engagement scores were high, with nearly all children engaged in most clubs: Ratings ranged from 4.7 to 4.9 for the different types of High 5s activities.

- While the program was generally implemented with fidelity to the model, **ensuring the highest quality of instruction — instruction that included differentiation, involved reflective questioning, and underscored the mathematical objective of the activities — was more challenging,** as it was for the kindergarten teachers in our sample, despite ongoing and high-quality training and coaching.

- **Overall, the logistics of the program proved to be the most challenging aspect of running the clubs.** The most common logistical challenges included finding an appropriate time and place to meet, escorting children to and from clubs, and having facilitators who traveled from school to school.

All students who were part of the High 5s study also received typical math instruction in their kindergarten classrooms. To better understand the potential value that the High 5s program added, kindergarten classrooms were observed to understand the nature of the mathematics instruction students were receiving and how it compared with the instruction students were receiving in High 5s clubs. Instruction in kindergarten classrooms was found to differ in a number of ways from the instruction in High 5s:

- **The High 5s program presented a wider range and somewhat more advanced instructional content than was observed in kindergarten classrooms.** Classroom teachers were, for the most part, following the district's Common Core-aligned kindergarten math curriculum, which focused on numbers and operations for a majority of the year. Geometry, measurement, and patterning activities were included throughout the year in High 5s.

- **Content in the High 5s clubs was delivered in a small-group, hands-on format, while small-group instruction in the kindergarten classroom tended to be limited.** By design, the High 5s clubs were small groups, and all the High 5s activities involved the use of hands-on manipulatives. In the kindergarten classrooms, small-group activities accounted for around 5 percent of the activities observed, and about two-thirds of the activities observed in kindergarten classrooms involved only workbooks or no materials at all.

- **Observations indicated that High 5s facilitators asked more open-ended questions and engaged in more differentiation of material than was observed in kindergarten classrooms.**

Overall, despite uncertainty in the planning phases about the viability of a math club model like High 5s, the program was implemented well, with high attendance rates and strong student engagement. Staff members with a variety of backgrounds and experiences but limited formal teaching experience were able to deliver a wide range of math content with adequate instructional quality. The program had a robust, statistically significant impact on one of two measures of math achievement.

- Findings from this study suggest that small-group enrichment may be one way to provide kindergarten instruction that is more closely aligned with the pre-K experience, which typically involves a substantial amount of small-group instruction with many hands-on learning opportunities.

- The small-group experiences that a math club model offers can also help ensure that children get more individualized instruction and do not "fall through the cracks."
- It is worth considering whether experiences that are more closely aligned with the preschool experience and that emphasize differentiated instruction may help mitigate the fade-out often associated with high-quality preschool experiences.

The positive impacts of the High 5s program demonstrated in this study suggest that further research is needed to examine whether and how it works in different contexts. For example, is the program effective in scenarios in which children come into kindergarten with a variety of different pre-K math experiences? Would it be effective if schools used in-house staff members to deliver the clubs, or could it be done without the level of training and supervision that facilitators were provided in the model that was tested? At the same time, future research is needed to parse how the different components of the program work and for whom.

Chapter 1

Introduction

In 2011, MDRC and the Robin Hood Foundation, one of New York City's leading antipoverty organizations, entered into a collaboration to identify and rigorously test promising early childhood interventions that had the potential to change the life trajectories of New York City children growing up in poverty. The decision was made to focus the initiative on trying to boost early math skills, which have been shown to be a strong predictor of later achievement for young children.[1] Early math skills predict not only later math achievement, but also reading achievement, executive function (the skills underlying self-regulation), and high school completion and college attendance.[2] Math concepts, such as making comparisons, can help expand and enrich vocabulary as children use language to express and justify mathematical thinking.[3] And early math is thought to strengthen children's executive function skills by requiring them to manipulate numbers and shapes and explain their thinking.[4] Thus, boosting children's early math skills is thought to be a means to improve long-term outcomes across a wide range of domains.

A two-pronged approach to improving early math skills was planned. The first approach, called Making Pre-K Count, provided prekindergarten classrooms in New York City with a high-quality math curriculum (Building Blocks) and ongoing teacher training and coaching over two years. Building Blocks is a 30-week curriculum designed to take into account and build on children's natural developmental progression in math skills.[5] The curriculum had demonstrated effectiveness in raising children's early math achievement in a number of prior randomized trials.[6] For the study, 69 sites were randomly assigned either to implement two years of the curriculum and professional development or to continue their usual pre-K practices.[7]

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[1]Duncan et al. (2007); Duncan and Magnuson (2009).

[2]Duncan et al. (2007); Blair and Razza (2007); Duncan and Magnuson (2009).

[3]Ginsburg, Lee, and Boyd (2008).

[4]Clements, Sarama, and Germeroth (2016).

[5]Clements and Sarama (2013).

[6]Clements and Sarama (2007, 2008); Hofer, Lipsey, Dong, and Farran (2013).

[7]While pre-K sites implemented the program for two years, children in this study entered the classroom in the second year and received only one year of enriched pre-K math instruction.

Fade-Out of Early Childhood Impacts

Despite the apparent importance of early math, it is well known that many early childhood programs that show evidence of effectiveness at the end of the pre-K year see a fade-out of effects as children move out of the preschool setting and into later grades.[8] One hypothesized explanation for this fade-out is the lack of alignment between the instructional content and pedagogical approaches in pre-K and the instruction provided in elementary school.[9] Research suggests that kindergarten teachers spend a significant amount of instructional time on basic number and shape concepts that students already know when entering kindergarten.[10] Preschool programs are also often play-based and use a variety of manipulatives, and students frequently interact in small groups with a teacher or other students, while kindergarten classrooms may take a more didactic approach, with instruction occurring in a whole-group setting or with students working individually at their desks. To mitigate the potential fade-out of effects from early childhood programming that might result from such misalignment, and to test the benefit of providing an additional year of enhanced math instruction to children, a second initiative was designed.

The High 5s Math Club Program

The second initiative, a math club program called High 5s, is the focus of this report. The High 5s program was designed specifically as a follow-on to the larger Making Pre-K Count study and was developed using the learning trajectories research on which the Building Blocks curriculum is based. The program was intended to provide a small-group math enrichment experience that was aligned with both the content and the approach of Building Blocks for kindergarten students who had experienced Making Pre-K Count in pre-K. The Building Blocks curriculum is designed to focus on children's developmental progression or learning trajectories and also encourages such instructional practices as hands-on learning, student reflection about mathematical thinking, formative assessment to measure student progress and allow teachers to modify their approaches, instruction differentiated by children's ability levels, and a mix of small- and whole-group activities.[11] High 5s was designed to include these key elements as well. Some of these practices are more easily implemented in pre-K classrooms than in kindergarten classrooms because of smaller class sizes and smaller teacher-to-student ratios.

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[8]Hofer, Lipsey, Dong, and Farran (2013); Puma et al. (2012).

[9]Lee and Loeb (1995).

[10]Engel, Claessens, and Finch (2013).

[11]Clements and Sarama (2013).

Before the math club model was selected, a number of different kindergarten interventions were considered. Small-group enrichment was chosen because there is substantial evidence regarding the effectiveness of small-group tutoring for young students in reading and of two-on-one tutoring with older students in math.[12] Offering enrichment outside of regular classroom instruction also provided the study team with maximum flexibility to ensure that students' pre-K and kindergarten experiences would be well aligned. Since the program was not being implemented in classrooms, the study team was able to develop curricular materials and train staff independently. The High 5s program paired about four children with one facilitator for each club, which met three times a week for approximately 30 minutes, either before or after school or during lunch.

Making Pre-K Count and High 5s were developed as part of the Robin Hood Early Childhood Research Initiative, which was established to identify and rigorously test promising early childhood programs. The initiative is a partnership between Robin Hood and MDRC, a nonprofit, nonpartisan, education and social policy research organization. These studies, conducted in collaboration with Bank Street College of Education and RTI International, were also supported with lead funding from the Heising-Simons Foundation, the Overdeck Family Foundation, and the Richard W. Goldman Family Foundation.

The High 5s study was designed to rigorously test whether the positive effects of a pre-K math program could be sustained if combined with math enrichment in kindergarten. As described in more detail in a companion report, students who were offered two years of enhanced math instruction (both Making Pre-K Count in pre-K and High 5s in kindergarten) had stronger math skills (on the REMA-K,[13] one of two measures of math achievement used in the study) at the end of kindergarten than those with no enhanced math instruction in either pre-K or kindergarten (effect size = 0.30 standard deviations).[14] This is equivalent to 4.2 months of additional growth in math learning. Students who were offered two years of enhanced instruction also had more positive attitudes toward math at the end of the kindergarten year than students who received no enhanced instruction.[15] In a second comparison, two years of math enrichment (High 5s in kindergarten and Making Pre-K Count in pre-K) led to stronger math skills on the REMA-K (effect size = 0.19) compared with only one year of enhanced math

[12]Slavin, Lake, Davis, and Madden (2010); Fryer (2011).

[13]The Research-Based Early Math Assessment–Kindergarten (REMA-K) is a version of the full REMA. See Mattera, Jacob, and Morris (2018) for more information about the impact measurement.

[14]Effect size is calculated by dividing the estimated effect of the program (the difference between means for the program group and the control group) by the standard deviation for the control group. An effect size of 0.30 therefore represents an improvement in math skills equal to 30 percent of the standard deviation.

[15]Mattera, Jacob, and Morris (2018).

instruction (Making Pre-K Count in pre-K but kindergarten as usual), an impact equivalent to approximately 2.5 months of growth.

Given these positive findings, this report describes the High 5s program in detail, noting what was needed to implement the program with fidelity. Because the High 5s program was new and developed specifically for this project, and because it set out to achieve an ambitious set of logistical and educational objectives, it was not clear at the outset whether it could be implemented successfully. In the end, the program, supported by a strong, ongoing training and supervision model, was generally implemented with fidelity to the model. The program was also found to differ substantially from the math instruction already in place in kindergarten classrooms, suggesting that the High 5s program may have provided substantial added value to the children's kindergarten math experiences. A number of important lessons about implementation, attendance, and student engagement are described in this report.

Chapter 2 describes the structural components of the program, and Chapter 3 details the staffing and associated training and supervision. The quality and fidelity of implementation is assessed in Chapter 4, and the math environment and instruction in the kindergarten classrooms are described and compared with High 5s in Chapter 5. The report concludes with a discussion about what might be needed to replicate the program in other contexts.

Chapter 2

The High 5s Program

The High 5s program was developed by staff members at the University of Michigan with input from Doug Clements and Julie Sarama, the developers of the Building Blocks curriculum. The program had an ambitious set of objectives: It was designed to build on the content of the Building Blocks curriculum; to deliver hands-on, engaging instruction in a game-like format; and to provide opportunities for both differentiated instruction and for children to delve deeply into mathematical concepts by explaining their mathematical thinking to others. By delivering instruction in a small-group setting, the team hoped to avoid some of the challenges that make delivering differentiated instruction difficult in a large classroom with a limited number of adults. An initial version of the program was piloted in three schools during the 2014-2015 school year, and revisions to the model were made based on lessons learned from the pilot.

The Structure of the High 5s Program

The High 5s clubs took place during noninstructional time (before school, after school, or during lunch). Each club consisted of about four children and was led by a trained facilitator who was hired and supervised by Bank Street College of Education. Bank Street also provided a high level of ongoing training and support for the facilitators throughout the year. Clubs were designed to meet three times a week for about 28 weeks starting in fall 2015, with each club session lasting approximately 30 minutes. Activities in the clubs were delivered in a game-like format and were intended to be fun, engaging, and developmentally appropriate.

Each club session included two start-up activities and a main activity. The start-ups were meant to help students adjust to the club setting and reinforce key skills. Start-ups were usually repeated each session for one week, and together the start-ups were intended to last between 7 and 10 minutes. The main activities, designed to last 15 to 20 minutes, were the key component of clubs. Each main activity was intended to be repeated up to three times over the course of the year, but not in consecutive sessions.

Each activity came with a mathematical objective, a materials list, a brief description of the activity, the mathematical development levels being targeted, and a picture of the set-up (Figure 2.1). This was followed by a semiscripted activity plan or instructions for playing the game. The instructions gave facilitators enough support to implement the activities with fidelity but also the flexibility to include adaptations. Suggestions were given for how to “scaffold” students at different levels of development (that is, how to provide assistance based on a

Figure 2.1

Sample Lesson

Chocolate Chip Count

Early Addition and Subtraction

Students will subitize (know amount without counting) the number of dots on two separate cards and then **use a method to find the sum**. To find the sum, they may need to count the objects or use their fingers.		
You will need:	**Activity Description:**	**Concept:**
☐ 5 sets of counting cards (0-5) ☐ 4 sets of numeral cards ☐ Printed monster with slit cut in mouth, placed over a container ☐ Bowl or small trash can ☐ 12 laminated blank numeral cards	In this game, students imagine that the cards are brownies with chocolate chips and that a monster is eating the brownies. After the students have determined the number of chocolate chips on two brownies, they write that number on a blank numeral card and 'feed' it to the monster. At the end of the game, the students can look inside and see what the monster ate.	*Building early addition strategies*

Early Addition and Subtraction					
Red	Orange	Yellow			
(Counting Cards 1 to 5) + (Counting Cards 0 to 5)	**(Numeral Cards 1 to 9) + (Counting Cards 0 to 5)**	**Numeral Cards (1 to 20) + (0 to 5)**			
Student models addition problems by counting each set and joining them, then counting from 1 to find the total.	Student models addition problems as previously and also models subtraction problems by getting the larger set, counting to remove the smaller set, then counting to determine what remains. Student may count from one to add two sets.	Student can count on to add sums in the range of 20, which includes counting from a number other than 1 and tracking the number of counts necessary (e.g. to do 7 + 4 the student may count "8, 9, 10, 11," while using fingers to keep track of the counts).			

Activity Set-Up

student's current level of ability and extra support or additional challenges to help the child move to the next level) and draw out student thinking about the mathematics. A full sample lesson is provided in Appendix A.

Every fourth club session was a Game Day. During Game Day, students were given the opportunity to choose from three or four activities set out by the facilitator. Facilitators could choose from new activities designed just for Game Day or from main activities that students had played previously in a regular club session. Game Days provided students with an opportunity to make choices, added variety, and allowed students to interact with materials independently. They also provided facilitators with an opportunity to reinforce concepts on which students needed more practice and to work with students who needed individualized instruction.

A detailed pacing guide (see Appendix B) was provided to facilitators to prepare for each club session. Most clubs ran from October 2015 through May 2016.

