# Cultivating Formative Intervention Research Partnerships in Mathematics

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**Abstract:** This paper describes an approach to cultivating formative intervention research partnerships in mathematics with school districts in the U.S. state of Missouri by researching the diagnosis and specification of problems as framed and experienced by those grappling daily with challenges related to learning and teaching mathematics. Through a mixed methods approach, we engage various stakeholders in identifying and describing important problems of practice, work to specify the inherent contradictions that often exist in those challenges, and, by confronting those contradictions, initiate a process of innovation rooted in the contexts in which students, teachers, leaders, and parents learn and work.

## Introduction

Changing the nature of mathematics teaching in the U.S. at any significant scale has proven to be extremely difficult (Hiebert, 2013). The predominant approach continues to be some variant of what Freire (1970/2000) criticized as the "banking" method, with teachers narrating largely procedurally-focused demonstrations and asking students to repeat it themselves. A common story in research in mathematics education has been the introduction of some conjectured driver of change (e.g., a professional development program, a new curriculum, different approaches to assessment, etc.), for which researchers work to find schools or districts willing to provide test-sites and subjects for their research, with the idea that an "effective" idea will eventually get "scaled up." While innovations in education are certainly needed (and worthy of support) and while there are potential benefits for the students, teachers, parents, principals, and district leaders who act as research participants, the problems and designs for solutions are typically identified at the outset by researchers, rarely originating in the communities with whom those researchers briefly partner. Consequently, the innovations that are put in place are often not sustained after the research effort has concluded (Resnick & Hall, 1998), and typically fail to change the "instructional core" of what happens between teachers and students around disciplinary ideas (Elmore, 2004; Hiebert, 2013).

## Innovation through partnership

To address this shortcoming, different models for collaborating and conducting research in/with entities such as school districts have emerged in recent years, often captured under the umbrella term "improvement science" (Lewis, 2015). There are variations across different models, but all share a commitment to taking up "problems of practice." For example, one of the more prominent models in recent years—and one that has been well received in mathematics education—has been *design-based implementation research* (DBIR). As described by Penuel, Fishman, Cheng, and Sabelli (2011), DBIR focuses on persistent problems of practice from multiple stakeholders' perspectives through iterative, collaborative design work. Consistent with the tradition of design research in education (Cobb, Confrey, DiSessa, Lehrer, & Schauble, 2003), the aim of DBIR is to develop theory related to both classroom learning and implementation through systematic inquiry, but it is also concerned with developing capacity for sustaining change in systems. Thus, DBIR holds potential for research partnerships that lead to more authentic, lasting change.

Of course, improvement science approaches such as DBIR implicitly require something to be implemented, and often that design quickly becomes the predominant focus as collaborators pursue potential solutions. Less attention—particularly in scholarly writing about such partnerships—has been devoted to first understanding and defining the problem(s). As Lewis (2015) noted, "there is relatively little education research in the improvement science tradition, which emphasizes building organization members' understanding of the problem and its causes" (p. 2015). One approach that holds promise for treating such problem specification as an object of interest (and not merely prerequisite work) is the cultural-historical activity theory tradition of *formative intervention research*. Drawing on Engeström (2011), Penuel (2014) suggested that the methodology includes three key commitments: (a) *focusing on a problem of practice*—a contradiction encountered by participants in their life or work activities (the "germ cell"); (b) *stimulating participants to produce innovations*—by first calling attention to a challenging situation or set of obstacles, and then triggering a process for overcoming those obstacles through design work; and (c) taking as the primary goal the *expansion of*

 

*participants' agency*—to "enable new forms of collective activity to emerge through direct engagement with the contradictions embedded in practice" (p. 100). These contradictions are, at first, abstract. Through attempts to understand and model their relationship, they are made concrete, through which "learners learn something that is not yet there" (Engeström & Sannino, 2010, p. 2).

As an example in mathematics education, for teachers who strive to provide students with culturally relevant and responsive opportunities to engage in meaningful mathematical practice and to become proficient in standard ideas and skills, a contradiction in practice (or "germ cell") might be the inherent challenge of affording learning opportunities that are *emergent* in order to achieve learning goals that are, to a large extent, *prescribed* (Munter, Stein, & Smith, 2015). Neither emergent nor prescribed learning goals and processes can be eliminated; the transcendence of the contradiction is fundamental to the work (and agency expansion) of teachers and students. But, as the first commitment of formative intervention research above suggests, such "germ cells" cannot be identified a priori, but only as the result of investigating a problem of practice. Instead of pursuing a predetermined agenda or implementing a particular program, "the researcher aims at provoking and sustaining an expansive transformation process led and owned by the practitioners" (Engeström, 2011, p. 606).

