Using Design to Advance Learning Theory, or Using Learning Theory to Advance Design

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First Experiences
I remember my first design experience. I was a doctoral student at the University of Connecticut. I had learned about situated cognition the previous semester and found that I truly resonated with this theoretical perspective. In particular, I resonated with the emphasis on the reciprocal character of the interaction in which individuals, as well as cognition and meaning, are considered socially and culturally constructed. However, in 1998 there was much theoretical speculation but less experimental work being done to test the practical significance of the underlying assumptions in terms of their potential to influence instruction. It is with this goal of contributing to the dialogue on situated cognition that I initially found myself engaged in instructional design. However, and while I had taken a course in which Gagné, Reigeluth, and Merrill were discussed, I did not turn to instructional design but instead simply designed “from the hip.” My focus was not on employing or testing design principles but rather building a design-based treatment to which I could test the underlying power of situativity theory and, hopefully, apply some evidence-based claims to theoretical conjectures.

Definitions and Distinctions
Pushing forward on this distinction, I will briefly offer two definitions. First, instructional design is a systematic process that involves the creation of detailed specifications for the development, implementation, evaluation, and maintenance of a particular set of conditions (e.g., instructional materials and activities) that facilitate the learning of both large and small units of subject matter at all levels of complexity. It encompasses the entire process of analysis of learning needs and goals and the development of an instructional or delivery system to address those needs. The learning sciences is an interdisciplinary field that draws on multiple theoretical perspectives and research paradigms from the human sciences so as to understand the nature and conditions of learning, cognition, and development. Researchers in the learning sciences investigate cognition in context, at times emphasizing one more than the other but with the broad goal of developing evidence-based claims derived from both laboratory-based and naturalistic investigations and that result in theory (and new practices) about how people learn in the real world that has methodological rigor, theoretical grounding, and practical significance. However, and in spite of the learning scientists’ current interest in researching in naturalistic contexts, instructional designers have a more practical and applied history, with an emphasis on advancing usable products and processes as
opposed to advancing theoretical and empirical claims about learning.

This distinction is especially salient when one compares ‘design experimentation’ or ‘design-based research’ with more traditional design work focused on the production of a product. Design-based research, as conceived by Brown (1992), was a methodological approach that involved systematically adjusting various aspects of the designed context with the expectation that each adjustment served as a type of experimentation that allowed for the testing and generating of theory in naturalistic contexts. Since Brown’s (1992) and Collins’s (1992) seminal work introducing design experiments, there has been a flurry of work falling under the general umbrella of design-based research (Barab & Squire, 2004; Dede, in press; Edelson, 2002; Design-Based Research Collective, 2003; Kelly, 2003; Roth, 2001). Cobb, Confrey, diSessa, Lehrer, & Schauble (2003) stated:

Prototypically, design experiments entail both “engineering” particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them. This designed context is subject to test and revision, and the successive iterations that result play a role similar to that of systematic variation in experiment. (p. 9)

Cobb et al. further suggest that design experiments result in the production of theories on learning and teaching, are interventionist (involving some sort of design), take place in naturalistic contexts, and are iterative. Design-based research is not simply a type of formative evaluation that allows learning scientists to better understand the ecological validity of theoretical claims generated in the laboratory. Instead, it is a methodological approach for generating and advancing theory in those situations where the researcher is interested in manipulating the context so as to better understand the boundary conditions of the actualized theory. Design-based research, with its emphasis on theory generation, represents a core utility of design work to learning sciences; this is because from a design-based research perspective, the design work is in the service of theory evolution and not an end in itself. It is important to note that for many learning scientists, including myself, it is also necessary that the design work, in addition to theory development, impacts the target participants in a positive manner. This service agenda is not simply a result of our commitment that such impact justifies theory but because of our desire to meaningfully contribute to the world—not simply scholarship about the world (Barab, Thomas, Dodge, Carteaux, & Tuzun, in press). In the words of Marx (1845/1967, p. 400), “The philosophers have only interpreted the world, in various ways; the point is to change it.”

A Personal Journey

In light of these posed distinctions and this description of design-based research, let me return to my personal trajectory. Although my doctoral preparation was that of an educational psychologist, due to my prior design-based research, I was hired as an assistant professor in the Instructional Systems Technology (IST) program at Indiana University. Over the first two years, I engaged in a number of design-based research projects so as to test particular theoretical conjectures centered on situated cognition and constructivism. During this period I worked with a number of doctoral students who were prepared in the core classes of instructional systems technology. These students clearly had a knowledge base with which I was unfamiliar and helped to develop a fertile design context to research particular theoretical suppositions. While some of my students informally integrated instructional design principles in this work, by and large, it was informal and made little impact in my thinking about design. In fact, prepared as an educational psychologist, or what I now refer to as a learning scientist, I would not pass the general qualifications exam of the department in which I was employed. In general, this was treated as a strength in that I brought a fresh and perhaps useful perspective to the department for the preparation of doctoral students. However, I still felt like an outsider to the instructional systems technology field. I would present papers at the International Conference of the Learning Sciences and the American Educational Research Association, while most of my colleagues presented at the Association for Educational Communications and Technology conference. Although I built things for learning, I did so with the goals of a learning scientist focused on advancing theory and not as an instructional designer focused on articulating a design process or simply producing a useful design.