Communication with Families and Teachers

Efforts were made to communicate with families and teachers throughout the year. Family Notes (in English and Spanish) were sent home regularly before each Game Day. The notes were designed to give families an overview of what was happening in clubs and ideas for activities to try at home. Twice over the course of the year, facilitators sent a personalized note to each student's family that included one positive comment about the student's behavior or participation in the group and one positive comment about what the student did mathematically during clubs. During the second half of the year, families were also provided with access to the Building Blocks online math practice program, which was designed to offer additional practice for students. Families were encouraged to log on and use the activities with their children.

In addition, facilitators were twice given a note to distribute to their students' classroom teachers. This note described what was happening in the clubs and offered the teacher an opportunity to meet in person with the facilitator. Few teachers took advantage of the opportunity to meet with facilitators.

The Learning Trajectory Framework

To ensure that the High 5s curriculum would build on what students had learned in Making Pre-K Count, the curriculum for High 5s was developed using the learning trajectories research on which the Building Blocks curriculum is based. Learning trajectories are the developmental progressions through which children learn mathematics. Each trajectory includes a mathematical goal, a developmental path along which children develop on the way to achieving that goal, and a set of instructional activities that can help children develop higher levels of thinking as they progress toward that goal.[1] Figure 2.2 shows the counting trajectory that was used in High 5s. The High 5s activities were designed to move students along four different mathematical learning trajectories: counting, composition of numbers, early addition and subtraction, and geometry. The clubs also included some measurement and patterning activities. Main activities contained recommendations about how to tailor or differentiate the content for students at different points on the learning trajectory. The pacing of the program was intended to align, roughly, with the Go Math! curriculum used in most New York City kindergarten classrooms so that, for example, activities focused on counting were scheduled during the portion of the year in which counting was being emphasized in the classroom, and addition and subtraction activities occurred around the time that students were introduced to addition and subtraction in the classroom. However, the material in High 5s was designed to be somewhat more advanced than what students would have received in their

Figure 2.2

High 5s Counting Trajectory

Counting					
Red	Orange	Yellow	Green	Blue	Purple
Student counts from 1 while pulling objects from a pile to 'get' a given amount (progressing from a small set to sets as large as 30).	Student counts verbally and with objects starting from a number other than 1 (e.g. gets 3 and says '3' then pulls another and says '4' and so on).	Student counts backward from 10 and skip-counts by 10s up to and beyond 100 verbally and with object, such as bundles of sticks or full ten frames.	Student counts by 1s fluently through the decade transitions starting at any number (e.g. 37, 38, 39, 40, 41).	Student counts by 10s and 1s (e.g. 10, 20, 30, 40, 41, 42, 43) when counting four sets of 10, as in a bundle of sticks and three single objects.	Counts accurately to 200 and beyond, recognizing the patterns of 1s, 10s, and 100s (e.g. 197, 198, 199, 200, 201, 202). Before this, students often confuse what should come just after 199 or 200.

[1]Clements and Sarama (2014).

classrooms. For example, the counting activities in High 5s emphasized counting backward and skip counting (such as counting forward by 10s), while the kindergarten Go Math! curriculum typically only focused on counting forward by 1s.

The research team developed each activity with the goal of supporting student learning and development along the trajectory. The lessons were written anticipating that students would enter at one of the first levels, labeled red and orange, at the beginning of the year, with the goal of moving students toward the green and blue levels by the end of the year. Activities were written to support students at an initial level but also to provide opportunities for the facilitator to help students develop more advanced skills. In the addition activity “Chocolate Chip Count” (Figure 2.1), which was introduced on Day 6, students imagine that cards are brownies with chocolate chips and that a monster is eating the brownies. After the students have determined the number of chocolate chips on two brownies, they write that number on a blank numeral card and “feed” it to the monster. At the end of the game, the students can look inside and see what the monster ate. For students in red on the trajectory, the facilitator can use pairs of counting cards (which show both the numeral and the corresponding number of dots in a ten frame) in the ranges of 1 to 5 and 0 to 5 for the two brownies. For students in orange, the facilitator can use numeral cards (a card with just a numeral displayed) in the range of 1 to 9 and counting cards (0 to 5). And for students in yellow, the facilitator can use a pair of numeral cards (1 to 20 and 0 to 5). In each case, students are just adding 0 to 5 to the original addend, but it becomes more developmentally challenging as they move away from a visual representation of the number to the more abstract numeral.

Formative Assessments

To help facilitators understand each student’s place on the learning trajectory, individual formative assessments — which measure student progress and allow teachers to modify their approaches — were developed based on the learning trajectories in the areas of counting and early addition and subtraction. Students were asked to complete a small set of counting or addition and subtraction tasks similar to some of the High 5s activities that spanned a range of developmental ability. These assessments provided an opportunity for facilitators to sit with each student to learn what the student was able to do unassisted. Facilitators conducted assessments on scheduled Game Days.

Summary

In the High 5s program, facilitators met with small groups of students three times a week and used a clearly specified curriculum to play fun, engaging games that were designed to move students along mathematical learning trajectories in four different domains. Behind the scenes, a good deal of logistical and training support was put into place to ensure that the program would be implemented with fidelity and quality. This support is described in more detail in the next chapter.

Chapter 3

Staffing the High 5s Program

The High 5s program was implemented by Bank Street College of Education, which hired, trained, and supervised the facilitators. A total of 24 facilitators (most with bachelor's degrees but limited formal teaching experience) administered the program to over 300 children in 24 New York City public schools during the 2015-2016 school year. The facilitators were supported by five supervisors and a program director at Bank Street College. Bank Street also provided administrative, information technology, and human resources support for the program.

As shown in Table 3.1, the group of facilitators hired for the project was diverse. They ranged in age from 22 to 39 and came from a variety of racial and ethnic backgrounds. A majority were recent college graduates who had an interest in education or related course work. They were mostly female (75 percent), and 29 percent identified as Hispanic or Latino, 38 percent as white, 29 percent as black, and 4 percent as some other race. One-quarter were fluent in Spanish and 83 percent had a bachelor's degree. Just over a quarter of the facilitators had their highest degree in the field of education, but none had a New York State teaching certificate. They averaged less than two years of formal teaching experience, defined as an "assistant or lead teacher, including student teaching"; about one-third (30 percent) had none. Most had some experience working with children, defined as experience in "a non-academic or non-classroom setting (e.g., tutoring, summer camp, after school program)." Facilitators were paid a salary commensurate with that of a paraprofessional teacher in the New York City public schools (around $25 per hour, depending on experience).

The hiring process was extensive; facilitators were recruited through a variety of methods. A job description was posted at Bank Street College, at colleges and universities with early childhood programs throughout New York City and New Jersey, and on a number of social media and job search outlets such as the Day Care Council of New York, Indeed, and the National Association for the Education of Young Children. Bank Street and MDRC also partnered with the City University of New York and held recruiting events at Brooklyn and Lehman Colleges. Over 300 résumés were received, 107 candidates were offered a phone interview, and 48 candidates were interviewed in person. Ultimately 24 facilitators were hired.

Training and Supervision

The High 5s model involved a substantial amount of training and supervision designed to support facilitators over the course of the year. The original study design called for only a few

Table 3.1

Facilitator Demographics

Characteristic	
Race/ethnicity (%)	
Hispanic	29.2
Non-Hispanic white	37.5
Non-Hispanic black	29.2
Other/multiracial[a]	4.2
Bachelor's degree (%)	83.3
Degree in education (%)	26.1
Female (%)	75.0
Fluent in Spanish (%)	25.0
Age[b] (mean)	26.3
Years of formal teaching experience[c] (mean)	1.6
Years of informal experience working with kids[d] (mean)	4.0
Facilitators	24

SOURCE: MDRC calculations based on a demographic survey administered to High 5s club facilitators in spring 2016.

NOTES: Rounding may cause slight discrepancies in sums and differences.

[a]Other/multiracial includes Asian, Native Hawaiian/Pacific Islander, and American Indian/Alaska Native; facilitators who identified as the option "some other race"; and facilitators who selected more than one race on the survey.

[b]Facilitator age ranged from 22 through 39 years old.

[c]Facilitator has experience as an assistant or lead teacher, including student teaching for all grades and preschool. Formal teaching experience ranged from 0 to 5.8 years.

[d]Facilitator has experience working with children in a nonacademic or nonclassroom setting (e.g., tutoring, summer camp, after-school program). Informal experience working with kids ranged from 0 to 14 years.

days of training, but based on a pilot conducted during the 2014-2015 school year, it was decided that facilitators would need more training to implement the program with fidelity to the model. This was particularly true given the diverse backgrounds of the facilitators. Those without formal classroom experience or a mathematics education background needed additional training in the mathematical concepts behind the curriculum, small-group management, and using high-quality instructional practices (for example, differentiated instruction and encouraging mathematical thinking).

Supervisors began training on August 3, 2015, and received 18 days of training from the program director and research team during that month. They also spent time preparing materials and planning for facilitator training. The program director and three of the five supervisors had been Making Pre-K Count coaches and were already familiar with the Building Blocks instructional approach, which helped them get up to speed quickly on the High 5s curriculum. All the supervisors had significant experience working in early childhood education as well. Facilitators received 16 days of training in August and September (about 6 of which were spent on research-related activities, such as learning to log information about their clubs for research purposes, or administrative tasks, like technology setup and fingerprinting).

Training — conducted by staff members from Bank Street, MDRC, and the University of Michigan, as well as Doug Clements, the codeveloper of Building Blocks — incorporated a variety of topics, including how to teach mathematics in an age-appropriate manner and how to facilitate small groups, as well as practice implementing the curricular activities. Facilitators were trained on mathematical learning trajectories at the beginning of the sequence. Facilitators were also given an opportunity to observe in a pre-K or kindergarten classroom.

All facilitators completed a certification process at the end of training. Facilitators were asked to conduct a short version of a club (one start-up and the main activity) from beginning to end. To be certified, facilitators had to meet the time requirements and receive a 3 or above (on a 5-point scale) for all the instructional quality and fidelity items.

Eight additional days of training at Bank Street College were conducted by the research team, program director, and supervisors throughout the school year. These training sessions were held on days when the public schools were closed for in-service or school breaks. Topics of training sessions held during the year were chosen in response to the needs of the facilitators as expressed to supervisors and reflected in management information system data. These training sessions also gave facilitators an opportunity to build a professional community and learn from each other.

Supervision Model

Supervisors met frequently with facilitators throughout the year, providing both logistical and instructional support. Each supervisor was responsible for a cohort of four to five High 5s facilitators and met with the cohort weekly. Supervisors also met with facilitators individually as needed — they were intended to meet, at a minimum, once every few weeks — and provided coaching in the field as necessary. Supervisors reviewed data from the daily facilitator logs frequently to monitor timely completion of logs, completion of activities as scheduled, curricular challenges, behavioral or attendance issues, and logistical problems. Facilitators communicated by email, phone, or text with supervisors as needed.

Cohort Meetings

Members of the research team observed a weekly meeting of each cohort in April 2016. Supervisors were free to structure their meetings to best fit the needs of their facilitators, but all meetings included some combination of the following activities: logistics, curriculum review, reflection about students, and professional development. Logistical topics included reminders about school closings, when to introduce the Building Blocks software, and space issues.

Curriculum review varied in format. In some cohorts, a facilitator was assigned an activity to prepare and practice with the group. In others, the group discussed a set of activities as a group and then had time to practice them individually or in pairs. Each group also spent time reflecting on their students. In one cohort, all facilitators prepared case studies on one or two students, and one facilitator was selected to share his or her case study with the group. The group brainstormed ideas to help the student in question and facilitators were encouraged to think about how the ideas generated could be applied to other students. In another cohort, facilitators wrote notes on large sheets of paper about how their students engaged with the set of activities from the previous week and then discussed each sheet as a group. Discussions included tactics for differentiating and scaffolding students at different places on the learning trajectories. Finally, cohort meetings also included some type of professional development, including discussion of instructional practices, mathematics research, or group management strategies. At the end of the year, one facilitator wrote:

> My supervisor did a great job of creating an environment where we felt comfortable sharing our challenges with each other in our meetings. Our cohort meetings were so valuable that our relationships extended outside of them. I frequently spoke with and presented challenges to members of my cohort out in the field on a daily basis. I felt like I was being mentored by every member of my cohort and I don't think this experience would have been the same without them.

Individual Coaching and Supervision

Individual supervision involved both big-picture topics and issues specific to the facilitator. Supervisors also viewed individual supervision as a time to provide oversight and ensure that facilitators were accountable for their work. The frequency of individual meetings changed during the year and depended on need, but they typically occurred once every two to three weeks.

Supervisors also provided coaching in the field to help facilitators integrate what they learned from training and supervision and apply it to their clubs. Coaching served the dual purpose of supporting facilitators in addressing challenges in their clubs and helping to improve the quality of implementation. All facilitators were observed and given coaching in the field at least every other month. Some facilitators with particularly challenging clubs or less experience working with young children received coaching as often as once a week.

In general, the staff hiring, training, and supervision model was deemed effective. The hiring process went smoothly and resulted in a qualified and committed set of supervisors and facilitators. The training and supervision model was well received. Most facilitators indicated that they felt prepared for their roles and that they received enough supervision. Nineteen of 24 indicated that the amount of supervision they received was "just right"; four said there was too much supervision. Facilitators indicated that they felt like part of a team, and retention was high. No facilitators resigned because they were dissatisfied with the position; two took time off for maternity leave and one left due to a personal issue. At the end of the year, one facilitator wrote:

> I think one thing that made this job really stand out from any other job I've had was how much support I had as a facilitator. I honestly felt like I could count on every single person in our team to help me and that made me feel more secure in what I was doing.

Logistical Support for the Program

The High 5s program, as implemented in this study, also involved substantial logistical support from MDRC and the Bank Street supervisors, particularly regarding scheduling and attendance. At the beginning of the year, MDRC staff members worked closely with schools to find a convenient time and an appropriate place to hold clubs. In many schools, both the timing and location of clubs had to be rescheduled throughout the year to accommodate changes in school schedules. MDRC staff members, Bank Street supervisors, and school staff members worked hard to ensure that there would be an appropriate time and place for clubs to meet. MDRC and Bank Street also followed up regularly with families when children were absent and worked to find solutions to chronic absenteeism, particularly at the beginning of the year.

Summary

The High 5s facilitators who were hired for the project were a responsible and dedicated group, but for the most part they came to the program with limited formal teaching experience. An extensive array of training and support structures were put in place to help them implement the High 5s program with fidelity, including not only initial training but also weekly supervision delivered in a variety of forms. As will be described in more detail in the next chapter, this support may have helped to ensure that the implementation of the program was strong.

