Defining Collaborative Problem Solving Research: Common Values and Distinctive Approaches

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Executive Summary

This white paper defines the values that animate a set of approaches to education research that we are calling *Collaborative Problem Solving Research (CPSR).* The name describes some attributes shared among these approaches at a high level. The approaches are *collaborative,* in that they share a commitment to drawing on the voices and expertise of different stakeholders in education in defining and conducting research. They are focused on *solving problems* related to equity in education. What defines them as approaches to *research* is that they use systematic forms of inquiry into education problems and solutions to those problems. These approaches stand in contrast to forms of research in which participants in research and other educational stakeholders have little opportunity to define the aims of, select methods for, or present conclusions from research.

This white paper addresses challenges faced by reviewers of proposals and manuscripts that use these approaches. Our focal audiences include: (1) funders of research; (2) editors and reviewers of journals and magazines in education; (3) people who conduct education research; and (4) intermediary organizations engaged in brokering connections between researchers and practitioners.

We review four approaches to CPSR in this white paper. We selected them purposefully both for their breadth and their relative maturity as approaches to research and development. These approaches are:

- Strategic Education Research Partnership (SERP);
- Design-Based Implementation Research (DBIR);
- Improvement Science in Networked Improvement Communities (IS/NICs);
- Community-Based Design Research (CBDR).

Naming the complete set of approaches to research and development that share these characteristics is a challenging task, and this white paper details both the potential value of naming these as a family of approaches and the pitfalls of attempting to bring them together.

For each approach, we describe how values that we identified as common to CPSR approaches are embodied in specific exemplar projects, and we look across accounts of CPSR research to identify themes with respect to what is and isn't described in projects. We used a participatory strategy for identifying common values, engaging advocates of each approach in a collaborative process for identifying potential commonalities and differences among the approaches. We also solicited their input on articles to review and candidate projects to analyze. For each of the four leading CPSR approaches, we reviewed one exemplar project:

- SERP: Word Generation (WordGen) and a subsequent, related initiative, Strategic Adolescent Reading Intervention (STARI);
- DBIR: the SunBay Digital Mathematics Project;
- IS/NICs: Carnegie Math Pathways (initially Community College Pathways); and,
- CBDR: the PRIMES project, which stands for Parents Rediscovering and Interacting with Math and Engaging Schools.

The preliminary set of *shared values* we identified to analyze these projects are:

1. The problem should be important to a broad range of stakeholders.
2. The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research.
3. The research should support the agency of participants.
4. The research should attend to context.
5. The research should provide something of practical value to participants.
6. The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge.
7. The research should account for the gap between what was intended and what was accomplished.
8. The research should contribute to organizational or community culture and practice.
9. The research should be of value to others outside the partnership.

In using these shared values as a framework for analyzing these four CPSR projects, our purpose was not to compare the different approaches to CPSR, but rather to focus on what was included and excluded in the written accounts of each project. Working to uncover what was missing from these written accounts but available through dialogue with model advocates was critical to establishing a set of action steps for our focal audiences.

Our analytic approach to the cross-model comparisons revealed four initial conclusions. Our four conclusions are :

1. Developing a relatively complete account of how a project embodies CPSR values required examining multiple kinds of reports (e.g. formal publications, white papers, conference proceedings).
2. The accounts maintained a central focus on problems and problem solving, though justifications for addressing specific problems were more often framed in terms of their national/general importance than their local/contextual importance.

3. Responsiveness of researchers to emerging concerns and problems remained central, even during carefully controlled studies as programs or interventions matured.
4. In each exemplar, researchers held themselves accountable to participants in some way throughout the research process.

On the basis of our review of projects, we offer the following recommendations to funders and reviewers of CPSR projects:

1. Prepare proposal reviewers to look for embodiment of CPSR values in CPSR proposals and manuscripts.
2. Reviewers should look for evidence that CPSR proposals and manuscripts have articulated a problem that addresses local problems, needs, and opportunities, as well as broader, more general problems and issues that affect policy, practice, and research.
3. Consider how and when involvement of participants in research activities might strengthen, rather than threaten, the validity of findings.
4. When evaluating generalizability, take a broad view of what is valuable to others.

This white paper contributes toward an effort to build identity and influence among those seeking to advance collaborative problem solving research approaches in the U.S. At present, these approaches are still limited to use within a small number of districts, networks, and schools. In addition, they operate within political and policy contexts that currently place a premium on the use of scientific evidence as a resource for improvement and the use of rigorous evaluations to assess impact.

Looking to the future, building an improvement field able to (a) advance improvement approaches and support their use in large numbers of districts, networks, and schools and (b) advocate for improvement in political and policy contexts that currently place a premium on bottom line impact will most surely require a level and type of organization beyond the distributed federation of organizations and enterprises currently leading the improvement movement. Indeed, there is much in organizational scholarship on field building to suggest advantage in establishing a “supporting institution” (Nelson, 1994): an organization akin to a professional association that is chartered with the specific charge of coordinating activity among organizations, legitimizing and publicizing their value and contributions, and asserting their collective interests.

Defining Collaborative Problem Solving Research: Common Values and Distinctive Approaches

This white paper defines the values that animate a set of approaches to education research that we are calling *Collaborative Problem Solving Research (CPSR).* The name describes some attributes shared among these approaches at a high level. They are *collaborative,* in that they share a commitment to drawing on the voices and expertise of different stakeholders in education in defining and conducting research. They are focused on *solving problems* related to equity in education. What defines them as approaches to *research* is that they use systematic forms of inquiry into problems and solutions to problems. These approaches stand in contrast to forms of research in which participants in research and other educational stakeholders have little opportunity to define aims, select methods, and draw conclusions from research.

We review four of these approaches in this white paper, selected purposefully for both their breadth and relative maturity as approaches to research and development. These approaches are:

> **Strategic Education Research Partnership:** A model of design, development, and research in partnership with school districts that develops and studies interventions to address important problems of educational practice. This model is based on a National Research Council (2003) report of the same title.
>
> **Design-Based Implementation Research:** A family of approaches that blends the orientation and methods of design-based research in the learning sciences with a focus on addressing problems related to implementation using methods and theories that are typically the domain of policy and organizational research.
>
> **Improvement Science in Networked Improvement Communities:** An emerging model that leverages the power of a group of individuals and organizations committed to meeting a specific, ambitious improvement goal using the methods of improvement science adapted from healthcare and applied to educational problems.
>
> **Community-Based Design Research:** A group of approaches to educational research that are grounded in the concerns of stakeholders such as parents who are outside the school system and that collaboratively address those concerns through participatory inquiry.

Naming the complete set of approaches to research and development that share these characteristics is a challenging task, and this white paper details both the potential value of naming these as a family of approaches and the pitfalls of attempting to bring them

together. On the one hand, identifying a family of approaches may help to build a community of scholars who can advance our understanding about the distinctive benefits of organizing the research and development enterprise more collaboratively and in a way that is focused on solving persistent educational problems. On the other hand, each approach brings a distinct set of theoretical and methodological commitments to its work, as well as different definitions of who collaborates and how, what kinds of problems most deserve our attention, and even the weight placed on traditional peer-reviewed research relative to the goal of improving educational practice.

The scholars who are leaders in developing the principles and methods that guide these approaches do share a common concern that the logic of inquiry they employ is not well understood by the broader education research community. The people and methodological practices to which they hold themselves to account are, in our view, distinctive. This white paper describes the ways that the four different approaches answer a common set of questions that their leaders agree are important, in order to determine the trustworthiness of conclusions drawn from applications of their approach.

Context and Audiences for the White Paper

In this section, we describe both the larger context, guiding questions, and audiences for the white paper.

Context

There is growing interest among policy makers, education leaders, researchers, and funders in new approaches to organizing research and development in education. These new approaches are in part a response to calls for research that is not only rigorous but also relevant to addressing problems of persistent inequality in education (Bang & Vossoughi, 2016; Gutiérrez & Penuel, 2014; Tseng, Easton, & Supplee, 2017). But they also have roots within more established forms of inquiry both inside and outside of education (e.g., Deming, 1986; Whyte, 1991), and the projects and collaborations that we describe in this paper draw from calls made more than a decade ago for more practice-relevant research (e.g., Burkhardt & Schoenfeld, 2003; Commission on Behavioral and Social Sciences and Education, 1999; Donovan, Wigdor, & Snow, 2003). They also resonate with calls to promote more collaborative efforts to engage both educators and diverse publics in building system-wide capabilities and coherence (e.g., Fullan, 2009; Hargreaves & Shirley, 2009; Levin, 2008).

The advocates for the approaches presented in this white paper view their approaches as implicated in and partly supportive of the past decade's efforts to increase the quality of education research available to guide policy and practice. These scholars have been relatively successful in securing funding for projects from federal agencies and foundations that otherwise have given much greater emphasis to identifying programs and practices that can work through random assignment studies. Some have tested programs and practices experimentally, while others have focused their efforts on early stage design and development research, both of which have a sanctioned role within federally funded education research today (Institute of Education Sciences & National Science Foundation, 2013). In addition, many have secured resources from new federal and foundation funding streams for long-term research-practice partnerships in education (see, e.g., Farrell et al., 2017). In their proposals and reports, all of these approaches carefully report the methods and sources of evidence they use to warrant claims for research, taking care to document if and when they can support claims about the impacts of programs and policies.

At the same time, these leaders say that their approaches address questions that many other researchers do not regularly take up in their work. For instance, these scholars consistently ask, "To whom does this research matter?" and "What practical value does this offer to participants and stakeholders?" While we expect that most researchers hope their research is of value to a wide range of stakeholders, in these approaches to CPSR, researchers develop empirical evidence to support answers to these questions. They have a commitment to "making social science matter" (Flyvbjerg, 2001), and they give equal if not greater weight to changing practice as to publishing research in traditional academic

venues. Others describe their approach as providing models of "use-inspired basic research" (Stokes, 1997), that is, research that aims to produce scientific insights that are related to practical problems.

This white paper is animated by challenges faced by reviewers of proposals and manuscripts that employ these approaches. Reviewers may have limited familiarity with specific approaches, and therefore need guidelines to help them judge whether a proposal or manuscript meets the standards of the particular approaches advocates. They also need help discerning whether a proposed project has the potential to impact the local context and make a broader contribution to the field. And, they need assistance knowing just how each approach defines the "field" to which they are seeking to contribute. Reviewers need guidance as to how to evaluate its larger portfolio as a whole, including whether common guidelines might be applied across a range of proposals using different CPSR approaches.

Two large questions flow from the opportunities and challenges named above:

- *How can CPSR approaches be described as forms of research, and what are their shared values?*
- *What is needed to strengthen accounts of applications of particular CPSR approaches in order for others to evaluate the quality of individual proposals and reports?*

We take up both questions in this white paper, offering preliminary answers to them and also posing new questions that have arisen from us through the course of this project. Whether these distinctions help to define a set of approaches that adhere to common principles and practices is an open question that this white paper also takes up. The four approaches reviewed here engage scholars and educators from different communities within the education sector, and they connect to different communities outside it, as well. Those communities only partially overlap in the venues where they gather (e.g., at national conferences), and the leaders of models have had limited interchange with one another. No doubt, it is too soon to proclaim even the possibility of a common identity or shared standards of quality, but only the value of exploring together where common cause might be discovered.

Audiences for this White Paper

There are four primary audiences for this white paper: (1) funders of research; (2) editors and reviewers of proposals and journals and magazines in education; (3) people who conduct education research; and (4) intermediary organizations engaged in brokering connections between researchers and practitioners.

Funders of research. We view this effort as relevant to the questions many funding agencies and foundations have about CPSR proposals. These include funding agencies that support a researcher-initiated project that employs a wide range of approaches to research and development, not just CPSR approaches. The value to these agencies goes beyond review of proposals, because funding agencies of all kinds make decisions about what problems and questions are given priority, a central concern of CPSR approaches. In

addition, many funding agencies are engaged in efforts to support field building through pre- and postdoctoral training programs and clearinghouses for research. Such efforts can be informed by a better understanding of the knowledge, skills, and dispositions required of researchers employing CPSR approaches.

Those funders who provide direct funding to research-practice partnerships, long-term collaborations between educators and researchers focused on investigations of problems of practice (Coburn & Penuel, 2016; Tseng et al., 2017), may be particularly interested in the conclusions of this paper. These include the National Science Foundation, which provides funding to RPPs through the *Computer Science for All: Research-Practice Partnerships* program at the National Science Foundation, as well as the U.S. Department of Education, which provides funding through its *Researcher-Practitioner Partnerships* Program. The Spencer Foundation, William T. Grant Foundation, and Hewlett Foundation each have current funding opportunities that support collaborative approaches to producing and using research to address persistent educational problems, such as inequities of opportunity to learn linked to race and income.

Editors and peer reviewers. Questions about the quality and contributions of a research study are also important to editors and reviewers of manuscripts produced by CPSR teams, as well as to reviewers of proposals. These include not only editors and reviewers of traditional academic journals but also of practice-oriented magazines and journals such as *Phi Delta Kappan* and *Educational Leadership,* which periodically publish accounts of CPSR (e.g., Henrick, Munoz, & Cobb, 2016). Though what each considers a valuable contribution for its readers differs, all of these venues are potentially important audiences for CPSR. Peer reviewers for journals and magazines bring varied backgrounds and preparation to the task of assessing the quality and contributions they are assigned to review. Use of a framework of questions to consider in evaluating manuscripts from CPSR projects can help develop a common understanding among reviewers of what qualities are necessary to meet the standard for publication.

A challenge identified by advocates of CPSR approaches is that no one publication is likely to be able to reveal the richness and complexity of the research. Often, a single aspect of the study must be represented that highlights the contributions to just one of many areas of concern to the team. As a consequence, the contribution can be judged to be "thin," when in fact it might have much broader application precisely because of its multidimensional aspect. For example, a research-practice partnership might adapt a widely used tool for assessing the rigor of mathematical tasks in the classroom (Stein, Smith, Henningsen, & Silver, 2009), something that might not make a significant contribution to our understanding of how such tasks contribute to mathematics learning. However, the study could advance our understanding of what it takes to use such a tool at *scale* to guide improvements to teaching in a district, to the extent that it meets multiple goals of different stakeholders in a partnership (Johnson, Severance, Penuel, & Leary, 2016).

The challenge for reviewers of proposals is somewhat different. Like reviewers of manuscripts, reviewers are concerned with questions about the adequacy of the methods chosen to address the questions posed. But there are typically constraints on how much depth can be portrayed in proposals, and some of the requirements for CPSR approaches call for providing details to warrant the strength of a proposal that traditional research rarely takes into account, for example, about how questions were generated or about the nature of the relationships on proposal teams. Thus, reviewers may have to settle for less detail on some aspects of method or theory, in exchange for more details about how the proposed project maintains integrity to the values of CPSR.

People who conduct research. People who are involved in the conduct of inquiry into educational policies and organizations, teaching practices, and learning are also a key audience for this white paper. These people include those who identify as research professionals, as well as people who develop and apply research skills in the context of asking questions and solving problems. Many CPSR approaches engage educational practitioners, community members, and youth in multiple aspects of research (e.g., Bryk, Gomez, Grunow, & LeMahieu, 2015; Cammarota & Fine, 2008; Campano, Ghiso, & Welch, 2016; Kirshner, O'Donoghue, & McLaughlin, 2005). Some intentionally erase the distinction between who is a researcher and who is a practitioner (e.g., Bryk et al., 2015), while others emphasize the complementary roles and engagement of educators in research (e.g., Fishman, Penuel, Allen, Cheng, & Sabelli, 2013).