Three years into my faculty position I became the principal investigator of a fairly large National Science Foundation grant focused on the design of an online community to support teacher inquiry. My doctoral students in this venture were primarily instructional systems technology students and, given the scale of what we were developing, it was important that we used a process for its development. In contrast to my situated and frequently idiosyncratic process, we chose to use a process akin to the ADDIE (analysis, design, development, implementation, evaluation) model. It was my first experience at employing prescriptive models. In fact, previously I had prided myself on my rich descriptive accounts that were not meant to be overly presumptuous or to advance over-generalizations. My focus was to go and build things and share rich descriptions, tying my discussion and assertions to

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the literature and trying to present things in a way that would have experience-distant relevance but not that advanced prescriptive claims. As a situationist theorist, I was very careful to honor local dynamics, but as a member of my field I also worked to situate these discussions in the field more broadly in hopes that my research would benefit other researchers working in similar environments. I offer this as another distinction between instructional design and learning sciences; that is, whereas the former is comfortable advancing prescriptive theories, the latter prefers descriptive accounts, which, over time can be reflected on in a manner so as to advance a particular theory.

Returning to my story and this particular design project, these students brought an appreciation for usability and implementation that was not as fully addressed in my previous work or by the learning sciences field more generally. I also think that the development process used was in part responsible for the practical success of this work. This derives in part from the applied beginnings that drove the development of the instructional design field. That is, whereas learning scientists were concerned with advancing theory, instructional designers were focused on helping people accomplish tasks more efficiently. This applied focus has led the instructional design field to have a richer understanding of the challenges of implementation. In fact, at one National Science Foundation Principal Investigator meeting I attended, the program officers expressed concern with what they characterized as “boutique projects,” referring to funded design projects that were good for researcher vitas but did not have any wide-scale impact. In contrast, the instructional design field was very concerned with usability, implementation, and adoption issues, of which they even had a specialized language for discussing the process of diffusion.

Using these design strategies, we managed to develop a useful Website (see http://ilf.crlt.indiana.edu) that currently has thousands of members, and the project has continued beyond the life of funding due to the value of the design to the School of Education where I have worked. We also developed and published numerous manuscripts that focused on the implications in terms of community of practice theory (see, for example, Barab, Makinster, Moore, Cunningham, & the ILF Design Team, 2001). In fact, from my perspective as a learning scientist, it was this rich understanding of these challenges that was the core focus of this work. However, as an instructional designer, the process of design was also of interest and I published articles that focused on the designed artifact as well as the challenges in building it. So as not to advance an artificial distinction, it is important to note that there was much overlap in the various manuscripts in that I was not talking about design in a vacuum but the challenges of design with respect to issues of sociability and in terms of supporting something like community. Also, when I talked about theoretical advances, I was not simply writing about disembodied conjectures but about my perspectives on communities of practice with respect to my design work.

Non-traditional/Participatory Design

Reflecting on the last three years and my experience with another design project, I would like to make one final point. This other project was again funded by the National Science Foundation but was targeted towards 3rd through 6th graders as opposed to adults (Barab, Thomas, Dodge, Carteaux, & Tuzun, in press). My experience in the previous project was that although we designed a useful environment for supporting learning, its success was primarily in the classroom context, where participation was mandatory. In this latter project, our work was much more akin to notions of participatory design and evolved in a haphazard fashion more akin to the working of a bazaar rather than the development of a cathedral. Over a two-year period, we managed to get a powerful teaching and learning system together of which there are now over 3000 members (see http://atlantis.crlt.indiana.edu). In fact, we are getting glowing praises from teachers, principals, parents, and especially those kids actively using the system. Learning from my previous work and having a richer appreciation of the challenges of implementation, this project evolved in a participatory fashion with participants contributing to the continual design. In contrast to my previous work, in which we worked hard to get voluntarily participation and in which there were almost no usability issues, this latter system was more unstable, changed weekly, yet had more voluntary participation than we could research and support. It is in this way that my work departed from previous instructional design theory and adopted a more participatory model.

