Organizing Research and Development at the Intersection

of Learning, Implementation, and Design

William R. Penuel[1]

Barry J. Fishman[2]

Britte Haugan Cheng[3]

Nora Sabelli[3]

[1]*University of Colorado* [2]*University of Michigan* [3]*SRI International*

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Abstract

This paper describes elements of an approach to research and development called *design-based implementation research.* The approach represents a significant expansion of design research, which typically focuses on classrooms, to develop and test innovations that foster alignment and coordination of supports for improving teaching and learning in classrooms. As in policy research, policy and program implementation are key foci of theoretical development and analysis. What distinguishes the approach from both traditional design research and policy research is the presence of four key elements within a project: (1) a focus on persistent problems of practice from multiple stakeholders' perspectives, (2) a commitment to iterative, collaborative design, (3) a concern with developing theory related to both classroom learning and implementation through systematic inquiry, and (4) a concern with developing capacity for sustaining change in systems.

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An enduring goal of research in education has been to identify programs that can reliably work in a wide variety of settings, so that such programs can be scaled up to improve system-level outcomes. But nearly all programs' observed treatment effects vary significantly from setting to setting, and even the most promising programs have proven difficult to scale. Improving educational systems, moreover, requires more than the adoption of effective programs; it demands alignment and coordination of the actions of people, teams, and organizational units within a complex institutional ecology (Rowan, 2002).

For decades, policy researchers have observed that top-down strategies for producing alignment and coordination from the top down rarely work (e.g., Cohen, Moffitt, & Goldin, 2007; Elmore, 1980; Rowan, 2002). Berman and McLaughlin (1975) observed that teachers' adaptations of programs at the classroom level, not policy makers' plans, largely determine programs' effectiveness. Implementation problems evolve, moreover, as programs go to scale, both as a consequence of the adaptations teachers make and of changes in the environment (McLaughlin, 1987). Successful scaling, most policy researchers agree, depends on local actors—district administrators, school leaders, and teachers—making continual, coherent adjustments to programs as they work their way through educational systems (Weinbaum & Supovitz, 2010).

In this paper, we argue for the potential of an emerging form of *design research* as a strategy for supporting the productive adaptation of programs as they go to scale. An iterative approach to developing innovations, design research is particularly well suited to

informing decision-making about needed adjustments to programs (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). The potential utility of design research to support implementation also derives from its commitment to developing practical theory and tools that can be used to support local innovation and to solve practical problems (Reinking & Bradley, 2008). Further, the collaborative nature of much design research positions practitioners as co-designers of solutions to problems, which can facilitate the development of usable tools that educators are willing to adopt (Penuel, Roschelle, & Shechtman, 2007). Our perspective in this paper has benefited from recent policy research that makes a turn toward design and that makes use of theories of implementation to develop and study implementation supports for the leadership practices (Spillane, 2006; Honig, 2008), instructional coaching (Gallucci, Van Lare, Yoon, & Boatright, 2010), and the coordination of school-linked services to improve student outcomes (McLaughlin & O'Brien-Strain, 2008).

Efforts by a number of interdisciplinary teams over the past decade to conduct design research at the level of educational systems have shown the significant promise of the strategy of engaging learning scientists, policy researchers, and practitioners in a model of collaborative, iterative, and systematic research and development. This represents a significant expansion of design research, which typically focuses on classrooms, to develop and test innovations that foster alignment and coordination of supports for improving what takes place in classrooms. We call this approach to collaborative research and development *design-based implementation research*, because design thinking figures prominently in the projects and initiatives we describe below, and because research on the implementation of reforms drives iterative improvements to

designs. Researchers involved in these projects span multiple disciplines, including the learning sciences (where design-based research methods figure prominently) and policy research (where policy and program implementation are often foci of theoretical development and analysis).

In this paper, we elaborate on some elements that define design-based implementation research as it has been practiced, illuminating these elements by describing partnerships that exemplify each element and analyzing how those elements contributed to the partnerships' success. Then we consider challenges to the approach and propose ways to organize a community of scholars whose aim is to develop, test, and improve this model of design research. Finally, we suggest ways to leverage existing federal investments to cultivate norms to guide and improve this model of research and development.

Elements of Design-based Implementation Research

Since the 1990s, several interdisciplinary research and development teams worked collaboratively with practitioners to develop and test designs for improving teaching and learning. These projects shared four common elements:

- A focus on persistent problems of practice from multiple stakeholders' perspectives,

- A commitment to iterative, collaborative design,

- A concern with developing theory related to both classroom learning and implementation through systematic inquiry,

- A concern with developing capacity for sustaining change in systems.

