NUMERACY AT SCALE FINDINGS BRIEF

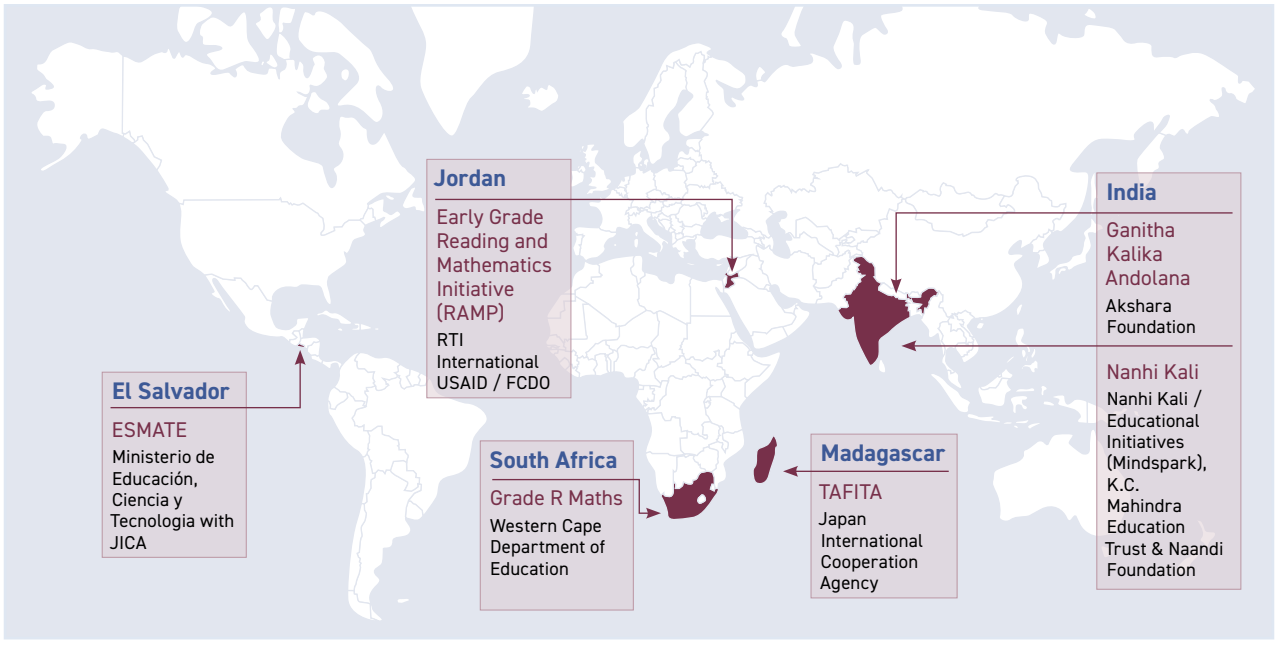
GKA in India

Introduction to Numeracy at Scale

The Learning at Scale study was designed to explore programs that have a demonstrated impact on foundational learning outcomes at scale. The goal of this research is to identify and examine successful aspects of these programs to provide policy makers and development practitioners with evidence-based strategies for improving instruction and learning outcomes across contexts. The research is being led by RTI International and is part of the Center for Global Development education research consortium, funded by the Bill and Melinda Gates Foundation.

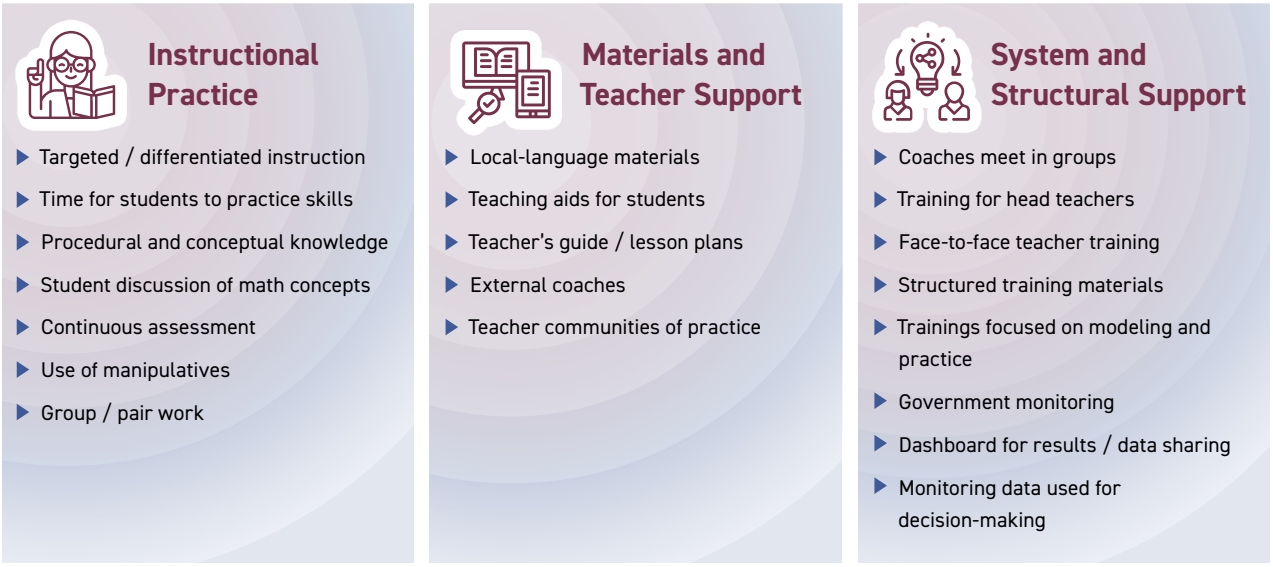
While the first phase of Learning at Scale focused on literacy, the second phase, Numeracy at Scale, is focused on (1) identifying instructional strategies that are essential for improving numeracy outcomes at scale in low- and middle-income countries; and (2) learning about the characteristics of the education systems within which successful scaled-up numeracy programs operate. To this end, the study team identified and analyzed six programs across five countries that had rigorous evidence of impact on numeracy learning outcomes and which were operating at scale or which showed the potential for scale in an entire region or country (see Figure 1).