The interests of people who conduct research in this white paper are likely to be varied, depending on their relationship to CPSR. Some will mainly be reviewers or critics of CPSR who are seeking to better understand the different approaches and the kinds of questions they address. Others will be expert in, or advocates for a particular approach to CPSR who are seeking to understand commonalities and differences with related approaches. Still others will be interested to learn more about what one or more approaches looks like in practice, and they are likely to find value in the description of specific projects in this white paper.

Intermediary organizations. A fourth category of readers is comprised of people who work in intermediary organizations engaged in brokering connections between researchers and practitioners. Intermediary organizations in education play an increasingly important role in expanding the capacity of districts and states to carry out ambitious reforms demanded by contemporary policies, including mandates to make greater use of research evidence in decision making (Honig, 2004; Honig & Ikemoto, 2006; Scott & Jabbar, 2014; Scott, Lubienski, DeBray, & Jabbar, 2014). Some intermediary organizations focus mainly on "translating" research findings into usable forms for uptake by educators, and such organizations may find the white paper's framework for describing projects to be useful as a model for developing summaries of CPSR projects. Still other intermediary organizations are focused on brokering stronger relationships between researchers and practitioners (e.g.,

Wentworth, Carranza, & Stipek, 2016); these organizations in particular may find value in this paper's attempt to identify example projects linked to different approaches to CPSR, so that they can be more effective in brokering connections that match practitioner problems to researcher expertise.

This white paper is part of a focused project that is aimed at establishing consensus about some core principles that are shared among different approaches to CPSR among researchers who are leaders in the field. The project aimed to identify commonalities and differences among the different approaches to CPSR and begin to articulate some of what constitutes quality within CPSR projects. The white paper is a key end product of the project, but we view it as an intermediate step toward meeting the larger project aim, particularly since there are still many areas where agreement among leaders of different approaches is yet to be forged.

Project Aims and Strategy

A central aim of our project was to build an understanding of the principles, commitments, and practices that different approaches to CPSR share, as well as what distinguishes different CPSR approaches from one another.

We focused on *principles and commitments,* because we conjectured on the basis of a preliminary review of different approaches that one of the distinctive characteristics of these approaches are particular values, such as the value of educators having a say in research (e.g., Penuel, Roschelle, & Shechtman, 2007) or to social justice (Bang, Faber, Gurneau, Marin, & Soto, 2016; Campano, Ghiso, & Welch, 2015). These values, we further conjectured, are likely what distinguish these approaches from some other approaches but also connect them to related approaches that are not represented directly in this white paper but could have been (e.g., youth participatory action research; Cammarota & Fine, 2008).

We also focused on *practices,* because these are aspects of CPSR approaches that are typically invisible to outsiders. We focused specifically on how practices that reflect the shared values of CPSR approaches are described in accounts of CPSR projects. With a few exceptions, most accounts of research findings focus on the aspects of research methods that are of most relevance to potential reviewers, which excludes practices that are linked to the values and commitments of teams of researchers, education professionals, and others co-engaged in CPSR. Those practices, moreover, are what distinguish different approaches from one another, so a focus on practices allows us to name some of the ways approaches embody their values in their projects.

A second aim of the project was to help clarify—in a very preliminary way—the ways in which each approach seeks to define quality in a project. We sought to understand each approach on its own terms, giving voice to both ideals and concerns that advocates have about how approaches might be misinterpreted or misused. We characterize our effort as preliminary, because our review of products from projects is in no way comprehensive and represents just one set of perspectives on quality. Ultimately, it is the community of people who engage both within and across different approaches to education research who define

quality on a day-to-day basis through their critical reviews of others' proposals and manuscripts; their assessment of the significance of a project and its impact on policy and practice; their mentoring of newcomers to the work; and their evaluation of contributions of peers for personnel decisions.

Our overall strategy for accomplishing these aims was threefold: (1) to engage advocates of different approaches in a collaborative meeting to identify potential areas of commonalities and differences among approaches; (2) to synthesize input from advocates about common values that (3) could provide a lens for reviewing exemplar projects from each approach. Below, we describe how we chose the approaches we did, the process for gathering input from approach advocates and feedback on our initial ideas, and our methods for reviewing project-specific literature.

How we chose the focal approaches. There are many different approaches to research that engage researchers and educators collaboratively, and many that also focus on solving practical problems. Coming to understanding any one approach requires deep analysis of the approach, including its antecedents and related fields. For example, understanding of improvement science requires an understanding of its roots in both management (Deming, 1986) and health care (Berwick, 2008), as well as how it has been applied in the context of building networked improvement communities in education (e.g., Hannan, Russell, Takahashi, & Park, 2015). We were constrained, by both resources and our appreciation of the complexity of different approaches, to select a small number of approaches to analyze, recognizing the limits that places on our analysis.

A criterion we applied to help us select approaches was that the approach needed to engage participants—and not just researchers—from different organizations in the process of *collaboratively designing and testing solutions* to problems. In applying this criterion, we excluded some forms of research-practice partnerships in which researchers are not engaged in collaborative design but rather only with research that is intended to support practitioners in searching for solutions or evaluating policies of schools and districts (e.g., the research of the University of Chicago Consortium on School Research; Roderick, Easton, & Sebring, 2007). This research also excluded some approaches to participatory research that do not involve researchers taking direct action to address problems, as is common in some models of participatory and developmental evaluations of programs and policies (Earl, 1995; Peurach, Glazer, & Lenhoff, 2016).

A second criterion we applied was that the approach needed to embrace addressing problems that require *systemic change.* This focus was important because we conjectured that these approaches to research were each concerned with systemic and not just individual change. We did not specify a particular scale ahead of time, because approaches with which we were familiar conducted inquiry at different scales, depending on the phase of an initiative. However, focusing on systems led us to exclude approaches that are closely related and might be considered part of an "extended family" of approaches, because of shared commitments to focusing on problems or to collaborative design. These include

design-based research that is focused on developing new possibilities for learning but that is not focused on implementation at scale (e.g., Cobb, Stephan, McClain, & Gravemeijer, 2001; Shaffer & Squire, 2006) and teacher action research that seeks to promote reflection and change primarily within a single classroom.

A third criterion we applied was that the approach needed to be *relatively mature*: that is, to have a range of potential projects and teams to choose from, if we were to select representatives to bring together to identify principles, commitments, and practices of the approach. By "relatively mature," we mean that there are published or otherwise public accounts of projects in which methods of inquiry are systematically described and a community of practitioners of the approach engaged together in conversation (e.g., at conferences, on listservs, in institutions and organizations dedicated to their advancement). We recognize that this criterion is in direct tension with our claim that these are emerging approaches for which criteria for quality are not well established and that established researchers might not recognize. But it was necessary to choose relatively mature approaches in order to conduct some preliminary review of quality as embodied in specific projects.

A fourth criterion was applied to the set as a whole: We sought some level of *breadth* in order to test the limits of any initial consensus regarding commonalities among the different approaches. We sought approaches with clearly defined practices, as well as those that had articulated mainly common principles or features. We sought approaches that were centered on improvement efforts within particular organizations, as well as ones that focused on efforts that sought to bring about change across multiple organizations and within networks. And we sought diversity in terms of participation. Because of our common understanding that changing educational systems involves not only making improvements to the technical core of teaching but also political and cultural change (McDonald & Weatherford, 2016; Oakes & Rogers, 2006; Opfer, Young, & Fusarelli, 2007), we sought to include approaches that were explicit in the need to address political and cultural dimensions of change.

The process of selecting both approaches and participants for an initial meeting involved consultation with the Spencer Foundation. Spencer had already convened a meeting focused on "Continuous Improvement Research" models in education at their offices in September, 2016, and we understood the need for this project as an outgrowth of that meeting. Therefore, as a first step, we identified three distinct CPSR approaches as candidates from among the attendees there: the Strategic Education Research Partnership (SERP), Design-Based Implementation Research (DBIR), and Improvement Science within Networked Improvement Communities (IS). A second step entailed a review of funded projects of Spencer's Research-Practice Partnership program. This led to the identification of a fourth approach, Community-Based Participatory Research, which was represented within Spencer's portfolio. Through a preliminary review of literature, we identified two other named approaches, Community-Based Design Research (Bang et al., 2016) and practice-embedded educational research (Snow, 2015).

On the basis of this review, we provided a list of potential participants for a small meeting to identify additional and related approaches, as well as to identify common principles and practices among those represented at the meeting. We invited representatives from all six named approaches, though we should note that the name "practice-embedded educational research" was given by a key member of SERP, Catherine Snow, and so that approach was not intended to be represented as distinct from SERP. Each of the five approaches were represented at the meeting; however, we have combined Community-Based Participatory Research and Community-Based Design Research for purposes of this review.

Engaging participants in identifying commonalities and differences among the approaches. At a meeting in spring 2017 in Boulder, Colorado, we convened 14 participants, roughly half of whom were leaders of their respective approaches to CPSR. Prior to that meeting, we asked two participants from each approach to nominate two articles for the group to read ahead of the meeting and to prepare a brief, 15-minute overview of their approach and an example of it in practice. At the meeting, we also had reflectors — two of whom came from intermediary organizations in education and were not researchers — provide their own thoughts about the contributions of each approach. Participants made individual reflections on the talks, and we discussed each as a group. In addition to the talks, we engaged in an activity to identify similarities and differences among the approaches represented in the meeting and discussed indicators of quality within the different CPSR approaches.

Subsequent to the convening, our team developed a memorandum that identified our initial summary of key conclusions from the meeting about commonalities among the models. We invited feedback from participants on the memorandum and received comments from six of the meeting participants, representing three of the four different approaches. This white paper's conclusions reflect the subsequent dialogue we had in person, over the telephone, and over email regarding the core principles of the different approaches. Concurrently, we wrote an essay (to be published as in a forthcoming Sage *Handbook on School Organization*) that situates our work among broader field building efforts aimed at strengthening policy, political, and philanthropic support for CPSR (Peurach, Penuel, & Russell, in press).

All of the preceding led us to the larger conclusion that though the approaches share some common values, it is too soon to assert that the approaches reviewed here belong under a common umbrella of approaches. It was, we concluded, also too soon to characterize precisely what was distinctive about each approach. At the same time, the combination of dialogue and scholarship gives us hope that a synthetic understanding of both commonalities and distinctions can be identified over the long-term.

Positionality of the Authors

Our position within the field and stance toward the work are both important to name. The first author (Penuel) is a leader and advocate for one of the forms of CPSR reviewed here, Design-Based Implementation Research. In addition, he has close collegial relationships with many of the leaders involved in the project through his involvement in the Research+Practice Collaboratory, an NSF-funded research and development center focused on developing and testing new strategies for relating research and practice. The second author (Peurach) is a scholar whose work includes a focus on infrastructures of research and development that support CPSR. He is a senior fellow at the Carnegie Foundation for the Advancement of Teaching. Carnegie is a leader in developing one of the four approaches to CPSR presented here, Improvement Science in Networked Improvement Communities.

Despite our affiliations with particular models, we embrace a stance of "methodological pluralism" (Moss & Haertel, 2016), in that we are committed to exploring ways to productively work across different approaches, putting each in conversation with one another to explore complementarities as well as to "illuminate taken-for-granted assumptions and limitations" of each approach (p. 129). We also consider CPSR approaches to be complementary to—and not a replacement for—other forms of education research, including basic research on learning and efficacy and effectiveness studies conducted outside a research-practice partnership context. Even so, our position is that the infrastructure for the latter is much stronger in education than for CPSR approaches. We have written separately and together about the need for more and better infrastructure to support these kinds of approaches to research and development (Penuel & Gallagher, 2017; Peurach, 2016; Peurach, Penuel, & Russell, in press).

The Function of the White Paper within the Project

The white paper represents an early effort to identify points of convergence with respect to common values, practices, products, and the intended impacts of four approaches to CPSR. It also seeks to identify some points of difference or distinction among these approaches that we have constructed both from our analysis of meeting interactions and accounts of exemplar projects. Our analysis of distinct characteristics focuses on a set of common questions that could be asked of any CPSR project and that reflect the values that we posit are shared across projects.

At the conclusion of this white paper, we make recommendations to different audiences related to building toward consensus regarding common values, commitments, and practices across CPSR approaches. We also make recommendations regarding how different kinds of publication outlets might need to change to accommodate adequate descriptions of projects.

Organization of the White Paper

The remainder of this paper is organized as follows:

- First, we identify a set of values among CPSR projects that reflect our emerging ideas about what different CPSR approaches have in common
- Second, we synthesize multiple accounts of a single exemplar project for each CPSR approach. Those accounts focus on the answers to the common questions we have identified.
- Third, we present a synthesis of our analysis across approaches, noting similarities and differences in how the approaches are documented in written work, as well as limitations of our analysis.
- Fourth, we summarize what we see as key resemblances and differences among the set of approaches reviewed, open questions, and the activities needed to answer these questions.
- Finally, we present a set of recommendations for each of the audiences of the report.

As sketched above, we begin by identifying a set of common questions that can be asked of CPSR projects that reflect our emerging ideas about the common values, principles, and practices of different CPSR approaches. We offer them as a lens for developing case studies that illustrate how each of the values is reflected in exemplar projects of each approach.

Focused on Problem Solving

Shared Value 1: The problem should be important to a broad range of stakeholders. Unlike traditional investigator-led research that focuses principally on developing a knowledge base defined by academics and that chooses partners based on their ability to serve as a site for knowledge development, these approaches propose and conduct research that address problems related to educational opportunities. They relate to problems of both *access* to opportunities, as well as the *design of,* and *student learning from* effective policies, programs, and interventions for all learners (Campano, Ghiso, & Welch, 2016; Hand, Penuel, & Gutiérrez, 2012; Oakes & Rogers, 2006).

These approaches emphasize that it is imperative to develop a "theory of the problem," that is, that teams need to formulate a sense of how problems came to be and why they persist (Bryk, Gomez, Grunow, & LeMahieu, 2015). Moreover, the assumptions these approaches share is that problems evolve, and that researchers continue to work with practice partners (whether in schools or in the community) on those problems, "following their contours" (Donovan, 2013) where they might lead.

As such, given the structure of research funding (one project at a time), a hallmark of these approaches is that researchers work with the same group of educators over successive projects that address emerging problems, and overlapping projects that address some different aspect of the problem(s) they are working on together (Penuel & Gallagher, 2017).

Valuing the Expertise of Partners

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research. In CPSR approaches, the "problem" that is the focus of research and development is always one that is defined not by a single actor (whether the researcher or practice partner) but by a group of stakeholders (Fishman, Penuel, Allen, Cheng, & Sabelli, 2013). That is, the approaches assume that multiple types of actors should have a role in defining the problem and research questions to be answered. Each of the approaches accords strong value to having the perspectives and expertise of a broad range of stakeholders in the improvement efforts. Advocates of these approaches believe that drawing on these perspectives leads to a deeper understanding of the problem, as well as to insights valuable in searching for solutions to the problem (Bryk, Gomez, & Grunow, 2011; Donovan & Snow, in press).

To accomplish the goal of eliciting multiple stakeholder perspectives, these approaches all use intentional strategies for organizing the effort to identify who needs to be at the table, to define problems, and to support the search for solutions to those problems (Coburn, Penuel, & Geil, 2013; Penuel & Gallagher, 2017). This involves building a social structure or infrastructure for the work, to which these approaches give strong attention. Indeed, an essential characteristic of these improvement approaches is that they are not exclusively (or even fundamentally) technical. Rather, they gain their power and moral authority through the integration of the technical and the social (Campano, Ghiso, & Welch, 2015; Dolle, Gomez, Russell, & Bryk, 2013).