Below, we elaborate on each of these elements, presenting projects that exemplify each. Though all of the projects we describe employed all four elements, we highlight particular elements with individual cases because we judged that case to be especially indicative of the potential of that element.

Teams form around a focus on persistent problems of practice from multiple stakeholders' perspectives. Design-based implementation research, as a descendent of the pragmatic tradition in American educational philosophy (e.g., Dillon, O'Brien, & Heilman, 2000) shares a commitment with other forms of design research (e.g., formative experiments, design experimentation) to using research to solve practical problems. What distinguishes it from most forms of design research, however, is how "practice centered" the problem definitions are. The SERP Institute, an organization that supports coordinated design research in large districts, exemplifies this approach (Donovan, 2011). The Institute holds fast to the principles that research and development should be a collaborative endeavor between researchers and practitioners and that partnerships should be based on addressing important problems of practice and that practitioners should have a say in defining those problems. Many whole-school reform models, such as Success for All, already require teachers to have a say in adopting the programs to build ownership in the reform process (Datnow & Castellano, 2000). SERP goes further, requiring researchers to take up what educators perceive as local obstacles to improving teaching and learning. Initially, it is unlikely that teachers and school and district leaders will share a definition of these obstacles, and their formulations are likely to differ widely from those of researchers. Thus, a key early task in forming a partnership between researchers

and an educational system is to develop a shared understanding of the problem(s) that will be taken up among people representing different stakeholder groups.

A "Core Group" of researchers and district and school leaders in a SERP site is tasked with defining an immediate problem of practice and agreeing on a plan of action for instructional improvement. In Boston, one of four SERP sites, the Core Group initially collaborated around a middle school literacy challenge: improving students' knowledge of specialized academic vocabulary. To identify strategies for improvement, the Core Group chartered a *Design Team* with expertise in the design of instructional materials, pedagogy, the design and use of assessments, and data management and use by school staff, all focused on the selected problem. The Design Team drew on the expertise of two researchers, Catherine Snow and Richard Elmore; Snow to develop an intervention, *Word Generation,* to implement in schools, and Elmore to analyze the coherence of the instructional program at implementing schools. Snow and her colleagues conducted research on the impact of *Word Generation* on student learning (Snow, Lawrence, & White, 2009), and Elmore's research contributed to understanding the conditions under which its implementation was effective in improving student outcomes (Elmore & Forman, 2010).

In reflecting on what made the *Word Generation* experience successful, SERP researchers credit listening to and responding to educators' needs (Snow, 2011). By focusing on academic vocabulary—a persistent problem of practice that was affecting performance on accountability tests (a system level outcome)—and by adhering to teachers' constraints on how much time they could allocate for the intervention, SERP researchers solidified the commitment of district leaders to the collaboration and built

trust and buy-in among teachers (Donovan, 2010). In addition, bringing together learning

researchers with policy researchers enabled the research on *Word Generation* to provide

insight both into whether the program worked and into the conditions for success. That

focus provided the district with the feedback it needed to justify further investment in

implementation, as well as clues as to where to intervene to improve outcomes in future

years.

      To improve practice, teams commit to iterative, collaborative design.

Collaborative design research often focuses on the development and testing of usable

tools for improving teaching and learning in specific subject matter domains and settings.

A hallmark of design-based research in the learning sciences has been its focus on

improving the learning environments of classrooms; however, learning scientists have for

the most part had limited success in bringing their classroom innovations to scale within

educational systems (Pea & Collins, 2008). As a consequence, some learning scientists

have begun to focus more explicit attention on designing learning opportunities for

teachers. This includes work on helping teachers learn to enact inquiry-oriented curricula

through the design of educative curriculum materials (e.g., Davis & Krajcik, 2005) and

the design of professional development to better equip school and district leaders for

supporting classroom-based reform (e.g., Bowyer, Gerard, & Marx, 2008). Others have

drawn in policy researchers, engaging theories of organizational and institutional change

in designing new approaches for bringing about systemic improvements (e.g., Bryk,

Gomez, & Grunow, in press; Resnick & Spillane, 2006).

      A good example of a design-focused multi-year collaborative research and

development effort is the Middle School Mathematics and the Institutional Setting of

Teaching (MIST) project at Vanderbilt University (Cobb, Henrick, & Munter, 2011).

MIST is a five-year project in which a team of learning scientists, policy researchers, and

educational anthropologists work in collaboration with four school districts to analyze

and inform policies for improvement in mathematics instruction as part of a participatory,

collaborative approach to research. In a departure from traditional design-based research

where researchers establish the learning goals, in MIST the district makes decisions and

drives the designs for helping improve how teachers enact ambitious instructional

practices in mathematics. The research team helps facilitate the design process, first by

eliciting a policy-based theory of action from different actors in the system and then by

conducting research on the implementation, informing future cycles of design and

implementation.

