

Toward an Argumentative Grammar for Socio-Cultural/Cultural-Historical Activity Approaches to Design Research

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Abstract: This symposium will introduce and illustrate the Socio-cultural/CHAT family of approaches to Design Research. Design Research has become central to the Learning Sciences. It is a key strategy for the study of learning in settings outside the laboratory, and it embodies the twin goals building theoretical knowledge about learning and contributing to educational practice. The contributors to this symposium will argue, however, that Design Researchers need to be aware that they are designing artificial settings in which to study culturally constituted, not biologically-given, processes of learning. The 'argumentative grammar' of socio-cultural/CHAT Design Research will be outlined.

Overview of Symposium

Design Research (DR) has become central to the Learning Sciences. It is a key strategy for the study of learning in settings outside the laboratory. It embodies the twin goals of the Learning Sciences: to build theoretical knowledge about learning, and to contribute to educational practices, broadly defined. Drawing upon theoretical traditions in cognitive science that trace a common genealogy to the work of Herbert Simon. Learning Sciences researchers have been at the forefront of testing and refining educational designs primarily in the artificial settings of school-based classrooms.

One might say, however, that contemporary DR in the Learning Sciences takes the form of designing artificial settings in which to study processes of learning that are themselves assumed to be natural properties of humans: perception, memory, attention, and learning itself. The contributors to this symposium will argue that Design Researchers need to be aware that they are designing artificial settings in which to study culturally constituted, not biologically-given, processes of learning. All the contributors take the position that learning is a culturally-mediated activity, not a purely natural process.

This symposium will present several examples of a family of approaches to DR that we believe holds promise for informing Learning Sciences in this burgeoning area of research and theory. We refer to this family as "Socio-cultural" and "Cultural-historical activity theoretical" (CHAT). The family members share an interest in theories and methodologies that grew to prominence in Russia in the latter half of the 20th century and that have found many adherents in contemporary approaches to learning and development, concerns that are central to Learning Sciences. These approaches, taken as a whole, emphasize the cultural and institutional organization of human action in various forms, in a wide variety of social settings ranging from classrooms in schools to community settings and workplaces. Demonstrating the power of this family of approaches is a central goal of the symposium.

It has been argued that DR requires an "argumentative grammar," an explicit and clear logic for its research methodology (Kelly, 2004). The papers in this session will articulate an argumentative grammar for socio-cultural/CHAT Design Research, in terms of four issues: (1) defining the unit of analysis, (2) conceptualization of change, (3) kind of explanation sought, and (4) what counts as evidence.

Because of the variety among Socio-cultural/CHAT Design Researchers, the contributors were each asked to take up a common set of questions as a means of encouraging a shared focus.

1. How are theory, methodology, and praxis linked in your approach to design?
2. Who designs in the work you do?
3. How is design bounded by the *object of activity*?

4. Under what conditions does design activity produce new forms of activity and expanded agency, and for whom?
5. What generalizes in design, and how?

A Fresh Perspective on Design Research: The Science of the Doubly Artificial

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Herbert Simon noted that “The world we live in today is much more a man-made, or artificial, world than it is a natural world. Almost every element in our environment shows evidence of human artifice” (Simon, 1996, p. 2). Artifacts, he pointed out, do not violate laws of nature, but they are aspects of nature adapted to human goals and purposes. The natural sciences seek knowledge about natural phenomena; we ought to call, then, a science that seeks knowledge about artifacts an “artificial science.”

Simon defined information processing systems as “artificial” in the sense that they adapt to complex environments, “as though they were deliberately designed to fit those environments (as indeed they sometimes are)” (Simon, 1980, p. 33). Cognitive science, it followed, was a “science of the artificial.” Like engineering, medicine, business and architecture it was concerned with the contingent rather than with the necessary; with things not simply as they are but as how they might be. Simon provocatively defined design in these terms: “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (p. 111).

Alan Collins subsequently suggested that “a design science of education must determine how different designs of learning environments contribute to learning, cooperation, motivation, etc.” (Collins, 1992, p. 15). For Ann Brown, too, design experiments involve “engineering” the classroom while simultaneously conducting experimentation. DR in education is “modeled on the procedures of design sciences such as aeronautics and artificial intelligence” (Brown, 1992, p. 141).

