



## Interactive Technologies in Early Mathematics Learning: Inquiry Group Report on Strategies to Advance Understanding Among Researchers and Educators

Josephine Louie, Pamela Buffington, Marian Pasquale,  
Catherine McCulloch



How can we generate deep and meaningful exchange among researchers and educational practitioners to improve knowledge and practice in the use of interactive technologies to support mathematics learning in the early grades?

### Introduction

On November 14–15, 2014, 35 educators and researchers from across the country—including experts in interactive technologies and early mathematics learning—met in Auburn, Maine, to form the Interactive Mobile Technologies in Early Mathematics Classrooms Inquiry Group (ITIG). The goal of the meeting was to exchange knowledge and deepen understanding of work occurring across the research-practice divide and to address the use of interactive technologies to support mathematics learning in the early grades.

The group was convened by the Research + Practice Collaboratory (RPC), a five-year project funded by the National Science Foundation to help bridge the gap between research and practice in formal K–12 and informal science, technology, engineering, and mathematics (STEM) education.

This report describes the strategies used by the organizers to promote meaningful cultural exchange among the assembled researchers and educational practitioners. The goal of the exchange was to elicit and build upon the expert knowledge in both groups on promising uses of interactive mobile technologies to support mathematics learning in the early grades. An underlying conjecture of the inquiry group, as well as of the RPC project in general, is that stronger communication among researchers and practitioners, as well as a deeper understanding of one another's work, will promote more widespread and sustainable research-based learning and teaching practices.

### Who Attended?

Participants included 13 school- and district-based educational practitioners—comprising school administrators, teachers, technology integration specialists, and curriculum leaders—from Auburn, Maine, and surrounding school districts (see appendix). Educators



from Auburn were invited to participate because they are involved in a collaborative effort with RPC researchers to investigate and build local capacity in using iPads to support mathematics learning in grades K–3. Also in attendance were a group of Maine educators from outside Auburn who are participating in school and district initiatives that focus on the integration of technology to support learning and teaching in early elementary grades.

Participants also included 22 researchers and technical assistance providers from colleges, universities, and non-university organizations across the country. They were invited to join because of their affiliation with the Research + Practice Collaboratory or their expertise in interactive technologies and/or mathematics learning among students in the early grades.

**“It was a very rich and varied group. Wow! Everyone was professional and caring and respectful of one another and clearly valued the contributions from our different points of view.”**

—Participating teacher

### Approach

Organizers of the inquiry group used four main strategies—each with a set of substrategies—to promote meaningful exchange among researchers and practitioners to deepen knowledge of promising uses of interactive mobile technologies in early mathematics learning.

1. Give an equal voice to all community members
2. Address problems or questions of importance to both communities
3. Create and maintain engagement through collaborative activities
4. Include bicultural actors or groups who can help facilitate cultural exchange

The mechanics of these strategies are explained here.

### Strategy 1: Give an Equal Voice to All Community Members

The RPC project recognizes that power and cultural differences exist between and within communities of researchers and educational practitioners, and these differences may hinder cross-group and cross-role communication as well as the development and spread of knowledge. A primary strategy of the RPC project is to attend to these power differentials by working to give equal voice to members of both communities. At the ITIG meeting, these strategies were used to promote equal voice among researchers and practitioners.

#### *Attend to Group Composition*

Organizers aimed to achieve a balance between researchers and practitioners at the meeting. They also paid close attention to the composition of each group to ensure a balance in perspectives, levels of authority, and leadership. For example, organizers worked to establish diverse representation among educational practitioners by including district leaders, school principals, classroom teachers, and technology integrationists. Organizers designed meeting activities such as panel presentations and small group discussions with an equal mix of researchers and practitioners, intentionally matching participants with diverse roles, viewpoints, and communications styles (e.g., balancing individuals known to be outspoken with those who were more reticent).



### *Provide Multiple Formats and Opportunities for Exchange*

Understanding that people learn and communicate in different ways, the organizers offered a variety of sharing outlets to honor and accommodate different communication styles:

- » Formal panel presentations – Allowed participants to help frame broad topics of discussion by delivering prepared remarks and showing examples of work
- » Small group discussions – Enabled participants to engage more deeply in specific ideas as well as in dialogue with each other
- » Informal conversations – Helped participants to learn more about each other’s work and interests



Most of the meeting was devoted to small group discussions to maximize opportunities for structured personal exchange. Meeting organizers also deliberately rotated small-group membership to spark new ideas through new encounters. Participants were asked to share their knowledge and views through various media, including iPad recordings; online Padlet notes; and traditional chart paper, sticky notes, and index cards.