  "District B," a MIST partner for four years is, like many other large urban districts

with high levels of socioeconomic and cultural diversity, under pressure to improve

student outcomes in mathematics to satisfy mandates of No Child Left Behind. Its theory

of action is to improve the quality of instruction by creating new positions (coaches in

mathematics to provide instructional supports to teachers), and implementing new

routines to support principals' instructional leadership in mathematics (learning walks or

"walkthroughs" co-led with coaches to observe mathematics instruction). The MIST

research team conjectured that the coaches' subject matter expertise and new roles could

plausibly lead to achieving the district's goal, but expressed concern that the principals

lacked sufficient expertise in mathematics to make effective learning walks, and that

learning events organized for principals were too isolated to make up for their lack of

expertise. Over the first year of data collection, the team discovered that principals were

not in agreement about the policy goal. Many saw their job as requiring a sharper focus on instructional management (ensuring compliance to teaching to standards) rather than on the instructional improvement goals established by district leaders.

What happened next makes MIST a good example of how design-based implementation research can contribute to system improvement. The Vanderbilt team shared their conjectures and research findings with district leaders at the end of the year in a highly facilitated meeting that left plenty of time for discussion. Researchers were able to make evidence-based recommendations to district leaders about the importance of making the vision more explicit for all principals and increasing the coherence of principals' learning supports in the context of their district. These recommendations were partly reflected in the revised theory of action that the districted implemented the next school year to support instructional improvement. The district's leadership focused on making sure supervisors of principals had common expectations consistent with the district's theory of action, and placed increased emphasis on how the Leadership Directors communicate those expectations to principals. They also organized more sustained professional development for principals. Though they did not see all of their recommendations fully implemented, the team's presentation and collaborative approach paid off in terms of having implementation research impact policy at the district level.

As a strategy for promoting quality in the research and development process, teams develop theory related to both classroom learning and implementation through systematic inquiry. In its focus on persistent problems of practice and collaborative approach, design-based implementation research shares some features of participatory approaches to educational evaluation (see especially Fetterman, 2001).

Also, like rigorous, well-designed program evaluation studies, the research is informed

by theories of how people learn in particular contexts (e.g., Donaldson, 2007). However,

in contrast to most evaluation studies—which are motivated by practical and policy

questions—design-based implementation research aims to develop and refine theory

through systematic inquiry (Cobb et al., 2011). The objects of this theory development

include both explicit ideas about how to support classroom learning and ideas about how

to prepare teachers and administrators to implement programs and how to coordinate

implementation of programs within and across organizations (Confrey, Castro-Filho, &

Wilhelm, 2000). Design-based implementation research can also contribute to theories of

organizations and institutions that guide much contemporary policy research in

education, particularly by pointing out how the deployment of new tools (e.g., curricula,

technologies) can bring to light new needs for coordination across different system levels

and for capacity building (e.g., Stein & Coburn, 2008). In design research, it is through

the analysis of what happens when researchers engage in design and help support

implementation that theory develops (Edelson, 2002).

In the Center for Learning Technologies in Urban Schools (LeTUS), a research

center funded by the National Science Foundation, a key focus was to develop a theory of

the conditions under which a technology-supported innovation in science could be *usable*

to a wide range of teachers (Blumenfeld, Fishman, Krajcik, Marx, & Soloway, 2000).

Usability is a concept that describes an ideal of software design, and the LeTUS team

sought to explore its applicability to education. Immediately, and as a direct consequence

of their efforts to attempt to deploy technology in the Detroit Public Schools and Chicago

Public Schools (who were partners in the Center), they saw that the value of technology

lay not in what it could do on its own but in its integration with successful curriculum materials. In addition, LeTUS researchers confronted the different layers of the system that affected student access to computers and realized that actors in different departments and schools would need to coordinate their activities to implement technology successfully in the classroom. In urban schools, in order for technology to be usable, there must be "fit" of the innovation to school culture, technical capability, and policies (Blumenfeld, et al., 2000). If the gap between the capacity of a system and the requirements of an innovation along any of those three dimensions is large, a technology-supported innovation will be less usable. Where gaps are large, designers have a choice: scale down the demands along one or more dimensions, or intervene to enhance system capacity, improving chances that an innovation will be usable.