Figure 1. Numeracy at Scale partners



The six Numeracy at Scale programs represent a variety of designs, from providing instruction to at-risk girls via interactive software to a national-scale numeracy initiative integrated into all public primary schools. Despite their differences, these programs share a large number of common elements (see Figure 2).

Figure 2. Common elements across successful large-scale numeracy programs



Even with these common elements, these programs provide evidence of multiple pathways to success. For example:

- All programs provided teachers with training and support, but the approaches that teachers found most impactful for student learning varied.
- In all programs, teachers incorporated independent and group work and focused on building both procedural and conceptual understanding, but their use of materials and student discussion varied.
- Head teachers were trained and relied on the use of data for decision-making in five of the programs, but they differed across programs in how they provided (or sought) support for struggling teachers.
- Coaches or mentors were engaged across programs, but their roles, expectations, and level of support varied greatly.

The remainder of this brief provides an overview of the Numeracy at Scale research methodology generally and explores the findings from one of the programs studied—Ganitha Kalika Andolana (GKA) in India.

Numeracy at Scale Research Methodology

The Numeracy at Scale study investigated three main research questions:

1. What classroom ingredients (such as teaching practices and classroom environment) lead to learning in programs that are effective at scale?
2. What methods of training and support lead to teachers adopting effective classroom practices?

3 What system-level support is required to deliver effective training and support to teachers and to promote effective classroom practices?

In addition, cross-cutting questions, based on previous research on mathematics teaching and learning, focused on whether and how teachers emphasized conceptual understanding, the role of representations or conceptual models, and the use of manipulatives or other hands-on activities.

In each country, the study teams carried out a mixed-methods study. See Figure 3 for an overview of the study design.

The data collection to examine the GKA program followed the overall design for the other program. Figure 4 shows the respondents from the data collection for GKA in India.

Figure 4. GKA study respondents

Respondent	Total
Quantitative	
Schools	80
Teachers	80
Head teachers	80
Qualitative	
Schools	9
Teachers	9
Students	45
District/local officals	4
Region/central officials	12
Program/partner staff	9

Figure 3. Numeracy at Scale study design

Quantitative:

- 80–130 schools per country
- In each school:
  - Math lessons observed
  - Interviews of teachers, head teachers, trainers, teacher meeting facilitators, and/or coaches
  - Mathematical Knowledge for Teaching survey[1]

Qualitative:

- 9 schools (subsample)
- In each school:
  - Math lessons observed for 3 days
  - Open-ended interviews of teachers
  - Cognitive interviews with students
- Semi-structured interviews with program staff and Ministry of Education officials, including those responsible for teacher training, school supervision, and curriculum and materials

1 The Mathematics Knowledge for Teaching survey is a short survey (23 items) that measures primary-grade teachers' knowledge of mathematical concepts and their pedagogical content knowledge. For more information, see Wendi Ralaingita, Aizada Mamytova, and Yasmin Sitabkhan, "Capturing Teachers' Mathematical Knowledge for Teaching" (2023), https://shared.rti.org/content/mathematical-knowledge-teaching-survey-cies-2023-presentation.

GKA Program Overview

GKA is a multi-stakeholder initiative designed by the Akshara Foundation for improving mathematics learning outcomes for primary students attending government schools in three Indian states: Karnataka, Odisha, and Andhra Pradesh. For this study, we examined GKA in its origin state, Karnataka, where it focuses on grades 4 and 5 (See Figure 5). Central to the GKA model are math kits aimed at providing small groups of students with hands on experience in applying math knowledge.

Figure 5. The Ganitha Kalika Andolana (GKA) model

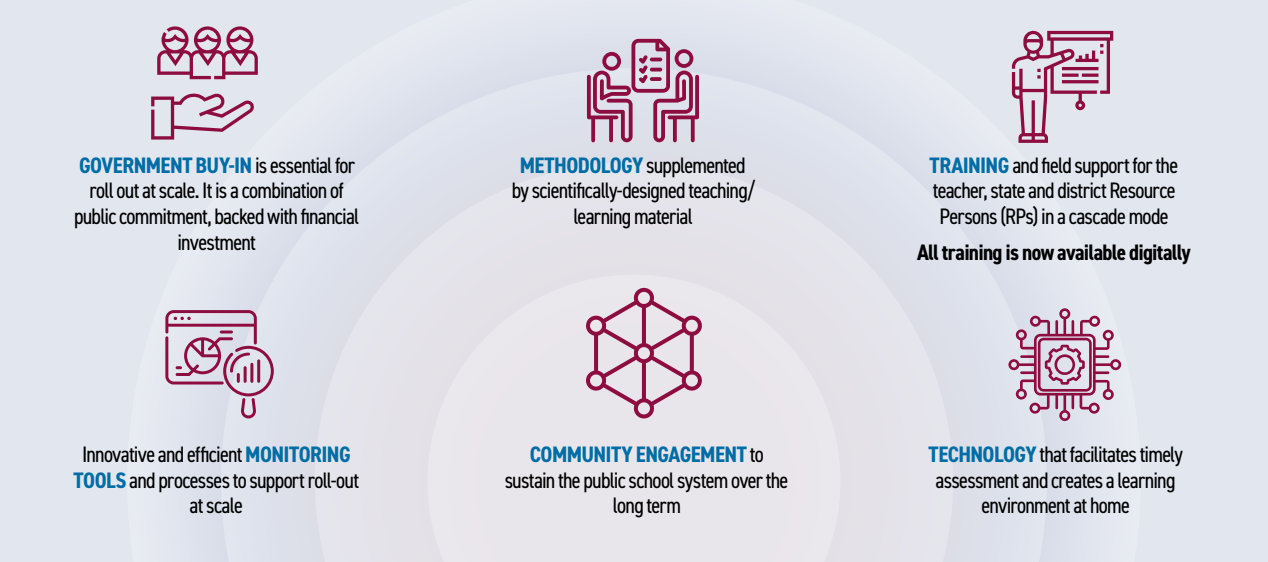
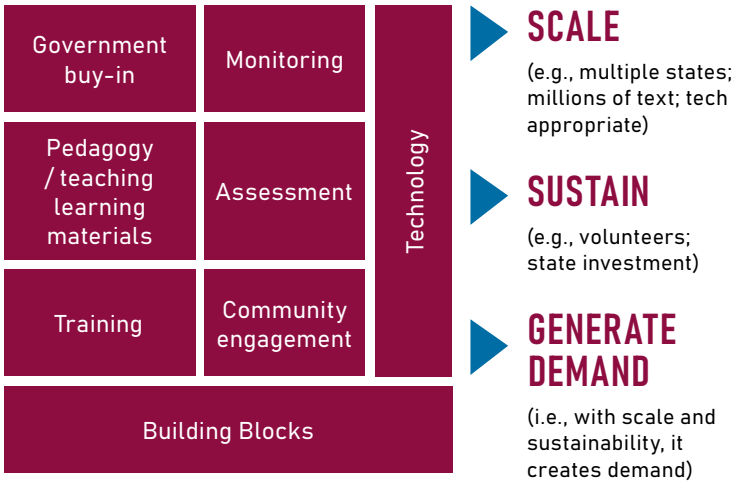