While this latter system is a successful design project, it has not followed traditional instructional design models. An adage comes to mind: If you like politics and sausage, don’t ask how they are made. Instructional design work, however, is frequently depicted and implemented using “arrows and boxes” that are intended to represent some systematic design process. In contrast, one would rarely find arrows and boxes depicting learning sciences research. I would argue that design work, like current understandings of cognition, is much more situated and emergent than can be represented using a pre-defined process—especially when the goal is to support human-human interactions as mediated by technology and not simply human-computer interactions. While this belief in a situated and emergent process is consistent with both learning scientists discussing cognition and instructional designers discussing design work, it is much
more common among learning scientists than instructional designers—even those who adopt participatory frameworks. Design models are useful, but they do not explain the entire process, and I have found that successful design work involves stepping into contextual dynamics, collaborating with participants, and responding opportunistically to situational constraints as they reveal themselves. As such, I believe that the instructional design field would benefit from the sharing of more design stories that highlight successes and failures, providing illuminative accounts of the struggles and nuances of implementing design in context.

**Conclusion**

When it comes to understanding theory in context, learning scientists may be even more culpable. There has long been a frustration within IST over the utility of educational and cognitive psychological principles that have historically been derived in laboratory contexts. Even when learning scientists work in more naturalistic contexts, and given their appreciation for understanding cognition in context, there tends to be a focus on examining only one or two implementation contexts; thus, supporting the generation of theory but not necessarily the wide-spread diffusion of products or even transferable theory. For this reason, learning scientists could learn much from the instructional systems technology field and their appreciation for usability and implementation challenges, as well as their experience in supporting widespread diffusion. However, both fields could benefit from more nuanced stories of successful and failed implementation. Well-articulated stories that maintain what anthropologist Clifford Geertz (1976) referred to as experience-near meaning at the same time offering experience-distant significance can provide much guidance for others involved in the design process.

In my own trajectory, I have found the learning scientist's explicit focus on understanding learning and advancing learning theory to be more akin to my end goals. Further, I think as a field the learning sciences tend to be more current in terms of situated theories of learning and to be more directly involved in K–12 schools—where my interests most directly lie. I also find the field and community of learning sciences to be more eclectic and open to change in that they draw from a wealth of literature and tend to rely more on peer-reviewed articles grounded in empirical accounts than prescriptive theories presented in books. I think this level of accountability necessitates that the learning sciences field continues to grow and does so based on evidence-based claims derived from scientific studies on learning. In contrast, I think that as a field the instructional design field has become somewhat “insider” focused, and its adherents are not necessarily making links to current thinking and policy issues outside of their own core thinkers—links that are necessary for an applied science to stay healthy (see Reigeluth, 1999, for an exception in that his edited volume is an instructional design book that includes many ‘learning sciences’ researchers who would probably not pass an instructional design qualification examination). With that said, in terms of practical significance, I have learned much from the instructional design field and am confident that my work would not have progressed in the manner it has if it were not for the opportunity I have had to stand on the shoulders of academics located in both camps.

I see individuals from both camps focusing on supporting learning, with instructional designers having much to teach me about process, and learning scientists having much to teach me about testing theoretical assumptions and about embracing change. I consider myself both an instructional designer and a learning scientist. I am indebted to both the previous work of instructional designers and of learning scientists in that both have contributed much to my thinking and my work. More dialogue between these two fields will allow us to develop generative frameworks for understanding learning and developing artifacts and systems with greater power for transforming learning. Design-based research as an emerging methodological framework has the potential to bring together both groups of researchers, serving a useful bridging function so that we can more readily develop theory and design that will have practical significance in the world.

**References**


Dede, C. (in press). If design-based research is the answer, what is the question? To appear in *Journal of the Learning Sciences*.


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### Instructional Systems and Learning Sciences: When Universes Collide

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#### Introduction

In 1992, I was one of seven students to enter a new program at Northwestern University called the Learning Sciences (LS). At the time, few of us really understood what it meant to be a “Learning Scientist.” We weren’t alone: We soon learned that our faculty (and researchers at other institutions) had vague ideas about our futures, how we would be trained to create a new disciplinary area around designing and studying artifacts for cognition and learning.

At some point, this fledgling field became bigger than Northwestern’s program, spawning a respected journal (*The Journal of the Learning Sciences*), a conference (*The International Conference on the Learning Sciences*), and, most recently, *The International Society for the Learning Sciences*. I believe Northwestern is still the only university with an operational Learning Sciences program, but the community has expanded to include instructional designers, educational psychologists, cognitive scientists, anthropologists, and computer scientists at other institutions.

Strangely enough, there is another field that does similar research and development, the “parallel universe” known as instructional systems design (ISD). As a student, I knew that this other universe existed and

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