Chapter 4

Quality and Fidelity of Implementation

When the project team set out to design a math enrichment program that would be provided to children outside of regular instructional time, it remained to be seen whether schools would be receptive, whether enough facilitators could be hired at a paraprofessional-level salary and retained over the course of an entire school year, whether an appropriate time and place to hold the clubs could be identified, and whether children would attend regularly and be engaged. But as described in Chapter 3, facilitators were indeed hired and retained, and with the help of a strong training and supervision model, the implementation of the High 5s program was successful. The program met all the benchmarks identified at the outset: Throughout the year, attendance and engagement were both high, sessions were held on a regular basis, and activities were implemented with fidelity.

In assessing the implementation of the High 5s program, the team set out to answer the following questions:

1. Did children attend regularly (at least 80 percent of the time)?
2. Did facilitators implement the clubs with fidelity to the program model? Specifically, did they spend at least 20 minutes per club on math activities, implement the correct activities on the correct days, deliver at least one start-up and the main activity in each club, and set up materials correctly and conduct the activities as intended?
3. What was the overall quality of instruction? Specifically, did facilitators develop a positive instructional climate, encourage mathematical thinking, and differentiate instruction for students at different points on the learning trajectory?
4. Were students engaged during the clubs?
5. What logistical challenges did the program face?
6. How was the High 5s program received by teachers and school administrators?

Implementation Data

Program implementation was measured using a variety of methods: logs, observations, and facilitator reflections, as well as surveys and interviews. First, facilitators were asked to complete logs after every club session.[1] Supervisors closely monitored the log data to ensure that facilitators were filling out logs for each club. Compliance was high, and all logs were filled out in a timely manner. Over 8,000 club logs were completed across the school year.

The research team also conducted observations of clubs. High 5s clubs were observed by trained MDRC staff members and outside consultants in both the fall and spring of the program year.[2] Observers received training and were certified on the observational instruments before they were able to conduct observations in the field. Each facilitator was observed once in each semester, for a total of 25 observations in the fall and 26 in the spring; at least one club in each school was observed.[3] The particular clubs that were observed in the fall were not necessarily observed again in the spring, although many were.

Facilitators completed exit memos at the end of the program in which they reflected on their experience. Finally, focus groups, surveys, and interviews were conducted with school administrators. The data collected from these sources provide the information to assess the following measures of program implementation:

- **Child attendance.** The logs asked facilitators to indicate which children were present, absent, or in partial attendance (that is, came late or left early but were there for at least 10 minutes) each day.

- **Fidelity to the High 5s model.** To measure the degree to which facilitators were implementing the program with fidelity, the logs included items in which facilitators recorded the activities that were implemented each day, the amount of time spent on activities, and, if the club was canceled for any reason, the reason why. The research team that conducted observations also recorded information about the activities that were implemented and the length of those activities. In addition, researchers rated facilitators on the degree to

[1]See Appendix C for the full log content.

[2]Fall observations took place in November 2015. Spring observations took place in March 2016, except for four observations on the last day of February 2016.

[3]In order to observe in all schools and to observe each of the facilitators, it was necessary to conduct more than 24 observations. In the fall, this meant that one facilitator was observed twice. In the spring, one facilitator was on maternity leave and one had left the project for personal reasons. To cover the clubs originally run by these two facilitators, one full-time and two substitute facilitators were hired, and all 25 of the facilitators were observed. Again, one facilitator was observed twice so that all schools could be included in the observations.

which the activities were conducted as written, materials were set up correctly, and facilitators displayed an understanding of the math behind the activities they were implementing. Ratings were given on a 5-point scale where a rating of 3 indicated meeting expectations and 4 or above indicated exceeding expectations.

- **Instructional quality.** Measures of the quality of instruction were drawn mainly from club observations. Observers rated facilitators on a number of dimensions, including the instructional climate of the clubs, the amount of mathematical reflection that facilitators engaged in with their students, and the degree to which facilitators differentiated instruction for children at different points on the learning trajectory. Ratings were given on a 5-point scale where a 3 indicated meeting expectations and 4 or above indicated exceeding expectations. In addition, facilitator exit memos illuminated the instructional areas that facilitators found most challenging over the course of the year.

- **Student engagement.** Daily logs also included items about child engagement, which asked facilitators to rate the level of engagement for both the start-up activities and the main activity on a scale of 1 (all students are disengaged) to 5 (all students are engaged). During the pilot, student engagement numbers were used to modify activities or the pacing guide if necessary, but during full-scale implementation they were used primarily to guide supervisors in supporting facilitators. During club observations in the fall and spring, researchers also rated the level of student engagement using the same rating scale. During spring observations only, the research staff recorded the degree to which students were engaged with one another and the number of students in each club who were consistently engaged throughout the session.

- **Logistics.** Facilitators recorded any challenges they faced each day on their daily logs, and observers also recorded any logistical difficulties they observed. Facilitators reflected on the challenges they faced more generally across the school year in their exit memos.

- **School leaders' perceptions of the program.** Information regarding teacher and principal perceptions of the program were taken from focus groups, surveys, and interviews conducted with school administrators, as well as from facilitator exit memos.

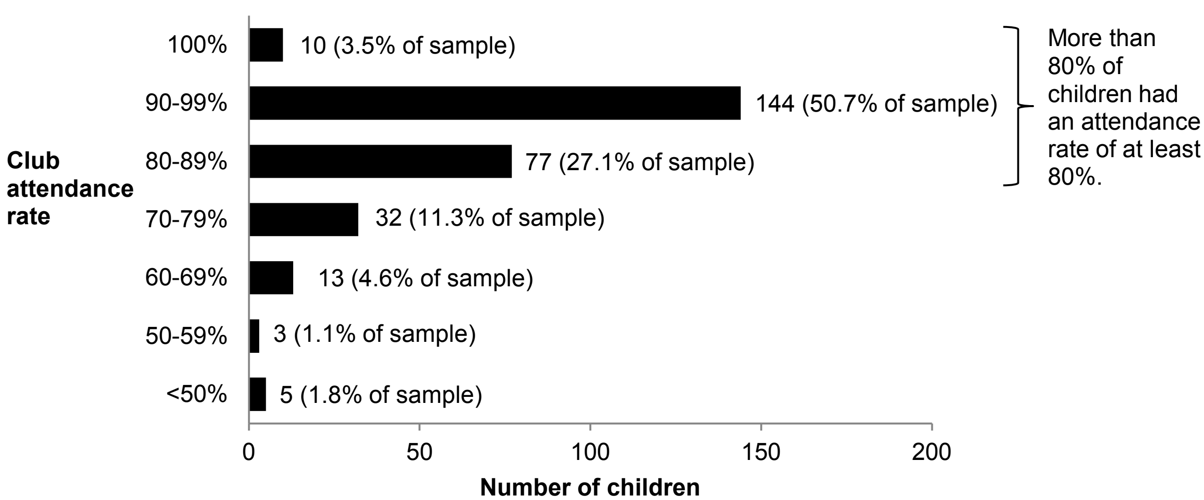
Implementation Findings

Child Attendance

Student attendance was high. At the outset of the program, a benchmark was set for overall student attendance rates of at least 80 percent. That benchmark was exceeded; the average attendance was 87.4 percent over the year. As shown in Figure 4.1, four out of five students had attendance rates over 80 percent, and nearly all students (more than 90 percent) had attendance rates over 70 percent. To achieve this rate, supervisors monitored attendance; if a student was absent or had partial attendance two or more times over a two-week period, supervisors would follow up with the facilitator. If necessary, someone from the project team would contact the student's parent or guardian. The high attendance rate was a result of significant time and energy devoted by both MDRC staff members and Bank Street College supervisors to contacting families whose children were absent from clubs and making scheduling and other changes to accommodate each family's needs.

Figure 4.1

High 5s Club Attendance Rates



SOURCE: MDRC calculations based on High 5s facilitators' club session logs.

NOTE: Club attendance was calculated for each child who did not drop out of High 5s by dividing the number of club sessions for which a student was present or partially present by the total number of sessions held.

Fidelity to the High 5s Model

As noted earlier, each club included two start-up activities that were intended to last 7 to 10 minutes and one main activity that was intended to last 15 to 20 minutes. The total time spent on mathematics content was intended to be greater than 20 minutes each session. As shown in Table 4.1, facilitators consistently met these benchmarks. On average, clubs spent almost 25 minutes on math during a session. Facilitators spent an average of 8 to 9 minutes on start-up activities and 16 to 17 minutes on main activities. Club observations confirmed facilitators' reports.

Club sessions were completed as scheduled, and the curriculum was delivered as intended. As shown in Table 4.2, according to facilitator logs, 93 percent of scheduled sessions were completed. Sessions were canceled primarily due to changes in school schedules, unavailability of space, or an insufficient number of students in attendance.[4] Facilitators also reported

Table 4.1

Amount of Time Spent on Math in High 5s Clubs, Based on Facilitator Logs and Spring Club Observations

	Facilitator Logs		Spring Club Observations	
Use of Time	Mean	Standard Deviation	Mean	Standard Deviation
Minutes spent on start-up activities	8.4	2.26	8.5	2.42
Minutes spent on main activities	16.5	3.03	15.6	2.95
Minutes spent on math[a]	24.7	4.17	24.1	4.11
Sample size				
Sites	24		23	
Clubs	79		26	
Club sessions[b]	5,971		26	

SOURCES: MDRC calculations based on facilitators' club session logs and on observations of individual clubs conducted in spring 2016 using an instrument developed by MDRC research staff to assess implementation fidelity.

NOTES: [a]Minutes spent on math includes time spent on start-up and main activities.
[b]The number of club sessions includes only those with scheduled activities and does not include Game Days, when students were given the opportunity to choose from four activities set out by the facilitator. During observation, only one session of each club was observed, so the number of sessions observed is the same as the number of clubs.

[4]Clubs were held if two or more students were in attendance.

Table 4.2

Fidelity to the Model: Instructional Quality, Based on Facilitator Logs and Club Observations

		Club Observations	
Measures of Fidelity (%)	Facilitator Logs	Fall	Spring
Scheduled sessions held[a]	92.5	-	-
Completed at least one start-up	98.6	96.0	100.0
Completed both start-ups	89.9	92.0	92.3
Completed main activity	99.6	100.0	100.0
Correct activities conducted	96.2	96.0	92.3
Facilitator met or exceeded expectations[b]			
Conducted activities as written	-	96.0	92.3
Set up materials correctly/was familiar with the activity	-	88.0	100.0
Displayed an understanding of mathematical concepts, using correct vocabulary, and making no significant mathematical mistakes	-	100.0	96.2
Sample size			
Sites	24	24	23
Club sessions[c]	7,031	25	26

SOURCES: MDRC calculations based on facilitators' club session logs and on observations of individual club sessions conducted in fall 2015 and in spring 2016 using an instrument developed by MDRC research staff to assess implementation fidelity.

NOTES: [a]Percentage of scheduled sessions held is calculated by dividing the number of clubs held by the total number of expected sessions.

[b]Facilitators were rated on a 1 to 5 scale. Facilitators who met or exceeded expectations received a rating of 3 or above.

[c]For facilitator logs, the sample size for club sessions is the total number of expected sessions. The denominator for the variables related to implementation fidelity from the facilitator logs includes only sessions with scheduled activities (5,971), not Game Days, when students were given the opportunity to choose from four activities set out by the facilitator.

that the main activity was completed in more than 99 percent of the completed sessions and that both start-ups were conducted in 90 percent of sessions (at least one start-up was conducted in 99 percent of sessions). Facilitators conducted the specific activities that were scheduled for that day in 96 percent of clubs. These findings were corroborated in club observations. On average, 82 of the 89 sessions that were developed and included in the pacing guide were completed, with a range of 66 to 89 sessions completed (not shown in table).

As shown in Table 4.2, club observations also indicated that activities were conducted as written, materials were set up correctly and facilitators were familiar with the activities they were implementing, and facilitators understood the mathematical concepts they were teaching.

Respectively, 96 percent, 88 percent, and 100 percent of the facilitators met expectations in these areas in the fall, and similar numbers were observed in the spring.

Instructional Quality

While the program was implemented in a fun, game-like atmosphere with fidelity to the model, ensuring the highest quality of instruction — instruction that included differentiation, involved reflective questioning, and underscored the mathematical objective of the activities — was challenging, as it is for many teachers, despite ongoing and high-quality training and coaching.

To provide an overall perspective on the quality of instruction, the study team looked at average facilitator quality ratings over the course of the school year. Averaging across all 12 instructional quality ratings given by observers in both the fall and spring, six facilitators were rated consistently high on all categories (that is, their average rating was 4 or above on a 5-point scale where 4 represents exceeding expectations). Five facilitators had average scores below 3 on a 5-point scale on which 3 was considered satisfactory. The remaining 14 facilitators had average scores above 3 but below 4, indicating that they met expectations but did not exceed them.