Figure adapted from the Akshara Foundation's 'Six-Box Model'

The design and ongoing implementation of GKA is a partnership between the Akshara Foundation, the state of Karnataka, and community members. The foundation designed the GKA model to work at scale, funded the pilot, trains the trainers, and monitors the program. The state now funds the trainings and kits and communicates expectations to districts and schools. The community helps monitor the use of the math kits and student learning. Figure 6 presents GKA's theory of change.

The alignment between the program's content and government policies is one reason for GKA's success. Another factor is the community's engagement in monitoring the use of the math kits and student learning. The development and ongoing implementation of GKA is a partnership between the foundation, the state, and community members.

Figure 6. GKA's theory of change



Source: Recreated from an image drawn by Akshara Foundation Chairman Ashok Kamath

GKA's Approach to Math

Materials

GKA enhances math education through comprehensive kits that emphasize problem-solving skills, conceptual understanding, and real-world application[2]. The kits are intended to be used across grades (grades 1–3 or 4–5). The cost per kit is 3,500 rupees (about US$42). Each kit comes with a corresponding teacher's handbook.

Teacher training

GKA's approach to teacher trainings has evolved to respond to realities and improved technology. GKA designs the trainings, and the state government funds them. In-person trainings are given to 35 handpicked math practitioners to serve as key resource people who can then train at the district level. Additional trainings are then provided at the block and the cluster levels.[3] GKA ensures that at least one teacher per school is trained, and head teachers are educated about the math kits in order to support teachers' use of them. Monthly teacher meetings are held at the cluster level and are led by the government. The podcast Pratibimba provides another means of training teachers.

Teacher support

Multiple methods are used to indirectly support teachers. Trained education volunteers conduct school visits and use the Karnataka Learning Partnership app to respond to five questions about teachers: 1) Are they present at school that day; 2) Do they adhere to the recommended class schedule; 3) Have they been trained; 4) What is their usage of teaching and learning materials; 5) How do they incorporate group work activities.

Another method is the use of math contests at the community level. Held at the lowest administrative unit (which consists of about seven to nine schools) students in grades 4, 5, 6 convene at one school to take a written competency-based math test.

Students are arranged according to their school, while teachers and community members serve as onlookers and monitors. Over a four-hour period, the assessment is given and scored, and then results are shared and discussed by the teachers and community. The education volunteers have a role here too as mediators as needed. The Akshara Foundation creates the assessment, and the activity is funded by the local community.

Pedagogical approach

The GKA model posits that learning is active, dynamic, and social and happens when students have hands-on experiences where they can apply their math knowledge. One key feature of GKA's pedagogical approach is group collaboration, whereby five to six students with mixed abilities work together to solve problems. In addition, the teacher's handbook addresses all of the concepts in the government syllabus and provides guidance so that teachers can act more as facilitators than instructors during group work.

2 The materials include the following: abacus, base ten blocks, clock, clothes clips, coins, decimal place value strips, decimal set, dice, fraction shapes, fraction strips, geo board, geosolids with nets, math concept cards, measuring tape, number line, place value mat, place value strips, play money, protractor and angle measure, square counters, tangram, and weighing balances.

3 The government, with support from Akshara Foundation, trains the math teachers through a cascade model

Findings from GKA

Findings from the Numeracy at Scale study's qualitative and quantitative data collection activities in India provide insights into how GKA was able to achieve improved outcomes at scale.

The following subsections discuss the findings from GKA in relation to the Numeracy at Scale research questions.

Research Question 1

What classroom ingredients (such as teaching practices and classroom environment) lead to learning in programs that are effective at scale?

To understand what instructional practices may be leading to improvements in learning outcomes, the study team analyzed data from both quantitative and qualitative classroom data, as well as teacher interviews.

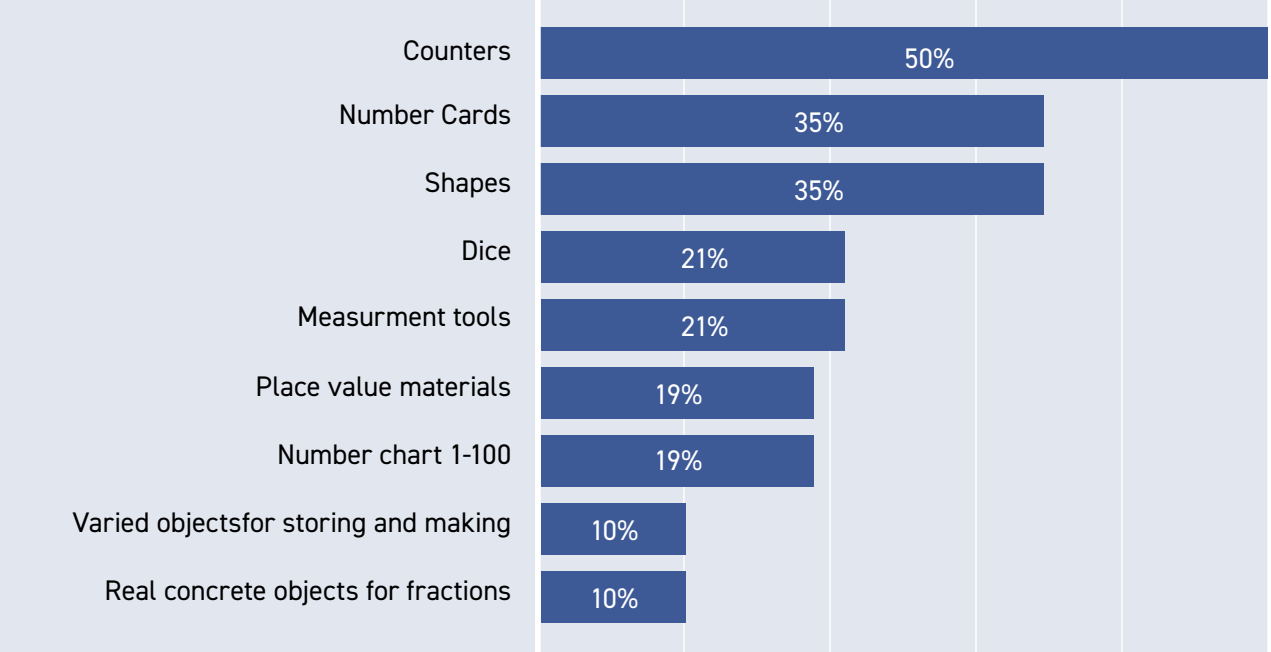
THEME 1 Use of multiple representations.