Supporting Agency

Shared value 3: The research should support the agency of participants. One of the impacts sought by researchers in this tradition is an expanded sense of agency, that is, a greater sense of the possibilities for and scope of action to change their local environments (Campano et al., 2015). With respect to classroom-level instructional reforms, that might entail supporting the agency of teachers, whose voices are not always integrated into designs for improving instruction (Severance, Penuel, Sumner, & Leary, 2016). In other instances focused on access to educational opportunity, the voices of parents and community members are ones that are particularly sought out, with the intent of expanding the definition of what counts as a "problem" to be solved and the solution space for those problems (Booker & Goldman, 2016). The intent is also to expand the agency of often-marginalized groups within reform discussions (Renée, Welner, & Oakes, 2009).

Foregrounding Context

Shared value 4: The research should attend to context. In each of these approaches, there is a strong emphasis on the context of educational change efforts. Context is in the foreground, rather than background. Context and intervention are considered integrally related to one another (Cole & Packer, 2016; Datnow, Hubbard, & Mehan, 2002; Mehan, Datnow, & Hubbard, 2010). Where traditional models seek to identify what things work, *ceteris parabis* (all things being equal), these models never see "all things as equal" when it comes to context and, instead, focus on what works where, when, and for whom (Bryk et al., 2015; Means & Penuel, 2005). To be successful, innovations need to be "adaptively integrated" (Bryk et al., 2015; Hannan, 2016) or integrated into existing infrastructures of systems (Penuel, 2015).

These approaches assume that persistent problems have systemic causes, not single causes. Indeed, this is where "following the contours of the problem" leads them: deep into the systems that give rise to these problems and cause them to persist. This value relates to the one above, in that within a system, actors have only a partial view from where they sit and perhaps have access to a few other perspectives through their social interactions. From advocates' perspectives, some effort to elicit and integrate perspectives on systems is

necessary to diagnose the educational problems that are the focus of the research and development effort (Bryk et al., 2015; Donovan, Snow, & Daro, 2013).

Value and Usability for Practice

Shared value 5: The research should provide something of practical value to participants. A key determinant of the value of a CPSR project is that it can inform what individual participants in the research do in their day-to-day work. The "what" can encompass ideas from research, curriculum, tools, and practices—that is, more than just knowledge that might be developed for the benefit of other scholars (Edelson, 2002; Ikemoto & Honig, 2010). Researchers proposing new studies within one of the approaches should be able to make an argument for the significance of what would be produced *for practice,* to demonstrate that proposed innovations or initiatives would in fact yield improvements that the participants valued (Gutiérrez & Penuel, 2014). A key part of practical value is demonstrating the usability of an innovation. That is, it should not only accomplish the goals intended for improving educational opportunity and outcomes but also be relatively easy to implement, given supports that can be readily put into place in the context (Fishman et al., 2013).

Research Designs That Are Adaptive But Accountable to Community Norms

Shared value 6: The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge. Though CPSR embraces uncertainty and complexity, and though those embraces always requires fluidity and adaptability, that does not absolve teams engaged in CPSR from being explicit and rigorous in detailing their plans for navigating uncertainty and complexity. Like all research, CPSR researchers select methods appropriate to the question at hand, use systematic forms of data collection and analysis, and develop claims that were supported by and did not go beyond the evidence available. They expect results to be explained, not just described, and there is a strong value accorded to clearly specified conjectures or a theory of action that can be tested, as part of evaluation of the worth of the project or proposal. The findings should resonate with key stakeholders and participants in the project, a standard within much qualitative research.

Importantly, methods and presentations of findings, moreover, are held to community norms for what counts as evidence. At present, however, it is too soon to articulate what might be shared norms across the different CPSR approaches.

Documenting Where Efforts Fall Short to Accomplish Aims

Shared value 7: The research should account for the gap between what was intended and what was accomplished. In more conventional research, variation is something that is to be explained. In CPSR, variation is a fundamental resource for collaborative learning and improvement. From the standpoint of CPSR approaches, there is a strong need for giving an account in research of the ways that projects failed to accomplish their intended goals. In

iterative approaches like this tradition's, failure is expected and is thought to be a vehicle for learning (O'Neill, 2016). However, there is a need to describe failures directly, to inform the work of others. CPSR researchers emphasize that implementation involves adaptation, as individuals work to make innovations fit into their local context (DeBarger, Choppin, Beauvineau, & Moorthy, 2013). And, they seek to learn from these adaptations, by documenting the work of supporting implementation and by identifying "productive deviance," that is, outliers who others can learn from (Bryk et al., 2015). By doing so, they hope to inform others as to what it takes to make things work in a real educational setting.

Targeting Organizational Culture and Practice

Shared value 8. The research should contribute to organizational or community culture and practice. For CPSR approaches, there is an additional "stakeholder" in the research, namely the organization or community in which the research is taking place. These approaches emphasize the need for research activities and results to help build or transform cultures of organizations in ways that support use of research or use of evidence-based innovations (Henrick, Cobb, Jackson, Penuel, & Clark, 2017). Collaborative problem solving research is sometimes directly involved in helping to design or redesign educational infrastructures necessary for improvement, that is, policies and guidance that are likely to increase the likelihood that interventions being tested will be implemented with integrity (Penuel, 2015; Vahey, Roy, & Fueyo, 2013).

Informing the Work of Others

Shared value 9: The research should be of value to others outside the setting of research. Like other forms of research, collaborative problem solving research seeks to produce knowledge and practical tools of value to people beyond the immediate setting for research. Researchers sometimes refer to this as "generalizability," but the meaning is somewhat different for scholars in this tradition, who emphasize that any idea, practice, or program will need to be adapted in a new context (Gutiérrez & Penuel, 2014). Moreover, these scholars emphasize that the tools and practices may be taken up by practitioners elsewhere, without the mediation of researchers. The notion of "transferability" of research from qualitative inquiry is relevant here to describing how it is ideas, tools, and conclusions might be transferred or re-contextualized by others for their use.

CPSR Approaches and Exemplary Projects that Embody the Shared Values

Having elaborated these shared values, we continue by synthesizing multiple accounts of a single exemplar project for each CPSR approach. Our aim in this section is to document the ways in which an exemplar project from each of the selected CPSR approaches (SERP, DBIR, CBDR, and IS/NICs) embodies the shared values described above. An exemplar project was defined as one that was educationally focused, had a long history in terms of at least one iteration in the educational improvement effort, and was confirmed to be an appropriate selection by the developer or advocate of the CPSR approach. We also looked across the exemplar projects to identify similarities and differences in the depth to which written accounts depicted the full picture of the CPSR approaches in action. This allows us to make initial recommendations for ways that future written work can move toward a more complete portrayal of these approaches as implemented.

Our methodology for selecting and reviewing the written material included:

1. The collection of all documents that described the empirical results of research focused on the educational improvement effort. This included peer-reviewed journal articles, book chapters, and white papers available on project websites.
2. The collection of supplemental documents (e.g., book chapters and white papers) that provided a narrative of the life course of the exemplar project, including the motivation for the partnership formation, rationale for selected research questions, and explanations for how the focus of the partnership evolved over time to address the needs of the educational partner.
3. The development of questions for each CPSR shared value (see Appendix A) to guide analysts as they documented the shared values in action. This operationalized the shared values in ways that readers could expect to encounter them in the written work.
4. A test of reader reliability when documenting the shared values, with two readers focusing on a single empirical document for each CPSR approach. This ensured that the assigned readers were interpreting the shared values and associated guiding questions in a consistent manner.
5. The assignment of a single reader to each CPSR approach's exemplar project and its identified written work to surface the shared values in action. The assigned reader then drafted the analysis of the shared values for that particular CPSR approach.
6. The draft analysis for each CPSR approach's exemplar project was sent to the project lead for review and feedback. This surfaced instances where shared values were present during the life course of the project, but were not visible in written work.

The results from this review of the CPSR exemplar projects are presented below. We begin with an overview of each CPSR approach and follow with our findings for each shared value. We then conclude with an analysis across the CPSR approaches to identify where the written accounts were strong in terms of documenting the shared values, and where there is a need for greater transparency of the CPSR approaches in action.

The Strategic Education Research Partnership Approach

The Strategic Education Research Partnership (SERP) approach was the first of the four approaches that we reviewed to emerge, and the first to define a set of principles for a collaborative problem solving approach. The SERP Institute operates as an intermediary organization that connects researchers and partners at the educational organization of interest in three main field sites: Boston, San Francisco, Oakland, Baltimore, and a network called the Minority Student Achievement Network.

The origins of the SERP approach and institute trace back to a National Research Council committee report by that name (Donovan, Wigdor, & Snow, 2003). Calling for a more "vigorous connection between research and the practice of education," the report defined SERP as (1) a program of research focused on building and testing solutions to persistent problems of practice, (2) two-way partnerships between leading researchers and educators in school districts that would function as field sites for the research, and (3) an organization that could serve as an infrastructure for a network of field sites that could learn from one another's activity (Donovan et al., 2003). Though the $500 million investment called on in the report to build the network of field sites did not materialize, in 2005, the Spencer Foundation and The William and Flora Hewlett Foundation provided funding to launch an initial partnership with Boston Public Schools (Donovan, Snow, & Daro, 2013).

Informed by research in other sectors (e.g., medicine, agriculture, and transportation), SERP is premised on the idea that sustained, collaborative efforts of researchers, policymakers, and practitioners can produce high-quality, effective, and relevant work (Donovan, 2013). The descriptor "problem solving" approach used to characterize the approaches we reviewed in this report follows from this premise, that there is benefit in designing partnerships "to follow the contours of problems" (Donovan, p. 318) as they identify systemic, sustainable solutions to problems.

In SERP, field sites initiate problem identification (Donovan et al., 2013). Once the local partner identifies the problem, SERP locates researchers with expertise in the problem area of interest and experience for further refining the problem and who can help design improvement strategies. These researchers are charged with bringing research knowledge to help frame problems and with drawing on the best evidence available on successful interventions to solve the focal problem. This serves as the starting point for regular partnership meetings during which the evidence is reviewed and adapted to meet the unique needs and organizational characteristics of the local context (Donovan & Snow, 2017).

In the early stages of endeavors, the SERP approach leans most heavily on administrators and teachers who demonstrate a clear vested interest in supporting the work to provide critical feedback in the design and piloting phases. A primary goal of SERP is to design interventions that are practical for both the educational partners as well as educational organizations outside of the partnership. This is done by intentionally developing programs that are feasible to implement within the demands and restrictions of the educational context, and to make the resulting tools, intervention materials and resources for professional learning freely available to others interested in benefiting from the partnership improvement efforts.

Unlike the other approaches we reviewed, SERP is unique in that the approach is linked to a specific organization. The focal projects, though, are not the only initiatives we might have chosen to review. Another project that illustrates how SERP research follows the contours of problems is the AlgebraByExample project, which was undertaken within the Minority Student Achievement Network of SERP to develop and test an intervention to reduce achievement gaps in algebra (Booth et al., 2015). Other SERP projects have focused on supporting learning in other disciplines, including social studies (Duhaylongsod, Snow, Selman, & Donovan, 2015) and science (Henderson, MacPherson, Osborne, & Wild, 2015). There are other partnerships structured in a similar fashion to SERP, where an intermediary organization serves as a link between researchers and educators. An example is the partnership between San Francisco Unified School District and Stanford University, which is facilitated by California Education Partners, a nonprofit organization (Wentworth, Carranza, & Stipek, 2016).

SERP Focal Project and Its Aims. The projects selected to examine how SERP operationalizes the CPSR shared values was Word Generation and a subsequent, related initiative, Strategic Adolescent Reading Intervention (STARI). These initiatives were chosen because they were mainly developed within the longest standing partnership between SERP and an educational organization, Boston Public Schools. This supported examining how this project evolved over time and adapted to the needs and challenges of the educational partner.

The primary aims of the partnership were to address the root causes for struggling readership among middle school students in Boston Public Schools and to develop a curricular improvement strategy that met the needs of these students in a way that was feasible for the district to implement within the confines of its organizational culture and context. This district wanted to know who was struggling with what and how to bring about improvements to reading. A secondary aim was to develop a set of materials that could be implemented effectively in educational contexts beyond Boston.

To represent the iterative nature of this SERP partnership, we selected empirical articles that spanned the life course of the Word Generation and STARI programs: one article focused on the quasi-experimental effects of Word Generation (Snow, Lawrence, & White, 2009); two articles describing the subsequent results from the larger randomized

trial of Word Generation (Lawrence, Crosson, Pare-Blagoev, & Snow, 2015; Lin, Lawrence, Snow, & Taylor, 2016); and a recent article discussing the results of a randomized trial of STARI (Kim et al., 2017). To supplement these journal articles to examine SERP more comprehensively, we also reviewed a forthcoming book chapter that provides an account of the SERP and BPS partnership journey from its origin to present (Donovan & Snow, in press).

Shared Values in Action within the Focal SERP Project. In this section, we describe how the Word Generation and STARI projects embodied the shared values of CPSR.

Shared value 1: The problem should be important to a broad range of stakeholders. The combination of identifying the problem locally and deepening the understanding of the problem through careful review of a broad research literature allows for the SERP approach to clarify problems with and for partners and to produce knowledge that benefits a sweeping set of stakeholders, locally and beyond.

This value was evident in accounts of the SERP collaboration with the Boston Public Schools. In this case, the superintendent initially presented the challenge to SERP to help the district improve literacy growth in the middle-school grades, pointing to stagnating growth despite engaging in intentional improvement efforts focused on this age range (Donovan & Snow, 2017; Lawrence, et al., 2015; Snow & White, 2009). The superintendent also pointed to a related challenge: they needed better tools to help them understand *why* growth was so difficult for this population of students. The superintendent noted that contemporary reading assessments administered in BPS failed to uncover the nature of the underlying challenges facing struggling middle-school readers, and more sensitive assessments were needed (Donovan & Snow, 2017). These concerns were reiterated by teachers at group meetings and were confirmed by local test data.

While problem identification originated in the local context, the SERP researchers also articulated the relevance of the problem to national policy leaders and teachers across the country. For example, SERP researchers described the evidence base regarding reading challenges as supporting the claim that such problems are multifaceted (Snow & White, 2009), and they asserted that teachers across the country are hard pressed to identify promising solutions given the limited success of previous interventions, particularly when brought to scale (Kim, et al., 2016). They also turned to other national studies that have shown that a lack of student motivation and engagement can serve as a barrier to successful literacy interventions, using these findings to uncover likely root causes of the problem at hand (Kim, et al., 2016).

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research. Synergies and coordination among researchers and partners is at the core of the SERP approach. Indeed,

accounts of the SERP collaboration with the Boston Public Schools make clear the unique contributions of (and the coordination among) researchers and partners.

For example, in the case of Word Generation and STARI, researchers first identified established design principles in the existing interventions focused on struggling readers. These principles were shared in successive partnership meetings and reshaped based on feedback from BPS leadership and practitioners. The researchers described how Boston leaders and teacher partners volunteered to serve as a test case of the program and to critique its design based on their experience in the BPS organization and with BPS students (Donovan & Snow, in press). They observed that educator expertise enriched the design of Word Generation by ensuring that the vocabulary content was relevant and engaging across curricular areas in which it would be taught. One example given by Donovan and Snow (in press) showed how the research literature encouraged the introduction of new words across contextual boundaries (e.g., the word variable as it relates to math, science, and English Language Arts).

Shared value 3: The research should support the agency of participants. The SERP approach not only defines key roles for partners, but also depends on them to exercise agency in those roles.

In accounts of the development of Word Generation, practitioner partners were empowered to affect the intervention design by encouraging the research team to pay careful attention to the classroom activities in which these words were taught, and to ensure that the activities were clearly relevant to the subject matter (e.g., math, science, history). They were concerned that if this aspect of the design were overlooked, the teachers would reject the activity and revert to previous teaching strategies that had greater relevance to the subject matter. The research team heeded this advice and selected activities accordingly.