The LeTUS example illustrates what can be learned about policy and program implementation from engaging in the activity of design. By having to plan for implementation in classrooms and then adapt their plans on the basis of what they discovered through their research activities, the team refined its definition of the problem at hand, shifting from the idea of usability as a relationship between a technology capability and the task at hand (the definition from software design) to the idea of usability as entailing the capability of systems to make good uses of technology. This shift led to theory building about the system-wide conditions of scalability and sustainability up front in design, a primary goal of design-based implementation research.

Design-based implementation research is concerned with developing capacity for sustaining change in systems. One strategy for promoting sustainability of designs is to develop capacity through intentional efforts to develop organizational routines and

processes that help innovations travel through a system. The LeTUS team was not the first to claim or discover that the capacity of systems acts as both a resource and constraint for change: this idea has been fundamental in policy analyses for some time (e.g., Darling-Hammond, 1993). However, the predominant approaches to building capacity in education have long been focused on improving human capital—whether through professional development or by selecting and rewarding teachers on the basis of their students' test scores—and on developing and supplying improved material capital (e.g., curriculum). Often overlooked as a potential target for design efforts is improving social capital, that is, the resources and expertise that individuals can access to accomplish purposive action. A teacher's colleagues, for example, can be an important resource for implementing new reforms (Frank, Zhao, & Borman, 2004). Routines in schools, such as ones teachers use to structure conversations about teaching and learning in teams, serve as important resources for teachers' own learning and growth (Horn & Little, 2010). School administrators' processes for coordinating reform activities likewise can be resources for leading change efforts (Spillane, 2006). Design-based implementation research can help develop local capacity by fostering cohesion among networks of local actors tasked with implementing change and creating designs for routines and coordination mechanisms that can help innovations travel readily along those networks and that themselves can travel to new contexts.

A good example of a research and development effort focused on developing routines for innovation and coordination that travel well is the 5th Dimension, part of the UC Links program in the University of California system (Cole & the Distributed Literacy Consortium, 2006). Developed initially by Michael Cole and colleagues at the

Laboratory for Comparative Human Cognition at the University of California-San Diego, the 5th Dimension links university students and faculty to local communities through the joint activity of planning and running an after-school program. For children, participation is voluntary. For the undergraduates who help staff and research the program, attendance is part of a for-credit class. Program activities include academic, school-like tasks, but assigned within a broader context of learning through play.

The 5th Dimension program is a good example of capacity building because its routines and organizational processes have traveled well to support the formation of over three dozen university-community partnerships nationally and because it has proven successful in promoting a range of traditional academic and other outcomes. The necessary student labor is counted in the cost of running a course for the university, making the program attractive to communities and sustainable as a program that offers something to children in community settings and helps undergraduates learn about human development. Designing for sustainable improvements to teaching and learning is the ultimate goal of design-based research and as part of that, identifying and putting into place routines and processes that build or leverage existing capacity to support programmatic scalability is a crucial step.

Furthermore, the program's developers consider the adaptation required when implementing the program in a new site as a core object of research study. Notably, the primary interest of Cole and his colleagues in studying the Fifth Dimension has been on "tracing implementations in widely disparate conditions" to better understand the conditions under which the design principles are appropriated and transformed as it is integrated with the values, norms, and practices of host institutions (Cole & Engeström,

2006, p. 500). These findings help the team to refine theories of how the sociocultural setting shapes adoption of particular program elements.

Threats and Challenges to the Success of Design-based Implementation Research

There are significant practical challenges to engaging in design-based implementation research (Donovan, Wigdor, & Snow, 2003). The demand of the public and of schools for quick success from reforms often makes researchers uneasy. On their own, researchers may not have the capacity to function successfully as reform intermediaries at the same time they are conducting research; effective partnerships are likely to require an intermediary organization whose focus is primarily on capacity-building, not research. In addition, much policy discourse and funding for large-scale research on innovations leans toward the need to promote implementation fidelity rather than productive, mutual adaptation of programs. Funding cycles from both federal agencies and private foundations are typically short and ongoing funding of collaborations for the time required for building capacity is rare, making the multi-disciplinary projects that serve as examples in this paper the exception rather than the norm for organizing research and development efforts.