The design of the GKA model was influenced by teachers who saw a need for concrete materials to teach math concepts. Years later, materials—specifically the manipulatives provided in the math kit—are the center of the program and were observed being used widely during lessons. Teachers were universally observed (100%) using materials from the math kit during the modeling and discussion portion of the lesson in order to represent mathematical concepts. By using multiple representations, including both concrete materials and abstraction symbols, teachers can help students understand mathematical concepts better, as well as link these concepts to abstract notation. For example, in one class, the teacher demonstrated how to find place value using both an abacus and base ten blocks. He wrote a number on the board and asked students to find the place value. One student found the answer using an abacus, while another found it using the base ten blocks.

In addition to the teacher using multiple representations by drawing on the materials from the math kit, students also used the materials themselves. During the modeling and discussion phase of lessons, all students were observed using materials from the math kit in over half (51%) of lessons. During independent and group work, all students had an opportunity to use the materials in 66% of lessons, and in 27% of lessons a subset of students used the materials, which may reflect the use of the kit in groups.

Observations revealed the diversity of materials used during lessons (see Figure 7), with counters being used in half of the lessons observed and objects for fractions being used the least, which likely reflects the topics being covered in the lessons observed.

Figure 7. Materials used during independent work



The ubiquity of the use of materials aligns with teachers' opinions of which GKA supports are most useful. Over two-thirds of teachers interviewed (68%) identified materials for students (such as manipulatives) as the most useful.

THEME 2 Connections with real-world contexts and students' experiences.

In 93% of the lessons observed, teachers drew connections to students' experiences and real-life contexts. Linking formal mathematics with informal, everyday math and contexts with which students are familiar can both help them understand math concepts and increase their motivation and engagement.

The qualitative observations were replete with examples of teachers making connections with the real world and students' experiences—often combined with the use of realistic representations (such as money and clocks). Some examples include:

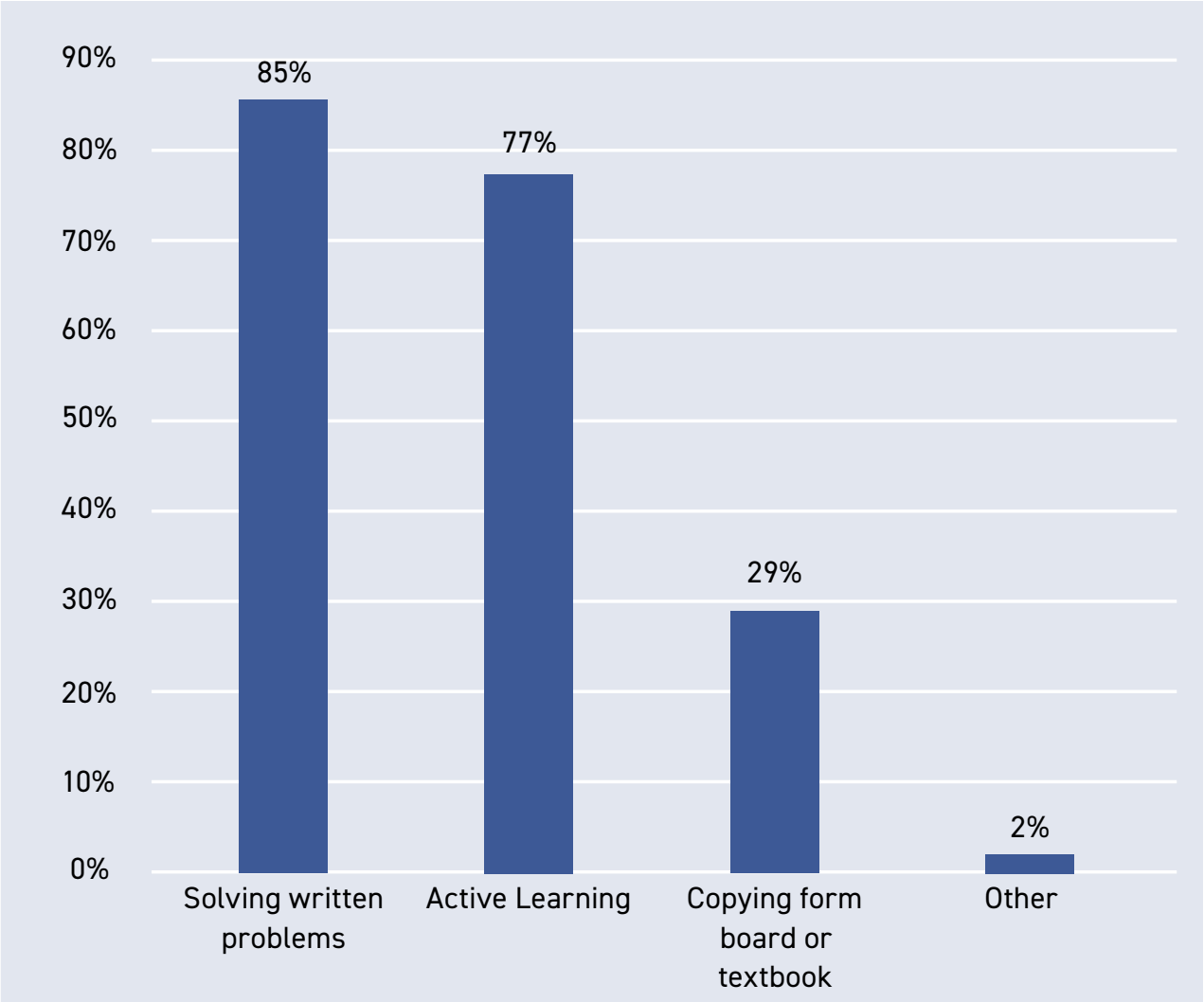
- When introducing and discussing different shapes, the teacher asked students to draw the shape and then give examples of where they might find it in real life.
- A teacher showed a clock, asked students why time is important, and facilitated a conversation about the different times at which children do things throughout the day.
- A teacher provided rupee notes to students and asked them to find out how much they each had and then to find out how much they all had together.