Despite Simon’s insights into the importance of the artificial, however, design research in the Learning Sciences has mainly taken the form of creating artificial environments while the phenomena within it are assumed to be natural properties of human organisms: sensation, attention, perception, and learning processes themselves. Our own perspective, in contrast, offers a different way to advance Simon’s original insight. The classroom is already an artificial environment designed to bring about specific kinds of transformations in the students and teachers who act within it, before researchers arrive. In this sense, the behavior of those students and teachers is itself artificial; teaching and learning are not merely natural processes but are cultural activities that are the product of human design. That is to say, teaching and learning are not the results of fixed and universal psychological processes, but the purposeful consequences of particular local and temporally bounded practices that employ the material artifacts of their environment in order to create, to constitute, specific functional systems of psychological processes. Classroom teaching and learning has always already been designed, albeit sometimes in a tacit, unexamined fashion, or “old fashioned” manner.

From this viewpoint, Simon was correct that human psychological functioning is artificial in the sense that it is the result of adaptation to a contingent environment (though we would not agree with his characterization of psychological functioning as information processing). We argue, however, that human psychological functioning is in fact *doubly* artificial, since the environments to which it is an adaptation are themselves artificial and contingent, the products of design.

In short, then, DR as usually practiced within the Learning Sciences is the design of artificial settings in which to study natural processes, while a CHAT-inspired DR is the design of artificial settings in which to study processes of design (i.e., “courses of action aimed at changing existing situations into preferred ones”). Our proposal will be that CHAT-inspired DR is a science of the artificial in the double sense that we have just articulated. This paper will illustrate this proposal by describing a form of CHAT-inspired DR that involves creation of a out-of-school activity setting, the Fifth Dimension.

DR has been at the core of the Learning Sciences, in so far as LS involves the study of learning outside the laboratory in real world settings. DR has been defined as having “dual goals”: contributing to educational theory as well as educational practice. However, in the 20 years since it was first defined, DR has been criticized in various ways. It has been accused of paying insufficient attention to theory, and as often amounting merely to the testing of theory whose origins come from outside the classroom. Instead, it has been argued, DR offers the potential for “ontological innovation,” the positing and validation of new “categories of existence in the world” (diSessa & Cobb, 2004, p. 84). We agree with this proposal, and will illustrate such innovation in the Fifth Dimension.

At the same time, DR has been accused of paying insufficient attention to practice, in the sense that it is usually the researchers’ definition of the practical goals of the design intervention that are emphasized. Instead, it is argued, DR should adopt a more critical stance, and seek to “develop sociotechnical structures that facilitate individuals in critiquing and improving themselves and the societies in which they function” (Barab et al., 2007, p. 263). We also agree with this proposal, and will illustrate the role of critique in CHAT DR.

In addition, DR has been accused of lacking a clear and explicit logic of inquiry, an “argumentative grammar,” that is, a clear statement of “the logic that guides the use of a method and that supports reasoning about its data” (Kelly, 2004, p. 118). It is important to note, however, that Kelly assumes that DR is at its heart a form of research that seeks to identify what is “necessary” in a situation of learning, and to separate this from what is “contingent” (understood as “arbitrary”). Simon’s insight that cognitive science, and by extension educational research and in particular Learning Sciences, is a science of the artificial, that is to say of the contingent, appears to have been lost. Our own starting place, in contrast, is with the observation that what is “contingent” - in the sense of what is locally customary and valued - is equally important to practices of teaching and learning as what is necessary, and that what appears necessary often turns out to be contingent.

We believe that when DR is properly understood as the design of (artificial and contingent) environments in order to study (artificial and contingent) practices of learning, an adequate argumentative grammar can be provided. We shall outline such a grammar in the form of answers to the following questions: (1) What is the unit of analysis? (2) How is change conceptualized? (3) What kind of explanation is sought? and (4) What counts as evidence?

Our presentation will offer, justify, and exemplify the following answers to these questions:

- (1) The unit of analysis is the activity system and its associated cultural practices created by participants from (at least) two different institutions.
- (2) Change is conceptualized as having its source in contradiction. Change can include not only learning and development but also dissolution and decay. An activity system may transform in a productive way or it can die; people can forget what they have learned.
- (3) Explanation takes the form of the detailed articulation of constitutive processes. A sufficiently detailed documentation of process-oriented design research makes it possible to observe constitution and to reconstruct it as a real sequence of events.
- (4) Evidence is obtained by researchers who are themselves participants in the design process, tracing and documenting cultural practices over extended periods of time, at several levels of analysis, using a variety of methods (field notes, audio and video recordings).

The goal of the project to be described is to change, and where possible, reduce, constraints on the activities to be designed in order to obtain a deeper understanding of the learning potential of activities, in circumstances that differ markedly from the institutional constraints of standard classrooms. We have taken this route because Learning Sciences DR in the classroom typically takes for granted - and leaves unchanged in many respects - the institutional roles that are defined by the school: those of student and teacher. DR may, and often does, seek to transform these roles, but it does not, and arguably cannot, eliminate them. Yet these roles impose severe constraints on the character of learning and teaching. The people who inhabit such roles must cover curriculum, often defined by externally imposed “standards,” and they must implement forms of evaluation that lead to scores on tests, grades in courses, and ultimately ratings of their school. Within these constraints details can be changed - such as whether students work together and on what, whether the teacher is the primary source of information or not - but the fundamental logic of the institution must be accepted by researchers as much as by the participants with whom they conduct their studies.