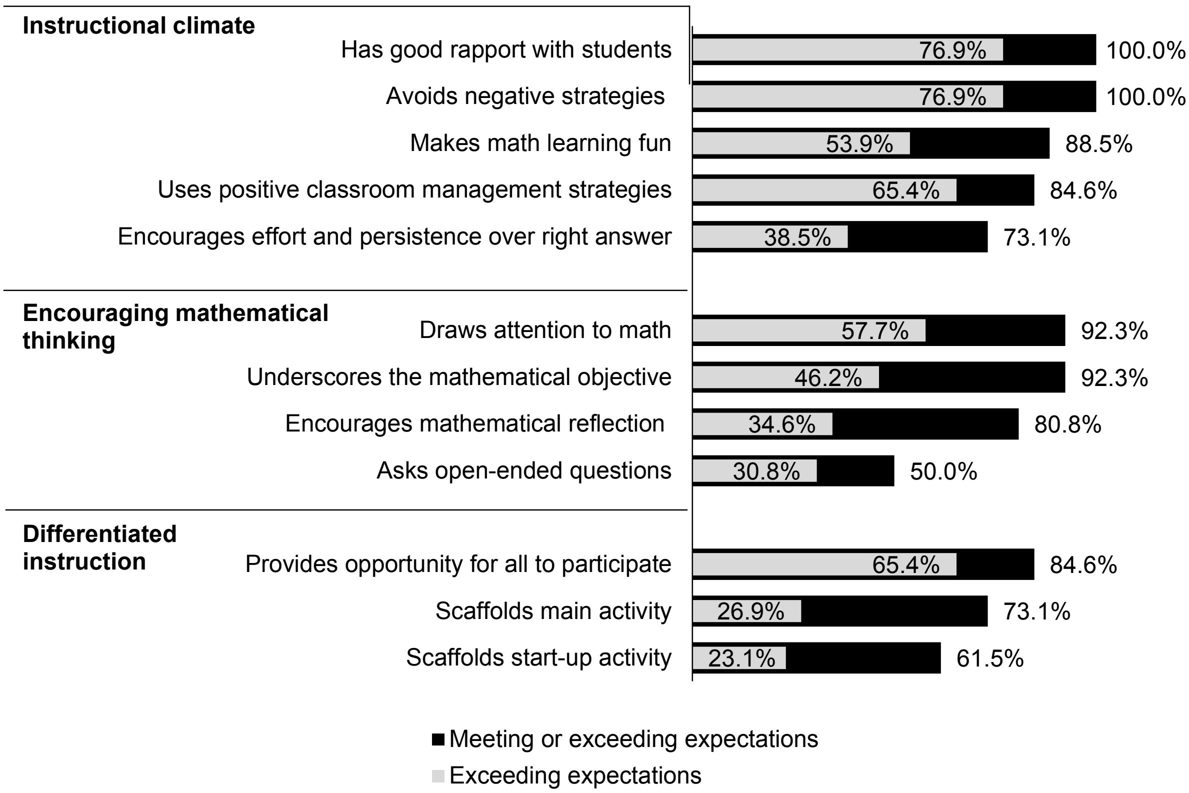
Figure 4.2 shows a more detailed breakdown of the ratings of facilitators' instructional practice during the observations that were conducted in the spring. Facilitators were rated on the instructional climate of the clubs, the degree to which they encouraged mathematical thinking among their students, and how well they differentiated instruction. The table shows the percentage of facilitators who were deemed to be exceeding expectations for each item (a rating of 4 or 5 on a 5-point scale) and the percentage who either met or exceeded expectations (a rating of 3 or higher on a 5-point scale).

Facilitators created a positive instructional climate for children. All facilitators met expectations for having good rapport with students and avoiding negative strategies to manage behavior, and over 80 percent met expectations for making math learning fun and using positive strategies to manage behavior. Many facilitators consistently encouraged effort and persistence over getting the right answer, with 73 percent meeting expectations and 39 percent exceeding expectations. The instructional climate that was developed in the clubs is illustrated by the following quotes from facilitators when asked to reflect at the end of the year on the most rewarding aspect of their job:

> Watching my kids understand the concepts and retain strategies for future use.
> When I saw their faces light up as they arrived to the answer on their own.
> Growing my relationships with my kids and them knowing they can make a mistake without it being a problem.

Figure 4.2

Facilitators Meeting and Exceeding Expectations of Implementation Quality



SOURCE: MDRC calculations based on observations of 26 High 5s clubs conducted in spring 2016 using an instrument developed by MDRC research staff to assess implementation fidelity of club activities.

NOTE: Facilitators were rated on a 1 to 5 scale. Facilitators who met or exceeded expectations received a rating of 3 or above. Facilitators who exceeded expectations received a rating of 4 or above.

> Forming relationships with my students, and seeing them grow over the course of the year. One student stands out in particular — she was often frustrated at the beginning of the year because she could not get to the answers or use the strategies to solve problems as easily as her peers. Now, she easily counts on, counts by 10s past 200, and knows how to apply addition strategies to different questions. Not only does she have all of these skills but also her confidence is striking to me.

As can be seen in Figure 4.2, encouraging mathematical thinking and differentiating instruction were somewhat more difficult for facilitators. The Building Blocks curriculum on which High 5s was based emphasizes asking open-ended questions and helping students engage in mathematical reflection. In the spring observations, facilitators were given a rating of 4 or 5 on an item asking about open-ended questions in 31 percent of the observations (where 5 indicates that the facilitator asked open-ended questions throughout the lesson) and were rated as meeting expectations in 50 percent of the observations. In 35 percent of the observations, facilitators were rated a 4 or 5 on an item asking about mathematical reflection (where 5 indicates that the facilitator reviewed key ideas for all activities). Throughout the year, facilitators were encouraged to underscore the mathematical objective of each activity during club sessions. In 46 percent of the spring club observations facilitators were rated as exceeding expectations on this item.

Options for differentiation were written into the curriculum, were provided in supervision, and were a focus of training and supervision in the second half of the year. In the spring club observations, 73 percent met expectations regarding scaffolding the main activity (giving individual children extra support or challenges when needed to help them move to the next skill level), while 27 percent of facilitators exceeded expectations on this item. These practices are difficult even for more experienced classroom teachers, as will be illustrated in findings from the kindergarten classroom observations described in Chapter 5.

Another challenge experienced by some clubs was managing the behavior of small groups of young children. Facilitators received training in small-group management and establishing behavioral expectations before entering the field, but some felt they were unprepared for the level of challenge they encountered. In exit interviews, about one-third of the facilitators (7 of 24) listed difficult behaviors or group dynamics as the most challenging aspect of their job. In approximately 14 percent of the clubs, facilitators spent substantial time managing behavior and, as a result, were less able to focus on the mathematics or on other aspects of their instructional delivery.[5] Supervisors provided ongoing support to clubs experiencing high levels of challenging behavior throughout the year, but this took time away from other instructional support activities in which they might have been engaged. As noted above, however, facilitators were able to avoid negative strategies for managing behavior, probably because of the training and supervision they received.

Student Engagement

As shown in Table 4.3, student engagement was also high (as reported by both facilitators and observers). Engagement was rated on a scale of 1 (all students are disengaged) to 5 (all students are engaged). As rated by facilitators, nearly all children were engaged in most clubs,

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[5]Facilitators indicated in their daily logs the degree to which they experienced challenging behavior in each club. Over the course of the entire year, four clubs had an average rating above 2.0 (where 1 = no instances of challenging behavior, 2 = intermittent minor challenges, 3 = frequent minor challenges or intermittent intense challenges, 4 = somewhat frequent and intense challenges, and 5 = ongoing and intense challenges). Another seven clubs had a yearly average between 1.7 and 2.0.

Table 4.3

Student Engagement,
Based on Facilitator Logs and Spring Club Observations

Activity	Facilitator Logs Mean	Facilitator Logs Standard Deviation	Spring Club Observations Mean	Spring Club Observations Standard Deviation
Start-up activities	4.8	0.55	4.0	0.66
Main activity	4.7	0.65	3.9	0.74
Game Days	4.9	0.36	-	-
Engagement with other children[a]	-	-	2.7	0.98
Sample size				
Sites	24		23	
Clubs	79		26	
Club sessions[b]	5,971		26	

SOURCES: MDRC calculations based on facilitators' club session logs and on observations of individual clubs conducted in spring 2016 using an instrument developed by MDRC research staff to assess implementation fidelity.

NOTES: Engagement was rated on a scale of 1 (all students are disengaged) to 5 (all students are engaged).

[a]Observers rated the extent to which "students are responsive to and engage with one another while working on activities with or without the support of the facilitator."

[b]The sample size for the start-up and main activity engagement items from the facilitator logs includes only sessions with scheduled activities, not Game Days. The sample size for Game Day club sessions is 1,749. During club observations, only one session of each club was observed, so the number of sessions observed is the same as the number of clubs.

with average scores of 4.8 for start-up activities, 4.7 for main activities, and 4.9 for Game Days. Club observations confirmed high levels of engagement, although not quite as high: 4.0 for the start-ups and 3.9 for the main activities in the spring observations.[6] Children's engagement with other children was somewhat lower (observers rated this as 2.7 on average). The number of children consistently on task averaged a little more than two (not shown), meaning that while students were generally engaged, it was difficult to keep them consistently on task throughout the entire club session.

Logistics

As expected, the detailed logistics of running the program proved to be one of the most time-consuming aspects. Getting students to and from the club was the most frequently

[6]In the fall, observers did not rate engagement separately for start-ups and main activities; instead they rated engagement "throughout the lesson." In the fall average engagement was 3.7 on the 5-point scale.

cited problem in the facilitator logs and in club observations. Facilitators picked up students from the lunch room or their classrooms, but changes in the school schedule or teacher absences often caused students to be in different locations from day to day and week to week. Similarly, several sites experienced recurring issues with finding an appropriate space for clubs to meet. It took substantial staff time from MDRC, Bank Street, and the schools to work around these issues.

No ideal time to hold clubs was identified; each possible time frame had strengths and weaknesses. After-school clubs experienced the fewest problems with attendance and finding and keeping a dedicated space to meet, and offered the most time for completing activities. Facilitators reported, however, that students were often tired or emotionally spent at the end of the day. Before-school clubs faced the biggest challenges in terms of child attendance. Lunch clubs had fewer attendance problems than before-school clubs, but facilitators reported that they had difficulty locating children in the lunch room and frequently felt rushed. Sometimes students who attended lunchtime clubs missed part of recess to attend, which was not ideal. Commuting between schools was also difficult for facilitators. In exit interviews, 7 of the 24 facilitators listed the commute as the biggest challenge they encountered as a facilitator.

As described in Chapter 6, many of these logistical issues might have been mitigated by integration of the program staff into the school, which might be more feasible in a non-research-based implementation of High 5s. However, as noted in Chapter 1, operating the program independently gave the study team maximum flexibility in hiring and training the staff and thus increased the chances that the program would be implemented with fidelity right from the start. This was particularly important because program impacts were measured at the end of the first year of implementation.

School Leaders' Perceptions of the Program

The program was generally well received by the schools. When asked to rate the support they received from their schools for the program, facilitators cited only three schools in which they felt unsupported by the school administration and staff. The backing for the program may have been due, in part, to the strong relationship that was developed with these schools as part of the larger Making Pre-K Count project. During end-of-the-year focus groups, interviews, and surveys, most administrators confirmed this robust support. On the surveys, administrators generally agreed or strongly agreed that they were satisfied with High 5s, with a mean of 4.6 on a scale of 1 (strongly disagree) to 5 (strongly agree). In interviews and focus groups, most administrators mentioned at least one of the following as a benefit of High 5s for the children who participated: extra math support, enjoyable math lessons, more time for small-group work, improved math skills, and a sense of structure and independence.

Summary

Overall, the implementation of the High 5s program went as intended and met the expectations that had been established at the outset. This was encouraging because High 5s was a newly developed program, and initially it was unclear whether it could be implemented successfully. The training and supervision that were provided to facilitators may have contributed to the successful implementation. Having several supervisors who were already knowledgeable about the Building Blocks program also may have helped. In the concluding chapter of the report, considerations for replicating the model in other contexts are discussed.

Chapter 5

Instruction in the Kindergarten Classrooms Compared with High 5s

All students who were part of the High 5s study also received typical math instruction in their kindergarten classrooms. To better understand the value the High 5s program may add, the research team observed kindergarten teachers and studied the nature of the mathematics instruction students were receiving in their classrooms, compared with High 5s clubs. Instruction in kindergarten classrooms was found to differ in a number of ways from the instruction in High 5s, both in the content covered and in the mode of delivery. Classroom instruction was primarily delivered in a whole-group format or with children working individually in their seats. In part because there was typically only one teacher in each classroom, there were few opportunities for hands-on, small-group experiences.

Researchers observed kindergarten classrooms in the 24 High 5s schools in the fall and spring of the kindergarten year. The classrooms included students who participated in High 5s in kindergarten and received enriched math in prekindergarten (Making Pre-K Count and High 5s), students who received enriched math in pre-K only (Making Pre-K Count only), and students who were not part of the study and had received neither Making Pre-K Count in pre-K nor High 5s in kindergarten. A total of 75 observations were conducted, with participating classrooms ($n = 42$) observed once in the fall and once in the spring. When a teacher who was observed in the fall was not available in the spring, a replacement teacher was selected for observation.[1]

Two types of observations were conducted: math block and full day. The math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instructional time. Full-day observations were intended to capture any mathematics instruction that occurred outside of the regular math lesson and to measure the amount of mathematics in relation to other subjects. Observers included MDRC staff members and researchers from the University of Chicago, the University of Michigan, and Vanderbilt University.

The observation protocol included a simplified version of the Narrative Record and an adapted version of the Classroom Observation of Early Mathematics — Environment and

[1]Thirty-three teachers were observed in both the fall and the spring. Three were observed only in the fall, and six new teachers were observed in the spring.

Teaching (COEMET).[2] The Narrative Record is an open-ended format for describing the types of activities and the content of instruction. The COEMET describes math instruction during formal math activities, including items related to math practices, type of activity, student engagement, and instructional quality. As with the club observations, kindergarten classroom observers received training and were certified on the observation instruments before they were able to conduct observations in the field. Several of the items in the observation protocol were identical to items that were included in the High 5s club observation protocol, which helps facilitate comparisons. About one in five observations were checked for reliability by having a master coder observe and code with the staff member conducting the observation. Overall reliability calculated for these double-coded sessions using Cohen's kappa was 0.92.

The Kindergarten Classrooms

Table 5.1 provides descriptive statistics on the typical kindergarten classroom in these schools. Between 19 and 20 students were present, on average, in the observed classrooms. This is lower than the national and New York State primary school averages of 21.6 and 21.5, respectively.[3] Most classrooms included between one and eight High 5s program students and a similar number of Making Pre-K Count only students. Fewer than 20 percent of classrooms had a teacher's assistant. A larger percentage did have another staff member or adult present in the classroom for at least 10 minutes. However, the role of these adults and the length of time spent in the classroom varied widely. The roles included, but were not limited to, grandparent or parent volunteers, teacher's aides, and reading specialists.

As shown in Figure 5.1, teachers spent 56 minutes on average per day on math instruction. This compares with approximately 97 minutes per day spent on literacy instruction and almost 50 minutes spent on other academic content (including science, social studies, art, and music) combined. Most math instruction was conducted during the math block. Teachers spent fewer than 10 minutes on math, on average, outside of the math block. Forty-two percent of the day (more than two and a half hours) was spent in noninstructional transitions or meals.

[2]The Narrative Record was developed by Dale C. Farran and Carol Bilbrey at the Peabody Research Institute, Vanderbilt University, Nashville (Farran and Bilbrey, 2004). The COEMET was developed by Julie Sarama and Douglas H. Clements at the State University of New York at Buffalo (Sarama and Clements, 2007).

[3]National Center for Education Statistics (2013).

