Scaling Up SimCalc Project

Designing the Logistics for Large-Scale Randomized Controlled Trials

Six Strategies for Implementation at Scale

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Gucci Estrella, Nicole Shechtman, Jeremy Roschelle

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Research collaborators:

University of Massachusetts, Dartmouth; Virginia Polytechnic Institute and State University;
The University of Texas at Austin; and the Charles A. Dana Center at the University of Texas at Austin

SRI International
Center for Technology in Learning
333 Ravenswood Avenue
Menlo Park, CA 94025-3493
650.859.2000

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Prepared by:

Gucci Estrella, SRI International

Nicole Shechtman, SRI International

Jeremy Roschelle, SRI International

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Designing the Logistics for Large-Scale Randomized Controlled Trials

Six Strategies for Implementation at Scale

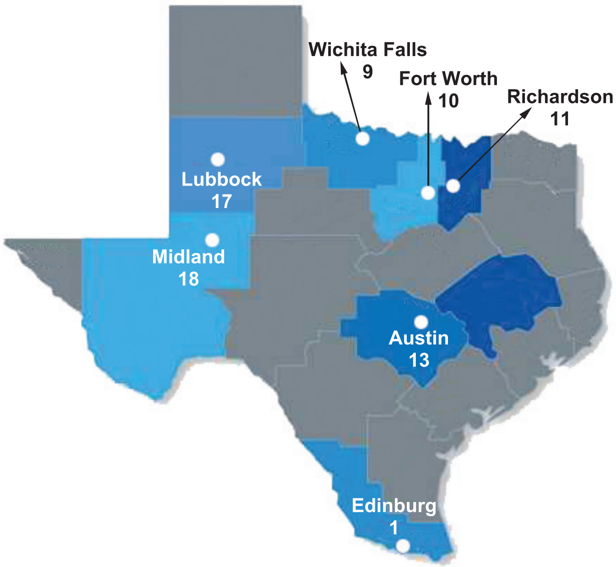
The Scaling Up SimCalc Project demonstrates how careful attention to logistics can permit use of a distributed data strategy in a set of large-scale experiments without compromising rigorous control and systematic organization of data. This technical report documents the key challenges and strategies.

In conducting large-scale randomized controlled trials (RCTs), the meticulous attention paid to research design, methodology, and data analysis is only useful if the same meticulousness is devoted to the logistics of collection of data in the field. Yet little documentation exists about best practices in large-scale research logistics. In the Scaling Up SimCalc Project, we conducted two large-scale RCTs[1] with a sample of 196 seventh- and eighth-grade teachers (before attrition) spread across 8 of the 20 regions in Texas, as shown in Exhibit 1. Here we discuss the logistical challenges that arose and the strategies we developed to handle these challenges.

The Challenges

Prior to these large-scale RCTs, the Scaling Up SimCalc team conducted a pilot study with a smaller sample (21 teachers). This pilot helped to uncover challenges that could arise at a larger scale. Based on these findings and what we learned subsequently in the large-scale implementations, key challenges that needed to be addressed in the design of the logistical system included:

Exhibit 1. Participants in the SimCalc studies were geographically distributed across the 8 highlighted regions of Texas.



- *Experimental control and consistency.* In any RCT, the need for rigor and experimental control is crucial, regardless of the sample size. The intervention and measures must be administered consistently without any significant differences between experimental and control conditions. Similarly, teachers across all groups must receive consistent messages about the purpose of the research and the research processes in which they are engaged.

[1] For a complete description of the research, see Roschelle, J., Shechtman, N., Tatar, D., Hegedus, S., Hopkins, B., Empson, S., Knudsen, J. & Gallagher, L. (in press). Integration of technology, curriculum, and professional development for advancing middle school mathematics: Three large-scale studies. *American Educational Research Journal*.

- *The necessity to have research participants be the data collectors.* To have the research team on site throughout these two large and geographically diffuse experiments would have been prohibitively costly. Consequently, the research participants — the teachers — had to collect most of the data. Of course, teachers have limited time and energy, and additional activities, research or otherwise, could become burdensome, particularly for an RCT that required the administration of multiple instruments at different times.

- *Staying on top of communications with more than 100 teachers at a time.* We needed to track teachers' progress throughout the school year, each working on their own and constantly changing schedule. Communication needed to be tailored to individual teachers for where they were in the project trajectory at any given moment.