CHAT-inspired design research outside the school classroom takes advantage of the fact that it can, in contrast, start without many of these institutional constraints if not from scratch. Our design research in San Diego takes place in the Learning Center of a government-subsidized housing project. In Bogotá it takes place in a small apartment rented from the parents of one of the founders of the non-profit organization Inti Tekoa, with which we are collaborating. In both cases, children and youth simply drop in from the street, or are dropped off by a parent or come with older family members. In San Diego, the adolescents and young adults come from the local university. In Bogotá, the adolescents are enrolled in a “social service” requirement for their secondary school, but we have worked hard to confound their expectation that they would find themselves in something like a school classroom. In this basement apartment we can paint on the floor, decorate for Halloween to create a House of Horror, spray water, cut watermelon, invite in a passing dog, and simply mop the floor afterwards.

On the other hand, each of the participants at this site is involved in one or more institutions elsewhere: the university, the secondary school, their family. Each of us arrives with expectations, and with dispositions to act and interact that have been shaped by years, sometimes decades, of involvement in these institutions. Some of these expectations and dispositions transfer well into the site, while others do not. Documenting how the contradictions among these expectations are resolved by participants by virtue of their collaboration in, and in order to collaborate in, activities provides us with evidence we can use to reconstruct how our work in designing the site articulates with the ways participants are themselves artificial, products of design processes of education and work.

Formative Interventions and Transformative Agency: Principles, Practice, and Research

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Some 35 years ago Urie Bronfenbrenner wrote that “research on the ecology of human development should include experiments involving the innovative restructuring of prevailing ecological systems in ways that depart from existing institutional ideologies and structures by redefining goals, roles, and activities and providing interconnections between systems previously isolated from each other” (Bronfenbrenner, 1977, p. 528). This recommendation remains largely unheeded in educational research. This may be so in part because the transformative agency of the learners and teachers has seldom been taken as central challenge in design-based research.

Bronfenbrenner referred to Soviet cultural-historical activity theory as a key inspiration. The historical legacy of cultural-historical activity theory is one of theoretically and methodologically argued interventionism. This interventionist legacy has been picked up and systematically developed further in a few places in today’s world, including Helsinki, Paris, and San Diego. We will present the Helsinki variation, which we will call a methodology of formative interventions (Engeström, 2011).

This idea of formative interventions is being adopted in various educational research communities internationally (e.g., Anthony, Hunter & Thompson, in press; Bronkhorst, Meijer, Koster, Akkerman & Vermunt, 2013; Eri, 2013). Research done using formative interventions focuses on transformations and learning in object-oriented activities (Greeno & Engeström, in press), often outside schools, in workplaces and communities (e.g., Mukute & Lotz-Sisitka, 2012). The object of these activities is not self-evident; it is typically at risk or in crisis, ambiguous, fragmented, and contested. The object is rediscovered as a result of historical and empirical work of data collection and analysis with the help of conceptual models by the researcher-interventionists and the participants. The object is inherently contradictory from the beginning. Negotiations emerge as shared tools and concepts are built to depict and handle the contradictory object and the conflicting motives related to it. The emphasis is on the creation and implementation of “germ cells”, foundational models for new patterns of the activity, usually first constructed in relatively bounded units that then open up, expand and multiply.

The methodology of formative interventions is built on two epistemological principles, namely (1) the principle of double stimulation and (2) the principle of ascending from the abstract to the concrete (Sannino, 2011). The first one was formulated and implemented by Vygotsky and his colleagues (e.g., Vygotsky, 1997). The second one stems from the classic works of Hegel and Marx, was brought into activity theory by the philosopher Il’enkov (1982), and systematically implemented as foundation for a theory of learning and instruction by Davydov (1990).

The principle of double stimulation, in its full Vygotskian version, regards developmentally valuable learning as a process in which the subject faces a paralyzing conflict of motives (first stimulus) which is resolved by discovering an artifact which is filled with meaning and turned into a sign (second stimulus) that enables the subject to redefine the situation and to take volitional actions to break out of it. The principle of ascending from the abstract to the concrete depicts developmentally valuable learning as transforming a problematic situation to discover and model an initial “germ cell” abstraction that is then applied and implemented to construct a complex new concreteness. Both principles put the formation of volitional action and transformative agency in the center of learning. We define transformative agency as breaking away from the given frame of action and taking the initiative to transform it. The new concepts and practices generated by this type of expansive learning activity are future-oriented visions loaded with initiative and commitment from below. They cannot be predefined and safely constrained by researchers or authorities.