Teacher input regarding implementation and expectations of the intervention was also valued throughout the partnership process and affected changes over the course of developing and revising the intervention. Within the pilot school testing Word Generation, teachers said they could not fit the initial set of 10 new words per week into their classroom schedule. The research partners responded by reducing the number of words by half in order to garner the most support in implementation among teachers (Donovan & Snow, in press). STARI teachers were similarly empowered to provide feedback on implementation challenges and strategies for promoting student learning within the program during their district-based professional learning community meetings (Kim et al., 2017). This feedback loop while designing and piloting Word Generation and STARI incorporated non-researcher voices at every stage and strengthened the likelihood of success as it was implemented more widely in the district.

Shared value 4: The research should attend to context. Within the SERP approach, attention to context goes beyond defining roles for partners and empowering them to

exercise agency. It also has researchers, themselves, engaging and understanding local context as a foundation for the partnership.

In the case of SERP collaboration with the Boston Public Schools, the researchers in the SERP partnership worked carefully to understand how the problem of struggling adolescent readers played out in the local context, as well as the demands on participating teachers in order to appropriately modify plans for implementation of Word Generation. Prior to building the intervention, the research partners conducted teacher interviews and classroom observations in order to gain a deeper understanding of the barriers to comprehension success among the students in BPS. A single pilot school was selected in order to test drive the program and make modifications based on feedback from school leadership and teachers (Donovan & Snow, in press). For example, the material in the math portion of the program shifted from a focus on conceptually more interesting math problems to those that supported review and test preparation to meet the needs of teachers as they prepared students for their end-of-year exams (Donovan & Snow, in press).

In addition to being sensitive to the classroom context and teacher demands, the SERP researchers recognized contextual issues at the school level that could influence the success of the program and worked to overcome potential challenges. For instance, the Boston schools serving middle school students varied in the grade ranges they offered (e.g., grades K-8 versus 6-8). In the middle schools serving only grades 6-8, the instructional planning was typically siloed within departments such that teachers only communicated about teaching activities within subject areas. The Word Generation program developed opportunities for cross-subject communication to occur without overburdening the teaching staff (Snow et al., 2009). By studying the school and classroom environments during the initial design of Word Generation and making adjustments to accommodate the needs of the various actors participating in the program, the SERP partners developed a program that was more responsive and flexible to the local context.

Shared value 5: The research should provide something of practical value to participants. Central to the SERP approach is devising support and resources that bear on the practical, day-to-day work of partners. Moreover, as discussed below, under Shared Value 9, the most powerful proof of concept of practical value is the practical use of resources produced through the partnership in other educational organizations.

Accounts of the development of Word Generation provided evidence of how this value is operationalized within SERP. Other schools within Boston chose to implement the program after the piloting work of the program was completed in a handful of schools and the participating educators expressed their appreciation of the program and its results (Donovan & Snow, in press). SERP subsequently made the Word Generation materials and implementation guides freely available to educators beyond BPS, and have reported over 20,000 downloads by registered educators (Donovan & Snow, in press). The wide reach of the Word Generation program demonstrates the ability of the SERP partnership approach

to produce educational improvement strategies that are feasible for practitioners to implement in real world settings.

The Word Generation and STARI examples demonstrate how the SERP approach strives to provide something of practical value—by intentionally designing the program to be feasible within the time constraints and demands placed on teachers. For example, Word Generation required only 15 minutes a day once a week for each teacher in mathematics, science, and social studies. In other words, a single teacher in these subjects is only required to teach using Word Generation or STARI for 15 minutes a week (Kim et al., 2017; Lawrence et al., 2015; Lin et al., 2016). This made the program exceedingly manageable for teachers to participate and helps to explain the willingness of more teachers and schools to implement the program.Teachers were also given the flexibility to implement the program in any order across subject matters that worked for their schedules, lifting yet another potential barrier to participation and successful implementation (Snow et al., 2009).

Despite the limited time requirements of Word Generation and STARI, the programs still introduced novel ideas and routines for teachers. In response, additional professional supports were provided as part of one study, including "Lead" teachers at each school who attended a three-day summer institute where they received intensive training on the foundations of Word Generation. This training allowed the Leads to provide hands-on support for other participating teachers at their school throughout the year (Donovan & Snow, in press; Lawrence et al., 2015). The SERP approach's combined attention to lifting time constraints and providing professional supports to participating practitioners contributed directly to the practical nature of the resulting research.

Shared value 6: The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge. Central to the SERP approach is moving beyond serendipitous experiential learning to rigorous, planful, deliberate design-and-improvement that both anticipates and addresses uncertainty and complexity in collaborating with partners to solve practical problems. That, in turn, positions the SERP approach to adhere to the expectations for more traditional research approaches while simultaneously attending to the other shared values of CPSR.

This attention to rigor, planfulness, and deliberateness is evident in accounts of SERP's collaboration with the Boston Public Schools. Alongside the careful attention to the design and implementation of Word Generation and STARI, SERP involved experts in the research methodology necessary to address the primary research questions raised in each empirical article. The research designs, data collection procedures, and analytic strategies were all coherent and appropriate for the questions raised at each phase of development of the intervention.

The research designs grew progressively more advanced after the initial quasi-experimental examination of Word Generation showed promise (Snow et al., 2009), making a strong case for conducting the randomized controlled trials of Word Generation and STARI that followed (Kim et al., 2017; Lin et al., 2016). This progression fits the Common

Guidelines for Research and Development (IES & NSF, 2013), which recommends conducting such trials only after there is some evidence from quasi-experimental studies that a program holds promise. The studies were also careful to acknowledge the limitations of the findings based on the research design, particularly for the quasi-experimental study, and placed the findings in context based on effect sizes from other reading interventions striving to accomplish the same goals (Snow et al., 2009).

Shared value 7: The research should account for the gap between what was intended and what was accomplished. Central to the SERP approach is "following the contours of the problem" by (a) reconciling theories of problems and solutions with evidence of implementation and outcomes, (b) accounting for those differences, and (c) addressing new problems discerned via this analysis. This value holds both for the development of interventions and for the production of research.

Attention to this intention-accomplishment gap is evident in the "limitations" sections of the empirical articles of Word Generation and STARI. In these sections, researchers described limitations of research designs that affected interpretation of findings, and they made recommendations for future research efforts. For example, there were discussions of internal validity and sampling issues, problems with self-report diagnostics, differential timing of surveys, and difficulty obtaining student-level control variables (Lawrence et al., 2015; Lin et al., 2016; Snow et al., 2009). These limitations were presented with transparency along with guidance to interpret the results with caution.

In some cases, the SERP research partners described implementation and measurement challenges, and the subsequent efforts taken to address those challenges (known as "following the contours of the problem" in the SERP approach). For example, Snow and colleagues (2009) acknowledged that there was variation in the amount of professional development delivered across schools, which potentially impacted how successfully the program was implemented. They also recognized that the selection of topic areas for Word Generation activities could influence how well the students engaged with the material and this should be considered in future iterations of the design and research of the program.

Donovan and Snow (in press) discussed other examples where they faced challenges to Word Generation success and another design and research cycle was initiated. For instance, the superintendent of Boston Public Schools identified the need for more appropriate measures to track the nature of students' struggles in reading beyond the state standardized achievement tests. This spurred the SERP team to work with assessment experts to develop RISE, a reading test more responsive to the specific reading challenges of greatest concern to Boston Public Schools' leadership and teachers (Donovan & Snow, in press).

Also, through intentional study of the implementation of Word Generation, SERP researchers had observed that the program had the greatest impact when there was higher internal coherence of the school leadership and teacher views on instruction and learning (Elmore & Forman, 2010). This spawned a whole new line of work that would strive to

improve the internal coherence at schools in the hopes of allowing Word Generation to have maximum positive impact on student outcomes. That work, in turn, led to the design of a more general set of tools for supporting schools in developing more instructional coherence (Forman, Stosich, & Bocala, 2017).

The STARI program grew out of a need to address readers who were struggling with much more than the academic vocabulary than Word Generation was designed to support. In another partner district implementing a different strategy for struggling readers, the district observed little gain for the readers that were struggling most. SERP partners responded by developing STARI to address this particularly disadvantaged population of students (Donovan & Snow, in press). These examples depict the commitment of the SERP approach to following the contours of the problem by developing subsequent iterations of the design and research cycle that address the weaknesses of the previous cycle.

Shared value 8: The research should contribute to organizational or community culture and practice. With the SERP approach, the focus goes beyond attending to local context to actually shaping local context — organizational structures, culture, and practice — to support problem solving activity. That, in turn, raises a tension endemic to CPSR: working to adapt structures, culture, and practice to be responsive to problem solving efforts while also working respectfully within (and honoring) existing structures, culture, and practice.

The internal coherence work discussed immediately above, under Shared Value 7, is an example of how SERP researchers sought to support organizational change across the district through work with individual schools while, at the same time, honoring existing organizational arrangements. The Word Generation example also demonstrates the intentional efforts of SERP partners to fit within the existing culture and practice of Boston rather than work to change it. This is evident in the efforts to modify the program such that it wouldn't interfere with accountability mandate requirements or push the teachers too far outside their comfort zone and therefore put implementation success at risk. This adaptation to meet the local parameters is very likely the reason that it was so successfully implemented in Boston.

Reports on the SERP collaboration with the Boston Public Schools go further, toward identifying general categories of challenge in local structure, culture, and practice likely to bear on other CPSR approaches. These include issues of churn among leadership, balancing the priority areas for grant funding with genuine needs of education partner needs, and being sensitive to power dynamics among educational leaders with differing visions for the educational organization as a whole (Donovan & Snow, in press). Surfacing these general challenges allows for SERP and other CPSR approaches to make progress on overcoming these organizational barriers to change.

Shared value 9: The research should be of value to others outside the partnership. As noted above, central to the SERP approach is addressing problems that have meaning

beyond the partnership context. That, in turn, is complemented by the goal of devising solutions and resources that have practical value in other contexts.

As detailed in accounts of the SERP collaboration with the Boston Public Schools, the Word Generation program materials have been made freely available to any and all educators interested in implementing the program. In addition to making the program available, SERP researchers have described how this particular program may be implemented outside the local context and issues to consider when doing so. For example, they highlighted pedagogical strategies that mediate outcomes and that might be emphasized in professional development in other places (Lawrence et al., 2015). Donovan and Snow (in press) discussed implementing Word Generation in other districts beyond Boston for the randomized controlled trial, and they described the adjustments they had to make to the intervention to accommodate differences in district cultures, organizational structures, and English Learner populations.

The SERP partners for the Word Generation program have also carefully detailed the implementation steps in the writings and have described in depth the professional development offered to teachers as part of the programs (Donovan & Snow, in press; Lawrence et al., 2015; Snow et al., 2009). These written accounts provide guidance for others not directly involved in the partnership to consider adapting and implementing the Word Generation program in their own educational organization.

The Design-Based Implementation Research Approach

Design Based Implementation Research (DBIR) is an approach to research and development that brings together two different research traditions: design-based research and implementation research.

Design-based research is a signature approach of the interdisciplinary field of the learning sciences. In design-based research, teams organize or "engineer" new forms of learning in order to study the conditions under which they can be supported (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Design-Based Research Collective, 2003). Design-based research typically takes place in small numbers of classrooms, and it can yield new learning theories, as well as concrete designs for learning, such as curriculum materials (Edelson, 2002).

Implementation research in education often focuses on what happens when policies and programs are brought to scale. It seeks to describe and explain patterns in implementation by examining individual, interpersonal, organizational, and institutional processes (Century & Cassata, 2016; McLaughlin, 2006; Spillane, Reiser, & Reimer, 2002). It, too, can yield new theoretical insights related to how and when policies and programs can spread and be sustained (e.g., Frank, Zhao, & Borman, 2004). DBIR seeks to study and engineer these conditions, using theories, design processes, and approaches of both design-based research and implementation research (Fishman, Penuel, Allen, Cheng, & Sabelli, 2013; Penuel, Fishman, Cheng, & Sabelli, 2011).

DBIR traces its origins to multiple sources, and is best understood as a name for forms of research and development that share common features. In addition to design-based and implementation research, inspirations for DBIR include participatory evaluation research, community-based research, and social design experiments. The SERP approach is another inspiration, and the example of Word Generation appears in the article outlining the key features of DBIR as an example of a project that embodies these features. Describing DBIR collaborations, Penuel and colleagues (Fishman et al., 2013; Penuel et al., 2011) named four core principles of this work:

- A focus on persistent problems of practice from multiple stakeholders' perspectives
- A commitment to iterative, collaborative design;
- A concern with developing theory and knowledge related to both classroom learning and implementation through systematic inquiry
- A concern with developing capacity for sustaining change in systems.

DBIR is an approach that is a suitable for long-term research-practice partnerships, because it entails designing supports for classroom learning and broad implementation across levels of a system (Penuel & Gallagher, 2017). Rather than working at one part of a system—for example, at the level of classroom teachers—projects that use DBIR include actors at multiple levels of the system. They bring together classroom teachers, administrators, researchers, and other stakeholders. DBIR follows in the tradition of design research by working outside lab settings to design and study what makes innovations successful in real classrooms (Fishman et al., 2013). In many projects, researchers assist school staff with the implementation of an intervention, often co-designing tools, resources, and solutions to problems of implementation.

DBIR Focal Project and Its Aims. Although a project can be organized around the features of DBIR at any phase in the development of a program, practice, or policy, DBIR is particularly well suited for adapting interventions to new contexts that have proven effective elsewhere.

As such, the focal DBIR project is an example of a project that involved adaptation of an evidence-based program to a new context, as part of a new research-practice partnership. Our focal project, the SunBay Digital Mathematics Project, is an example of such an effort, in that it involved the adaptation of a curricular intervention focused on middle school mathematics, SimCalc Mathworlds, that past research had been shown to impact student learning in multiple, large quasi-experimental studies and randomized controlled trials (Roschelle, Shechtman, et al., 2010; Tatar et al., 2008).

SimCalc Mathworlds focuses on helping middle school students develop foundational ideas related to the mathematics of change and entails solving problems related to rate and proportionality that entail coordination of multiple representations of functions (Roschelle & Hegedus, 2013; Roschelle, Kaput, & Stroup, 2000). A key goal of SimCalc from the start, has been to provide students with entry points into ideas needed for calculus, which many

low-income and students of color typically do not encounter in K-12 education (Kaput, 1994).

Through multiple years of design-based research studies, the project evolved from software projects with linked activities to a fully developed *curricular activity system*, that is a progression of activities that addresses important mathematics, supported by an integrated, coherent system of technology infrastructure, paper curriculum resources, teacher guides, and professional development workshops for teachers (Roschelle, Knudsen, & Hegedus, 2010). It is this system, rather than any one component, that was tested in experimental studies and then adapted within the SunBay Project, which involved a collaboration between researchers in two different institutions, SRI International and the University of South Florida St. Petersburg, and a school district, Pinellas County Schools (Roy, Vanover, Fueyo, & Vahey, 2012).

There are a number of DBIR projects other than our focal projects that we might have selected, each of which involve partnerships between researchers and educators. The MIST Project, for example, brought together learning scientists, policy researchers, and leaders from two different districts that were focused on supporting improvements to the quality of instruction in middle grades mathematics (Cobb & Jackson, 2011; Cobb, Jackson, Smith, Sorum, & Henrick, 2013). The University of Washington partnership with Seattle-Renton school district is focused on supporting equitable implementation of the Next Generation Science Standards. Lines of work within that partnership include professional development of teachers to support curriculum adaptation and assessment development (Bell & Wingert, 2017). The Inquiry Hub partnership between Denver Public Schools and the University of Colorado Boulder is similarly focused on supporting implementation of the Next Generation Science Standards, primarily through the design of new student-centered curriculum units (Severance, Penuel, Sumner, & Leary, 2016).