- *Coordinating communication across the geographically distributed research team a*s is often the case with large-scale research that requires complex multidisciplinary, multi-institutional teams. The research team itself was geographically distributed across several states (California, Texas, Massachusetts, New Jersey, and Virginia).

- *Avoidance of errors.* As the data moves back and forth between the research team and the many research participants, errors are a strong potential risk.

- *Avoidance of missing data.* Data collection must be systematic with a high rate of return and little missing data to diminish threats to the integrity of the research.

- *Minimization of attrition.* Because the experiments would place high expectations on teachers, attrition was a significant risk. Strategies needed to be in place to keep teachers motivated and not feeling frustrated, overburdened, or simply out of the loop.

- *Maintenance of participant anonymity.* A fundamental ethical and legal requirement of research is that participant anonymity be maintained. This introduces logistical challenges, particularly because all instruments must be tracked and matched for individual participants (i.e., teachers and students).

- *Conservation of resources.* Without careful design, logistically complex project management activities could consume considerable time and other resources.

We report on the elements involved in the careful design of an integrated system of logistics that addressed these challenges in the implementation of the Scaling Up SimCalc RCTs.

Six Strategies for Implementation at Scale

To address the challenges of implementing these large-scale experiments, we developed six strategies:

1. Appointment of a project manager with a strong customer service ethic who served as "mission control" for all the participants, partners and researchers in the study
2. A sequence of standard communications initiated with each teacher at the beginning of the school year and before, during, and after teaching the SimCalc replacement unit
3. A custom-designed online database with calendar and e-mail features
4. Use of carefully scripted orientation videos that delivered consistent messages about the project and laid the foundation for teachers' relationships with the project staff
5. A rigorous system of organization, logistics, and data tracking
6. Incentives for research participants in the form of professional development, instructional materials, and stipends

Each strategy is detailed below.

Strategy 1: Project Manager as Mission Control

The SimCalc project team assigned a project manager with experience in both classroom teaching and project management to serve as an accessible, professional yet personal point of contact to create a strong presence for the research among the teachers in Texas. The project manager had a customer service orientation, regarding the teachers as the customers to be served. Teachers experienced the project through one name, one face, one toll-free phone number, and one e-mail address.

At the most basic level, conducting communications through a single project manager reduced confusion about who teachers should ask about project matters and minimized conflicting messages that might have occurred if different members of the project team provided inconsistent information on different occasions. The project manager conveyed clear and consistent instructions while also emphasizing the purposes and requirements of the research to promote understanding, buy-in, and compliance.

Critical to SimCalc's success was the ability to anticipate teachers' needs and potential sources of trouble. Having benefited from the findings of the pilot study, as well as her own experience as a classroom teacher, the project manager was attuned to the needs of participants and the details of the research. Her goal was to proactively provide just-in-time supports when teachers needed them.

The project manager was a thoughtful listener, attentive to the concerns of the participants and the research team but able to balance any conflicts or misalignments. Moreover, she was empathic but also firm about nonnegotiable project requirements. She sought to troubleshoot situations in a manner that was respectful of the needs of both teachers and the project. Persistence was essential as the project manager worked to promote teachers' adherence to the rigorous schedule, with the recognition that they generally wanted to be compliant but were simply overwhelmed with balancing multiple demands. Repeated interactions therefore paved the way for establishing a personal relationship that showed her keen regard for the teachers as partners, although she remained cognizant of the need for professional distance.

Although mostly outward facing, the project manager was also key in coordinating the activities of the internal research team. The distribution of researchers across five institutions in four states necessitated regular contact to ensure synchronicity of tasks and unity as a team. For example, the project manager coordinated the research team and served as a primary point of contact for the subset of teachers selected for classroom observations and/or phone interviews. Having the project manager as the central source for questions about logistics reduced researchers' need to figure out where and how to obtain information or who to coordinate with. The SimCalc team — teachers and researchers alike — found the project manager to be like a mission control center, playing an instrumental role in the efficiency of communications. Throughout the duration of both studies she stayed in close communication with the research team, consulting with experts as needed and keeping all members informed about project management issues and solutions.

In addition, the project manager occasionally enlisted the assistance of the local Educational Service Centers (ESCs) in each region, whose primary function is to support teacher professional development. The ESC is a well-regarded institution, and in fact served as the main recruitment channel for the project. This provided the participants with a familiar local contact that they could call on as needed.