Just as design-based researchers often seek out classrooms that are suitable contexts for innovations (e.g., Reinking & Bradley, 2008), the teams above have largely worked within education systems that are "ready for change." In other words, the researchers have focused their efforts on places where they shared a broad vision for improvement with district officials. This may be a necessary condition for partnerships, and even in above examples where that condition is met, coordinating change has often proven a greater challenge than the research and development efforts are equipped to solve. An

ongoing challenge, which we hope can begin to be addressed in future projects, is the development of theories and models that can be used to initiate change where capacity is more limited and to develop designs for coordination that are better tailored to different contexts, including those that convene different kinds institutional and individual actors in and out of school to study and bring about improvements to children's learning. An example is the Youth Data Archive, (McLaughlin & O'Brien-Strain, 2008), in which researchers facilitate the assembly of datasets across different kinds of agencies (e.g., schools, social service agencies). Researchers involved with the Youth Data Archive help collaborative groups that provide the data to pose questions of these data and use the answers to inform the design of strategies to improve and coordinate services for youth. In addition, design-based implementation research teams will need to identify ways to involve young people themselves in designing and studying the educational systems of which they are part, both as a way to expand collaborations and as a strategy for promoting youth development (Kirshner, O'Donoghue, & McLaughlin, 2005).

Finally, an enduring challenge of design-based implementation research is to coordinate the activities of research and development. The projects described above involved multiple teams whose work had to be coordinated. In many instances, the practical work could have easily overshadowed the need for rigorous research. It was only because there were diverse teams with specialized roles for team members that teams were able to conduct the kinds of experimental, quasi-experimental, and mixed-methods longitudinal studies that they did. Even so, in their accounts of the design process, researchers did not always detail alternative approaches to redesigning innovations, explain how empirical evidence informed changes, or describe alternative

approaches to design and evidence that might have supported those approaches. These challenges suggest an important role for teams within projects that focus on the *processes* of research and development, to make visible the tensions and challenges in the work, as the cases in a recent edited volume on bridging the research-practice divide do (Coburn & Stein, 2010).

Looking to the Future: Organizing for the Improvement of Design-based Implementation Research

A first step toward developing design-based implementation research as a systematic form of inquiry and practice is to establish shared norms and practices regarding theory development and the specification and testing of specific claims or conjectures. In other words, the approach needs to establish a distinctive "argumentative grammar" (Kelly, 2004) for judging the adequacy of data supports for particular claims and theories and warrants that link claims to data. In design-based implementation research, the driving question may sometimes be a question of "what works," in which case experimental designs may be appropriate. Instead, much design-based implementation research asks questions such as, "What works when, how, and for whom?" "How do we improve this reform strategy to make it more sustainable?" and, "What capacities does the system need to continue to improve?" Answering these questions and the many sub-questions needed to develop and validate theory-based innovations will require a wide range of research methods. Longitudinal, historical, ethnographic, and case analyses of changing contexts are likely to be necessary to understand how reforms' trajectories across time and settings shapes implementation.

A second activity around which a community of scholars might organize is to develop standards regarding the use of evidence to guide refinements to design. If research and researchers are to mediate improvements, the community must articulate norms and practices regarding how to incorporate multiple points of view on problems and conflicting interpretations of data. One approach could be to encourage the use of *design rationales*, that is, accounts of the decisions teams make and the reasons for their decisions (Moran & Carroll, 1996). Professionals in the fields of architecture, urban planning, and software engineering articulate design rationales to clarify the purposes of design, record the history of the design process, and to reflect on and modify designs. In design-based implementation research in education, design rationales might serve as a means to make visible (and public for external review) the ways teams employ evidence to resolve conflicts, weigh competing approaches to improvement, and identify new areas of focus for their work.

Finally, to develop a community, scholars will need resources for conducting their work and venues for communicating their findings. Already, the National Science Foundation encourages scholars to propose implementation research studies to its Research and Evaluation on Education in Science and Engineering program competition. But in the Institute for Education Sciences, design-based implementation research would currently need to take place in the context of intervention development. One way for both the Institute and NSF to support design-based implementation research would be for requests for proposals to give priority to existing research-practice partnerships that have been successful, so that partnerships can develop new projects from groups with a shared history of collaboration. Finally, this area of research needs new publication outlets that

appreciate the interdisciplinary, iterative nature of the research. Many design-based implementation research studies are "fugitive documents," that is, they appear as book chapters, online reports, or manuscripts. Peer-reviewed journals that lie at the intersection of policy and learning sciences in particular are needed, where the work is currently most concentrated.

We are optimistic about the potential for this model of research, and that resources for design-based implementation research can be identified, because this mode of research is addressing directly important and timely policy concerns, namely scaling up and sustaining change and because this model builds upon prior work in both policy and learning sciences. The examples presented in this paper illustrate how collaborative design that focuses on problems of practice can produce effective programs, help districts augment the supports they provide to teachers for improving their instruction, contribute to advances in theory about what makes an innovation usable, and develop system capacity. The task ahead is to enable a broader community to undertake design-based implementation research systematically and expand the approach to address present and emerging challenges, so that it can have significant impact on the field of education.

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