For about 20 years, the methodology of formative interventions has been implemented in practice by means of a toolkit called the Change Laboratory (Engeström & al., 1996; Virkkunen & Newnham, 2013). The Change Laboratory is used when an activity system or a cluster of activity systems faces an uncertain but necessary transformation riddled with conflicting motives and energized by a possibility of reaching a qualitatively new, emancipated mode of activity. In Change Laboratories the practitioners, including students, take over the leading role in designing their future. The taking over is a crucial feature of a formative intervention. This means also that the end result cannot be fully determined ahead of time and controlled through the process. The very point is to generate the unexpected - learning what is not yet there. This does not mean that the interventionists do not bring in their own ideas and aims. The dynamism of the intervention stems from the tension and interplay between the interventionists’ and the practitioners’ ideas and intentions.

We will describe and analyze three Change Laboratory interventions (one conducted in an academic library in Helsinki, another one conducted among greenhouse vegetable growers in western Finland, and the third one conducted in a school in Moscow, Russia) as implementations of the two epistemological principles.

The methodology of formative interventions generates several varieties of research. These include (a) studies of manifestations of contradictions (e.g., Engeström & Sannino, 2011); (b) studies of expansive learning

actions and learning cycles (e.g., Engeström, Rantavuori & Kerosuo, 2013); (c) studies of expressions of transformative agency (e.g., Engeström & Sannino, 2013; Haapasaari, Engeström & Kerosuo, in press); and (d) studies of concept formation (e.g., Engeström, Nummijoki & Sannino, 2012). We will conclude by discussing these varieties and the prospective next steps in the development of formative interventionist research.

Designing for Possible Futures: The Potential of Social Design Experiments

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This paper is about designing for educational and social possibilities—designs that in their inception, social organization, and implementation squarely address issues of cultural diversity, social inequality, and consequential learning. We draw on a cultural historical activity theoretic framework to discuss the development of sustainable and resilient learning ecologies for non-dominant communities. Researchers working within this tradition employ a diverse range of theoretical perspectives, including cultural historical activity theory, to attend to the mediating role of social contexts and practices in human meaning-making processes and the role of researchers' efforts to improve the human condition of which learning is fundamental (Gutiérrez & Vossoughi, 2010). The goal of this work, then, is to make possible a sustainable and dignified life for all humans. This requires an interventionist stance that designs for new possibilities. Within this work, the approach to design focuses on re-mediating (Cole & Griffin, 1983) the effects of social inequity on vulnerable ecologies and communities who live in "tight circumstances," with particular attention to making visible the ingenuity in human activity (McDermott & Raley, 2011).

Envisioning New Forms of Intervention and Design

There are different kinds of interventions; however, few are theorized in ways that address a core human problem: our inability to resolve issues of cultural diversity and social inequality, to provide polycultural solutions, or to understand where one can allow for variability without turning it into a deficit (Cole, 1998; Gutiérrez, 2008). There is a need to formulate an alternative social science with a new social imagination, with some scale of social concept about how people can learn resonantly, as they live together productively and interculturally in resilient ecologies (Walker & Salt, 2006). There are extant models of this kind of formative intervention research in the field. The "change laboratory," for example, involves the collaboration of practitioners and researchers around an important and consequential problem of practice within an existing activity system (Cole & Engeström, 2006; Engeström, 2011; Engeström & Sannino, 2010).

Within this tradition, we discuss a new form of design: social design experiments (SDE)—cultural historical formations concerned with social consequences, transformative potential, and new trajectories for historically vulnerable people, especially people from non-dominant communities (Gutiérrez, 2008, Gutiérrez & Vossoughi, 2010). Organized around expansive notions of learning and mediated praxis, social design experiments are oriented toward transformative ends through iterative processes of mutual relations of exchange; specifically, SDE's seek to (a) leverage the histories and repertoires of practice of members of non-dominant communities to envision new futures and trajectories; (b) introduce new tools and practices for envisioning new pedagogical and social arrangements; (c) underscore the role of diversity in ecological resilience and in re-mediating and sustaining viable and thriving ecologies; and (d) develop ecologically valid interventions and representations.

Following Erickson (2006, p. 225), SDE's require sustained first-hand observation, sharing in the action and cognition of practitioners and community members. Studying "side by side" with research partners jointly engaged in work to transform systems involves the researcher assuming the role of a collaborative partner and a reflective "observant participant" who helps make visible the practices, meanings, and contradictions that often become invisible to those closest to the action (Erickson, 1986, p. 157; Gutiérrez & Vossoughi, 2010).