Strategy 2:
A Sequence of Standard Communications

To further help teachers adhere to research protocols, the SimCalc project manager contacted them (both the experiment and control conditions) in a predetermined and standardized sequence. These communications occurred at the beginning of the school year and before, during, and after the intervention period. A considerable investment was made in this function. The project manager spent an average of 2 hours communicating with each teacher over the course of the experiments, using both e-mail and telephone. She devised e-mail templates and phone scripts to ensure expediency and consistency but also personalized messages to address participants' unique concerns. Wait time to respond to teachers was kept at a minimum regardless of whether contact was made by e-mail or phone.

One standard communication was the "pre-unit check-in." The project manager, in collaboration with other members of the research team, constructed a script for a 30-minute telephone discussion that walked teachers through the elements of the research and implementation. This discussion was designed to remind teachers of the various activities required of them as described in the orientation video (Strategy 3) they had seen previously, go over all the data collection forms with the actual materials in hand, and provide an opportunity for teachers to ask questions.

Throughout teachers' intervention period, the project manager kept track of their progress, reminding them about milestone data collection tasks and providing opportunities for feedback. Contact was conducted primarily through e-mail, although telephone calls were made as a backup or when teachers specified a preference for telephone communication.

Upon completion of the unit, the project manager worked with the teachers to make sure all requirements were completed as necessary, the materials were shipped back to the research team, and any follow-up interviews were scheduled.

Through frequent communications and a personal/professional approach, the project manager gave teachers the feeling that they were partners in the research project rather than mere sources of data. As one teacher commented, "It was very nice to receive the amount of e-mails I received. I felt like I hadn't been forgotten, that they were keeping up with everything and it made me feel like this was important. So, it kept my attitude about this more serious."

Strategy 3:
A Custom-Designed Online Database with Calendar and E-mail Capabilities

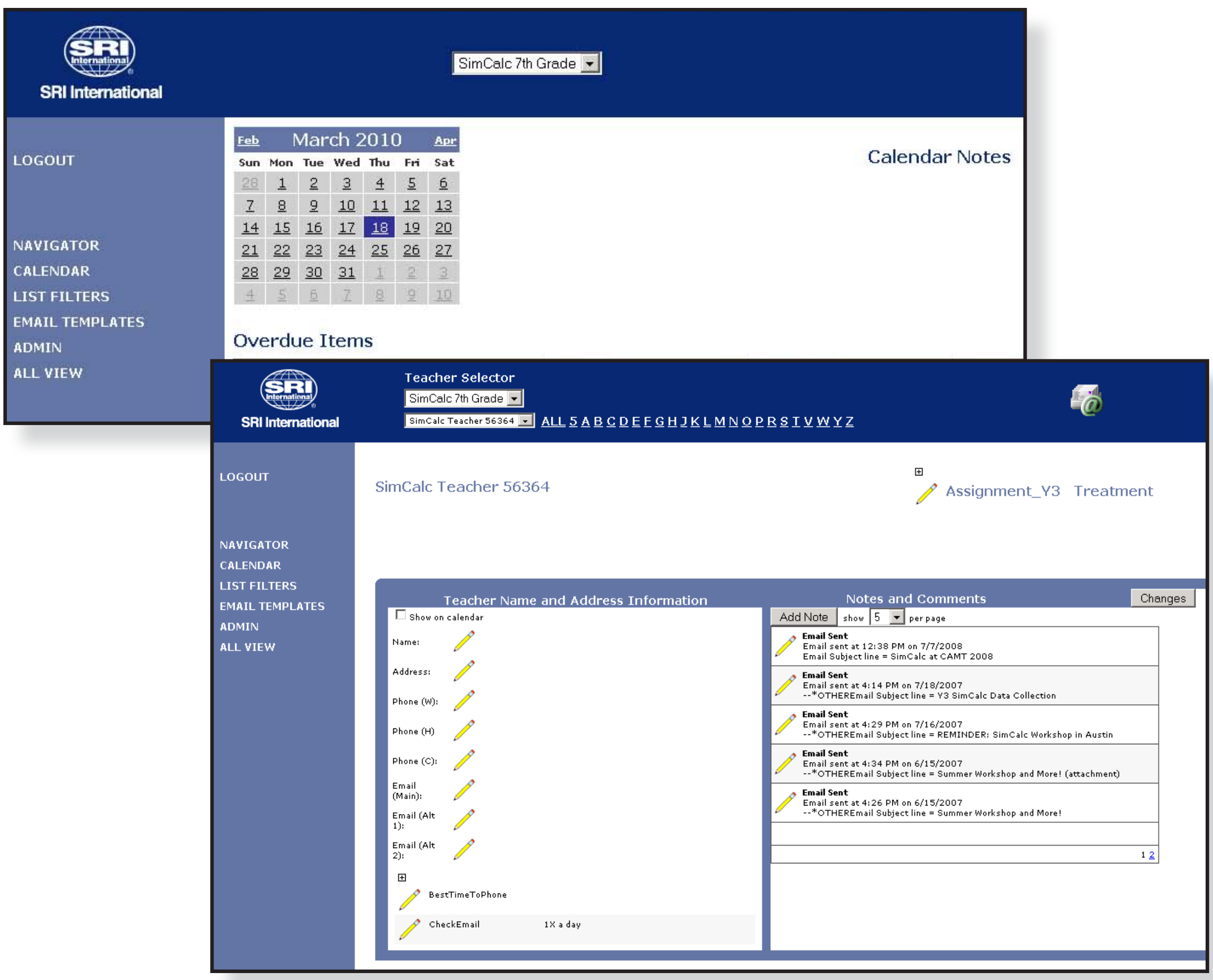
Because the SimCalc intervention was designed as a replacement for existing curricula, teachers were at liberty to use the intervention at any point during the 9-month school year. Therefore, the project manager needed to track simultaneously the various and constantly shifting schedules of more than 100 teachers at a time, in order to provide the appropriate communications in a timely manner and stay on top of the exchange of materials,.