### *Start with a Hands-On Leveling Exercise*

To help participants with different levels of authority and types of expertise begin on a more even playing field, it can be useful to start a meeting with a hands-on activity that is related to the focal topic of the meeting and places everyone in a novice position.



In the case of the ITIG meeting, organizers asked participants to break into pairs or small groups and to engage with a simple interactive technology tool that few were likely to know well. Specifically, participants were asked to introduce themselves to a partner by using the Notability app on the iPad—an app designed to capture text, drawings, audio, and pictures. Each participant was asked to write his or her name using the app, to swap iPads, to take a picture of their partner, and then to audio-record their partner as they introduced themselves.

After the introductions, the partners were asked to imagine and describe an app that would do anything they wanted. This exercise helped participants begin to reflect on interactive technology and the purposes it can serve. The activity was also structured in an open way to facilitate engagement from multiple perspectives.

The use of an app that was not familiar to the majority of the participants helped to act as a leveler across roles. The partners could work together and use text, video, audio, and/or drawings to explain their envisioned apps. The activity prompted rich conversations about personal interests, research, and practice while also establishing an environment of collaboration that helped individuals move quickly toward working together on a shared problem.

### *Establish Group Norms*

In general, productive group discussions benefit from a clear set of group discussion norms that are established at the beginning of the meeting with group input. It is then important for the group as a whole to take responsibility for making sure these norms are upheld. Initially, the group facilitator models the norms and redirects the group if norms are not



being observed. As a group develops a working relationship, the norms can be revisited and refined. In the case of the ITIG, we set the following goals for discussion etiquette:

- » Attend to timeliness – Respect set start and end times
- » Show common courtesy – Use active listening, do not interrupt or engage in side conversations, facilitate equitable participation, and maintain respectful interactions
- » Clarify language and terms – Commit to defining terms and acronyms that are specific to researchers or practitioners; create a virtual space using the Padlet online tool so that all participants could post terms, definitions, and clarifying questions across the various activities and discussions
- » Take shared responsibility for the enforcement of norms

## Strategy 2: Address Problems or Questions of Importance to Both Communities

The RPC conjectures that to foster productive collaboration and meaningful exchange among researchers and practitioners, both groups must come together to address problems or questions of importance to both communities. ITIG organizers adopted two approaches in line with this conjecture.

### Day 1 Discussion Topics

1. How do you define “interactive technologies for learning”?
2. What are current or potential uses of interactive mobile technology to support mathematics learning and teaching?
3. What are the affordances of using interactive mobile technology to support mathematics learning and teaching in the classroom?
4. What capacities need to be in place to realize these affordances?
5. How can we use interactive mobile technologies to support the development of mathematical content and practices in K–3 classrooms?
6. What are key concerns and challenges? Reflect on the targeted grade levels, content, and use for the development of mathematical practices.

### *Organize Discussions Around Both Theoretical and Practical Issues*

Members of research communities are often interested in more theoretical issues, whereas educators in schools and districts may be more concerned with practical day-to-day challenges. Therefore, discussion topics that address both types of issues are more likely to appeal to both researcher and practitioner communities.

For example, on Day 1 of the ITIG meeting, organizers asked participants to begin by discussing a broad theoretical question—*How do you define “interactive technologies for learning”?*—followed by questions that were more focused and practical: *What are current or potential uses of interactive mobile technology to support mathematics learning and teaching? What capacities need to be in place to realize the affordances of interactive mobile technology in the classroom?*

### *Focus on Classroom Practices and Implementation Supports*

Issues such as classroom practices and implementation supports are likely to be of greater interest to education practitioners, but often they are rich areas for research.