Two Models of Social Design Experiments

We elaborate two very different examples of social design experiments at very different scales to make the case for a design methodology distinguished by its grammar of hope, possibility, and resilience (Gutiérrez, 2011). To do so, we illustrate some key dimensions of this approach across cases. One illustrative case, an educational intervention, privileges intergenerational collaboration that foregrounds the agency of learners in ways that are distinct from the agency of designers and policy makers, for example, and emphasizes cross-institutional partnerships that promote new forms of engagement around learning; mediated by new technologies and divisions of labor, learning is reorganized in ways that create spaces to experiment pedagogically across institutional settings: the University and the community.

The second case involves a research team that has been studying a constellation of groups involved in the local food justice movement in three Western U.S. cities. The groups have chosen to focus their study on issues of food access among the most underserved communities in the state. These include people living in

poverty, vulnerable immigrant populations, and historically marginalized communities residing in neighborhoods with limited access to healthy and inexpensive foods. The problems facing these communities are entangled across multiple scales that include government (federal, state, and local), historical patterns of immigration, and shifts in global and local economies. Understanding how groups have chosen to intercede in the food system so that it can better serve vulnerable communities requires studying their efforts at rescaling across multiple levels of activity. We articulate the work of *equity-oriented scalemaking* in the local food justice movement drawing on examples from our multi-sited research study (Jurov, et al., under review). That is, given the fact that there are no ready-made answers to solving the problem of inequity in this system, these groups have developed unique strategies for transforming relations between communities, local food (its production, distribution, and consumption), and the geospatial organization of access to educational, environmental, health, and economic resources (Kurtz, 2013).

Though these two examples differ in their scale of intervention, they share important design principles that make the history of the ecology and its participants, available resources, diversity, resilience, and the possibility of new trajectories central to the conception of the design. Of significance, these interventions build for resilience and sustainability across longer timescales. Thus, while these interventions are aimed at local and institutional change, as social design experiments they are also aimed at broader social change through small and larger scale instantiations or realizations of a possible future. We argue that collectively these approaches become generative of a new imagination that conceives of resilience over cultural historical time, a resilience that encompasses ecological thinking about social and environmental systems, including educational systems. This is critical if we are ever to conduct research on learning and design for the social good in ways that have transformative and enduring consequences for people in vulnerable communities.

Negotiating and Accomplishing the Object of Design in Research-Practice Partnerships

William R. Penuel, Raymond Johnson, Samuel Severance, Heather Leary, and Susan Miller, University of Colorado Boulder

In Cultural-Historical Activity Theory (CHAT), understanding the *object* of activity is what helps us make sense of why individuals, groups, or organizations do what they do (Kaptelinin, 2005). The object bounds analysis of activity systems and interactions between activity systems: it is the reference point from which researchers develop claims about the organization and effects of activity (Spinuzzi, 2011). The object is also often understood as a kind of “shared problem space,” and as such, a site of intervention, transformation, and learning (Akkerman & Bakker, 2011; Engeström, 2011; Engeström & Sannino, 2010).

Research-practice partnerships are emerging as new forms for organizing intervention research in the learning sciences (Coburn, Penuel, & Geil, 2013). In these partnerships, the object of design emerges through joint negotiation of researchers and educators in particular educational systems, such as school districts (Penuel, Coburn, & Gallagher, in press). At the same time, the problem spaces of design often have the character of “runaway objects,” that is, objects held in common across multiple activities that take place across multiple settings and with different configurations of actors (Engeström, 2008). Research-practice partnerships in education today take on such objects as “improving instruction at scale” (Cobb & Jackson, 2012) and “improving the success rate of community college students who place into developmental mathematics” (Dolle, Gomez, Russell, & Bryk, in press). As with other runaway objects, these are not in any single person, group, or organization’s control, including participants in partnerships.

The work of partnerships takes place at the boundaries of the cultural and institutional communities of researchers and practitioners. Researchers and practitioners’ cultural and institutional contexts are distinct, but also related. They are distinct, in that the objects, tools, and community practices of researchers differ widely from those of educators in schools and other settings (National Research Council, 2012). At the same time, the two worlds are related, because much of educational research aims to inform or directly intervene to improve educational practice. In addition, there are many people and organizations who move across these boundaries and broker connections between them (Penuel et al., in press). Research-practice partnerships often entail the construction of boundary zones where they negotiate the object(s) of their design work, as well as boundary practices, hybridized forms of practice that they design to help accomplish the partnership’s object(s).