Shared Values in Action within the Focal DBIR Project. In this section, we describe how the SunBay Project embodied the shared values among different CPSR approaches.

Shared value 1: The problem should be important to a broad range of stakeholders. A key idea in DBIR is that the focal problem to be addressed is negotiated among stakeholders in a project (Penuel, Coburn, & Gallagher, 2013).

In the SunBay project, key stakeholders involved in defining the problem included the research teams at both universities, district leaders, and—to a more limited extent, teachers. From both educators and the SRI researchers' perspective, improving students' understanding of proportional reasoning in the middle grades was a priority, because these multiplicative relationships form foundational knowledge needed to understand "measurement, percent, scale, rate of change, similarity, and estimates of a population based upon a sample" (Roy, Fueyo, & Vahey, 2017, p. 2). Researchers from both universities also prioritized the need to build teachers' foundational mathematics understanding and pedagogical content knowledge in mathematics (Vahey, Roy, & Fueyo, 2013).

The district, for its part, was interested in an intervention that could help improve mathematics achievement in the middle grades, but they also did not want the materials to make significant demands on teachers (Vahey et al., 2013). Teachers' needs were considered in revisions made to the program after the first year, when, as part of the research, teachers were interviewed as to how well the materials meet the mathematical needs of their students (Vahey et al., 2013).

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research. DBIR strongly emphasizes the need for drawing on complementary expertise of researchers and educators to create more usable and effective interventions (Penuel et al., 2013).

The SunBay project drew extensively on the expertise of researchers, educational leaders, technology designers, and teachers. Roy and colleagues (Roy et al., 2012) include a chart of major contributions and expertise of the different stakeholders: university-based researchers brought their expertise in teacher preparation to the task of providing most professional development in the project; education researchers from SRI provided the curriculum and led SimCalc-specific professional development sessions; and district leaders provided support or "cover" for teachers to implement units, as well as extensive local knowledge of schools participating in the project, which facilitated implementation.

Teacher knowledge was highly valued in SunBay math and was integral to the future success and scaling of the projects. Teachers were not simply the recipients of PD, they were called upon to "provide the core of expertise in the district" (Vahey et al., 2013, p. 187). Teachers were positioned as sense-makers and participated in active professional development sessions where they helped to shape their own learning. This was a deliberate move; allowing teachers to explore their own learning experiences helped to link teacher thought processes to those of students, allowing teachers and students to become co-learners in the classroom.

Rather than focusing on fidelity to a particular instructional approach, teacher expertise was incorporated into the professional learning community, and teachers were encouraged to use their expertise as the saw fit in their own classroom. In SunBay, teachers were actively encouraged to make adaptations to the curriculum materials and teach them in whatever way made most sense to them, and the researchers grounded their conviction in past research on SimCalc that had found a wide variety of teaching strategies resulted in effective implementation (Roschelle, Pierson, et al., 2010).

Shared value 3: The research should support the agency of participants. Supporting educator agency is a key aim of many DBIR projects like SunBay, which rely on teachers to adapt and implement curricular innovations (Severance, Penuel, Sumner, & Leary, 2016).

In SunBay, district leaders took the first step of modifying the SimCalc materials, working with researchers to identify the parts of the curriculum that would most benefit students and the parts that needed to be modified, which included a mix of "cosmetic"

changes from Texas to Florida context and a few realignments of content to match Florida standards (Vahey et al., 2013). One decision, too, made by the district, was to focus implementation not on a single unit, but on different units, depending on the grade level of teachers and students (Roy et al., 2017).

Teachers in the SunBay project influenced improvement efforts by providing feedback on their professional development opportunities. The needs of teachers who were implementing MST in their classrooms shifted over time, as such, their PD was responsive to their changing needs. As a result of the evaluation received after the first several professional development meetings, "the focus of the subsequent sessions held during the school year emphasized each teacher's unique approach to teaching the unit" (Roy et al., 2017, p. 10).

Shared value 4: The research should attend to context. As the SERP approach, attention to context in DBIR goes beyond defining roles for partners and empowering them to exercise agency. Research on the local context often precedes design work within DBIR.

In the case of SunBay, the SRI-based team conducted some preliminary investigations into the unique opportunities afforded by Pinellas County Schools early on to identify key constraints and stakeholders in the work, which Vahey and colleagues (2013) detailed. The tailoring of the materials to fit standards better and selection of specific units reflect the ways that the design was adapted for the local context. In addition, the work to re-design the instructional guidance infrastructure elements like pacing guides reflects the careful attention to creating conditions within the SunBay project for teachers to perceive the curricular activity system as coherent with their local context's aims for student learning.

Shared value 5: The research should provide something of practical value to participants. A strong focus of DBIR is on creating programs and practices that are feasible to implement and valuable to different stakeholders (Fishman et al., 2013). In addition, implementation also leads to the need to address emerging needs of educators that may not always be apparent ahead of time to educational leaders or researchers (Johnson, Severance, Penuel, & Leary, 2016).

In the case of SunBay, some of the needs of educators for practical tools were anticipated ahead of time. These include the need for complete curriculum materials and teacher guides, as well as monetary incentives for participation in adult learning activities related to mathematical knowledge and pedagogical content knowledge (Vahey et al., 2013). But they also included concerns that previous studies had shown had inhibited the sustainability of SimCalc after experimental studies of impact had concluded, namely the need for materials to fit better within the local context and to clearly address the needs of students of different income and achievement levels (Fishman, Penuel, Hegedus, & Roschelle, 2011; Hegedus et al., 2014).

To address these concerns, the team made adaptations to fit materials better to the Florida standards and—when they were adopted—the Common Core State Standards in

Mathematics. In addition, the research team worked with district leaders to adopt pacing guides so the unit fit easily with them, and they recruited teachers that represented a diversity of schools with respect to racial composition and family income.

Shared value 6: The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge. DBIR projects employ methods and research designs that are appropriate to the phase of development, sometimes using "rapid ethnographic" methods to study context up front (e.g., Penuel, Tatar, & Roschelle, 2004), and other times conducting experiments of well-developed curricular innovations (e.g., Penuel et al., 2015).

The SunBay project might best be described as one focused on replication of previous findings from experimental studies, though the replication did not allow for new experimental studies to be conducted initially, due to constraints of the context. The district did not believe it would be fair or consistent with its own policies to conduct an experimental test of the materials there. As part of the research, the team conducted pre- and post-tests in a sequence of studies using measures developed as part of earlier studies (Roy et al., 2017; Vahey et al., 2013), and they also documented teacher implementation and responsiveness to professional development (Roy et al., 2012).

Through the project, the team was able to establish that the successive samples of students involved in SunBay achieved comparable levels of growth as students in the treatment group had in the earlier randomized controlled trials. Compared to the earlier SimCalc randomized controlled trial results, the SunBay average math gain scores in the first study were "almost identical to the SimCalc Treatment gain scores, and both are significantly greater than the SimCalc Control gain scores" (Vahey, Knudsen, Rafanan, & Lara-Meloy, in press, p. 192). In a later study, the SunBay students performed similarly; in that study, the teacher with the lowest gain scores outperformed more than two thirds of the control teachers in the earlier randomized controlled trial (Roy et al., 2017).

In both cases, it is important to underscore that the team relied on carefully constructed and validated measures of mathematics learning that addressed both procedural knowledge and more in-depth, conceptual understanding of concepts, measures that had been used in earlier studies (Shechtman, Roschelle, Haertel, & Knudsen, 2010).

Shared value 7: The research should account for the gap between what was intended and what was accomplished. A key value of design-based research is to document challenges and failures and what teams learned from them (O'Neill, 2016).

The accounts of SunBay present openly the challenges they faced in the project. They include descriptions of how teacher turnover partly undermined their efforts to build a cadre of teacher leaders who could help others learn how to implement the units and advocate for them. In addition, they noted that technology was not always available or in good working order. Given the centrality of technology tools for the curriculum, this was a

significant obstacle. Moreover, team members discovered that teachers' comfort with using technology in the classroom varied widely. The "found that some of the participating teachers did not use the technology with the level of intensity they forecasted during the initial professional development" (Roy et al., 2012, p. 156).

Shared value 8. The research should contribute to organizational or community culture and practice. Creating broader organizational change is often necessary to sustain policies and practices, and DBIR projects therefore seek to effect such change.

In the case of SunBay, a key goal was to enable both the curriculum materials use and the partnership itself to be self-sustaining (Vahey et al., 2013). The close collaboration between multiple stakeholders fostered the creation of a learning community of practice in the SunBay project. Teachers and researchers met regularly, and the professional development that teachers engaged in was responsive to their particular needs and desires. They actively co-created the professional development session. Teachers in the SunBay project appreciated how this collaborative approach provided them with peers and others to bounce ideas about implementation off of, which was different it was from the typical "canned" professional development they received (Vahey et al., 2013).

The mutual exchange between the two research teams was intended to build the capacity of each to design and implement effective and sustainable professional development. The content-focused professional development was to be integrated with the university's offerings and enable teachers to earn graduate credit. The SimCalc research team from SRI helped them integrate the SimCalc-specific content into courses, while the University of South Florida-St. Petersburg team provided a practical means by which the research team could offer a powerful incentive for teachers to deepen their knowledge base.

Shared value 9: The research should be of value to others outside the partnership. As with the SERP approach, central to DBIR is devising solutions and resources that have practical value beyond the partnership contexts. This includes generally-useful materials as well as generally-meaningful theoretical and empirical accounts of the work.

In the case of SunBay, the research that the team conducted has appeared in both peer-reviewed journals (Roy et al., 2017; Roy et al., 2012) and conference proceedings (Vanover, Roy, Unal, Fueyo, & Vahey, 2012), as well as in book chapters (Vahey et al., 2013), that is, traditional academic outlets. These have attempted to show the possibility of replicating findings from the original randomized controlled trials and therefore the potential value of the curriculum outside the context. The research has also highlighted ways that customization and adaptation does not have to undercut the efficacy of an intervention but can enhance its sustainability. It also underscores the importance of professional development as an integral component of the SimCalc curricular activity system to prepare teachers for implementation and to equip them with knowledge they can use to support it.

The team has also published strategies employed in the curriculum in magazines devoted to practitioner audiences. For example, several members of the team (Roy et al.,

2016) wrote an article that appeared in *Mathematics Teaching in the Middle School* focused on a teaching strategy emphasized in the professional development. The approach, the "Predict, Check, and Explain" routine for mathematical problem solving involving rates of change, was one of the strategies that team members thought might be portable to other places and embedded within different curriculum materials.

The Improvement Science in Networked Improvement Communities Approach

The Improvement Science in Networked Improvement Communities (IS/NICs) approach to CPSR began as an exploration by Bryk and colleagues into two coordinated approaches that might inform the building of a research and development infrastructure for American education that could support dramatic improvements in outcomes reliably and at scale: improvement science and networked improvement communities (Bryk, 2009; Bryk, Gomez, & Grunow, 2011). The leading organization for adapting these approaches has been the Carnegie Foundation for the Advancement of Teaching.

The first approach on which Carnegie draws is *improvement science* as developed within health care (Berwick, 2008) and as inspired by applications of Deming's (1993) writings on performance improvement. Improvement science is a form of systematic inquiry that begins with the definition of a persistent problem and, from there, maps backward to the system that (re)produces the problem, an improvement aim, a system for measuring progress toward that aim, and a design for devising and testing possible solutions using rapid Plan-Do-Study-Act cycles (Massoud, Nielsen, Nolan, Schall, & Sevin, 2006; McCannon, Schall, & Perla, 2008). In improvement science, inquiry is guided by three basic questions: What are we trying to accomplish? What changes can we make that will result in improvement? How will we know that a change is an improvement?

The second approach on which Carnegie draws is *networked improvement communities* as an organizational form through which to operationalize improvement science. As explained by Bryk et al. (2015), inventor and engineer Douglas Engelbart (1992) first coined this term to refer to a way that a high performance organization or network of individuals who are engaged in efforts to improve practice might organize itself to "get better at getting better." He asserted that people working on common problems and solutions to those problems could be more effective not only if they formed a network but also engaged in collective work to improve *how* they went about their work of developing and testing solutions.

In Carnegie's approach to networked improvement communities (NICs), members use principles of improvement science in combination with resources and routines to address practical problems and to improve work processes within educational systems. A NIC uses improvement science techniques to engage local practitioners in working iteratively, over time, to study the problem in local contexts, develop initial theories of problems and solutions, devise and test interventions, and review theories of problems and solutions in light of outcomes. Such work can have focus exclusively on locally-designed solutions. It can also focus on incorporating, using, and refining externally-developed solutions.

The Carnegie approach to coordinating improvement science and networked improvement communities grew out of a concern that research and development that is focused on identifying programs and practices that *can work* is not likely to be as useful for producing needed improvements as is an approach that is focused on *making programs and practices work* in a wide variety of settings (Bryk, 2009). The approach also attempts to address practitioner-led school reform efforts that suffer from what Bryk and colleagues (2015) call *solutionitis*: the tendency to adopt solutions without first developing deep understanding of problems and the systems that produce them.

Focal Project and its Aims. We chose the Carnegie Math Pathways networked improvement community as the focal project for analysis because: (a) it seeks to address a pressing educational problem; and (b) it is held up by the Carnegie Foundation as a successful case of using its IS/NIC approach to address that problem.

Originally called the Community College Pathways, this NIC began with the Carnegie Foundation and a team of community college partners setting out to dramatically increasing the percentage of developmental math students achieving college math credit in just one year of enrollment. At the time when this NIC first organized, approximately 60% of America's community college students began their postsecondary studies with a developmental math course, but 80% of them did not then move on to earn college-level math credit even after three years of college enrollment (Bailey, Jeong, & Cho, 2010). This was an especially acute problem for minority college students (Bailey et al.). The work of the NIC, then, focused both on increasing success rates in developmental math courses and on reducing variation in achievement.

Carnegie Math Pathways initiative yielded two of what Carnegie describes as "change packages" that replace existing developmental math courses: the Statway and Quantway learning programs. Statway is a year-long, introductory-level college statistics course. Quantway is a quantitative reasoning course with an initial semester of Quantway 1 that can be followed by either a second semester of Quantway 2 or another college level math class. Both Statway and Quantway feature accelerated coursework supported by an instructional and organizational infrastructure, all of which was designed by and is continually supported through the NIC. Each was designed to dramatically increase students' persistence in studying mathematics, their retention in mathematics courses; and their learning of mathematical content, skills, and practices in less time than is typical for developmental mathematics students.

We initially analyzed three papers describing the effects of Statway and Quantway on outcomes of interest (Hoang, Huang, Sulcer, & Yesilyurt, 2017; Norman, 2017; and Yamada & Bryk, 2016). To understand the IS/NIC approach to practice-based problem solving, we also reviewed one article on the initiation of networked improvement communities (Russell et al., in press) and another on the history and rationale behind this NIC approach (LeMahieu, Grunow, Baker, Nordstrum, & Gomez, 2017). We also reviewed a technical

report describing the Carnegie Math Pathways initiative (Yamada, Bohannon, & Grunow, 2016).

The Math Pathways project is but one of a number of Carnegie to develop the approach, and there are also efforts led by groups other than Carnegie that make use of improvement science methods. At Carnegie, the Building Teaching Effectiveness Network sought to apply improvement science approaches to improve the quality of feedback from principals to novice teachers (Hannan, Russell, Takahashi, & Park, 2015). In California, with coaching from Carnegie, the Central Valley Networked Improvement Community is making use of improvement methods to improve mathematics achievement in Tulare County Schools. That effort is notable, because there is no formal research partner helping lead the initiative: rather, education leaders in the County Office of Education facilitate the network.