Table 5.1

Description of the Kindergarten Classroom, Based on Classroom Observations

Outcome	Fall	Spring
Average number of students present in the classroom	19.6	19.2
Classrooms with a teacher assistant present (%)	19.4	12.8
Classrooms with another adult ever present[a] (%)	38.9	25.6
Sample size		
Sites	21	24
Classrooms	36	39

SOURCES: MDRC calculations based on full-day and math block observations conducted in fall 2015 and spring 2016 using a version of the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET; Sarama and Clements, 2007) that was modified for the High 5s study. Math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instruction time. Full-day observations took place over the entire school day.

NOTES: Rounding may cause slight discrepancies in sums and differences.
[a]Another adult ever present is defined to include any aides or school staff members present for longer than 10 minutes during the observation and does not include the participating lead teacher or primary teacher assistant.

Mathematics Instruction in the Kindergarten Classroom

The mathematics portion of the observation protocol included information on the content and organization of the math activities and the materials that were used, as well as items intended to capture information about instructional quality.

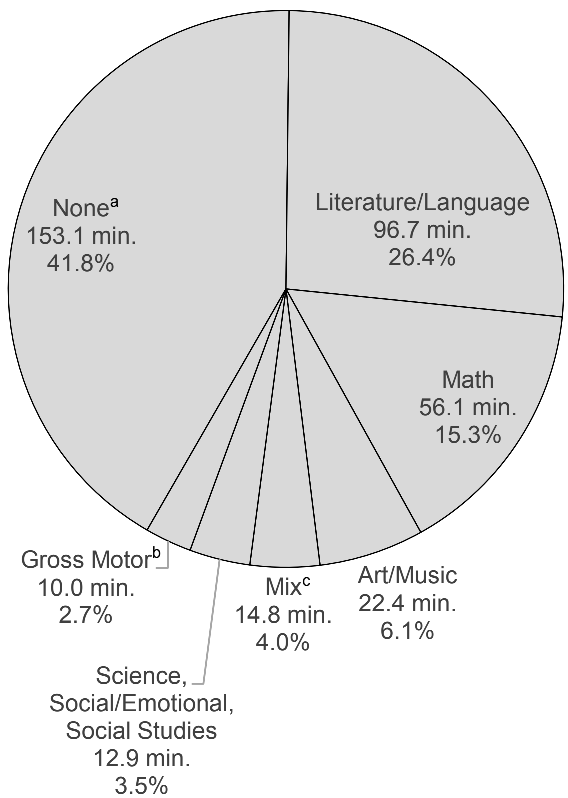
As shown in Table 5.2, some aspects of the observed math instruction were strong. A majority of the math activities were delivered clearly, teachers made relatively few mathematical errors, and teachers were actively involved in most activities (for example, teachers typically circulated during seat work and helped individual students, as opposed to sitting at their desks grading papers).

Other aspects were less strong. Research has shown more student growth in mathematical knowledge when teachers talk about math with their students.[4] To assess how much teachers helped students engage in mathematical thinking, observers rated each math activity on (1) the

[4]Klibanoff et al. (2006).

Figure 5.1

Instructional Content in Kindergarten Classrooms in Fall 2015



SOURCE: MDRC calculations based on observations conducted in fall 2015 and completed using the Narrative Record (Farran and Bilbrey, 2004).

NOTES: Rounding may cause slight discrepancies in sums and differences.

Minutes are calculated by multiplying the average proportion of time spent on each type of activity across classrooms by the average duration of the full-day classroom observations in fall 2015.

Spring observations were generally similar to those in the fall.

[a]Observers coded an activity content as "None" when it had no instructional purpose, such as meals and transitions between activities.

[b]Gross motor content develops children's ability to use their bodies through dancing, physical education, games at recess, etc.

[c]Observers coded an activity content as "Mix" when no single content area was covered for one continuous minute or when multiple activities were occurring simultaneously, such as in center-based play.

Table 5.2

Quality of Math Instruction in Kindergarten, Based on Classroom Observations

Quality Measure	Fall	Spring
Percentage of formal math activities in which:[a]		
The activity was delivered clearly[b]	97.9	97.9
The teacher made a mathematical error	4.7	5.4
Classroom management strategies hindered the activity	16.9	11.3
Teacher was actively involved in the lesson over 75% of the time[c]	81.7	86.2
Percentage of observations in which:		
Teacher changed math materials/content based on individual child skill level[d]	-	35.9
Use of practice (1-5)[e]		
Teacher asks open-ended questions	2.4	2.0
Teacher encourages mathematical reflection	2.8	2.7
Teacher scaffolds children to help them extend their math skills[d]	-	2.5
Sample size		
Sites	21	24
Classrooms	36	39

SOURCES: MDRC calculations based on full-day and math block observations conducted in fall 2015 and spring 2016 using a version of the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET; Sarama and Clements, 2007) that was modified for the High 5s study. Math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instruction time. Full-day observations took place over the entire school day.

NOTES: Rounding may cause slight discrepancies in sums and differences.

[a]A formal math activity is defined as one that meets the following criteria: (1) persists for at least 1 minute, (2) develops mathematics knowledge, and (3) has a discernible topic, goal, and task. This variable is calculated for the average classroom by creating the percentage of formal math activities meeting the quality benchmark for each classroom and averaging across all classrooms.

[b]This item is rated on a 1 to 4 scale (1 = not at all and 4 = almost all of the time), which was transformed into a binary variable in which formal math activities with ratings of 3 and 4 were recoded to 1.

[c]This item is rated on a 0 to 4 scale (0 = 0% and 4 = 76%-100%), which was transformed into a binary variable in which formal math activities with ratings of 4 were recoded to 1.

[d]This item was not asked in fall 2015; it was added to the instrument for spring 2016 data collection.

[e]While the wording for each item was specific to that practice, each item (Teacher asks open-ended questions; Teacher encourages mathematical reflection; Teacher scaffolds children to help them extend their math skills) is rated on a 1 to 5 scale (1 = low or not at all, 5 = high or throughout the activity). This calculation takes into account all formal math activities that occurred in the math block observations and only those that occurred during the math block portion of the full-day observations. The time-weighted average is calculated by multiplying the quality rating by the duration in minutes for each formal math activity in a classroom and then averaging across classrooms.

degree to which the teacher engaged in mathematical reflection with students and (2) the degree to which the teacher asked open-ended questions. Each math activity was evaluated on a scale of 1 to 5, where 1 = not at all, 3 = sometimes, and 5 = throughout the activity. These scores were weighted by the duration of the math activity, and a weighted average score was calculated for every classroom. As shown in Table 5.2, on average, kindergarten classroom teachers were rated somewhere between 2.0 and 2.4 on open-ended questions and about 2.8 on reflection — indicating that both of these aspects of quality occurred only occasionally. Looking at these numbers in a different way, during spring observations only about 8 percent to 13 percent of the recorded 172 math activities were given a rating of 4 or 5 on either of these two items.

There was also relatively little differentiation or scaffolding observed. Differentiated instruction is defined as whether the teacher adapted his or her instruction to suit the skill levels or needs of individual children. Scaffolding is similar, but more focused on helping students move to the next level of ability. The teacher gives assistance to children based on their current levels of ability and provides extra support or additional challenges to help individual children move to their next levels of ability. This might be done by providing a different set of materials, or just by asking different types of questions when helping a student solve a problem. Teachers were observed changing math materials or content for children based on the individual child's skill level in approximately 36 percent of the classrooms observed in the spring. Teachers' average score on a 5-point rating of scaffolding was 2.5.

In addition, the observed instruction was mostly delivered in a whole-group setting or while children were working individually at their seats. As shown in Table 5.3, most (over 80 percent) of the math instruction involved whole-group instruction or seat work, and about two-thirds of the activities either involved no materials (for example, the teacher was talking to the children while they were sitting on the rug or at their seats and the children did not have any materials) or only a workbook.

Math Instruction in the Classrooms Compared with High 5s Clubs

Table 5.4 compares the instruction observed in the kindergarten classrooms with instruction in the High 5s clubs, showing more open-ended questions and more mathematical reflection in High 5s clubs than in the classrooms. In the spring observations, kindergarten teachers were given an average rating of 2.0 on the item asking about open-ended questions, while facilitators were rated 2.7 on average. Similarly, teachers were given an average rating of 2.7 on the question about mathematical reflection, while facilitators received an average rating of 3.2 on this item. Looking at these numbers in a different way, in spring observations 31 percent of High 5s facilitators were given a rating of 4 or 5 on the item asking about open-ended questions (indicating that the facilitator asked open-ended questions throughout most of the lesson) and 35

Table 5.3

Activity Type and Materials Used During Math Instructional Time, Based on Classroom Observations

Instructional Approach	Fall	Spring
Activity type		
Percentage of math instructional time[a]		
Whole group	64.1	68.8
Seat work	19.3	16.9
Small group	4.2	5.0
Transition	11.7	9.3
Other[b]	0.4	0.0
Materials used by children		
Percentage of formal math activities[c]		
No materials	37.4	33.1
Workbooks only	29.4	27.7
Other materials[d]	33.2	39.2
Sample size		
Sites	21	24
Classrooms	36	39

SOURCES: MDRC calculations based on full-day and math block observations conducted in fall 2015 and spring 2016 using the Narrative Record (Farran and Bilbrey, 2004) and a version of the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET; Sarama and Clements, 2007) that was modified for the High 5s study. Math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instruction time. Full-day observations took place over the entire school day. Math instructional time includes math-block-only observations and the math block portion of the full-day observations.

NOTES: Rounding may cause slight discrepancies in sums and differences.

[a]Percentage of math instructional time is calculated by dividing the total time spent in each activity type by the minutes that were included as part of the teacher's regular math instruction block for each classroom and then averaging across classrooms.

[b]Other represents time that children spent outside, eating meals, and in special classes.

[c]Percentage of formal math activities is calculated by dividing the number of formal math activities using each material by the total number of formal math activities observed in each classroom and then averaging across classrooms.

[d]Other includes any materials used other than workbooks, such as math journals, manipulatives, or computer.

Table 5.4

Nature of Math Instruction in Kindergarten Classrooms and High 5s Clubs, Based on Spring 2016 Observations

Quality Measure	Kindergarten Average[a]	High 5s Average
Teacher asks open-ended questions (1-5)	2.0	2.7
Teacher encourages mathematical reflection (1-5)	2.7	3.2
Teacher scaffolds children to help them extend their math skills (1-5)	2.5	2.9
Teacher changed math materials/content based on individual child skill level (% of observations)	35.9	57.7
Sample size		
Sites	24	23
Classrooms	39	-
Clubs	-	26

SOURCES: MDRC calculations based on observations of individual clubs conducted in spring 2016 using an instrument developed by MDRC research staff to assess implementation fidelity, and on full-day and math block classroom observations conducted in spring 2016 using a version of the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET; Sarama and Clements, 2007) that was modified for the High 5s study. Math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instruction time. Full-day observations took place over the entire school day.

NOTES: Rounding may cause slight discrepancies in sums and differences.

[a]This calculation takes into account all formal math activities that occurred in the math block observations and only those that occurred during the math block portion of the full-day observations. The time-weighted average is calculated by multiplying the quality rating by the duration in minutes for each formal math activity in a classroom and then averaging across classrooms.

percent of facilitators were rated a 4 or 5 on an item asking about mathematical reflection (indicating that the facilitator reviewed key ideas for most or all activities). This compared with kindergarten classrooms in which only 8 percent and 14 percent of the math activities observed were given a rating of 4 or 5 on open-ended questions and mathematical reflection, respectively. Although these items were measured in slightly different ways (ratings were given for each activity in the kindergarten classrooms and for the session overall in the High 5s club observations), they nonetheless provide some insight into the differences between the two.

Instructional Content

Math practices are the specific skills that a teacher tries to address in a lesson (for example, counting forward by 1s or adding or subtracting single-digit numbers). During math instruction, observers recorded all the math practices that the teacher covered during each math activity and identified the primary math practice for each activity. The primary math practice is defined as the main practice or topic that the teacher intended to teach. As shown in Table 5.5,

Table 5.5

Percentage Breakdown of Content During Math Instructional Time in Kindergarten Classrooms and High 5s Clubs

Math Activities (%)	Kindergarten Fall Observations	Kindergarten Spring Observations	High 5s Activities School Year
Numbers and operations	**94.3**	**91.3**	**79.0**
Numeral recognition and writing	8.3	4.4	0.0
Counting forward by 1s	25.5	21.2	0.0
Recognizing quantity without counting	1.3	0.0	3.1
Complex counting	1.3	6.6	24.6
Comparing and ordering	24.2	6.6	11.3
Composing numbers	28.0	13.9	22.6
Adding and subtracting	5.7	38.7	17.4
Other math content areas	**5.7**	**8.8**	**21.0**
Patterning	1.9	0.0	4.6
Shapes	2.6	7.3	11.8
Measurement	0.0	0.0	4.6
Other	1.3	1.5	-
Sample size			
Sites	21	24	-
Classrooms	36	39	-
Math activities[a]	157	137	195

SOURCES: MDRC calculations based on the High 5s Full-Scale Curriculum developed by the University of Michigan and on full-day and math block observations conducted in fall 2015 and spring 2016 using a version of the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET; Sarama and Clements, 2007) that was modified for the High 5s study. Math block observations were approximately 60 minutes long and were conducted during regularly scheduled math instruction time. Full-day observations took place over the entire school day.

NOTES: Rounding may cause slight discrepancies in sums and differences.

Math content categories are based on the primary math practice categories from the COEMET. Complex counting includes counting backward by 1s, counting forward or backward by 10s, skip counting by a number other than 10, and counting forward by 10s and 1s.

For kindergarten classrooms, data on the math content of activities is based on observations at two time points during the school year; coding of the GoMath! curriculum, which was used in most classrooms, indicates that the activities implemented during these two time points are representative of the entire curriculum. For High 5s, coding of math content was based on all activities in the curriculum; fidelity data indicate that the planned activities in the curriculum were closely aligned with the activities that were actually implemented.

[a]In kindergarten classrooms, a math activity is defined as a formal math activity observed using the COEMET, which must meet the following criteria: (1) persists for at least 1 minute, (2) develops mathematics knowledge, and (3) has a discernible topic, goal, and task. All formal math activities observed in the math block observations are included. In the full-day observations, only formal math activities taking place during regularly scheduled math instruction time are included. In High 5s, a math activity is defined as either a start-up or main activity as outlined in the High 5s Full-Scale Curriculum.

the primary math practices observed in the fall were most commonly composing numbers — a precursor to addition and subtraction in which students become fluent with all the ways to "make" a number (for example, 4 is 1 and 3, 2 and 2, 4 and 0, and so on) — counting forward by 1s, and comparing and ordering (for example, knowing that 9 is greater than 5). As expected, instruction moved from these basic math practices to more sophisticated ones later in the year. In the spring, significantly more addition and subtraction and less comparing and ordering and composing numbers were observed. Relatively few math practices that were not related to numbers and operations, such as geometry, measurement, or patterning, were observed. Chapters on geometry and measurement come at the end of the district-supported Go Math! curriculum, and it is possible that teachers may have covered these topics later in the year. However, as is often the case, preliminary analyses of pacing in these classrooms suggest that most teachers would not have reached these chapters by the end of the year.