During Day 2 of the ITIG meeting, the opening panel presentation focused on promising practices within the field of interactive mobile technology in early mathematics education, drawing upon presenters’ knowledge of theory, existing research, and current practice from

## Day 2 Discussion Topics

1. What are some promising strategies and resources from pre-service teacher education, personalized learning initiatives, and mathematical practices literature to support effective implementation of interactive mobile technologies in K–3 mathematics?
2. What design elements for implementing interactive mobile technologies for mathematics learning and teaching in K–3 classrooms have emerged from the experience, craft knowledge, and research shared and discussed?
3. What design elements have been tested? Which of the elements that are emerging need to be explored or researched more fully?
4. What do we still need to do and learn to complete our design elements framework?
5. What, if any, research needs to be undertaken?

district and classroom perspectives. This panel was followed by small group discussions that focused on identifying design elements or implementation supports that may be needed—from both theoretical and classroom-based perspectives—to enable effective implementation.

### Strategy 3: Create and Maintain Engagement Through Collaborative Activities

To bridge cultural differences among diverse communities, groups may need to work together to identify and achieve common aims. In line with this conjecture, ITIG organizers adopted the following strategies.

#### *Have Participants Collaborate to Create Concrete Products throughout the Meeting*

It may not be enough to have meeting participants from different communities gather to discuss and share perspectives. It may also be important to have members from different groups work together to achieve concrete and meaningful goals throughout the meeting.

For example, on Day 1, participants were asked to produce three products:

- » *Definitions of “interactive technologies for learning”*
- » A list of capacities to realize the opportunities or affordances of interactive technology to support mathematics learning
- » A list of challenges in implementing interactive technologies for mathematics learning in grades K–3.

On Day 2, participants were asked to synthesize their ideas and generate the following:

- » A list of guidelines for the use and implementation of interactive mobile technologies for mathematics learning in the early grades (see the sidebar for the five preliminary guidelines that emerged).
- » A list of questions for further research (see the sidebar for sample research questions).



#### *Partner with Another Group or Event Focused on Related Issues*

The ITIG meeting was designed to build on and contribute to the annual [Leveraging Learning \(LL\) Conference](#) in Auburn, Maine. This conference brings together educators and researchers from around the country to learn more about current efforts to implement iPad initiatives to customize learning for students. By partnering with this conference, the ITIG drew upon the synergy created by a related gathering to help attract researchers and practitioners to our event. ITIG attendees could attend LL events, and several ITIG participants contributed to LL presentations (including the [keynote address](#)). At the same time, LL attendees could learn about RPC efforts and interests, offering further opportunities for researcher-practitioner exchange.



### Strategy 4: Include Bicultural Actors or Groups Who Can Help Facilitate Cultural Exchange

ITIG organizers and Auburn district leaders included individuals who had years of experience in both research and practice, with a strong understanding of concerns from both communities. ITIG organizers deliberately included these individuals to help plan and design meeting activities and facilitate group discussions. Their presence could also help broker conversations and translate terminology and perspectives should groups have difficulty understanding each other.

### Results of the Meeting and Organizers' Efforts

As noted earlier, the meeting generated two culminating products by the end of Day 2 (see previous sidebar):

#### Preliminary Implementation Guidelines

1. Take advantage of the affordances of interactive mobile technologies to support conceptual learning
2. Keep learning goals forefront
3. Create a classroom culture of exploration and sharing
4. Provide teachers with supports to use new tools and to transform instruction
5. Establish organizational arrangements to support effective use of technology

1. A set of preliminary implementation guidelines for using interactive mobile technology to support mathematics learning in the early grades
2. A set of research questions for further exploration

Attendees were also invited to complete a survey at the end of the meeting to give feedback on their meeting experiences, and 18 participants (51%) complied. Overall, the responses to the ITIG meeting were overwhelmingly positive.

- » All survey respondents (n = 18) somewhat agreed, agreed, or strongly agreed that they gained knowledge and understanding of research and practice in the use of interactive mobile technologies to support mathematics learning in the early grades.
- » Almost all respondents (17 out of 18) said they agreed or strongly agreed that they were able to contribute their ideas to group discussions; they felt their ideas were valued during the meeting; and they gained insights that would be helpful for their work.
- » All respondents agreed or strongly agreed that small group discussions during the meeting promoted rich exchanges between researchers and practitioners, and the list of implementation guidelines that emerged reflected contributions from both researchers and practitioners.