To address this challenge, SRI custom-built a database to manage information and communications (see Exhibit 2). Key features of the database were as follows:

- *All relevant information about the teacher and the status of his or her materials.* For example, the database contained teacher contact information, experimental group, the status of their unit implementation, and the status of their deliverables. It also tracked the teacher's predicted start-date of the unit during the school year. This was initially ascertained through an exchange with teachers at the beginning of the year, and tended to change with time.

- *A calendar page that automatically calculated due dates for each teacher's milestones and deliverables.* All key dates for each teacher were calculated based on his or her predicted start date. This page displayed automated alerts that facilitated precisely timed communications and the tracking of materials tailored to each teacher's schedules.
- *Capability to author, store, modify, send, and log the use of template e-mails.* This allowed the project manager to easily send out standardized messages to one, some, or all teachers at the appropriate time points. The template emails could be modified for each individual teacher at any given time. Each teacher's individual record also contained a log of the emails that had already been sent to them and allowed the project manager to also add notes regarding telephone calls.
- *Capability to import and export data records.* This facilitated the exchange of information with other members of the research team, such as those doing the technical data analyses.

Exhibit 2. The custom-built database allowed the project manager to see what actions were due. Clicking on the teachers' IDs displayed their information, offered the option of e-mailing teachers individually or as a subset (e.g., all those with overdue items), and kept a record of communications.



- *Secure online access.* While the project manager was the primary user of the database, online access allowed other members of the research team to access the information about teachers in real time as necessary.
- *Extensibility.* The database was designed so that administrative users could add new fields, studies, and users. This allowed the system to evolve robustly over the course of the project.

This integrated mechanism for communications and tracking provided the team with a running record that facilitated the project manager's ability to provide just-in-time support for teachers and the research team.

Strategy 4: Orientation Videos to Establish Experimental Control and Lay a Foundation for Relationships with the Project Team

One of the key challenges, maintaining experimental control and consistency, required that all participating teachers receive consistent messages about the purposes of the research and research activities in which they would engage. Teachers' relationship with the project began in a summer professional development workshop (2 to 5 days long, depending on the study and the group). While the main focus of the training was on the mathematical topics, another important goal was to introduce the research requirements of the project and develop the foundation of a year-long or even multiyear relationship with the research team. Multiple and repeated training sessions were conducted by a variety of trainers[2] whose focus was necessarily on communicating about mathematics and pedagogy, not research. We therefore needed to find a way to communicate the research aspects consistently, emphasizing the necessity of experimental control, without confusing or intimidating the teachers and without overburdening the trainers.