Constructing a Boundary Zone to Negotiate the Object

Work at the boundary of research and practice often requires constructing temporary spaces for negotiating the object of joint work and engaging in collaborative design. A key challenge to negotiating an initial object is to identify, name, and confront problems or challenges that are of mutual concern to participants in the partnership. Because researchers and practitioners often define their respective problem spaces differently (National Research Council, 2003), overcoming this challenge takes time and can benefit from explicit discussion and negotiation (Dolle et al., in press). At the same time, the process may be facilitated when the work practices of

both researchers and practitioners have been disrupted, such as through the introduction of new policies affecting both research and practice. These policies may help partners to identify a “shared problem space” (Akkerman & Bakker, 2011), an object that they agree is important and that requires the ongoing mutual engagement of researchers and practitioners to accomplish.

Accomplishing the Object in Research-Practice Partnerships

The objects that give meaning to partnership activity require that partners influence activities outside the boundary zone. Sometimes, the object of a partnership requires mainly influences on mechanisms of coordination in systems. Examples include work focused on the coordination of professional development across role groups in school districts (Jackson & Cobb, in press) and work that aims to coordinate youth’s opportunities to pursue science-linked interests across school and out-of-school settings in a community (Penuel et al., 2012). More common, however, is work that aims to develop new *boundary practices* that can help partnerships accomplish objects focused on transforming educational systems. The aim of such work is transformation (Akkerman & Bakker, 2011), in which new, hybridized practices that bring together elements from research and practices are developed and, ideally, integrated into new routines and procedures throughout the system.

An Example: The Inquiry Hub

The Inquiry Hub is a research-practice partnership among researchers, curriculum publishers, and a large, urban school district in the Western United States. The Inquiry Hub’s activities are funded through a grant from the National Science Foundation (NSF); its principal investigators include representatives from both research organizations and the district. The partnership’s activities are framed by the object of the funding agency, improving STEM education through researcher-initiated research and development projects. However, the specific object of the partnership is a focus of ongoing negotiation, and the resources allocated through the grant to accomplish the partnership’s object are shaped by those negotiations.

The partnership’s boundary zone is a fluid space comprised of a stable set of institutions in which specific partners change over time. It includes educational researchers with different forms of expertise (e.g., mathematics, assessment, professional development), software engineers, curriculum developers, district leaders from different departments and with different kinds of authority for decision making, and teachers. It is constituted through regular meetings whose agendas differ, depending on the composition of the group. A leadership team meets via telephone on a weekly basis to negotiate the overall work of the partnership, and a Teacher Advisory Board (TAB) meets with that team regularly to engage in design work.

The negotiation of the shared problem space is an ongoing activity within the Inquiry Hub, in part because of the changing needs of the district and differences in perspectives among the partners. Initially at least, the object of the partnership was to support adaptation of varied forms of “student-centered” instructional materials in mathematics and science throughout the district. However, with adoption of new standards in mathematics (Common Core State Standards), the district saw a need to focus more attention on developing understanding of new standards and the kinds of tasks that embodied the new standards. Teachers on the TAB, for their part, suddenly had a need for new instructional materials related to standards that had not been part of the curriculum before. These needs created a shared problem space related to the new standards, but it also led to some conflict over strategies for accomplishing the object of supporting implementation of new standards.

That conflict is reflected in the different perspectives on the design work of the TAB, which has focused on developing a new set of boundary practices related to instructional tasks in mathematics. The practice focuses on selecting, rating, and distributing instructional tasks in Algebra. For the researchers, the practice is a site for sociotechnical design: creating scalable social processes for supporting the task rating process and a technical (Web-based) infrastructure for distributing tasks and task ratings. For district leaders, the task rating process is a tool for developing awareness of what constitutes cognitively demanding mathematical tasks that can meet new standards. For teachers, the process of rating and distributing tasks is principally a means to discover new materials they might use in the classroom.

The partnership is also challenged by difficulties in crystallization of the boundary practices within ongoing routines and practices of the district. As with other boundary practices, the practices of the partnership are “subject to political processes, having a mediating role for contrasting goals, possibly reinforcing power structures and occupational hierarchies” (Akkerman & Bakker, 2011, p. 150). Making other teachers aware of tasks available to them in the technology infrastructure and providing professional development in the task rating process requires that the district partners gain and secure access to times when the district provides professional development to teachers. It also requires TAB members to gain access to agendas of teacher team meetings in their own schools. These are both settings where other district leaders not part of the partnership, as well as leaders of other initiatives and partnerships, compete for access to teachers. The partnership has yet to make its particular boundary practices “obligatory passage points” all teachers in the district must attend to and join as participants (c.f., Christiansen & Varnes, 2007).