It is exactly there that our project is attempting to initiate partnerships with school districts—in the investigatory work of understanding problems that students, teachers, principals, parents, and leaders face, and identifying germ cells for expansion through partnership. We do so with the expectation that what we are embarking on will be a long, slow process (in fact, internally, we describe the project as a 20-year pursuit). Ultimately, our aim is to revolutionize the learning and teaching of mathematics in the state of Missouri. Our starting point, however, is to enlist practitioner partners in co-investigating their current problems of practice.

## Methods

Our work is guided by the three commitments of formative intervention research listed above. Our first step—which is the focus of this paper—is to diagnose the problem(s) of practice that Missouri school districts are facing, and how various stakeholders frame those problems. To accomplish this, we employ a mixed methods approach—primarily through interviews, and supported by applicable quantitative analyses of district data.

### Setting and sample

This ongoing study is taking place in K-12 school districts across the state of Missouri. To date, we are collaborating with 9 districts, ranging in size from large urban districts to very small rural districts. Our sample includes 37 (and counting) district leaders, principals, teachers, and parents/community stakeholders.

### Data sources and analysis

Beginning with an initial, relevant contact in each district (e.g., curriculum director), we have conducted and audio-recorded semi-structured interviews, snowballing out to others from there (Talbert & McLaughlin, 1999), including district leaders, principals, teachers, and other partners (e.g., parents). In each case, we write a summary of the interview, share it with the participant and invite their feedback with respect to the summary's accuracy. Additionally, we make use of publically available quantitative data for each participating district.

After interviewing all of the additional individuals suggested by interviewees and similarly summarizing those interviews, we analyze the summaries using qualitative analysis software to identify the (a) problems, (b) underlying causes of those problems, and (c) responses to those problems described across all interviews in the district. Our interest is in understanding how individuals frame the problems that they identify, for which two of the framing tasks described by Benford and Snow (2000) are applicable. The first, *diagnostic framing*, concerns the source and attribution (or underlying causes) of a problem. The second, *prognostic framing*, pertains to the proposed solutions for (or responses to) a problem. We also conduct quantitative analyses of publically available data for the district that are relevant to the problems described by interviewees.

We then write a synthesis report for participants to review and to initiate a follow-up discussion, in which we call attention to similarities and differences between participants with respect to not only what problems, causes, and responses were identified but also how those problems, etc. were framed—with the intention of sparking subsequent investigations of those problems and possible responses, which, in some cases, we might take up in continued partnership. We audio-record those follow-up discussions as well and then write a summary of the discussion, which we share with participants.

To further prepare for facilitating those follow-up discussions, we create two artifacts—one to share with participants and one for internal purposes. The first acts as an accompaniment to the narrative report. It is a single-page representation of the district's problems, underlying causes, and responses, which we distribute at the meeting and use to structure the discussion (Figure 1 below). The second is our own agenda for the meeting, in which we list the participant reactions we anticipate and how we might respond. These are organized into 5

types, as we anticipate participants might: (a) think to express elaborations or new realizations after reading the report and seeing the diagram; (b) provide updates to the report since the interviews concluded; (c) invite our own ideas for solutions or professional development; (d) question the purpose or implications of the report (i.e., "so what?"); and/or (e) express disagreements (with us or among each other).

## Results

Thus far, a number of patterns have emerged across multiple districts with respect to the problems that are identified and the variations in participants' framing of those problems. Our focus here, however, is to describe the results of our efforts to date in terms of cultivating partnerships rooted in the co-investigation of current problems of practice. At this early stage, we consider it a success if the work described above sparks continued interest and conversation between our team and a school district. Below we describe initial success by this standard in District K, a public school district in an urban center.

Included below as Figure 1 is the representation we provided to district K leaders. As it indicates, the problems that emerged in interviews were related to student achievement outcomes, instructional quality, meeting students' (not strictly academic) needs, and teacher recruitment and retention (with the second and fourth of those framed by some as an underlying cause of the first and third). Items drawn outside the ellipse represent elements of the broader contexts in which the district is situated. Overall, district leaders' reactions to our summary report were positive with respect to its accuracy in capturing what they had expressed to us in interviews. This representation of "challenges and initiatives" was especially well received and acted as an important referent in our follow-up discussion in a variety of ways, including (district leaders') updates and changes to district plans and (researchers') questions about relations between components in the diagram, particularly between some that were not connected based on the interviews.