To address these issues, the research team produced an orientation video (Exhibit 3) that was shown during the initial professional development workshops. Careful planning went into the creation of an engaging script that conveyed the complex research processes in a simple yet comprehensive manner. The video was hosted by the project manager and presented in a format similar to a news feature. The principal investigator of the project also spoke directly to the teachers about the purpose of the research and its potential impact on mathematics education, emphasizing the valuable contributions of the research as a whole and the teachers in particular. The project manager provided an overview of the research and walked through all the procedures and research materials in a clear, consistent manner. The introduction of the project manager allowed teachers to put a face to the name and initiated the conversation that would endure over the project. Explanations were enhanced with dramatizations of procedures enacted by model teachers and researchers with the actual research materials (Exhibit 4). Slides and subtitles were used to emphasize important messages.

Exhibit 3. Using the format of a news feature, in the orientation video the project manager provided a guided tour of the research activities and materials.

2 One of the purposes of the Eighth-grade study was to examine scaling through a train-the-trainers model of professional development delivery.

The research team crafted a total of six versions of the video. The introductory shell and research instrument section were held constant, but the videos for the two different studies, treatment and control groups, and study years each contained slightly modified details. To the extent possible, the same video footage was used in each version.

Strategy 5: Carefully Designed Materials and Organizational System

Experiments at this scale require volumes of paper (see sidebar) and careful attention to detail to ensure the correct distribution of materials and to avoid the introduction of possible errors. The logistics system the project team designed enabled the teachers to pack-&-ship and the researchers to unpack-anonymize-&-analyze.

Quick Facts About Paper Volume in the Seventh Grade Year 1 Study

- Number of teachers: 117
- Estimated number of students: 3000
- Number of student workbooks shipped: 1800 (Treatment only)
- Number of student tests shipped: 7000 (pre/post for each student)
- Number of permission forms shipped: 4900 (English, Spanish, enough for turnover)
- Number of sheets of paper shipped to each teacher: 1060
- Total number of sheets of paper shipped out in two days: 124,000, which is about:
  - 21.5 miles, set out end to end
  - 3.7 stories, if stacked on top of each other

Pack-&-ship

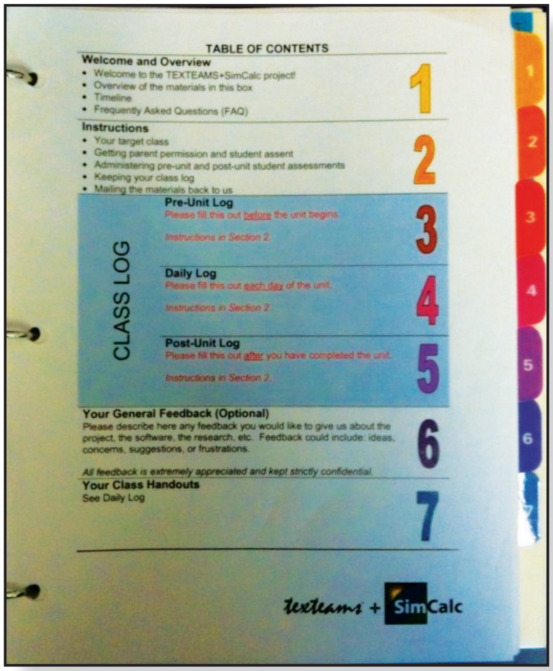
The project team designed a package that contained everything the teachers needed to teach their lessons with the SimCalc replacement unit (and/or control materials) and to complete the research requirements. The cornerstone of the SimCalc logistics system was the teacher box (Exhibit 4), an attractive and user-friendly consolidation of research materials intended to facilitate teachers' data collection in their classrooms. It was designed to withstand round-trip shipping and bore clear, recognizable markings (including SimCalc labels) so that teachers could keep all the materials in the box and store it in the classroom rather than have to use their already full cupboards.

Exhibit 4. The teacher box contained all the research and curricular materials with forms specific to the experimental group and study. The production and assembly of about 100 boxes required a team of 4-6 members working for about a week.

The teacher box contained:

- All instructional materials used in the project. For treatment teachers, this included student workbooks, teacher guides, and the SimCalc Mathworlds® software. For control teachers, this included other instructional materials used in the control workshop.
- A DVD of the research orientation video
- A personalized research binder (Exhibit 5) that described the research, provided written versions of the instructions presented in the orientation video, and provided customized information, such as which of their classes had been randomly chosen for the research.

Exhibit 5. To further augment communications, the research binder was a tool for outgoing messages on research instructions and incoming messages about teachers' implementation via the log (Sections 3–5) and a section for feedback collection.