In the Inquiry Hub, attending to boundaries foregrounds the need to confront multiple perspectives on the object of design in partnerships. All design research produces new practices that require ongoing work to sustain; however, a focus on these practices as boundary practices reveals potential sources of difference and conflict within the partnership. In addition, a focus on the challenges of crystallization of boundary practices reveals the ways that partnerships compete for scarce time and resources with other initiatives in educational systems, some of which may share the same object but pursue different strategies for accomplishing that object.

References

- Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. *Review of Educational Research, 81*(2), 132-169.
- Anthony, G., Hunter, R. & Thompson, Z. (in press). Expansive learning: Lessons from one teacher's learning journey. *ZDM – The International Journal on Mathematics Education*.
- Barab, S., Dodge, T., Thomas, M. K., Jackson, C., & Tuzun, H. (2007). Our designs and the social agendas they carry. *Journal of the Learning Sciences, 16*(2), 263-305.
- Bronfenbrenner U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*, 513–531.
- Bronkhorst, L. H., Meijer, P. C., Koster, B., Akkerman, S. F. & Vermunt, J. D. (2013). Consequential research designs in research on teacher education. *Teaching and Teacher Education, 33*, 90-99.
- Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences, 2*(2), 141-178.
- Christiansen, J. K., & Varnes, C. J. (2007). Making decisions on innovation: Meetings or networks? *Creativity and Innovation Management, 16*, 282-298.
- Cobb, P. A., & Jackson, K. (2012). Analyzing educational policies: A learning design perspective. *Journal of the Learning Sciences, 21*, 487-521.
- Coburn, C. E., Penuel, W. R., & Geil, K. (2013). Research-practice partnerships at the district level: A new strategy for leveraging research for educational improvement. Berkeley, CA and Boulder, CO: University of California and University of Colorado.
- Cole, M. (1998). Can cultural psychology help us think about diversity? *Mind, Culture, and Activity, 5*(4), 291–304.
- Cole, M. & Griffin, P. (1983). A socio-historical approach to re-mediation. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 5*(4), 69-74.
- Cole, M. & Engeström, Y. (2006). Cultural-historical approaches to designing for development. In J. Valsiner & A. Rosa (Eds.) *The Cambridge Handbook of Sociocultural Psychology*. (484-507). Cambridge, UK: Cambridge University Press.
- Collins, A. (1992). Toward a design science of education. In E. Scanlon & T. O'Shea (Eds.), *NATO ASI Series: New Directions in Educational Technology* (Vol. 96, pp. 15-22). Berlin: Springer. doi:10.1007/978-3-642-77750-9_2
- Davydov, V. V. (1990). *Types of generalization in instruction: Logical and psychological problems in the structuring of school curricula*. Reston: National Council of Teachers of Mathematics.
- Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher, 32*(1), 5-8.
- diSessa, A. A., & Cobb, P. (2004). Ontological innovation and the role of theory in design experiments. *Journal of the Learning Sciences, 13*(1), 77-103.
- Dolle, J. R., Gomez, L. M., Russell, J. L., & Bryk, A. S. (in press). More than a network: Building professional communities for educational improvement. In B. J. Fishman, W. R. Penuel, A.-R. Allen & B. H. Cheng (Eds.), *Design-based implementation research: Theories, methods, and exemplars. National Society for the Study of Education Yearbook*. New York, NY: Teachers College Record.
- Engeström, Y. (2008). *From teams to knots: Activity-theoretical studies of collaboration and learning at work*. Cambridge, UK: Cambridge University Press.
- Engeström, Y. (2011). From design experiments to formative interventions. *Theory & Psychology, 21*(5), 598-628.
- Engeström, Y., Nummijoki, J. & Sannino, A. (2012). Embodied germ cell at work: Building an expansive concept of physical mobility in home care. *Mind, Culture, and Activity, 19*(3), 287-309.
- Engeström, Y., Rantavuori, J. & Kerosuo, H. (2013). Expansive learning in a library: Actions, cycles and deviations from instruction intentions. *Vocations and Learning, 6*(1), 81-106.
- Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review, 5*, 1-24.
- Engeström, Y., & Sannino, A. (2011). Discursive manifestations of contradictions in organizational change efforts: A methodological framework. *Journal of Organizational Change Management, 24*(3), 368-387.