As Table 5.5 indicates, High 5s exposed children to a wider range of content. While fewer than 10 percent of classroom activities focused on geometry, measurement, and patterning, over 20 percent of High 5s activities focused on these content areas. In both the fall and the spring, High 5s clubs included fewer activities focused on basic math skills (for example, counting forward by 1s and numeral recognition and writing).

Summary

Overall, these findings suggest that the instruction in the High 5s clubs differed in a number of ways from the regular kindergarten instruction children received. First, the High 5s program presented a wider range and somewhat more advanced instructional content than was observed in kindergarten classrooms. Classroom teachers were, for the most part, following the district's Common Core-aligned kindergarten math curriculum, which focused on numbers and operations for a majority of the year. Geometry and measurement are introduced near the end of the Go Math! curriculum, while geometry, measurement, and patterning activities were included throughout the year in High 5s.

Second, content was, by design, delivered in a small-group format in the High 5s clubs, and all the High 5s activities involved the use of hands-on manipulatives. By comparison, there was very limited small-group instruction in the kindergarten classrooms, and about two-thirds of the activities observed in kindergarten classrooms involved only workbooks or no materials at all. One reason for the difference may be that in many classrooms there was only one teacher present, and it is difficult for kindergartners to participate in small-group activities without adult supervision.

Third, facilitators asked more open-ended questions and engaged in more differentiation of material than was observed in kindergarten classrooms. Differentiation and mathematical reflection were difficult for the High 5s facilitators, who were addressing the needs of just four students at a time, all of whom had been exposed to the Building Blocks curriculum in pre-K. Differentiating instruction and encouraging mathematical reflection is even more challenging in a classroom of 20 children with substantial variation in experience.

Finally, as discussed in Chapter 4, High 5s students received an additional 75 minutes of math instruction per week above what they would have received in their regular classrooms (approximately 280 minutes per week). This is an increase of more than 25 percent in mathematics instructional time each week. As will be discussed in more detail in the final chapter, these factors may have contributed to the program's positive impacts on achievement.

Chapter 6

Implications of the Findings

The High 5s curriculum was designed to pick up where the Building Blocks curriculum left off in prekindergarten and to move children along four key mathematical trajectories by engaging them in mathematical games that are fun and developmentally appropriate. High 5s was a test of whether it was possible to create and deliver aligned math enrichment across pre-K and kindergarten and whether that alignment had the potential to sustain the impacts of a high-quality math intervention in pre-K.

As described in detail in this report, the implementation of the High 5s program achieved the goals that were initially set out for the program — clubs met regularly, the activities were delivered consistently and accurately, and attendance and engagement were high throughout the year. Substantial resources (from both MDRC and Bank Street College of Education) were expended to ensure the high level of implementation. Staff members from MDRC and Bank Street worked closely with families to ensure high rates of attendance and cooperated with schools to ensure that there was time and an appropriate space for the clubs to meet. The Bank Street supervisors and program director worked closely with facilitators throughout the year to help ensure the curriculum was delivered effectively, providing a level of supervision and professional development beyond what most early career teachers receive.

As noted in a companion report, the program had a positive and statistically significant impact on the math skills of the children who participated in the High 5s program.[1] The program produced positive impacts (effect size = 0.19 standard deviations) on one of two measures of mathematical knowledge and skill when students who received High 5s in kindergarten and Making Pre-K Count in pre-K were compared with students who received only Making Pre-K Count in pre-K. The impacts were larger when students who received High 5s were compared with a group of children who received no math enhancement in pre-K or kindergarten, which suggests that the two years of enhanced math instruction had an additive effect.

Potential Contributions of the High 5s Program

The findings in this report suggest a number of potential mechanisms through which High 5s may have contributed to the development of children's math skills. First, High 5s led to additional mathematics instructional time: Students in High 5s received, on average, 75 minutes of

[1]Mattera, Jacob, and Morris (2018).

math instruction each week over and above the approximately 280 minutes they were receiving in class. This is an increase of over 25 percent.

Second, High 5s had a different instructional approach from kindergarten classroom instruction. In classrooms, 83 percent of math time was spent in either whole-group instruction or seat work, and most activities involved either workbooks or no materials at all. High 5s instruction occurred in small groups or individually with the facilitator (on Game Days, some facilitators worked one on one with individual students). High 5s was primarily game-based and provided students with opportunities to engage with mathematical concepts using a variety of manipulatives and materials. These instructional practices were highly aligned with the Building Blocks curriculum, and this consistency may have contributed to student learning in High 5s.

High 5s also exposed students to more advanced mathematical topics. As shown in Chapter 5, High 5s clubs covered a wider range of content than did kindergarten classrooms and more time was spent on more advanced mathematical skills.

Finally, the instructional climate in clubs may have differed from the climate in classrooms. The following exchange, as reported by one of the facilitators during the last week of the clubs, captures this difference:

> While filling out their "why we like math" page, the children [in this club] all concluded that they didn't like math. I [the facilitator] said that was strange because they've been doing math in High 5s all year and were loving it and were so happy. They clarified that they like math in High 5s but they don't like it in school. R explained in his words that "In school, you do math and you be quiet and look down at your paper. They just tell you that you're wrong. And then nobody talks to you. It's just wrong and you have to be quiet. But in High 5s we have you. You never say we did it wrong and we all talk and figure it out and then nobody's wrong. That's why I'm happy when I do math in High 5s."

Another facilitator wrote at the end of the year that the most rewarding aspect of the job was "When the kids finally 'get' a new concept and they become more confident in themselves it honestly makes it all worthwhile. One of my students wrote in her high 5s book that one of the things she learned in high 5s was to 'never stop trying.'" The extensive training and ongoing supervision that facilitators received from Bank Street likely contributed to this instructional climate.

There is some evidence to support each of these potential contributions, and any effects of the program likely arise from some combination of all four. It is therefore important to be cautious in concluding that just one or two of these elements would be sufficient to produce impacts.

Program Replicability

Given the program's impact on math skills, it is worth considering whether High 5s could be replicated in other contexts. There were many factors that led to the approach to implementation described in this study, including the requirements of the research design itself. However, it is likely that the program could be operated more efficiently and with fewer resources if implementation were approached in a different way. For example, in this study facilitators were required to travel from school to school, which expended both time and money. Similarly, holding the clubs outside of regular school time limited the times each day in which clubs could be held, required working closely with schools to find an appropriate time and place for the clubs, and required considerable coordination with families to help ensure high rates of attendance.

Many of these factors could be avoided if the program were run by staff members already in the schools and if clubs were held during the regular school day. Using paraprofessionals already within the school building would offer greater flexibility in scheduling and would eliminate commuting between schools, which was challenging for many of the facilitators. Such a model might have other benefits as well. Paraprofessionals in the school might have more experience working with small groups of children and might be better equipped to mitigate the behavioral challenges that the less experienced facilitators in this study faced. Pulling students out during the school day would also reduce attendance problems, might reduce the challenge of finding appropriate space, and could potentially be more conducive to instruction because students would be less tired.

Table 6.1 describes the set of resources that would probably be required to replicate the program with school-based staff members during the regular school day. Assuming that schools would want to serve most if not all of their kindergarten students, the numbers in the table reflect the following assumptions: Each school has three classrooms and 20 children per kindergarten classroom, for a total of 60 students. Students would be divided into 15 clubs with four children per club. Each of these 15 clubs would meet three times a week. To fit this many clubs into a typical school week would require that some clubs meet concurrently. Staffing could include three half-time facilitators each running 5 clubs, or one full-time facilitator running 10 clubs and one half-time facilitator running 5. Assuming that each session lasts around 45 minutes (including setup and transitions between clubs), running 5 clubs would require approximately 10 to 15 hours of staff time per week, plus an additional 5 hours weekly for preparation, supervision, and training.

As reflected in the table, in addition to the facilitators' time, schools would need to take into account the costs of materials, supervision, training, and administrative support. Schools would also need to identify appropriate spaces to hold the clubs. The assumptions made above,

Table 6.1

Potential Resources Needed to Replicate the High 5s Program During the School Day Using School-Based Staff

Resources	Amount	Notes
Facilitators	1-1.5 FTEs	• Estimate assumes clubs each last about 45 minutes, including setup and transition time. • To run 5 clubs meeting 3 times a week would require about 10-15 hours of staff time, plus an additional 5 hours for preparation, supervision, and training. • Staffing could include 3 half-time facilitators who each run 5 clubs or 1 full-time facilitator running 10 clubs and 1 half-time facilitator running 5 clubs.[a]
Supervisor	0.5 FTE	• In the High 5s implementation described in this report, each supervisor was responsible for a cohort of 5 facilitators. One supervisor could be shared between 2 schools.
Program director	0.10 FTE	• In the High 5s implementation described in this report, a program director provided support to the supervisors and helped ensure that the program was implemented consistently. • If the program were being implemented across an entire district, the costs of a program director could be shared across all schools.[b]
Administrative support	0.05 FTE	• The program requires some administrative support to run effectively: help ordering and distributing supplies, coordinating scheduling, identifying appropriate spaces to hold the clubs, etc.
Materials: High 5s kits and curriculum materials[c]	1 per facilitator	• The cost for materials is around $25 per child, depending on the number of children served.
Training	1 week of staff time before clubs begin	• This might require overtime or summer pay or release time and potential food or space. • In the High 5s implementation described in this report, there were also additional training days held throughout the year on days school was not in session.

SOURCE: MDRC calculations based on resources required to implement the program.

NOTES: FTE = full-time employee.

The table assumes 20 children per kindergarten classroom and three classrooms per school for a total of 60 students. Students would be divided into 15 clubs with four children per club. Each of these 15 clubs would meet three times a week. To fit this many clubs into a typical school week, some clubs would have to meet concurrently.

[a]If a school system decided to share facilitators across multiple schools, time and transportation costs would need to be included.

[b]If the program were adopted by a single school (as opposed to an entire district), a program director might not be needed.

[c]Materials include items such as the curriculum binder, manipulatives, activity-specific materials, and supplies.

on which the table is based, could change depending on how the program was implemented. For example, in a large school where the High 5s meeting room was a long way from kindergarten classrooms, more than 45 minutes might be required to move students to and from clubs and run a 30-minute club session. Or if the program were run as a push-in rather than a pull-out program, perhaps less time would be required and a designated space would not be needed, but it might be difficult to keep students focused in a classroom where other activities were also occurring. If the program were adopted by a single school (as opposed to an entire district), a program director might not be needed. If a school system decided to share facilitators across multiple schools, time and transportation costs would need to be included. High 5s could also be implemented as part of an after-school program, but it would probably require a larger number of facilitators if the goal were to serve all or most of the participating kindergarten students, since there would be a limited period of time in which to hold the clubs. In short, the program could potentially be structured in a variety of ways, and each approach would require a somewhat different set of resources.

A number of components of the current implementation that are harder to quantify may also have made a difference. First, as noted earlier, three of the five program supervisors and the program director involved in the implementation of High 5s had previously been a part of the Making Pre-K Count study; thus they already had a strong background in the learning trajectories approach and the pedagogical aspects of the Building Blocks program. This may have contributed to the strong implementation. Similarly, the project benefited from the infrastructure and experience of Bank Street College of Education, which had both experience and expertise in early childhood education as well as experience working in and credibility with New York City schools. The project was also able to tap into several colleges and universities, as well as a large network of education professionals in New York City, to recruit a strong and committed set of facilitators.

It might be difficult to replicate some of the instructional aspects of the High 5s model. Facilitators received a substantial amount of training and supervision both before clubs began and throughout the school year — much more support than is typically provided to a first-year teacher. In addition to the week of training shown in Table 6.1, facilitators received ongoing, daylong trainings throughout the year on days when schools were not in session. School staff members might not have the flexibility to attend this amount of training and schools might not have the resources to provide it.

The training and supervision infrastructure in the current implementation model was adopted to help ensure that the program could be implemented with fidelity right from the start, since program impacts were going to be measured at the end of the first year of implementation. It also helped ensure that the learning environment in clubs remained positive. Without a consistent message regarding the philosophy of instruction, clubs might have taken on the instructional climates of their schools, which varied widely. Although the curriculum is semiscripted and self-explanatory in its approach, ensuring that it is delivered with the highest level of quality may require more supervision and training than is reflected in Table 6.1.

Finally, the curriculum itself was designed to align with and build on what children in the study had experienced in pre-K. The study was not designed to demonstrate how effective the curriculum would be for children who did not have this grounding in preschool. Further research is needed on how these activities and instructional setup would work for children who may have had a different set of experiences in the year before kindergarten.

Conclusions

Despite uncertainty in the planning phases about the viability of a math club model like High 5s, the program was implemented well, with high attendance rates and student engagement. Staff members hired at a paraprofessional level, many with limited or no formal teaching experience, were, with the support of a strong training and supervision model, able to provide a wide range of math content with fidelity to the program model. The program had a robust, statistically significant impact on one of two measures of math achievement. A number of factors may have contributed to the positive impacts on math, including additional time on math, differences in content covered between classrooms and math clubs, and differences in both instructional approaches and instructional climate.

There is an extensive body of research on the effectiveness of reading instruction for young children in small groups[2] and of math tutoring for older students.[3] However, at the time the High 5s program was implemented, there was much less evidence on the effectiveness of small-group tutoring for boosting math achievement in the early grades. This study adds to the growing body of evidence that suggests that small-group instruction, even when delivered by paraprofessional-level staff, can be an effective way to improve math skills.

There are two potential ways in which small-group enrichment may have contributed to the positive outcomes observed in the study. First, small-group work could be one way to provide kindergarten instruction that is more closely aligned with the pre-K experience. Pre-K tends to involve a substantial amount of small-group instruction with many hands-on learning opportunities, and the High 5s program continued this approach. Instruction that is more closely aligned with the pre-K experience could help mitigate the fade-out that is often associated with high-quality pre-K experiences. At the same time, in the model tested in this study, not only the mode of instruction but also the content covered was aligned with children's pre-K experiences,

[2]Slavin, Lake, Davis, and Madden (2010).