Shared Values in Action within the Focal Improvement Science Project. We continue by using the shared values detailed above as a framework for describing the Carnegie Math Pathways.

Shared value 1: The problem should be important to a broad range of stakeholders in the local context. The IS/NIC approach begins with a common problem of practice of importance to all members of the network.

The Carnegie Math Pathways formed to solve a persistent and important problem of educational practice within and across many community colleges in the US: very low success rates in developmental mathematics that functioned as a roadblock to completing certification programs and associate's degrees (Bailey et al., 2010). Instead of being an avenue for access and success as they had been intended, conventional approaches to developmental mathematics have impeded many students' degree attainment. This was and remains a problem of national concern, but each of the community college partners joined the NIC in order to see progress happen on their own campuses.

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research. Central to the IS/NIC approach is coordinating diverse groups of experts using common improvement methods to solve problems more effectively, more quickly, and at a larger scale than possible when working independently (Bryk et al.; Russell et al., in press). That, in turn, requires that members of these diverse groups open themselves to refashioning establishing identities and habits to come together around a simple imperative: "How can we help each other best solve this problem?" (Bryk et al.: 156). It also requires a new type of organization and leadership – a network hub and leadership team – with responsibilities for coordinating among partners (Bryk et al., 2015). The hub organization often evolves out of a Network Initiation Team that assumes initial responsibility for constituting and chartering the NIC.

As is characteristic of NICs, the Carnegie Math Pathways brought together groups of partners with diverse expertise from research and practice communities, including: Carnegie Foundation leaders and staff; researchers; content area experts; designers; and community college mathematics faculty and administrators (Bryk et al., 2015; Carnegie Foundation for the Advancement of Teaching, 2017; Hoang, Huang, Sulcer, & Yesilyurt, 2017; Norman, 2017).

The Carnegie Foundation, itself, served as the hub of the network. While the Carnegie Math Pathways NIC did include a distribution of responsibilities among these diverse groups, their roles, expertise, and coorindation were not mapped out and described clearly at the outset. Rather, as explained by Anthony S. Bryk, President of the Carnegie Foundation for the Advancement of Teaching, in his keynote to at the 2016 Carnegie Improvement Summit, the Carnegie Math Pathways was something of a learning journey that featured a mix of planning, serendipity, and learning, with membership, responsibilities, and coordination evolving along the way.

Shared value 3: The research should support the agency of participants. A key aim of Carnegie's IS/NIC approach is to foster the generation of knowledge *from* practice: that is, what might be called "practice-based evidence" as a complement to what is often framed as "evidence-based practice" (Bryk et al., 2015). In this way, NICs emphasize the agency of educators in shaping both the improvement strategies and the knowledge of how and when they produce desired outcomes.

As the organizing entity for the Carnegie Math Pathways NIC, the Carnegie Foundation engaged the diverse members of the network in activities to develop a better understanding of the problem and of the systems in which local instances of the problem operated (Yamada & Bryk, 2016). Indeed, the first of the six guiding principles of Carnegie's model is to "make the work problem-specific and user centered" (LeMahieu et al., 2017, p. 13). Throughout the papers we reviewed, we found descriptions of the Carnegie Math Pathways engagement of educational practitioners in exploring the problem to be solved along with its (often multiple) causes. We also consistently found a commitment to collaboratively developing solutions among the very same educators and additional partners.

Also, the Statway and Quantway programs, themselves, directly support student agency. Both emphasize the importance of developing students' sense of contribution and belonging as a key to academic success. In addition to seeking to increase students' mathematical knowledge in order to help more of them earn college math credit, both the Quantway and Statway programs were designed to engage students as active agents capable of changing their relationships with mathematics and their identities as knowers and learners of mathematics.

Shared Value 4: The research should attend to context. A fundamental tenet of the IS/NIC approach is that problem solving begins with the use of common procedures and tools both to analyze the system that produces the problem and to devise solutions,

including fishbone diagrams, system improvement maps, journey maps, and driver diagrams (Bryk et al., 2015).

In the case of the Carnegie Math Pathways, these procedures and tools were used further to "follow the contours of the problem," as the use of new solutions opened up additional problems and needs as well as new perspectives and opportunities in these systems. For example, while Statway and Quantway helped many students in many classrooms across many colleges succeed in mathematics like they had not before, success was not universal. In one research brief, the authors explained the importance of further exploring the causes underlying instances of students' failure to find success. In several colleges, there were numerous students who had successfully completed the first semester of Statway, but did not begin the second. They explained:

> Over the past year, we have worked with colleges that have an above average proportion of students who succeeded in Statway 1 but did not enroll in Statway 2. The challenges are diverse. One large college has technical problems with its room and staff scheduling software that makes offering courses at consistent times from semester to semester nearly impossible. Another college shared that disruptions in the local labor market meant that a number of students were unable to enroll in the term we were studying. This in an area in which an improvement approach challenges us to understand the root causes of the non-successes and prototype and test possible changes that might address them. (Hoang et al., 2017, p. 13)

Shared value 5: The research should provide something of practical value to participants. Within Carnegie's IS/NIC approach, the practical value of participation lies in the development of solutions to practical problems. That is the raison d'etre for any given NIC. Indeed, as discussed above, the Carnegie Math Pathways yielded two change packages that displaced past, ineffective developmental math programs in participating community colleges: Statway and Quantway.

Yet the practical value of NICs to their many diverse members goes further. For example, in the case of the Carnegie Math Pathways, participating community colleges developed new roles, structures, and capabilities in participating sites that support continuous learning and improvement over time. Further, as discussed immediately below, the Carnegie Foundation leveraged the experience to begin to formalize its IS/NIC approach in print and other resources (e.g., Bryk et al., 2015) and to develop complementary professional learning opportunities.

Shared value 6: The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge. As a CPSR approach, the Carnegie approach to IS/NICs gives much greater emphasis to generating "practice-based evidence" that leads to large-scale improvements than to the construction of knowledge valued by most university-based researchers (Bryk et al., 2015). Toward that end, the approach has

been formalized as a collection of principles, routines, procedures, and values to be used with integrity in newly-constituted NICs as they organize to address specific problems of practice.

Rather than an a priori feature of the Carnegie Math Pathways, this formalized approach is an artifact of the Pathways initiatives, as Carnegie leaders and staff members leveraged the Pathways experience to begin to formalize the IS/NIC approach as a methodology. As discussed above, this methodology includes tools and procedures for analyzing systems and devising solutions, including fishbone diagrams, system improvement maps, journey maps, and driver diagrams. (Bryk et al., 2015). Further, dating back to Deming (1993) and Shewhart (1939), it also includes the use of disciplined Plan-Do-Study-Act (PDSA) cycles that position practicing educators at the center of efforts to develop context-sensitive solutions, as well as the use of "practical measures" for generating evidence of implementation and effects in the flow of practical work (Bryk et al., 2015; Yeager, Bryk, Muhich, Hausman, & Morales, 2013).

In the case of the Carnegie Math Pathways, the NIC went further, to include formal evaluation of the impact of the programs. Members of the NIC used methods appropriate for causal inference, notably propensity score matching, to compare outcomes of students in the program with similar students outside the programs (Yamada et al., 2016; Yamada & Bryk, 2016). These studies have underscored the magnitude of effects observed through the data collected as part of PDSA cycles, as well as demonstrated growth relative to comparable students.

Shared value 7: The research should account for the gap between what was intended and what was accomplished. A key goal of Carnegie's approach to IS/NICs is to learn not only what works to solve an enduring problem but, also, for whom and under what conditions particular solutions are put to effective use (Carnegie Foundation for the Advancement of Teaching, 2017). As discussed, attending to the gap between intentions and outcomes is central to the notion of "following the contours of the problem," as new solutions open up novel perspectives on problems.

The Carnegie Math Pathways team was explicit about the importance of understanding variation in effects within and across local contexts. In an evaluation of Quantway 1, the first semester of the Quantway program, researchers from the hub organization did not stop at estimating its effect size. They also explored the variation in effects across different student subgroups, teaching faculty, and colleges (Yamada, Bohannon, & Grunow, 2016). By doing so, they were able to determine that Quantway 1 effects were positive across all student subgroups of sex, race, and ethnicity. The program also had positive effects in classrooms and colleges in the network (Yamada, et al., 2016).

While these studies provided evidence that Quantway 1 *could* work for different faculty in various institutional contexts, they also revealed that Quantway 1 worked especially well in some places and not well in others. Exploring that variation within and across local contexts is an opportunity to leverage the power of the NIC approach. Members can seek to

understand the micro-processes that produce strong effects, where work routines broke down in some spaces, and where the effects were not positive. Discerning which students benefit from a new design and which students do not is viewed as a key activity and space for further inquiry by the NIC's partners (Yamada & Bryk, 2016).

Shared value 8: The research should contribute to organizational or community culture and practice. The Carnegie approach to IS/NICs aims to change organizational and community culture and practice through the articulation of core principles of improvement science and through the use of common tools and procedures. Understandings of these principles and use of the tools, in turn, creates social resources supporting collaborative problem solving: shared vocabulary and language, identity, motivation, and commitment (Bryk et al., 2015).

In the case of the Carnegie Math Pathways, the instrumental results of engaging math faculty in disciplined inquiry together with researchers, designers, and administrators was not only improvement in mathematics instruction and outcomes. It was the cultivation both of a "communal imperative to improve" (Bryk et al., 2015, p. 168) and "scientific community" organized around shared theories, practices, and measures (Bryk et al., p. 167).

Shared value 9: The research should be of value to others outside the partnership. The Carnegie approach to IS/NICs generates three key areas of knowledge valuable outside of the partnership, all evidence by the Math Pathways NIC.

First, the Carnegie approach to IS/NICs is, itself, the product of activity within the Math Pathways NIC that is of value to others. The Math Pathways functioned as a context in which to more fully elaborate, understand, and refine IS and NICs as an approach to improvement. As discussed above, the Carnegie Math Pathways has yielded methods, tools, procedures, and other resources aimed at supporting the initiation of other NICs. The Carnegie Foundation, in turn, has not only "disseminated" understandings of IS/NICs using print resource, as if knowledge of improvement approaches need only be straightforwardly transferred or communicated. It has established a conference, training opportunities, professional networks, and other resources for supporting the use of IS/NICs in other contexts among a broad array of stakeholders.

Second, the Carnegie Math Pathways has yielded Statway and Quantway as two change packages of potential use to other community colleges, as well as a functioning NIC that community colleges can join in order to learn to use (and to further improve) Statway and Quantway. Indeed, central to Carnegie's IS/NIC approach is for NICs to gather improvements into "change packages" that can support the acceleration of improvement activity among new members of the NIC. The Carnegie Math Pathways web site provides an overview of the program and an implementation guide, as well as a way to request a sample curriculum. Making use of the program, however, depends on becoming part of the NIC.

Third, the Carnegie Math Pathways has served as a context for generating a wide array of scholarly products of use and interest to a broad audience. This includes articles and

briefs on the Pathways, their design, and their effectiveness (Bryk et al., 2015; Carnegie Foundation for the Advancement of Teaching, 2017). In addition to providing specific insight into the Math Pathways, these articles and briefs provide evidence of the possibility of using IS/NICs as resources for improving educational practice at a large scale.

But the scholarly products that grew out of the Math Pathways go further, with the aim of supporting a broad array of stakeholders in understanding and pursuing IS and NICs. For example, one paper presents a framework for the initiation of networked improvement communities, illustrates how the theories, processes, and tools of Carnegie's NIC model coordinate with each other, and in doing so demonstrates clear commitments to many of the quality standards in this document (Russell et al., in press). Another provides details concerning the content of the theories, processes, and tools (LeMahieu et al., 2017). Rather than functioning as "how to" manuals, such resources explain improvement work in the IS/NIC context and provide compelling justification— theoretical and practical—for pursuing this approach.

The Community-Based Design Research Approach

Community-Based Design Research (CBDR) is an approach to research that is based upon equitable collaborations between community members and researchers throughout all phases of a research endeavor. Unlike the other approaches discussed so far, it is centered more in the community than in educational systems, though CBDR often does directly engage with school systems, as our exemplar project does. In our view, however, CBDR belongs in this family of approaches because of its focus on collaborative design and inquiry, and it pushes the other approaches to consider how inclusive improvement efforts might need to be to address persistent inequity in education.

As with Improvement Science in Networked Improvement Communities, the approach doesn't draw a distinction between professional researchers and others in inquiry. In many CBDR projects, participants are co-researchers, and the leaders of the projects function in ways that are akin to the way hub facilitators do in a Networked Improvement Community, as leaders of a process of systematic investigation of problems and search for solutions.

As with Design-Based Implementation Research, CBDR draws from design-based research in its emphasis on the design of new forms of learning in real educational settings. But where design-based research has been largely silent on questions related to power (e.g., "Who designs?") and persistent inequality (e.g., "Why do inequalities of opportunity persist for racially minoritized students?"), community-based design research put these questions in the foreground (Bang, Faber, Gurneau, Marin, & Soto, 2016; Bang & Vossoughi, 2016; Booker & Goldman, 2016; Le Dantec & Fox, 2015).

CBDR focuses on expanding participation in design, naming and disrupting historical inequities, and changing institutional relationships (Bang, Medin, Washinawatok, & Chapman, 2010). It is centered in the community, rather than in schools, but often includes schools as sites of collaboration. As with other forms of participatory and community based research, CBDR places strong emphasis on values, social justice, promoting the agency of

participants in research, and accountability to participants in research (Bang et al., 2016; Cammarota & Fine, 2008; Campano, Ghiso, & Welch, 2015; Whyte, 1989).

In contrast to approaches to CPSR that draw from policy studies, learning sciences, and organizational studies, CBDR draws primarily from anthropology and cultural psychology, both of which emphasize the ways that people live and learn culturally. Within anthropology, it draws on traditions emphasizing the need to decolonize educational research and adopt a more relational stance toward participants in communities that values them as equal participants in research (Campano et al., 2015; Patel, 2015). From cultural psychology, this tradition of research adopts a view of learning as a cultural process, while at the same time cautioning researchers about taking a monolithic, static view of culture and how people inhabit cultural identities (Gutiérrez & Rogoff, 2003; Lee, 2008). It positions learners as bringing relevant cultural resources or "funds of knowledge" (González, Moll, & Amanti, 2005) to the learning context, as well as to design (Gutiérrez & Jurow, 2016; Gutiérrez & Vossoughi, 2010).

Focal project and its aims. The focal project for CBDR is the PRIMES project, which stands for Parents Rediscovering and Interacting with Math and Engaging Schools. Funded by the National Science Foundation, the goal of the project was to increase parents' confidence with reform-based mathematics teaching and with engaging with their child's school.

As is characteristic of CBDR projects, the PRIMES project began with a premise that parents bring important resources themselves to accomplish this task. The researchers assumed that parents already engaged in some forms of mathematics in their household, some with their children, and that these could form the basis for supporting their children in school-based mathematics (Goldman & Booker, 2009). Therefore, as part of the research, they set out to discover these using ethnographic methods and a participatory design process to develop tools and resources for parents to support their engagement.

The PRIMES project resulted in a small number of research publications, as well as a number of parent-facing resources, including parent workshops, a television special called *The Family Angle* that aired on a digital public television channel, and a parent guide.

We chose this project, because it exemplifies the design process that helps identify CBDR as a distinctive approach to Collaborative Problem Solving Research with clear commitments to engaging marginalized groups in design to address historical and persistent problems of inequity in schooling and to offer an alternate framework for parent engagement. To analyze this project, we analyzed two journal articles written about the project (Booker & Goldman, 2016; Goldman & Booker, 2009), a book chapter (Goldman, 2006) and the PRIMES legacy web site (https://web.stanford.edu/group/PRIMES/index.html).