#### Sample Research Questions

1. It appears powerful for students to record and hear their own voices when doing mathematics. Why? What are the implications?
2. The same affordance that supports learning for some children may hinder learning for others. Which ones? When? For whom? Why?
3. What is the best role of the teacher when students are interacting with technology? When and how should the teacher interject when students are in the midst of online games? How to prepare teachers for new roles?
4. When and how might technology promote constructivist/reform-oriented learning?
5. To what extent is a constructivist/reform-orientation needed to promote effective technology use?

For at least one administrator who attended the meeting, efforts to promote meaningful exchange across communities was a success. This administrator wrote the following comment in the survey:

**I wish there were a [survey question] about feeling more comfortable collaborating with, understanding, feeling listened to by folks in roles different than mine (researchers vs. practitioners, etc.). I think that was one of the strongest outcomes of this meeting, the crossing of cultural bridges.**

## Appendix

### ITIG Participants



**Damian Bebell**, Assistant Research Professor, Boston College, Boston, MA  
**Bronwyn Bevan**, Director, Institute for Research and Learning, Exploratorium, San Francisco, CA  
**Pam Buffington**, Managing Project Director, Education Development Center, Inc., Gardiner, ME  
**Amy Busey**, Research Associate, Education Development Center, Inc., Waltham, MA  
**Kara Carpenter**, Co-Founder, Teachley, New, York, NY  
**Lisa Coburn**, Grade 1 Teacher/Team Leader Pre-K–2, Washburn School, Auburn, ME  
**Jere Confrey**, Joseph D. Moore Distinguished University Professor, North Carolina State University, Cary, NC



**Karen DeCarolis**, Grade 1 Teacher, Crescent Park School, Bethel, ME  
**Sue Dorris**, Administrator, East Auburn Community School, Auburn, ME  
**Bernadette Doynos**, Research Associate, University of Southern Maine, Gorham, ME  
**Amber Eliason**, Math Coach, Washburn School, Auburn, ME  
**Cathy Fosnot**, CEO, New Perspectives on Learning, New London, CT, and Professor Emeritus of Childhood Education, City College of New York, New York, NY  
**Jen Helms**, Researcher, Inverness Research, Denver, CO



**Lisa Hogan**, Technology Integrator, Freeport High School, Freeport, ME  
**Shannon Larsen**, Assistant Professor of Elementary Mathematics and Education, University of Maine at Farmington, Farmington, ME  
**Linda Laughlin**, Proficiency-Based Coordinator, RSU 18, Oakland, ME  
**Tiffany Lee**, Research Scientist, University of Colorado, Boulder, School of Education, Boulder, CO  
**Ashley Lewis Presser**, Senior Research Associate, Education Development Center, Inc., New, York, NY  
**Jo Louie**, Research Scientist, Education Development Center, Inc., Waltham, MA  
**Kelly McCormick**, Associate Professor of Mathematics Education, University of Southern Maine, Gorham, ME  
**Catherine McCulloch**, Project Director, Education Development Center, Inc., Waltham, MA  
**Carol Miller**, Technology Coach K–6, Auburn School Department, Auburn, ME  
**Heather Mitchell**, Researcher, Inverness Research, Lopez Island, WA  
**Patricia Moyer Pakenham**, Professor of Mathematics Education and Leadership Programs, Utah State University, Logan, UT  
**Mike Muir**, Multiple Pathways Director, Auburn School Department, Auburn, ME  
**Marian Pasquale**, Senior Research Scientist, Education Development Center, Inc., Waltham, MA  
**Laura Shaw**, Principal, Washburn School, Auburn, ME  
**Patrick Shields**, Executive Director, SRI International, Menlo Park, CA  
**Steve Spodaryk**, Lead Technology Engineer, TERC, Cambridge, MA  
**Denyell Suomi**, Grade 1 Teacher, Belgrade Central School, Belgrade, ME  
**Shawn Towle**, NCSM Leader and Mathematics Teacher, Falmouth Middle School, Falmouth, ME  
**Phil Vahey**, Director of Mathematics Learning Systems, SRI International, Menlo Park, CA  
**Brenda Wight**, Grade 3 Teacher, Crescent Park School, Bethel, ME  
**Kerri Wingert**, Graduate Researcher, University of Washington, Seattle, WA  
**Cathy Wolinsky**, Instructional Technology Integrator K–4, Yarmouth Elementary School, Yarmouth, ME