• An envelope containing a classroom set of student/parent informed consent forms. Since many of the students in Texas come from Spanish-speaking families, we included versions of the consent forms in Spanish.

• An envelope containing a classroom set of student pre-tests, and an envelope containing a classroom set of student post-tests.

• A mathematics content assessment that teachers were to take at the end of the unit.

• The daily log—contained in the research binder—that the teacher was to complete each day of the unit (materials for SimCalc in the treatment groups, business as usual in the control groups). Teachers also recorded important information about their students and classrooms, e.g., technology setup, in the pre-unit and post-unit logs.

• A set of pencils with the SimCalc logo. These were included as a gesture of good will, as well as to help keep the presence of the project active for teachers throughout the year.

Importantly, the box also contained a prelabeled, prepaid FedEx shipping box with a roll of packing tape. At the end of the unit, teachers were to ship back completed consent forms, student assessments, workbooks, daily log, and teacher content assessment. Forms that needed to be returned to SRI in advance of the teacher box were similarly sent with a self-addressed stamped envelope. Because the safe return of data to SRI in California was of utmost importance, it was important to make it easy for teachers to simply tape up a box of data and call FedEx for pickup or put it in the mail.

To facilitate tracking, quality control, and anonymization, forms were prelabeled with unique numeric IDs. In addition, attached to the box and in the binder, was a schedule of activities and checklist of items to submit to SRI. Specific instructions for collecting consent forms and administering student assessments were printed both in the binder and on the envelopes containing the forms.

In a few cases (less than 5%) when teachers had problems with shipping, the project manager helped find alternate methods, such as providing a prepaid UPS label if FedEx was unable to make a pickup at a remote location or arranging for the local ESC to secure the box for the teacher and ship it SRI. Because we used FedEx with its detailed tracking mechanisms, we were even able to retrieve one box that had been mistakenly routed to Anchorage, Alaska.

Commenting on the organization of materials, one teacher stated,

> *"The way [the project team] set up the whole binder … was just very organized. You could just go from one section to the other and not really have to guess what*

you needed to do and turn it in and fill it out. It was very planned out for us."

Another teacher commented,

"I thought everything was very well organized. The research binder was organized, the box that we received in the mail with everything in it — even including the tapes to tape up your box — everything was very organized."

Unpack-anonymize-&-analyze

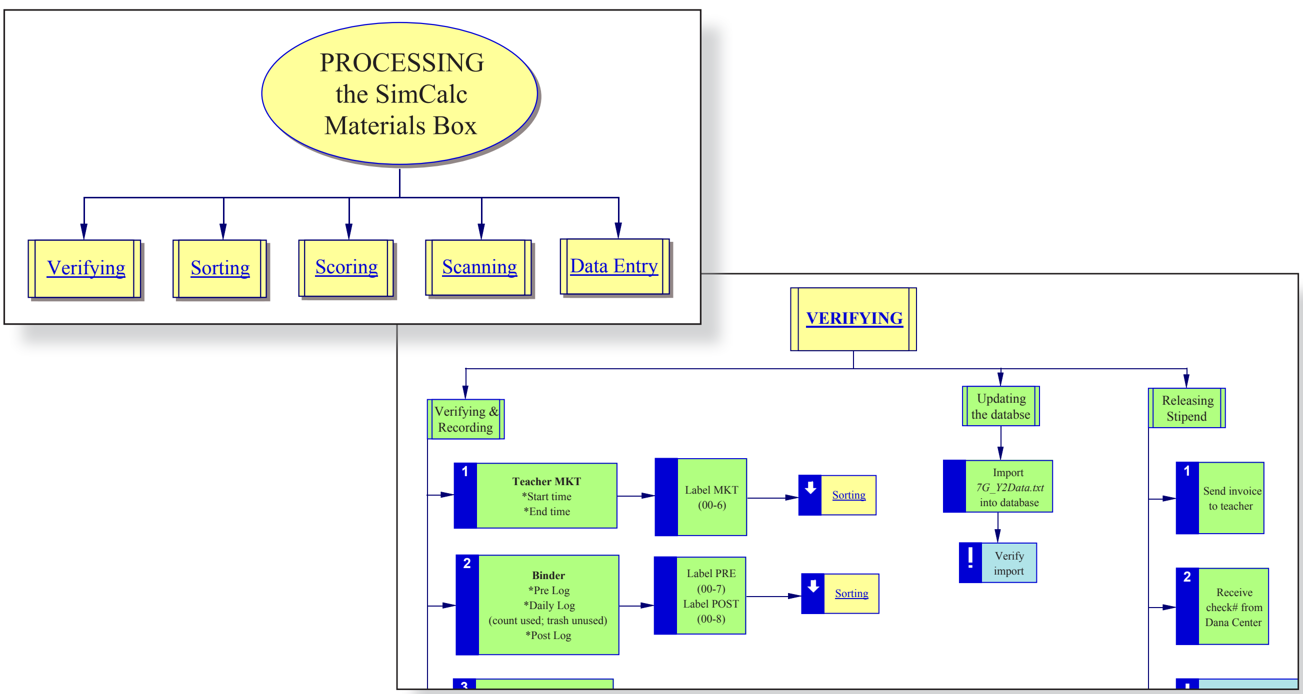
As illustrated in Exhibit 6, the arrival of data at SRI set off a chain of complex procedures to verify, sort, score, and convert the data into electronic form either through scanning or manual data entry. Student data on the pretest and posttest, workbooks, and the class roster included in the pre-unit log were cross-checked against each other. We developed a labeling system at both the teacher and student level to strip all identifying information from the data as soon as we linked the individual items of data collected using various instruments at different time points. (To have delegated this task to the teachers would have added significant burden to them.) Once data were in electronic form, hard copies were filed without identifying information by teacher ID for easy referencing. The wealth of data collected thus became accessible to all members of the research team, regardless of location, with the potential for accessibility by other researchers in the future.