THEME 3 Student engagement.

As noted above, observations showed students actively involved, with the majority of students having the opportunity to use concrete materials to aid in problem-solving. Over half of lessons (58%) included time for independent or group work. During this time, students were generally

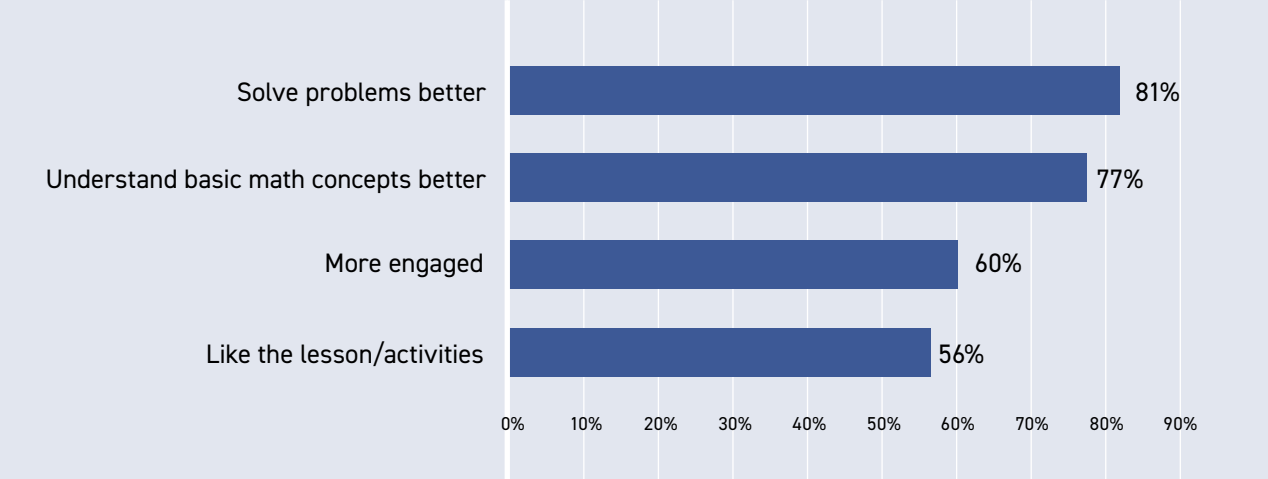
observed to be either working on solving written problems, such as practicing what the teacher had modeled or explained (85%), or working on an interactive activity, such as playing a game or working with the materials (71%) (see Figure 8). Less than a third of the time (29%) were students observed to be simply copying from the board or a textbook.

Figure 8. Student tasks



The benefits of this emphasis on student engagement, as well as the use of multiple representations and manipulatives, were apparent to head teachers and teachers. Three-quarters of head teachers interviewed (75%) noted that students are more active in the classroom than before GKA. In addition, the teachers reported specific ways that GKA has influenced their instruction. A significant majority of teachers noted that they now include a greater focus on using multiple strategies (79%) and having students explore and solve problems (75%). As a result of these new approaches, teachers noted that students are better at solving problems (81%) and understanding basic math concepts (77%). These increased abilities contribute to more engagement (60%) and liking the activities more (56%) (see Figure 9).

Figure 9. Teacher interviews: Changes in students since GKA started



THEME 4 Use of assessments to track student progress.

Classroom-based assessments are a part of the GKA program design. Over three-fourths (78%) of teachers reported being trained on conducting student assessments. Over one-half (51%) were observed giving an assignment for the purpose of grading. Nearly half (47%) were observed checking students' work, and nearly a third (32%) were observed collecting this work for the purpose of reviewing it. This attention to tracking student progress was identified by nearly half (47%) of the head teachers interviewed as a focus of the government following the COVID-19 pandemic.

Research Question 2

What methods of training and support lead to teachers adopting effective classroom practices?

Data from interviews with teachers and head teachers provide insight into how GKA's teacher training and support model has led to successful implementation of the program's instructional approach.

THEME 1 Teaching Aids and Student Materials.