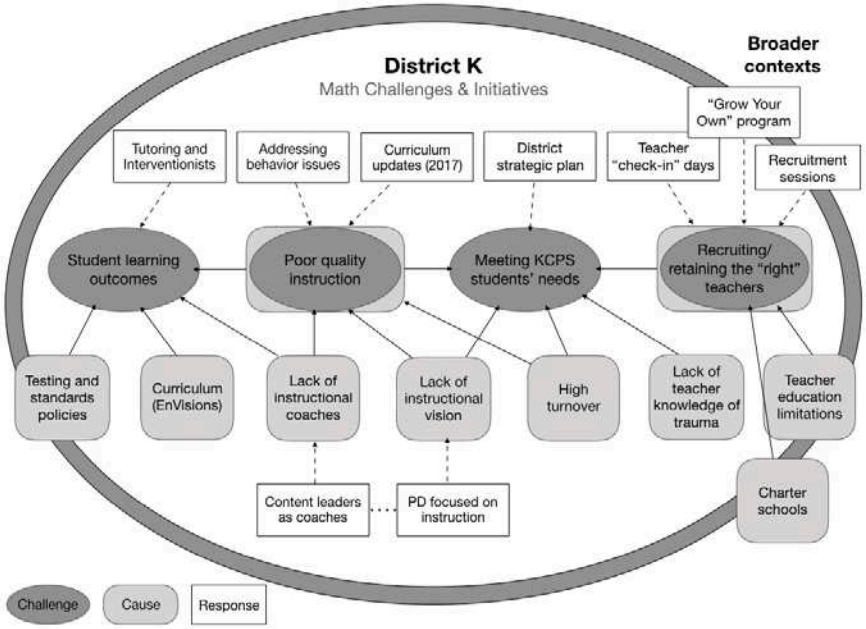


Figure 1. District K challenges and initiatives.

For example, a consistent emphasis in the new "strategic plan" that the district had recently released—which interviewees described as a key response to the challenge of meeting students emotional, relational, academic, and other needs—was the importance of cultural responsiveness. However, few details were included with respect to what that means in practice—particularly in any terms specific to mathematics learning and teaching. Using the diagram in Figure 1, we were able to raise questions about whether and how ideas in the strategic plan are (or should be) connected to other challenges (e.g., poor quality instruction) or initiatives (e.g., curriculum updates) that, up to that point, had not been explicitly connected. This led to a conversation about the possibility of considering all components of the strategic plan in terms of mathematics learning and teaching.

Allowing our (researchers') questions to emerge from ideas and goals that had already been established as important in the district oriented us to identifying inherent contradictions that might be fruitful to address and around which we might build a partnership. For example, with respect to culturally responsive learning and

teaching, the district's strategic plan stressed student-centeredness and tailoring to students' needs and strengths. But it also committed to a "rigorous" curriculum based on "high standards" supported by "reliable assessments." In response, we raised the question of whether those commitments might act as "competing forces" that are all likely necessary and helpful in their own way, but could potentially attract disproportionate attention, to the detriment of the overall plan. District leaders expressed interest in engaging with us in co-design efforts aimed at empowering students through mathematics by building from the district's strategic plan and confronting the contradictions that we uncover through our partnership.

## Discussion and conclusion

Our efforts our dual in nature. First, by investing in understanding the problems of practice that district leaders (perceive that they) face, including identifying the variation in how individuals within the same community might frame those problems, we hope to initiate partnerships at the ground level—a co-investigation and co-specification of problems before anything is "implemented." Second, through such a process, we hope to find inherent tensions on which we can focus sustained attention as a means for inducing innovation. In this paper we have described an approach to investigating the problems that practitioners identify and how they frame those problems, and our process for planning for and facilitating follow-up discussions about what we find. In those presentations of our findings to potential partnering school districts, we have used representations like Figure 1 to invite participants' reflection on whether tensions exist within their current challenges and initiatives (and broader contexts) that could be especially difficult to resolve, with the idea that continued co-examination of such contradictions could lead to the identification of "germ cells" that could manifest at multiple levels. As noted above, these are the very initial stages of what we hope will be prolonged partnerships. By starting a few "steps back" from where work typically has begun, we hope to make progress in confronting the stubborn challenge of changing mathematics teaching.

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