Strategy 6: Incentives for Research Participation

A final important strategy was making sure research participants were adequately compensated for their efforts. Teachers (and their schools) received a compensation package with three components (within each study the packages were identical for the treatment and control groups):

1. Free training by recognized math experts within the state of Texas that counted toward professional development credit certified by the state, which

Exhibit 6. Flowcharts of the data processing illustrate how converting materials in the teacher box into an analyzable electronic format required a five-step process comprising complex procedures.



was made possible by the partnership with the Charles A. Dana Center, the leading professional development center in the state.

2. A classroom set of the SimCalc and the Dana Center technology-enhanced mathematics materials that were aligned with state standards for mathematics and technology.

3. Substantial monetary incentives throughout the project. Stipends were paid on completion of two annual milestones: completion of the summer professional development session and completion of data collection (i.e., the return of required research materials).

The SimCalc project also reimbursed teachers for all travel expenses for attendance in professional development sessions (summer and fall) whether within or outside the region. Teachers and principals also received letters of appreciation and invitations to deliver presentations at the leading practitioner conference for Texas teachers, the Conference for the Advancement in Mathematics Teaching. In addition, teachers were granted a lifetime license to the SimCalc MathWorlds software. Seventh-grade teachers were given the opportunity to continue with the research (and receive similar compensation) for a total of 3 years.

Conclusion

In addition to producing positive gains in student learning, the SimCalc project shed light on what is needed for a distributed data collection model to work in a large-scale RCT. A strong logistical system with supports for every activity and milestone should form the foundation of any distributed model. Although establishing this requires large investments in planning from the very beginning, the returns are significant. Projects need to enable teachers to participate in the research by explaining research concepts and activities in meaningful ways. In the case of SimCalc, the orientation video and especially the principal investigator's explanation underscored the importance of teachers' contributions, a message that was repeated throughout all stages of the research. Moreover, researchers conducting projects of this magnitude should consider assigning a project manager to coordinate the flow of materials and data, as well as to communicate with participants frequently and consistently throughout. By attending to the minute details of the project and the individual needs and challenges of research participants, the project manager was able to maintain the careful balance between the often conflicting priorities of researchers and teacher participants. We further believe that the project manager's customer service attitude toward teachers enhanced the experience of both teachers and researchers. As research on the scaling up of promising interventions continues, we welcome additional reporting on implementation logistics as an important enabler of research success.

Additional Acknowledgements

Successful implementation of the Scaling Up SimCalc project would not have been possible without the contributions of all our collaborators and most especially the SimCalc teachers. In particular, we thank the following people, without whom the carefully designed logistics system would have failed:

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SRI International
Center for Technology in Learning
333 Ravenswood Avenue
Menlo Park, CA 94025-3493
650.859.2000

www.ctl.sri.com
www.math.sri.com