[3]Fryer (2011); Smith et al. (2013).

and it is unclear whether a program like High 5s could work in the absence of two years of enhanced and aligned instructional content.

In addition, the small-group experiences that a math club model offers might help ensure that children get more individualized instruction and do not “fall through the cracks.” Individualized instruction may be difficult to achieve in a classroom with only one teacher and many children with varying needs. In a small-group setting, it is easier for teachers to assess each child’s level of understanding, ensure that the children are engaging in assigned tasks, and differentiate instruction.

The positive impacts of the High 5s program demonstrated in this study suggest that it would be worth examining whether the program could work in different contexts. For example, would the model be effective in scenarios in which children come into kindergarten with a variety of different pre-K math experiences? Would the program be effective if schools use in-house staff members to deliver the clubs, or staff members without the level of training and supervision that facilitators were provided in the model that was tested? It is important to understand how the different components of the program work and for whom.

It is also worth considering whether the appropriate next step is to try to integrate more small-group work and hands-on learning opportunities into kindergarten math instruction in the classroom. This was challenging in the schools in this study, where there was often only one adult in the classroom. A pull-out or push-in math club program like High 5s that operates during the regular school day could provide such an opportunity. Additional research is needed to investigate whether the program could be successfully implemented in these ways or whether there are other ways to integrate small-group work and hands-on activities into the regular school day.

Appendix A

High 5s Sample Lesson

Chocolate Chip Count

Early Addition and Subtraction

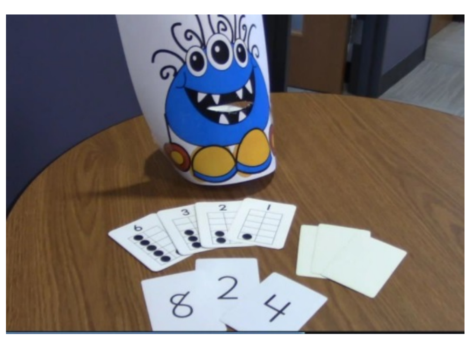
Students will subitize (know amount without counting) the number of dots on two separate cards and then **use a method to find the sum.** To find the sum, they may need to count the objects or use their fingers.

You will need:	Activity Description:	Concept:
□ 5 sets of counting cards (0-5) □ 4 sets of numeral cards □ Printed monster with slit cut in mouth, placed over a container □ Bowl or small trash can □ 12 laminated blank numeral cards	In this game, students imagine that the cards are brownies with chocolate chips and that a monster is eating the brownies. After the students have determined the number of chocolate chips on two brownies, they write that number on a blank numeral card and 'feed' it to the monster. At the end of the game, the students can look inside and see what the monster ate.	*Building early addition strategies*

Early Addition and Subtraction

(Counting Cards 1 to 5) + (Counting Cards 0 to 5)	(Numeral Cards 1 to 9) + (Counting Cards 0 to 5)	Numeral Cards (1 to 20) + (0 to 5)			
Student models addition problems by counting each set and joining them, then counting from 1 to find the total.	Student models addition problems as previously and also models subtraction problems by getting the larger set, counting to remove the smaller set, then counting to determine what remains. Student may count from one to add two sets	Student can count on to add sums in the range of 20, which includes counting from a number other than 1 and tracking the number of counts necessary (e.g. to do 7 + 4 the student may count "8, 9, 10, 11," while using fingers to keep track of the counts).			

Activity Set-Up:



ACTIVITY PLAN

Setting the Stage

Today, the students will practice addition by determining the number of chocolate chips that are eaten by the monster. The students will use counting cards to represent brownies, and write numbers on blank numeral cards to represent the sums that will be fed to the monster. Lay out the stacks of counting cards and create sets of numeral cards that correspond to the students' learning trajectory (above).

Place the bowl or small trash can on the table, and tape the monster to it so that the container can catch the brownies as the students feed the monster.

Introduce the game to the students.

- ***"Do you like chocolate chips on brownies?! Do you think this monster can eat a lot of chocolate chips? Today you get to tell me how many chocolate chips are on the brownies. Then, we feed them to the monster!"***

Walking Through the Activity Together

Now, you can model one example for the students.

- ***"I'm going to show you a brownie and I want you to see how many chips are on it. I'll turn over a card for just a moment, and then hide it again, so watch closely!"***

Take two counting cards that are appropriate for the students' learning trajectory. Place the cards face down on the table. Flip the first card so that the students can see the dots for about 2 seconds, then turn it face down again. Say:

- ***"How many chocolate chips did you see on the brownie?*** (Allow the students to answer.) ***Remember that number, because we're going to feed the monster another brownie!"***

- ➔ If the students are new to addition, you may want to use two very small numbers for this example.

Turn over the second card so that students can see how many chocolate chips are on the second brownie.

- ***"How many chocolate chips did you see on that brownie?*** (Allow the students to answer.)

- ***"Now, how many chocolate chips altogether?"*** (Give the students time to answer.) Tell

the students that now they get to feed the monster! Write the sum on a blank numeral card. For example, if the monster ate a brownie with 2 dots and a brownie with 1dot, write a 3 on the numeral card. Have a student feed it to the monster by placing the card through the monster's mouth and into the container. Now that you've done one example, you're ready to play the game!

Playing the Game

Begin play again. This time, have another student write the sum on the numeral card that is needed to feed the monster. Here are some strategies and tips for helping students play.

When you ask students to add the number of chips on the two brownies, it is appropriate for them to do the problem without looking, although some students may count on their fingers. If they hesitate or have trouble adding, ask:

- ***"Do you remember how many chocolate chips were on the first brownie?"*** (Listen for response.)

- If the response is correct, acknowledge the students' success and ask, ***"How many on the second brownie?"*** (Listen for response.)

- If the students give an incorrect response about the first or second brownie, ask, ***"Do you need to see that again?"*** (Turn over the brownie and leave it right side up for the students to see if needed.)

- Once the students have identified the correct number of chocolate chips on each brownie, ask: ***"And how many chips are there altogether?"***

  - If the students need to look at the cards, flash the first card, then show them the second card to see if they can first think of the number from the first brownie. Then, have the students count on the number of dots on the second brownie. If the students are not successful, they can look at both cards. The goal is for the students to add with as little support as possible, but to provide support if needed so that they don't get frustrated.

When students have successfully identified a sum, they get to feed the monster. You can say:

- ***"Now we get to feed the monster! Let's write the number and feed it to him."*** (Have students write the number on a blank card.) ***Look how many chocolate chips he is eating!"***

Students may use a variety of strategies to determine the sum of the chocolate chips. Here are some examples of how students might solve 5 + 3.

(red)	Students who are counting all of the sets (red) will need more practice with small amounts of dots on the brownies. They may count the first set, count the second set, then count both sets: "1, 2, 3, 4, 5, … 1, 2, 3 ….1, 2, 3, 4, 5, 6, 7, 8."
(orange)	Students who can work with slightly larger numbers (orange) may be able to use a numeral card and then continue counting the dots on a brownie. They may also be able to work in pairs. Students at this point in the trajectory may count the first set then continue counting on through the second set: "1, 2, 3, 4, 5 … 6, 7, 8."
(yellow)	Students who can count on can use two numeral cards to represent the chocolate chips on the brownies and can work in pairs. They can count on from the number of the first set: "5. . . 6, 7, 8."

To support students in focusing on the addition, you could ask questions like this:

- ***"How many chips on the first brownie? And how many chips on the second brownie? How many did you say that was altogether?"***

- ***"Let's say that with addition!*** (First number) ***plus*** (second number) ***makes*** (sum).***"***

- → Encourage playfulness by reminding the students that the monster *loves* chocolate chips, just like they do! You could also tease them by pretending to be worried about how many chocolate chips the monster is eating.

Play the game until the monster is completely "full" of chocolate chips, or until the cards are gone. When the students have played for a while and fed the monster each time, you can invite them to peek and see how many chocolate chips the monster ate.

- ***"Let's look at all the chocolate chips the monster ate today."***

- ***"Want to peek? Oh my! He ate a lot of chocolate chips! My tummy would be upset if I ate that many chocolate chips!"***

It's not important to come up with this total. Students may just want to see all that the monster has eaten.

Working Together

This activity is most conducive to group work rather than pairs. Once the students are comfortable with the game and you are feeding the monster for the second or third time, you may want to remind them of how to play.

Breaking It Down		
First you do this: Look at two brownies (counting cards).	**Next you do this:** Figure out how many chocolate chips are on the brownies.	**Then you do this:** Write the number on a card and feed the chocolate chips to the monster!

Feedback Phrases: You could say…		
"How many chocolate chips are on this first brownie? How many are on the second brownie?" ***"Let's count them altogether."*** To encourage counting on: ***"How many are on this brownie?*** (Flip the card so the dots can't be seen.) ***Let's keep counting on with this brownie."*** (Count on the dots on the second brownie.)	***"How many are on the first brownie? How many are on the second brownie?"*** Flip both cards down after the students have seen them. ***"How many is that altogether?"*** Students in this level may make use of their fingers and could count from one or begin by counting on. To encourage counting on, you could increase the number of dots on the first brownie: ***"How many are on this brownie?*** (Flip the card so the dots can't be seen.) ***Let's keep counting on with this brownie."*** (Count on the dots on the second brownie.)	***"How many are on the first brownie? How many are on the second brownie?"*** Flip both cards down after the students have seen them. ***"How many is that altogether?"*** Students at this level may find success counting on. You may want to encourage them to work with sums that are close to ten. ***"How many is 10 chocolate chips and 6 chocolate chips?"*** ***"So how many is 9 chocolate chips and 6 chocolate chips?"***

WRAPPING UP:

- ***"I noticed you doing addition today. When you say how many chips there are altogether on the two brownies, you are adding. Sometimes you did this by counting and other times you just knew!"***
- ***"Think for a moment and hold your answer while I ask you one more question. Tell me how many chocolate chips I would have if my first brownie had 4 chips and my second brownie had 3 chips?"*** (Wait for all students to think about this problem, then have one student share.)
- ***"The more you do addition like this, the better you will get at it."***

Appendix B

Curriculum Pacing Guide and Sample Activities

Curriculum Pacing Guide

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
0	**Getting to Know You**		**High 5s Expectations**	
1	**Blast Off**	**Guess My Number**	**Build Stairs** *Counting*	
2	**Blast Off**	**Guess My Number**	**Shake and Compare** *Composition of Number*	
3	**Blast Off**	**Guess My Number**	**Pattern Repeater** *Patterning*	**Family Note:** **Shake and Compare**
4	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
5	**Number Mat**	**Dump and Sing**	**Longest Train** *Counting*	
6	**Number Mat**	**Dump and Sing**	**Chocolate Chip Count** *Early Addition and Subtraction*	
7	**Number Mat**	**Dump and Sing**	**Clothesline Numbers** *Counting*	**Family Note:** **Clothesline Numbers**
8	**Game Day**			

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
9	**Ollie Otter**	**Break and Make**	**Shake and Compare** *Composition of Number*	
10	**Ollie Otter**	**Break and Make**	**Chocolate Chip Count** *Early Addition and Subtraction*	
11	**Ollie Otter**	**Break and Make**	**Longest Train** *Counting*	**Family Note: Chocolate Chip Count**
12	**Game Day**			

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
13	**Number Mat**	**Guess My Number**	**Clothesline Numbers** *Counting*	
14	**Number Mat**	**Guess My Number**	**Chip Stack** *Early Addition and Subtraction*	
15	**Number Mat**	**Guess My Number**	**Building With Shapes – Puzzle Maker – Day 1** *Geometry*	**Family Note: Building Shapes 1**
16	**Game Day**			

	Assessment Day (Counting) – Game Day #16

	Send Home Teacher Note – Meeting #17

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
17	**Number Before and After**	**Shape Sort**	**Chocolate Chip Count** *Early Addition and Subtraction*	
18	**Number Before and After**	**Shape Sort**	**Clothesline Numbers** *Counting*	
19	**Number Before and After**	**Shape Sort**	**Chip Stack** *Early Addition and Subtraction*	**Family Note: Number Before and After**
20	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
21	**Ollie Otter**	**Dump and Sing**	**Building With Shapes - Puzzle Shapes – Day 2** *Geometry*	
22	**Ollie Otter**	**Dump and Sing**	**Fish for a Number** *Composition of Numbers*	
23	**Ollie Otter**	**Dump and Sing**	**Addition Bingo** *Early Addition and Subtraction*	**Family Note: Ollie Otter**
24	**Game Day**			

Send Home Personalized Family Note – Club meeting #27

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
25	**Dot Strips**	**Break and Make**	**Chip Stack** *Early Addition and Subtraction*	
26	**Dot Strips**	**Break and Make**	**Fish for a Number** *Composition of Number*	
27	**Dot Strips**	**Break and Make**	**Building With Shapes – Shape Maker - Day 3** *Geometry*	**Family Note: Dot Strips**
28			**Game Day**	

Assessment Day (Addition/Subtraction) – Game Day #28

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
29	**Number Before and After**	**Shape Sort**	**Addition Bingo** *Early Addition and Subtraction*	
30	**Number Before and After**	**Shape Sort**	**Fish for a Number** *Composition of Number*	
31	**Number Before and After**	**Shape Sort**	**Sammy the Squirrel** *Early Addition and Subtraction*	**Family Note: Shape Sort**
32			**Game Day**	

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
33	**Number Flip - Decade**	**Find a Partner**	**Addition Bingo** *Early Addition and Subtraction*	
34	**Number Flip - Decade**	**Find a Partner**	**Memory** *Composition of Number*	
35	**Number Flip - Decade**	**Find a Partner**	**Sammy the Squirrel** *Early Addition and Subtraction*	**Family Note: Find a Partner**
36	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
37	**Dot Strips**	**What's the Number?**	**How Much Bigger?** *Early Addition and Subtraction*	
38	**Dot Strips**	**What's the Number?**	**Comparison Bingo** *Early Addition and Subtraction*	
39	**Dot Strips**	**What's the Number?**	**Memory** *Composition of Number*	**Family Note: What's the Number?**
40	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
41	**Core Unit Concert**	**Go Round**	**Sammy the Squirrel** *Early Addition and Subtraction*	
42	**Core Unit Concert**	**Go Round**	**How Much Bigger?** *Early Addition and Subtraction*	
43	**Core Unit Concert**	**Go Round**	**Comparison Bingo** *Early Addition and Subtraction*	**Family Note: Core Unit Concert**
44	**Game Day**			

Send Teacher Note – Meeting #44.