There are other examples of Community-Based Design Research that adhere to the values of CPSR. For example, Bang and colleagues' partnership with the American Indian Center in Chicago involved the design of programs to help Indigenous students explore

connections between Indigenous and scientific ways of knowing the environment (Bang, Faber, Gurneau, Marin, & Soto, 2016; Bang & Medin, 2010; Bang, Medin, Washinawatok, & Chapman, 2010). This particular project has developed innovative design methods that other design researchers have begun to apply to studying out-of-school learning in urban environments (Taylor, in press). A long-standing Youth Participatory Action Research (YPAR) group supported by the Educational Justice Collaborative in Los Angeles has engaged in successful community organizing efforts to expand access to advanced courses in high school within Los Angeles Unified School District (Oakes & Rogers, 2007; Renée, Welner, & Oakes, 2009). A number of lines of research related to the project have helped expand opportunities for youth participants while simultaneously developing knowledge of how to support culturally relevant learning (Enyedy & Mukhopadhyay, 2007; Rogers, Morrell, & Enyedy, 2007). We chose to focus on the PRIMES project, because of the availability of rich accounts of the design process used, and because its longer term influence on subsequent research could be easily traced.

Shared Values in Action within the Focal CBDR Project. Below, we describe how the PRIMES project embodied elements of CPSR in the context of an initiative to expand the agency of parents in supporting their children's mathematics learning.

Shared value 1: The problem should be important to a broad range of stakeholders. In CBDR, the concerns of parents, community members, and others are "centered" in the research, even more so than educators' concerns, in an effort to help reframe conversations about equity in education. In this reframing, concerns and perspectives of parents are cast as worthy of attention and not viewed through a deficit lens.

A problem that drove the PRIMES project was the shift parents experienced as their children moved from elementary school to middle school and, with that, the school's expectations of their involvement as parents. The authors describing it cite research that continued parent involvement contributes to student success (Fan & Chen, 2001; Fehrmann, Keith, & Reimers, 1987; Hong & Ho, 2005), but they also argue that when students transition to middle school, schools often "co-opt" responsibility for learning from parents, which some experience as "severe" and "extreme" (Goldman, 2006, p. 55). Many parents feel alienated from school mathematics, too, because they tend to remember moments of failure during these years (Goldman, 2006). Schools do express concern about this lack of involvement, and yet most parent involvement or engagement programs tend to ask parents to engage in ways that schools define for parents, rather than consider ways parents might help to define their involvement (Jay, Rose, & Simmons, 2017).

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research. In CBDR, the positioning of community members as "experts" is central: There is a presumption of equality among professional researchers and community members, which necessitates

"honoring and learning from the range of individuals' experiences and expertise" (Campano et al., p. 38). CBDR questions the assumption that expertise related to problems and their solutions resides with researchers alone (Campano et al., 2015).

As in some other forms of design-based research, the PRIMES research team set out to engage in the collaborative design of solutions, and they also engaged parents and educators on their team in some analysis of data. The value that parents could be equal partners in design came from the team's commitment to a "competence-based" view of parents (Goldman, 2006). With that, PRIMES included four teams in a design consortium coordinated by researchers from Stanford University, each composed of parents, educators, and researchers. Two teams were based in school districts, and two were based in community organizations.

Each of the role groups made distinctive contributions to the project based on their expertise and perspectives. Booker and Goldman (2016) describe the roles that different team members played that made use of their expertise as ethnographers, documenting the kinds of mathematics that families used in the home, with the purpose of bringing those to design meetings to share with parents and educators. They noted that parents and educators, along with researchers, made use of evidence related to family mathematics to identify connections with school-based mathematics and designed workshops to lead with parents to help them see those connections. Parents and educators co-led workshops, and researchers videotaped these sessions for later analysis.

In their accounting of the data analysis process, Booker and Goldman (2016) note that the researchers on the team facilitated collaborative data analysis sessions that made use of the video recordings of the workshops. Further, they note that parents in the study were more than informants to the research, they were collaborators in analyzing data that directly informed the designs produced and refined by the team (Booker & Goldman, 2016). Within this and other CBDR projects, the collaborative analysis of data activity is an essential part of what makes the research *participatory* in nature.

Shared value 3: The research should support the agency of participants. In CBDR, promoting the collective agency of participants to transform activity is a core aim (Bang et al., 2016; Bang & Vossoughi, 2016).

As reported by PRIMES researchers, a key aim of the project was to restore a sense of "epistemic authority" in mathematics (Booker & Goldman, 2016, p. 231) as a basis for supporting parents' agency. Epistemic authority here refers to a confidence in speaking up about what parents know from using mathematics in their everyday lives and claiming its relevance to school mathematics their children encounter. The researchers also sought to cultivate among parents "the understanding that school math success is dependent on many factors that involve parents, ones that are quite independent of their understanding of classroom math" (Goldman, 2006, p. 58). That is, the researchers helped parents ask questions about and advocate for their children in relation to course offerings and when their children should take certain classes in mathematics. The researchers describe helping

parents to analyze aspects of their own experience of their children's school from a critical perspective, for example, to raise questions about sorting and tracking of students, knowing the emphasis schools put on parent nights and parental participation, what the school's expectations are about homework, and the role tests might be playing in the classroom. From the perspective of CBDR, agency is often supported by engaging community members directly in pedagogical practices of critique in this way, drawing on liberatory pedagogies such as those of Freire (1970) and Horton (Horton & Freire, 1990).

Shared value 4: The research should attend to context. Attending to the context is a particular focus of CBDR, owing to its deep roots in anthropology. Indeed, the CBDR approach strongly emphasizes the need to deeply understand the socio-historical and socio-cultural contexts of the communities in which research is conducted, before design begins (Barab, Thomas, Dodge, Squire, & Newell, 2004).

In PRIMES, before beginning the design of solutions to the identified problems, the team engaged in extensive "up front" ethnographic observations in families. This involved observations and video recordings of the families throughout their day, as well as interviews about their interests and activities. Families were also asked specifically about the mathematics they did. The researchers coded approximately 40 hours of data for each family to develop case studies about their math activities. However, the families were also included in helping to make sense of the data collected. Family members were asked to review the recordings and also give feedback to the researchers about the interpretations of their activities. The participants' feedback was a critical component of the data analysis.

Shared value 5: The research should provide something of practical value to participants. A key aim of community-based design research is to produce change in a policy or practice that directly affects the lives of stakeholders in the community, such as through research-informed organizing (e.g., Oakes & Rogers, 2007), collaborative design of new policies in partnership with schools and districts (e.g., Anyon, et al., 2016), or presentations of findings by participants in public meetings (e.g., Kirshner & Polman, 2013).

The PRIMES project produced a number of resources that parents helped design and that they offered to parents outside the project sphere. A total of nine different workshop formats were created, delivered to multiple groups not only in the San Francisco Bay Area, but also across the country. The workshops were made available to others, too, to lead them independently of the research group. The team produced a television program for a digital channel of the Public Broadcasting Service (PBS). And, they produced a parent booklet detailing strategies parents could use to approach the school around aspects of school math during the middle school years. This booklet included topics from expectations around homework, to decisions about when to take algebra, to how to approach teacher conferences, and how to turn everyday math problem solving opportunities into family math instances.

According to the project's final report to the National Science Foundation, the workshops reached a total of 168 parents in three different areas: the San Francisco Bay

Area, New York City, and rural Michigan. The San Francisco Unified School District shared the parent resource with every one of its parent liaisons to schools. The report also indicated that the television special aired in 2002 to more than 60,000 people. A total of 14 PBS and other educational stations also accepted the feed.

Shared value 6: The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge. One of the ways that CBDR reflects its roots in anthropology and cultural psychology is the emphasis on in-depth study of communities, often well before beginning design work. The commitment to "up front" ethnographic research is based on an understanding of the complexity of community relations, as well as the need to understand inequities, sources of strength in communities, and opportunities for change (Gutiérrez & Jurow, 2016).

The PRIMES project, like other CBDR projects, followed a coherent sequence, beginning with "critical design ethnography" that examines needs and opportunities for systemic repair, followed by an iterative, collaborative design process in which research findings are analyzed collaboratively to inform iterations on the design (Booker & Goldman, 2016). The tools of video and data analysis were used frequently to analyze both practices in the home and the workshops the teams designed and co-led.

A common framework for analysis was used to characterize mathematics activities in the home. The researchers coded videotaped interactions for the activity context, what participants were present, ways of talking in the activity, mathematics practices and approaches, and the use of tools (e.g., rulers, calculators) for doing math (Goldman & Booker, 2009). The collective analysis of videotape from both homes and workshops were critical input into re-designs, and provided in-situ evidence of productive, collective agency in line with the goals for the project (Booker & Goldman, 2016).

Shared value 7: The research should account for the gap between what was intended and what was accomplished. The kinds of gaps between aims and accomplishments in CBDR that are emphasized often pertain to goals for creating more equitable policies and practices and what could be accomplished, given what scholars have called the "zone of mediation," that is, the set of political and institutional forces that shape the environment (Welner, 2001; Renée, Welner, & Oakes, 2009). This zone can shift, when CBDR efforts are successful in shaping the wider environment, but sometimes the political forces and resources available limit what can be accomplished.

The PRIMES project is an example of an effort where researchers called attention to the broader environment in framing their accounts of it. In particular, they pointed to the need for what they called "systemic repair," repairing historical inequities at the level of the community regarding parent participation and power in schools (Booker & Goldman, 2016). Through this multi-year project, researchers noted a shift in the sense of possibility *within* their particular team of 30 or so researchers, parents, and educators to form a temporary sub-community that repaired some of these relations in which parents had "epistemic

authority" and in which all of the participants shifted in some way: in their understanding of what kinds of mathematics took place in the family, in what it would take for parents to feel comfortable claiming expertise about mathematics with mathematics teachers in the room, and in the limits and possibilities for transforming their own relation to schools.

At the same time, their accounts of the PRIMES project pointed to limitations in changing the wider environment. One of the issues that the PRIMES team wrestled with continuously was that parents who felt comfortable being engaged in school often did not feel confident about mathematics. Parents reported being "stymied" by the mathematics they encountered in their child's homework, and these related in part to feelings about mathematics accrued in their own lives in school (Booker & Goldman, 2016, p. 223). Over time, they reported being relatively successful in fostering greater parent participation within the design process and in leading workshops, but this required continual experimentation with the proper balance of parent involvement in planning and leading workshops (see Booker & Goldman, for details).

Shared value 8: The research should contribute to organizational or community culture and practice. CBDR projects seek to create more equitable organizations and communities, that is, ones in which members of historically marginalized groups have a greater say in the direction of educational policies and programs (Jurow & Shea, 2015). CBDR projects that target specific inequitable practices--e.g., disproportionate suspension of African American students in school--may seek through their efforts to promote more effective and equitable practices throughout a system (Anyon et al., in press).

According to the PRIMES Principal Investigator, there was a more limited impact on organizations and the community long-term. In some cases, she said, teachers and parents held family math nights and used the materials in their schools independent of the researchers (Goldman, personal communication, 11/3/17). But because the partnership did not last beyond the life of the project, she noted that school turnover in personnel and changing parent populations meant there was little that changed in the organizations with which they had partnered as a consequence of PRIMES. It had been a goal, however, of PRIMES, to affect the practices of the educational organizations involved, particularly with respect to how they engaged parents.

Shared value 9: The research should be of value to others outside the partnership. In CBDR, one of the ways that research becomes accessible to and valuable to others is through accounts that focus on the research approach or method used to support or study participation. As Booker and Goldman (2016) themselves argue, one of the goals may be "scaling method rather than product" (Booker & Goldman, 2016, p. 233).

One of the biggest impacts of PRIMES on the research community has been to open up the space of designing for mathematical learning in families within the learning sciences. Moreover, the approach developed within PRIMES of observing family practices and identifying mathematical practices has been a common feature in this new line of research. For example, some members of the PRIMES team, joined by other teams from the NSF-

funded Learning in Informal and Formal Environments (LIFE) Center, employed the ethnographic methods used to generate examples of mathematics problem solving in families to inform participatory design of mobile applications to foster fun mathematics learning in families (Alexander et al., 2010; Esmonde et al., 2012). Other researchers have used the approach of identifying stories of mathematics use from families to explore the ways that values occasion and guide mathematics problem solving at home (Pea & Martin, 2010).

The research has also informed an emerging literature that focuses on changing conceptions of the relationship between families and schools. For example, research on the topic of "brokering" and parents' roles in supporting students in finding opportunities to pursue educational opportunities across different settings related to STEM has drawn on lessons from PRIMES (e.g., Ching, Santo, Hoadley, & Peppler, 2016). In addition, inspired by the idea of "systemic repair," scholars seeking to shift away from school-centered parent engagement models have pointed to PRIMES as an example for how to do so (Jay et al., 2017).

Comparing the Accounts of Reviewed Projects

The purpose of the preceding analysis was to examine ways that published accounts of projects using four different approaches to CPSR provide evidence of values shared among the approaches. One aim was to highlight how shared CPSR values are embodied in particular choices about research questions, methods, and means of organizing the design process and testing the designs. Another aim was to inform proposal and manuscript reviewers about aspects of CPSR approaches that Requests for Proposals and reporting genres may overlook but that are critical to fully understanding the implementation of the approach.

Again, the analysis is provisional, and it is intended to motivate continuing conversation about the values and methods of CPSR. After all, we sampled only a small number of exemplary accounts (and not a complete or representative set), from a small number of CPSR approaches.

Comparing across these four analyses, we learned that developing a relatively complete account of how a project embodies CPSR values requires examining multiple kinds of reports (e.g. formal publications, white papers, and conference proceedings). We suspected this at the outset, which is why we decided to look at empirical articles, as well as other descriptions of the projects. Empirical articles frequently left out aspects that make CPSR a distinctive approach to research, such as the partnership context and commitment to co-design. For example, an empirical study of Word Generation (Snow, et al., 2009) made little mention of the collaborative approach to the design of the intervention or the iterative process of design. By contrast, papers describing projects as they unfolded tended to present empirical findings in ways that would make it difficult to evaluate the appropriateness of methods used according to traditional research criteria. Thus, each type of written account contributed unique information to ascertain how the project as a whole embodied the values of CPSR.

Across the different projects reviewed, we found a strong emphasis on problems and problem solving, as one might expect. In these cases, we saw justification of projects' both in terms of national and local issues. For example, the SunBay DBIR project emphasized the need to address a nationwide issue of sustainability of learning sciences-based mathematics curriculum and the local district concern over low test scores (Vahey, et al., 2013). The descriptions of the Carnegie Math Pathways project emphasized the national problem of high failure rates in community college developmental mathematics, as well as local designers' concerns about solutions that would limit students' future educational opportunities (Cullinane & Treisman, 2010).

However, even though both the national and local problem contexts were represented, the broader, national context received greater emphasis in the accounts we reviewed. This is the case even within the description of the PRIMES project, an example of Community-Based Design Research, where researchers justified the project in writing by referring to the need to repair or restore parents' intellectual authority in mathematics, a

goal that parents in the study themselves did not initially share, but that is one of concern nationally because of its connection to the goal of enhancing parent engagement in their children's education (Booker & Goldman, 2016). On the one hand, the fact that these accounts were able to connect local concerns to the broader interests of those outside the partnership speaks to the potential for applying findings beyond the local context. In leveraging local CPSR efforts to inform a wider audience, there appear to be incentives to liberate the accounts from the specifics of local problem solving efforts in order to situate the accounts in a set of practical and theoretical conversations and concerns of interest to a broader audience.