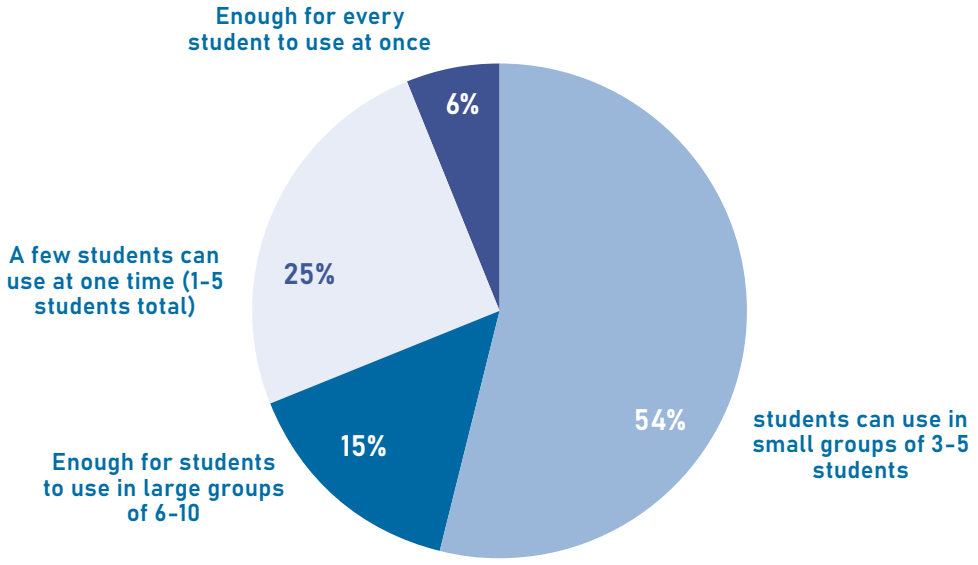
The overwhelming majority (87%) of GKA teachers cited the teaching and learning materials materials, including the math kit, as the single most useful support provided by the program. When asked how GKA materials differed from those received previously, over three-quarters of teachers explained that the GKA teaching aids and manipulatives keep students more engaged and that the materials include more activities. One-half of teachers also noted that these materials are well aligned with the curriculum.

Table 1. Difference between GKA and past materials, according to teachers

Teaching aids and manipulatives keep students more engaged	87%
Include more or better activities and examples	75%
Aligned with textbooks and curriculum	51%
Better organized and easier to follow	39%
Step-by-step instructions	39%
Manageable amount of content and materials	33%
Received sufficient quantity	13%
Delivered on time	10%

When asked about the quantity of materials received, the majority of teachers (54%) reported having enough materials so that students can use them while working in small groups of three to five. Another 40% of teachers reported fewer materials, saying that there are enough for children to share in large groups (15%) or for just a few children to use at a time (25%) (Figure 10).

Figure 10. Quantity of materials received from GKA, according to teachers



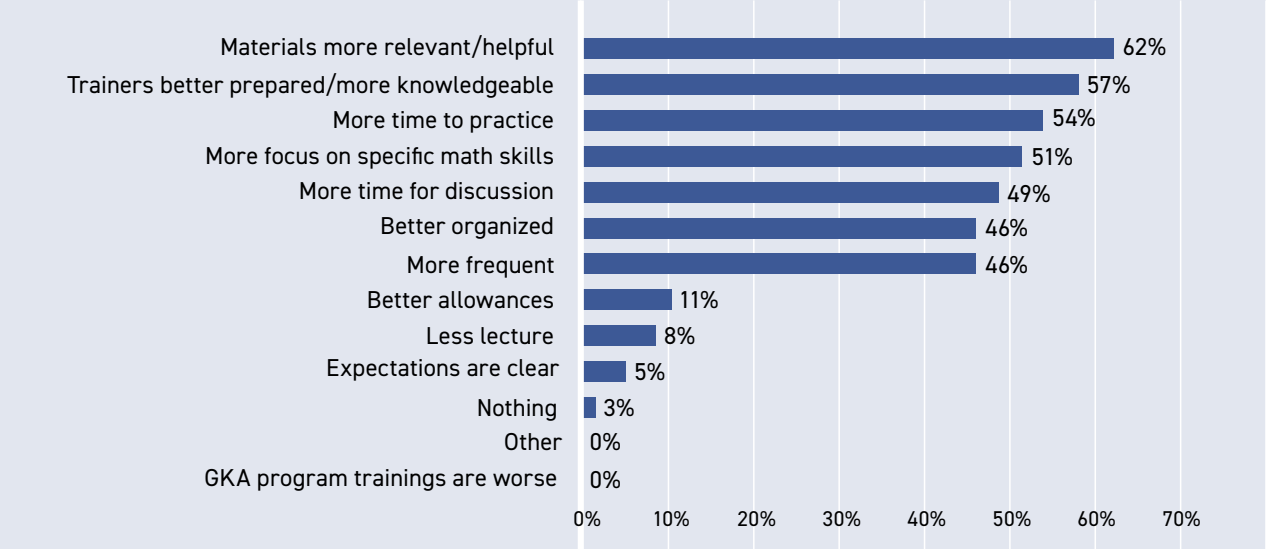
These findings draw a clear line from (1) the intended design of GKA to (2) the material supports reported by teachers to (3) the student engagement, student practice, and multiple representations of math concepts observed during lessons.

THEME 2 Trainings are relevant and organized.

GKA's support for teachers begins with training. When asked to compare GKA trainings to other trainings received in the past, teachers' responses suggest that GKA trainings are relevant and organized, which in turn contributes to teachers' success in using the GKA approach in classrooms (see Figure 11). When asked how GKA trainings were different from those of previous programs, over one-half of teachers noted that the materials used for GKA trainings were more helpful and that GKA training facilitators were more knowledgeable and better prepared. Additionally, nearly

half (46%) of the teachers described the GKA trainings as better organized, while 54% and 49% noted that the trainings allocated more time for practice and discussion, respectively. Lastly, 51% described the GKA trainings as having an increased focus on specific math skills.

Figure 11. GKA training differences noted by teachers



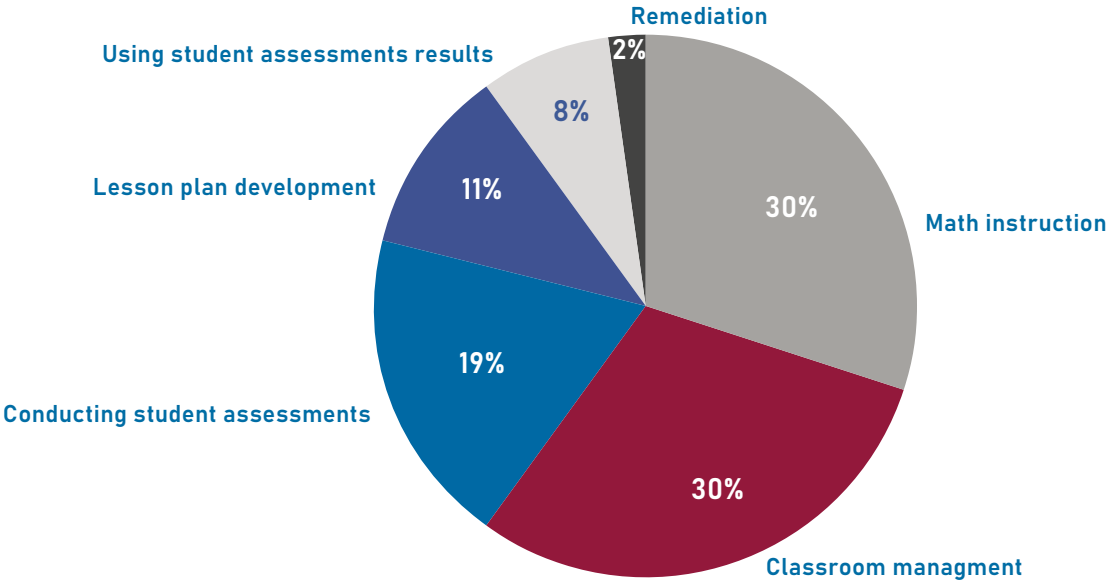
When asked to identify which GKA training approach they found most useful, more than one-half of the teachers cited modeling, while another one-quarter of teachers said small-group practice (Table 2).