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
45	**Busy Beaver 10s or 1s**	**What's the Number?**	**Pattern Repeater 2** *Patterning*	
46	**Busy Beaver 10s or 1s**	**What's the Number?**	**Memory** *Composition of Number*	
47	**Busy Beaver 10s or 1s**	**What's the Number?**	**How Much Bigger?** *Early Addition and Subtraction*	**Family Note: How Much Bigger?**
48	**Game Day**			

Assessment Day (Counting) – Game Day #48

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
49	**Number Flip - Decade**	**Core Unit Concert**	**Comparison Bingo** *Early Addition and Subtraction*	
50	**Number Flip - Decade**	**Core Unit Concert**	**Chilly Cherry** *Counting*	
51	**Number Flip - Decade**	**Core Unit Concert**	**Magic Number Trick** *Early Addition and Subtraction*	**Family Note: Magic Number Trick**
52	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
53	**Busy Beaver 10s or 1s**	**Go Round**	**Measurement Olympics 1** *Measurement*	
54	**Busy Beaver 10s or 1s**	**Go Round**	**Magic Number Trick** *Early Addition and Subtraction*	
55	**Busy Beaver 10s or 1s**	**Go Round**	**Chilly Cherry** *Counting*	**Family Note: Busy Beaver 10s or 1s**
56	**Game Day**			

	Send Home Personalized Family Note – Prior to Spring Break

Note: Consult your supervisor on the timing of this Personalized Family Note. It should be sent home prior to the school year's Spring Break week.

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
57	**Farmer Finnegan**	**Frog Jump Measure**	**Paper Folding Cat** *Geometry*	
58	**Farmer Finnegan**	**Frog Jump Measure**	**Chocolate Chip Monster** *Early Addition and Subtraction*	
59	**Farmer Finnegan**	**Frog Jump Measure**	**Magic Number Trick** *Early Addition and Subtraction*	**Family Note: Chocolate Chip Monster**
60	**Game Day**			

	Assessment Day (Addition/Subtraction) – Game Day #60

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
61	**Is it or Not?**	**Find a Partner**	**Chilly Cherry** *Counting*	
62	**Is it or Not?**	**Find a Partner**	**Paper Folding Boat** *Geometry*	
63	**Is it or Not?**	**Find a Partner**	**Crack the Code** *Counting*	**Family Note: Paper Folding**
64	**Game Day**			

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
65	**Busy Beaver 10s and 1s**	**Special Squares**	**Chocolate Chip Monster** *Early Addition and Subtraction*	
66	**Busy Beaver 10s and 1s**	**Is it or Not?**	**Measurement Olympics 2** *Measurement*	
67	**Busy Beaver 10s and 1s**	**Is it or Not?**	**Phil the Baker** *Early Addition and Subtraction*	**Family Note: Is It or Not?**
68	**Game Day**			

	Start-Up Activity 7-10 minutes		Main Activity 15-20 minutes *(Trajectory)*	Family Note
69	**Farmer Finnegan**	**Frog Jump Measure**	**Chocolate Chip Monster** *Early Addition and Subtraction*	
70	**Farmer Finnegan**	**Frog Jump Measure**	**Crack the Code** *Counting*	
71	**Farmer Finnegan**	**Frog Jump Measure**	**Shape Mosaic A** *Geometry*	**Family Note: Crack the Code**
72	**Game Day**			

	Assessment Day (Counting) – Game Day #72

Note: Consult your supervisor on the timing of this Assessment Day.

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
73	**Chip Flip Century**	**Make the Number**	**Phil the Baker** *Early Addition and Subtraction*	
74	**Chip Flip Century**	**Make the Number**	**Pattern Repeater 2** *Patterning*	
75	**Chip Flip Century**	**Make the Number**	**Cherry and Mr. S'more** *Early Addition and Subtraction*	**Family Note: Cherry and Mr. S'more**
76	**Game Day**			

Note: Pacing Guide Day 84 Wrap-Up Activity preparation: Facilitator/student photos should be taken to allow enough time for printing.

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
77	**Busy Beaver 10s and 1s**	**Special Squares**	**Measurement Olympics 3** *Measurement*	
78	**Busy Beaver 10s and 1s**	**Is it or Not?**	**Cherry and Mr. S'more** *Early Addition and Subtraction*	
79	**Busy Beaver 10s and 1s**	**Is it or Not?**	**Crack the Code** *Counting*	**Family Note: Measurement Olympics**
80	**Game Day**			

	Start-Up Activity 7-10 minutes		**Main Activity** 15-20 minutes *(Trajectory)*	**Family Note**
81	**Chip Flip Century**	**Make the Number**	**Phil the Baker** *Early Addition and Subtraction*	
82	**Chip Flip Century**	**Make the Number**	**Shape Mosaic B** *Geometry*	
83	**Chip Flip Century**	**Make the Number**	**Cherry and Mr. S'more** *Early Addition and Subtraction*	**Family Note: Phil the Baker**
84	**Make Ten**		**High 5s Bump** *Early Addition and Subtraction*	
85	**Get the Carrot**		**Crack the Code Puzzles** *Counting*	
86	**How Much Farther?**		**Building with Shapes #3** *Geometry*	
87	**Wrap-up Activity** (Wrap-Up Day 1)			
88	**Open Choice/Play Favorite Game(s)** (Wrap-Up Day 2)			

Note on Wrap-up/Final Day: It is possible not all clubs will have time for 83 meetings, plus the Wrap-up and Final Day activities. Consult your supervisor to ensure that these two activities occur on the last two meetings of your club, regardless of what Pacing Guide Day you are on in the last week.

Appendix C

Club Session Log Content

Session Details

Date	2/23/2/016	**Status**	Completed
Substituting?	No	**Club**	401A
Was Math Club Held Today?	Yes		

Lesson Details

Lesson Number	43	**Start Time**	2/23/2016 11:01AM
		End Time	2/23/2016 11:26AM

Attendance Matrix

	Present	Partial Attendance	Absent
Student A	○	○	○
Student B	○	○	○
Student C	○	○	○
Student D	○	○	○

Activities

Start-Up Activity?	Yes	**Game Day?**	No
Main Day Activity?	Yes	**Assessment Day?**	

Start-Up Activity Details

Start-Up Activity Duration (Minutes)	8
First Start-Up Activity	Core Unit Concert
Second Start-Up Activity	Go Round

Engagement

○ 1	○ 2	○ 3	○ 4	○ 5
All students are disengaged	More students are disengaged than engaged	Students are split equally	More students are engaged than disengaged	All students are engaged

Main Activity Details

Main Activity Duration (Minutes)	16
Main Activity	Comparison Bingo

Engagement

○	○	○	○	○
1	2	3	4	5
All students are disengaged	More students are disengaged than engaged	Students are split equally	More students are engaged than disengaged	All students are engaged

Overall Feedback

Please indicate whether any of these problems were encountered today

- ☐ Transitioning children to clubs
- ☐ Transition children from clubs
- ☐ Difficult to use start-up material
- ☐ Difficult to use main activity material
- ☐ Low levels of student engagement
- ☐ Not enough material for start-up
- ☐ Not enough material for main activity
- ☐ Other

Other Problems Description:

Challenging Behavior

○	○	○	○	○
1	2	3	4	5
No instances	Intermittent/minor behavior challenges	Frequent/minor OR intermittent/intense	Somewhat frequent and intense	Ongoing and intense

Definitions for select terms and phrases from the Facilitator Log are provided below in the order in which they occur on the log.

Basic Information

- **Date for which you are submitting a log:** The day the club was held.
- **Substitute facilitator:** Facilitator is facilitating a club they are not normally assigned to because the assigned facilitator is not available.
- **Location:** The name of the school at which the club was held.
- **Group:** The name associated with a specific club.
- **Math club held:** Mark "yes" if a math club occurred. If not, select from one of the following:
    - Scheduled School Closing: There was a planned school closing due to the observance of national, local, or religious holidays, scheduled school breaks or teacher professional development days. Neither children nor staff are in attendance on these days.
    - Unscheduled School Closing: The building is closed as a result of inclement weather, facilities malfunction or repair, or any other unforeseen reason.
    - Space Unavailable: No location was available to run the math club and therefore the facilitator was unable to conduct the club.
    - Change in School Schedule: A change in the student or teacher schedule prevented a math club from occurring (for example, if all kindergarten students are away on an all-day field trip).
    - Insufficient Number of Students Attended: The number of students in attendance was below two and only one adult was in attendance or no students were in attendance and therefore a math club could not be conducted. Do not select this option if no students were in attendance because of a change in the school schedule (see above).
- **High 5s Club Lesson #:** The lesson number (indicated on the High 5s Pacing Guide) that was implemented that day. Please indicate the lesson you implemented that day even if you made a mistake and implemented a lesson that was scheduled to occur on a different day.
- **Start time:** The time when instruction began.
- **End time:** The time when students were dismissed.
- **Present:** Student was present for the entirety of the club (from the start time to the end time).

- **Attendance**
    - **Partial Attendance:** Student was present for at least 10 minutes, but was 5 or more minutes late, or left the club 5 or more minutes early.
    - **Absent:** Student was not present for at least 10 minutes of the club.
- **Game Day:** A Game Day was held during the club. Please indicate if you held a Game Day even if you made a mistake and according to the Pacing Guide a Game Day was not scheduled to occur on that day.
- **High 5s Club routines**: The set of activities specified on the High 5s Pacing Guide, including Start-up and Main Activities.
    - **Start-up:** The set of activities, specified on the Pacing Guide, to be played at the start of a High 5s Club. Each lesson will include two Start-up Activities. Please indicate that Start-Up activities you implemented, even if you accidently implemented activities that, according to the Pacing Guide, were not schedule to occur that day.
    - **Main Activity:** The activity specified on the Pacing Guide to be played after the Start-up activities. A lesson will include one Main Activity. Please indicate that Main Activity you implemented, even if you accidently implemented activities that, according to the Pacing Guide, were not schedule to occur that day.

Section A – Feedback on Start-Up Activities

- **Start-up Activities played today:** The Start-up Activities played in a particular club on a particular day, regardless of what should have been played according to the lesson in the Pacing Guide.

- **Minutes spent on Start-up Activities:** The total amount of time, in minutes, spent on both Start-up Activities.

- **Student engagement in Start-up Activities:** The overall level of student engagement during both Start-up activities, on a scale of 1 to 5, based on whether the children are engaged, responsive, playing with materials, coming up with their own extensions to the activities, smiling and laughing, and want to continue beyond the time allotted. A score of 1 indicates that all students are disengaged while a score of 5 indicates that all students are engaged.

Section B – Feedback on Main Activity

- **Main Activity played today:** The Main Activity played in a particular club on a particular day, regardless of what should have been played according to the lesson in the Pacing Guide.

- **Minutes spent on Main Activity:** The total amount of time, in minutes, spent on the Main Activity.

- **Student engagement in Main Activity:** The overall level of student engagement during the Main Activity, on a scale of 1 to 5, based on whether the children are engaged, responsive, playing with materials, coming up with their own extensions to the activities, smiling and laughing, and want to continue beyond the time allotted. A score of 1 indicates that all students are disengaged while a score of 5 indicates that all students are engaged.

Section C – Game Day Activities

- **Student engagement in Game Day Activities:** The overall level of student engagement during Game Day Activities, on a scale of 1 to 5, based on whether the children are engaged, responsive, playing with materials, coming up with their own extensions to the activities, smiling and laughing, and want to continue beyond the time allotted. A score of 1 indicates that all students are disengaged while a score of 5 indicates that all students are engaged.

Section D – Assessment Day

- **Assessment Day:** Supervisor will collect formative assessment data on children's counting and geometry knowledge three times a year. This information is not used for the research but will be used to help improve facilitators' implementation by helping them to target the math activities to children's level more effectively.
    - **Assessment activity conducted:** The assessment conducted as specified by the ___.
- **Trajectory:** A highly probable progression of learning through which students develop over time. Our focus on learning trajectories, rather than on content standards, allows us to align the lessons and facilitator interactions with students' natural tendencies as they develop mathematically. Learning trajectories are based on the observed mathematical behavior of students, and each trajectory is focused on a single concept area. In the High 5s program, we have developed activities to support students in their learning in five concept areas; counting, composition of number, early addition and subtraction, constructing shapes, and attributes of shapes.
    - **Trajectory level:** On average, what a facilitator, supervisor, or other observer saw a child do in a particular activity during an assessment. See Section 3 of the manual for more information on trajectory levels.

Section E – Overall Feedback

- **Problems:** Any issues that hinder facilitation of a math club, force a facilitator to spent too much or too little time with a club, detract from the planned activities, reduce the quality of instruction, force a facilitator to veer off-script, lessen fidelity to the facilitation model, create distractions, reduce student engagement, etc.
  - **Problems transitioning children to clubs:** The facilitator or school staff had issues moving the children from their original locations to the High 5s club.
  - **Problems transitioning children from clubs back to their regular activities:** The facilitator or school staff had issues transitioning the children from the High 5s club back to their regular school activities.
  - **Materials for the Start-up Activities were difficult to use:** The materials intended for the Start-up Activity were designed in a way that made it difficult to facilitate the activity.
  - **Materials for the Main Activity were difficult to use:** The materials intended for the Main Activity were designed in a way that made it difficult to facilitate the activity.
  - **Low levels of student engagement:** Student shows a low level of interest, involvement, and excitement around the activities.
  - **Not enough material written to fill the time for the Start-up Activities:** The combined length of the Start-up Activities was too short to allow the facilitator to fill the -10-14 minutes allotted.
  - **Not enough material written to fill the time for the Main Activity:** The combined length of the Main Activity was too short to allow the facilitator to fill the 20-30 minutes allotted.
- **Challenging behavior:** Any student behavior that hinders facilitation of a math club by creating distractions for other students, reducing the quality of instruction, taking a significant portion of the facilitator's attention, creating a hostile environment, or causing any other problems. A score of 1 indicates that there were no instances of behavior challenges while a score of 5 indicates that there were ongoing an intense instances of behavior challenges throughout the club.

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Strengthening Children's Math Skills with Enhanced Instruction
The Impacts of Making Pre-K Count and High 5s on Kindergarten Outcomes
2018. Shira K. Mattera, Robin Jacob, Pamela A. Morris

Counting on Early Math Skills
Preliminary Kindergarten Impacts of the Making Pre-K Count and High 5s Programs
2017. Shira Mattera, Pamela Morris

Making Pre-K Count
Improving Math Instruction in New York City
2016. Pamela A. Morris, Shira K. Mattera, Michelle F. Maier

NOTE: All the publications listed above are available for free download at www.mdrc.org.

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