Related to generalizability, across multiple accounts but especially in those of Community-Based Design Research and Networked Improvement Communities, authors made the claim that the most important part of "what travels" or "what scales" is a process or method. Booker and Goldman (2016), for example, argued that "scaling method rather than product" is well-suited for Community-Based Design Research. In a similar vein, the Carnegie Foundation for the Advancement of Teaching and its collaborators are seeking to adapt the principles and methods of improvement science to education, refine them, and spread them through their efforts to cultivate and support different Networked Improvement Communities (Bryk, et al., 2015).

At the same time, several accounts presented arguments for generalizability through replication of findings. The logic of replication is central, for example, in the empirical accounts of the SunBay project, which presented evidence that the gains made by students in new research-practice partnerships were comparable to those in an earlier randomized controlled trial (Vahey et al., 2013). Similarly, in their connected literacy projects, SERP researchers sought to replicate results found for their interventions' effects with new populations, including beyond their partner districts (Donovan & Snow, in press). Thus, specific interventions can and do become central in accounts of Collaborative Problem Solving Research.

Another tension we saw in looking across different accounts was the emphasis on responsiveness of researchers, as compared to the need to create more controlled conditions at different phases of the research. In some accounts, the back-and-forth of collaborative design is central (e.g., Donovan, Snow, & Daro, 2013). From these accounts, it is easy to get the sense that researchers attempt to respond to core concerns whenever they might arise. Moreover, for three of these projects (Word Generation, SunBay, and Pathways), multiple years of iterative design research preceded larger studies to assess the efficacy of a specific intervention. But, efficacy studies were presented as (and were) relatively controlled studies. The iterative back-and-forth—and even the likely responsiveness of research partners to emerging problems—faded into the background in those accounts. No doubt, this is in part because the value of responsiveness and the relatively organic adaptation to emerging needs directly challenges traditional views about how and when researchers should intervene, lest changing an intervention mid-study bias the results of a study (Supovitz, 2013).

Finally, in the accounts, we observed researchers holding themselves accountable to participants in the research. In some cases, the researchers held themselves accountable to participants as co-interpreters of findings (Booker & Goldman, 2016). In Networked Improvement Communities, accountability took the form of support through the network for iterative refinement of the materials to address emerging issues related to how well they were meeting local students' needs and addressing concerns of instructors (Bryk et al., 2015). In the SunBay project, Roy and colleagues (2017) noted how important it was to them that the teachers were "vested" (p. 12) in the effort within the district; similarly, Vahey and colleagues (2013) highlighted as a key finding that the project "enjoyed strong local support" (p. 184).

Our review of different projects and comparison of the accounts given of them led us to offer a small number of preliminary recommendations to funding agencies and reviewers of proposals and manuscripts from CPSR projects. We focus on funders of research, because the guidance they give to applicants for what to include in proposals both signals what is valued to them and provides a basis for reviewers to judge the quality of proposals. We focus on reviewers because, as individual members of the research community who may participate in multiple, partly overlapping subcommunities of scholars, they judge the merit and value contributions of proposals based on what proposers and authors write.

Given that proposals and manuscripts must be concise, there is no way to provide the complete background of a partnership or tell the full story of a project. So, funding agencies and reviewers should be prepared to evaluate CPSR proposals according to criteria that might diverge from a proposal that does not share CPSR values. As with all research, there must be a coherent, explicit chain of reasoning that can be evaluated, and the coherence of CPSR research depends on an expanded set of values that emphasizes the interconnections among rigor, relevance, and the agency of research participants.

Recommendation 1: Prepare proposal reviewers to look for embodiment of CPSR values in CPSR proposals and manuscripts.

All reviewers need preparation for the task of reviewing proposals. Typically the Request for Proposals and some additional guidance are provided to reviewers. When reviewers convene, there are further opportunities to discuss the aims of a program or portfolio of research projects. We suggest that some guidance as to the key values of CPSR approaches be provided to reviewers when programs or funding streams seek to promote quality proposals using CPSR approaches.

Recommendation 2: Reviewers should look for evidence that CPSR proposals and manuscripts have articulated a problem that addresses local problems, needs, and opportunities, as well as broader, more general problems and issues that affect policy, practice, and research.

All research seeks to inform future research in some way, and some also seeks to impact practice beyond the settings where it was conducted. The value of a research study to others outside the community where it was conducted hinges on its potential to speak to problems faced in educational systems elsewhere, but for CPSR projects, there should also be value to stakeholders where the research is conducted. As such, CPSR teams need to do more than articulate a claim that the problem they addressed or propose to address is important to local stakeholders. There also needs to be a warrant for that claim--evidence

presented from interviews with stakeholders, for example, or an account given of how a group convened to decide on the focal problem. Because of limited space in manuscripts, journals might encourage authors to include online supporting materials that speak to how the project's aims addressed local problems.

Recommendation 3: Consider how and when involvement of participants in research activities might strengthen, rather than threaten, the validity of findings.

A challenge named by CPSR researchers at our convening was the degree to which they continually confronted charges of bias from reviewers because of a project's involvement of participants in the research process. A chief concern reviewers have raised is the that involvement of participants in the research process is a potential source of bias in at least two ways. First, it potentially biases interpretation of findings when certain participants have a strong stake in a positive outcome. Second, it potentially biases researchers to report more favorably on an initiative of a partner because of their close relationships to them.

But, the involvement of participants can and often does strengthen the validity of claims from the standpoint of CPSR researchers for at least three reasons:

- It strengthens the potential of research to support the agency of participants in their own endeavors to improve opportunities to learn. Involvement of participants gives them a say in developing answers to questions they care about.
- The involvement of participants in helping make sense of research can serve as a useful, more intensive form of "member checking," whereby interpretations are checked against the experiences and viewpoints of participants.
- Research conducted in close partnership with educators can yield a better sense of the strengths and limitations of data sources. Many educators have pointed out the limitations of administrative datasets (e.g., how data are collected and maintained) that were discovered only because researchers worked in close partnership with them to understand those datasets (Farrell, et al., 2017).

At the same time, as with all researchers, CPSR researchers should acknowledge their own positionality in studies and how it may affect the conclusions they draw from research. They should also name potential conflicts of interest that would diminish the credibility of findings.

Recommendation 4: When evaluating generalizability, take a broad view of what is valuable to others.

In research, we consider generalizability often from the standpoint of replicability of findings. That is, we ask whether the same result could be observed in a new, different population. Increasingly, scholars are encouraging replication studies, moreover, to ensure the robustness of findings from educational research (e.g., Makel & Plucker, 2014). CPSR

approaches embrace replication studies, as evidence by the Word Gen/STARI projects and the Carnegie Math Pathways initiative.

But the value of results to others is not always contained in the research findings. As Booker and Goldman (2016) note, processes can be spread, and we can test their replicability in new settings. A key outcome of design-based research can be new design principles for developing learning environments in the future (Edelson, 2002). Such principles can, moreover, be powerful ideas that guide the practice of others, such as educational leaders in curriculum (Allen & Penuel, in press). These conceptual uses of research can expand how leaders think about problems and give them new ideas about potential solutions to those problems, especially when research partners facilitate their sensemaking.

In addition, we have observed in partnerships that some ideas spread not from researcher to researcher, but through practitioner networks themselves (e.g., Hopkins, 2017; Hopkins, Penuel, Wiley, & Farrell, under review). Reviewers of proposals for CPSR projects might expect plans for dissemination to include plans for educators and other stakeholders to be involved in helping spread ideas and findings from research through their networks.

In this paper, we contributed toward an effort to build identity and influence among those seeking to advance collaborative problem solving research approaches in the U.S. The participants in this effort were primarily researchers, but they also included educators and leaders in intermediary organizations and a funder, the Spencer Foundation. The aims of this effort were (a) to build community and collective identity among developers and leaders of the research approaches and (b) to exercise a shared voice in articulating to funders and journal editors common values and priorities that they could use in assessing the merits of proposals and publications. The products of this effort include:

- Collaborative Problem Solving Research as an name for this group of improvement methods and approaches.
- A set of values shared among four leading approaches to Collaborative Problem Solving Research.
- Descriptions of exemplar projects, framed in terms of the shared values.

We present this name and these shared values as provisional. They are the product of a "rapid prototyping" process that engaged a subset of actors advancing these research approaches. This group of actors was representative of the set of approaches selected, but by no means exhaustive. Moreover, the group lacked any authority to act on behalf of the broader community of researchers, practitioners, philanthropists, and others advancing these approaches. Some participants raised a concern that it was too soon to forge a synthesis that could claim the approaches belong together in a single family.

Indeed, we recognize that we are introducing this provisional identifier of Collaborative Problem Solving Research and the provisional values into an "improvement movement" that is both rapidly developing and plural, with different kinds of organizations and enterprises bringing diverse expertise both for real-time support and large-scale evaluation beyond that provided by traditional academic researchers (Peurach, Penuel, and Russell, in press).

This broader movement includes researchers and enterprises advancing specific methods and approaches (such as those represented in the Boulder convening), non-profit and for-profit enterprises providing improvement support (e.g., AIR, Mathematica, SRI, and WestED), and enterprises aiming to develop programs and networks that coordinate research use with continuous improvement (e.g. Building Assets Reducing Risk, the New Tech Network, Reading Apprenticeship, Reading Recovery, and Success for All).

This improvement movement also includes multiple efforts to build identity, community, and voice among those advancing improvement research. Examples of enterprises leading this cause include: the Carnegie Foundation for the Advancement of Teaching; the SERP Institute; LearnDBIR; the Research + Practice Collaboratory; the National Center on Scaling Up Effective Schools; the National Network of Education

Research-Practice Partnerships; and the National Center for Research in Policy and Practice.

These enterprises, in turn, have benefited from funders open to providing support for continuous improvement in education, both federal (in the case of the national centers) and philanthropic (as from the Spencer Foundation, the William T. Grant Foundation, the Annie E. Casey Foundation, and the Wallace Foundation).

Among enterprises leading the improvement movement, a common aim is to move beyond a loosely-organized social movement to a more coherent organizational field able to (a) advance these approaches and support their use in large numbers of districts, networks, and schools and (b) advocate for CPSR in political and policy contexts that currently place a premium on the use of scientific evidence as a resource for improvement and the use of rigorous evaluations to assess impact.

This type of field building goes beyond advancing approaches and methods for Collaborative Problem Solving Research to include such essential activity as:

- Legitimizing improvement research.
- Establishing quality standards that reflect shared values and distinctive practices of the approaches.
- Investing in the development of improvement methods, along with researchers able to support their use in practice.
- Establishing stable funding streams supporting collaboration among researchers and educational professionals.
- Cultivating sources of operating capital to establish and operate networks that support improvement activity.

While it is possible to advance such an agenda as a loose federation of enterprises, doing so brings with it both challenges and risks. Challenges include inducing cooperation among these different enterprises (and their members) at the same time that each (and its members) competes for influence, funding, partners, and journal space, all in a broader educational research enterprise more inclined to fragmentation and incoherence than to cooperation and coherence. Risks include dependence on soft funding and, thus, the shifting agendas of public and private funders; shifting membership of (and support from) boards of directors; executive leadership turnover; and simple burnout among those leading the charge.

Indeed, there is much in organizational scholarship on field building to suggest advantage in establishing a "supporting institution" (Nelson, 1994): an organization akin to a professional association that is chartered with the specific charge of coordinating activity among organizations, legitimizing and publicizing their value and contributions, and asserting their collective interests. As an example of such a supporting institution, consider the Society for Research on Educational Effectiveness, a professional association chartered with the express purpose of "provid(ing) an organizational infrastructure that supports and promotes research focused on cause-and-effect relations important for education" (SREE, 2017).

From this perspective, we see advantage in establishing a parallel to the Society of Research on Educational Effectiveness: for example, an "Association for Collaborative Problem Solving Research in Education" as a professional association (replete with journals, academic conferences, and associated quality standards) chartered with the express purpose of establishing an organizational infrastructure that supports and promotes research, policy, and practice focused on continuous improvement in classrooms, schools, networks, and systems.

Needed also are sites for long-term, specialized training and education of both scholars and practitioners in these models. Preparation in "problem finding" and collaborative design are just two kinds of skills that are not typically included in graduate training programs for either researchers or education leaders, and yet they are essential for CPSR approaches. So, too, are skills in developing research-practice partnerships (Penuel & Gallagher, 2017). Pre-doctoral and postdoctoral training opportunities could greatly assist in building the capacity of the field to make effective use of CPSR approaches.

At the time of this writing, potential seeds for field building were being sewn beyond the May, 2017 convening in Boulder. For example:

- In Summer, 2017, the DBIR network linked up with leaders in the CBDR community to identify ways to partner for equity-focused change initiatives.
- In Fall of 2017, a diverse team of researchers proposed the launch of an Improvement Science Special Interest Group in the American Educational Research Association, with the aim of advancing scholarship on improvement methods, the organization and leadership of improvement, and the yield from improvement activity.
- In Fall of 2017, a team of researchers, in collaboration with (and support from) the William T. Grant Foundation, released a framework for understanding and assessing the effectiveness of research-practice partnerships (Henrick et al., 2017). Subsequent to this: A meeting to bring together different people involved in RPP work together to build an agenda for RPPs.
- In Fall of 2017, the Carnegie Foundation for the Advancement of Teaching began planning an academic symposium for researchers, theorists, and practice leaders, with the aim of beginning to galvanize a community of academics open to working collectively to deepen scholarship on continuous improvement and to advance its legitimacy.

Whether any of the preceding initiatives evolves into an organization on the level of a SREE-like supporting institution hinges on such matters as legitimizing initial leadership, securing startup funding, establishing a sustainable financial structure, and devising a system of professional governance.

Yet, looking to the future, building an improvement field able to (a) advance improvement approaches and support their use in large numbers of districts, networks, and schools and (b) advocate for improvement in political and policy contexts that currently

place a premium on bottom line impact will most surely require a level and type of organization beyond the distributed federation of enterprises currently leading the improvement movement.

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Appendix A

Guiding Questions to Identify CPSR Shared Values in Action

Shared value 1: The problem should be important to a broad range of stakeholders.

- Do the author(s) describe relevance to practitioners, administrators, policy leaders?
- Is there documented empirical warrant for focusing on the problem?

Shared value 2: The role and contributions of partners should be clearly described, particularly their expertise and how it was integrated into the research.

- Are the active roles of partners clearly described (beyond "sample")?
- Is expertise of participants and its integration into research clearly described?

Shared value 3: The research should support the agency of participants.

- Do the author(s) describe participant influence on improvement efforts or active authority around educational access?

Shared value 4: The research should attend to context.

- How did the researcher(s) study the context before and/or during the research?
- How did the researcher document power and authority in the setting?

Shared value 5: The research should provide something of practical value to participants.

- Do the author(s) make an argument for the significance of what is produced for practice?
- Do the author(s) describe the feasibility of implementation and available supports?

Shared value 6: *The research plan should include specific, logical, and coherent plans for studying and following problems; for designing, testing, and iterating upon solutions; and for constructing and using practical knowledge.*

- Do the author(s) clearly articulate a set of aims, hypotheses, or objectives with justification for their contribution?
- Are the research design and methods (setting, sampling strategy, data collection protocol, measures, analytic strategy) appropriate and sufficient to address the primary aims?
- Are the conclusions and claims tied to level of evidence of the study? (i.e., tentative assumption, tentative conclusion, certain but context-bounded conclusion)?

Shared value 7: The research should account for the gap between what was intended and what was accomplished.

- What account is provided of project challenges and/or failures?

Shared value 8: The research should contribute to organizational or community culture and practice.

- How does the research transform cultures of organizations to support use of research or evidence-based innovations?

Shared value 9: The research should be of value to others outside the partnership.

- Do the author(s) describe how ideas, tools, and conclusions might be transferred or recontextualized by others for use?