Table 2. Most useful training approach, according to teachers

Modeling and demonstration	54%
Small-group practice	24%
Discussion	16%
Lecture	3%
None of the above	3%
Large-group practice	0%

Interestingly, teachers also reported that the most useful content they received during GKA trainings was math instruction and classroom management (see Figure 12). Teachers' approval of a focus on math instruction has been mapped across all programs in the Numeracy at Scale study, while the emphasis on management is unique to GKA. This may be due in part to the high number of materials and manipulatives used by GKA teachers—their use necessitates clear, consistent classroom norms and procedures

Figure 12. GKA training differences noted by teachers

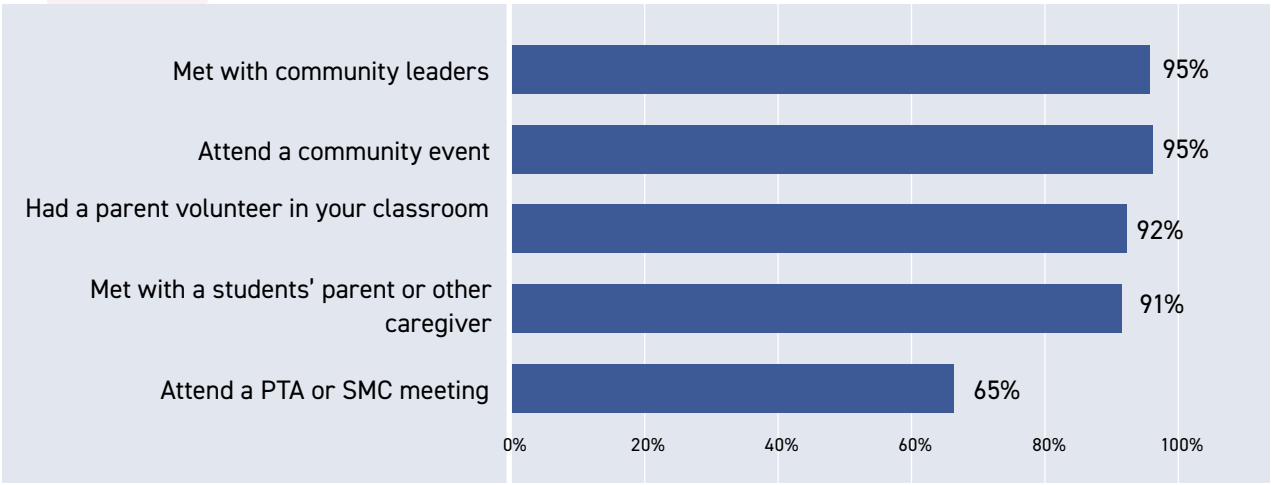


Also interestingly, more than one-third of teachers (37%) reported that the last training they received was virtual—one of the highest rates of reported participation in virtual trainings across Numeracy at Scale programs, which points to an area for discussion and learning from GKA.

PROGRAM HIGHLIGHT: Parent and Community Engagement.

As Figure 13 shows, when asked about parent- and community-engagement activities they had taken part in over the past month, virtually all teachers reported meeting with community leaders, attending a community event, meeting with parents and caregivers, and attending a parent-teacher association or school management committee meeting.

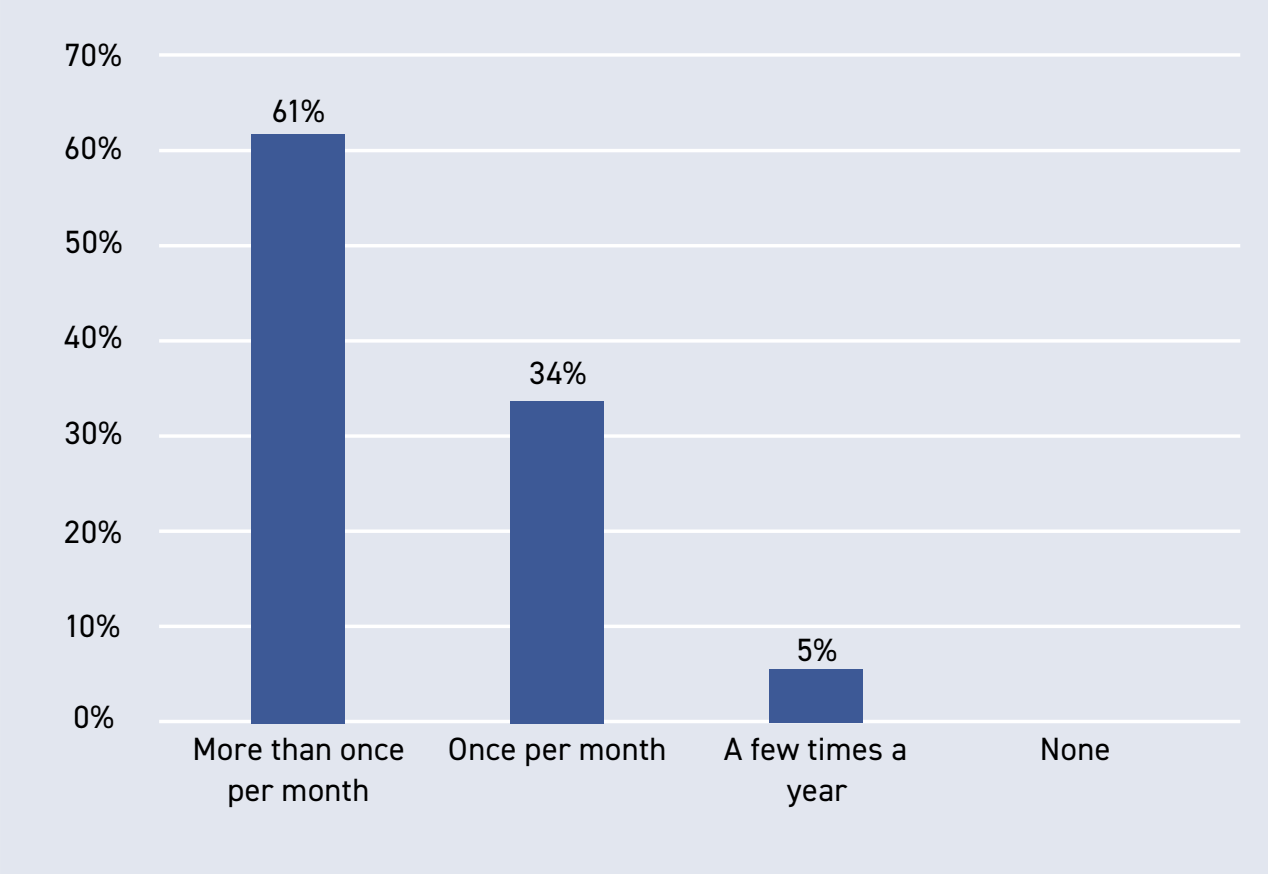
Figure 13. Teachers' average participation in parent- and community-engagement activities during the past month