- Engeström, Y., & Sannino, A. (2013). La volition et l'agentivité transformatrice: Perspective théorique de l'activité. *Revue Internationale du CRIRES: Innover dans la tradition de Vygotsky*, 1(1), 4-19.
- Engeström, Y., Virkkunen, J., Helle, M., Pihlaja, J. & Poikela, R. (1996). Change laboratory as a tool for transforming work. *Lifelong Learning in Europe*, 1(2), 10-17.
- Eri, T. (2013). The best way to conduct intervention research: Methodological considerations. *Quality and Quantity*, 47(5), 2459-2472.
- Erickson, F. (2006). Studying side by side: Collaborative action ethnography in educational research. In G. Spindler & L. Hammond (Eds.), *Innovations in educational ethnography: Theory, methods and results* (pp. 235-257). Mahwah, NJ: Lawrence Erlbaum Associates.
- Greeno, J. G. & Engeström, Y. (in press). Learning in activity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences*. 2nd edition. Cambridge: Cambridge University Press.
- Gutiérrez, K. D. (2011, April). Presidential Address: *Designing resilient ecologies: Towards a human science of learning*. Presented at the Annual Meeting of the American Educational Research Association.
- Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, 43(2), 148-164.
- Gutiérrez, K. D., & Vossoughi, S. (2010). Lifting off the ground to return anew: Mediated praxis, transformative learning, and social design experiments. *Journal of Teacher Education*, 61(1-2), 100-117.
- Haapasaari, A., Engeström, Y. & Kerosuo, H. (in press). The emergence of learners' transformative agency in a Change Laboratory intervention. *Journal of Education and Work*.
- Ilyenkov, E. V. (1982). *The dialectics of the abstract and the concrete in Marx's Capital*. Moscow: Progress.
- Jackson, K., & Cobb, P. (in press). Coordinating professional development across contexts and role group. In M. Evans (Ed.), *Teacher education and pedagogy: Theory, policy and practice*. New York, NY: Cambridge University Press.
- Jurow, A.S., O'Connor, K., Shea, M.V., Cartun, A., & Wiley, K. (under review). Learning, as organizing, in social movements. *The Journal of the Learning Sciences*.
- Kaptelinin, V. (2005). The object of activity: Making sense of the sense-maker. *Mind, Culture, and Activity*, 12(1), 4-18.
- Kelly, A. (2004). Design research in education: Yes, but is it methodological? *Journal of the Learning Sciences*, 13(1), 115-128.
- Kolodner, J. L. (2012, July). *Envisioning the next generation classroom and the next generation of learning technologies*. Paper presented at the 10th International Conference of the Learning Sciences, Sydney, Australia.
- McDermott, R., & Raley, J. (2011). Looking closely: Toward a natural history of human ingenuity. In E. Margolis & L. Pauwels (Eds.), *The SAGE handbook of visual research methods* (pp. 372-391). Thousand Oaks, CA: Sage.
- Mukute, M., & Lotz-Sisitka, H. (2012). Working with cultural-historical activity theory and critical realism to investigate and expand farmer learning in Southern Africa. *Mind, Culture, and Activity*, 19, 342-367.
- National Research Council. (2003). *Strategic education research partnership*. Washington, DC: National Research Council.
- National Research Council. (2012). *Using science as evidence in policy*. Washington, DC: National Academies Press.
- Penuel, W. R., Coburn, C. E., & Gallagher, D. (in press). Negotiating problems of practice in research-practice partnerships focused on design. In B. J. Fishman, W. R. Penuel, A.-R. Allen & B. H. Cheng (Eds.), *Design-based implementation research: Theories, methods, and exemplars. National Society for the Study of Education Yearbook*. New York, NY: Teachers College Record.
- Penuel, W. R., Falk, J. H., Dierking, L. D., Kirshner, B., Haun-Frank, J., & York, A. J. (2012). Locating the development of interest: Tools for studying the mutual constitution of persons and cultural practices in places. In J. van Aalst, K. Thompson, M. J. Jacobson & P. Reimann (Eds.), *The future of learning: Proceedings of the 10th international conference of the learning sciences (ICLS 2012) – Volume 2, short papers, symposia, and abstracts* (pp. 326-330). Sydney, Australia: ISLS.
- Sannino, A. (2011). Activity theory as an activist and interventionist theory. *Theory & Psychology*, 21(5), 571-597.
- Simon, H. A. (1980). Cognitive science: The newest science of the artificial. *Cognitive Science*, 4(1), 33-46.
- Simon, H. A. (1996). *The sciences of the artificial* (3rd ed.). MIT Press.
- Spinuzzi, C. (2011). Losing by expanding: Corraling the runaway object. *Journal of Business and Technical Communication*, 25(4), 449-486.
- Virkkunen, J. & Newnham, D. (2013). *The Change Laboratory: A tool for collaborative development of work and education*. Rotterdam: Sense.

- Vygotsky, L. S. (1997). The history of the development of higher mental functions. In *The collected works of L. S. Vygotsky. Vol. 4. The history of the development of higher mental functions*. New York: Plenum.
- Walker, B. & Salt, D. (2006). *Resilience thinking: Sustaining ecosystems and people in a changing world*. Washington, D.C.: Island Press.