Relatedly, all head teachers reported that their school has a functioning school management and development committee (SMDC). The vast majority (90%) also reported having an annual operational plan, while 44% reported having a school strategic improvement plan (all as part of the SMDC's work). When asked how frequently SMDCs meet, virtually every head teacher said that they convene once a month or more (Figure 14). When asked about the main activities resulting

from the SMDC's work in the past year, 85% of head teachers mentioned at least one activity that involves instruction.

Figure 14. Frequency of SMDC meetings, as reported by head teachers



Research Question 3

What system support is required to deliver effective training and support to teachers and to promote effective classroom practices?

Following the initial pilot, the Akshara Foundation worked hard to gain state government buy-in for the program and, in turn, government funding for the math kits and teacher training. As a result of these efforts, today the GKA program is institutionalized within the education system in several ways: it has dedicated government funding, it is aligned with the official curriculum, and training takes place through preexisting mechanisms established by the government.

THEME 1 Government resources for GKA scale-up.

Right from GKA's design, the Akshara Foundation aimed to secure government buy-in to ensure scalability and sustainability. By consulting teachers during the design phase, assessing the pilot's effectiveness, and showcasing its successes, the foundation convinced the Karnataka state government to finance the initiative. This led to budget provisions for the math kits and teacher training. The state government also funded a statewide training of teachers in grades 4 and 5 on how to use the kits to teach the math curriculum. Moreover, the government is now extending the GKA program to grades 6–8, and the development and testing of new kits are fully funded by the state.

THEME 2 Alignment with government policies and system priorities.

The government's embrace of the GKA program was possible because of GKA's alignment with the existing curriculum and its addressing of teachers' needs. The Akshara Foundation carefully designed kits that helped teachers implement the new government curriculum that emphasized activity-based learning. Because teachers and math experts were consulted in the design and pilot phases, the kits were easily adaptable to individual classrooms, and teachers did not see using them as additional work. In addition, the Akshara Foundation designed the math kits to align with similar kits already in use as part of the government's Nali Kali program in the early grades. The foundation's partnership with the government also extends to embedding QR codes in official government textbooks, which links students and teachers to additional resources developed by GKA.

THEME 3 Implementing through government systems.

Being able to reach over 45,000 schools and 12 million children in grades 4–5 necessitates implementation through government systems. GKA relies heavily on the state's infrastructure, personnel, and processes to be able to implement at such a scale. For example, to communicate expectations to teachers, GKA collaborates with the Karnataka education department to issue government orders or official "circulars." Given the state's bureaucratic nature, such directives are vital for stakeholder action. Additionally, teacher training is organized through the District Institute for Education, block resource centers, and cluster resource centers, which are systems that the government uses to provide in-service training and support for teachers.

Summary

By strategically collaborating with the government of Karnataka, the Akshara Foundation has effectively championed government scale-up of the GKA program. From the program's inception, the foundation prioritized government endorsement and institutionalization—a decision that ultimately paid off. Today, the government of Karnataka is supporting the implementation of GKA in all schools by paying for the math kits and teacher training and integrating the program within the existing education system. The government's commitment to scale the program to additional grades (6–8) is further proof of government ownership and collaboration.

Future Considerations

As governments and NGO's seek to learn from the GKA model, there are both key findings that should be emphasized and areas to be explored further in terms of instruction, teacher support, and community engagement:

The GKA math kits, full of learning materials, were key in engaging students and strengthening their understanding of math concepts through different representations. These may have been especially helpful as teachers and students work to make up for learning lost during COVID-19. As state education departments look to sustain or replicate GKA, it could be useful to collect additional data from teachers currently using the math kits – in order to prioritize investments in those materials the teachers report as being most helpful.

In terms of teacher support, three unique factors stood out that other programs and governments may find valuable to learn more about/may warrant further study: 1) the role of parents and the community in using assessment results; 2) virtual training mechanisms and 3) the emphasis on classroom management during training, as a pre-requisite for materials use and increased student independent work.

While the community math concepts appear useful for strengthening accountability relationships between the school and parents, the results are not available to policy makers. As the program matures, the systematic collection of data on math learning outcomes will help the system with decisions about curriculum and professional development needs of teachers.

Authored by: Dr. Margaret M. Dubeck, Dr. Wendi Ralaingita, Dr. Bidemi Carrol, Rachel Jordan, and Julianne Norman

SEPTEMBER 2023