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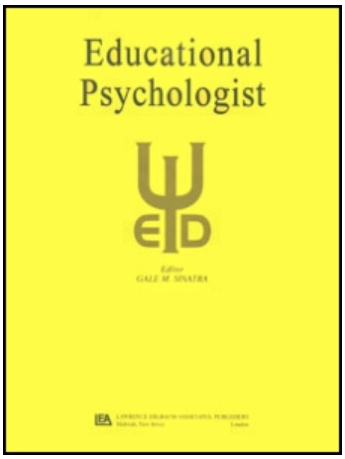

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Design-Based Research Methods for Studying Learning in Context: Introduction

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Design-Based Research Methods for Studying Learning in Context: Introduction

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The field of psychology has a long history of interaction with education, and educational psychology has had a profound impact on how issues of learning have been framed and studied in educational contexts. Still, it has never been simple to translate theoretical insights into educational practice. Educational psychology has been criticized for not creating "usable knowledge" (Lagemann, 2002). Currently, educational researchers generally have been pushed to justify how their claims are "scientific" and "evidence-based" (National Research Council, 2002). There is a tension between the desire for locally usable knowledge on the one hand and scientifically sound, generalizable knowledge on the other. Lagemann, for example, argued that the traditional paradigm of psychology has striven for experimental control at the expense of fidelity to learning as it actually occurs. Thus, although such claims might be scientific in one sense, they do not adequately explain or predict the phenomena they purport to address. This critique extends the long-standing debate surrounding the ecological validity of well-defined psychological tasks and their relation to psychological phenomena as they come to occur in everyday settings (Brunswik, 1943; Lewin, 1943). As a field, we still lack an adequate methodological reconciliation that attends to issues of both experimental control and ecological validity. At the same time, there is considerable unease with the perceived "credibility gap" (Levin & O'Donnell, 1999) of much of educational research because it is not produced with what are considered to be scientific methods. From this perspective, the knowledge from educational research has limited usability because it is not trustworthy.

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An educational psychology that is both usable in a practical sense and scientifically trustworthy cannot proceed without directly studying the phenomena it hopes to explain in its inherent messiness. A little over a decade ago, Brown (1992) described her evolving approach to "design experimentation" as an effort to bridge laboratory studies of learning with studies of complex instructional interventions based on such insights. She showed how insights from the laboratory were inherently limited in their ability to explain or predict learning in the classroom. The challenge, as she saw it, was to develop a methodology of experimenting with intervention designs in situ to develop theories of learning (and teaching) that accounted for the multiple interactions of people acting in a complex social setting. At the same time, Collins (1992) was putting forth a notion of educational research as a "design science," like aerospace engineering, that required a methodology to systematically test design variants for effectiveness. Achieving such a design science, however, requires a sufficient understanding of the underlying variables at all relevant layers of a complex social system (schooling)—an understanding that we do not yet have (Collins, Joseph, & Bielaczyc, 2004).

The last 12 years have seen an increasing uptake of the design experimentation methodology, so much so that a recent handbook on research in math and science education is replete with examples and formulations of the approach (Kelly & Lesh, 2000). The general approach has been called by many names. We have settled on the term *design-based research* over the other commonly used phrases "design experimentation," which connotes a specific form of controlled experimentation that does not capture the breadth of the approach, or "design research," which is too easily confused with research design and other efforts in design fields that lack in situ research components. The approach to research described in this issue is design based in that it is theoreti-

cally framed, empirical research of learning and teaching based on particular designs for instruction. Design-based research simultaneously pursues the goals of developing effective learning environments and using such environments as natural laboratories to study learning and teaching. On the research side of the endeavor, design-based researchers draw from multiple disciplines, including developmental psychology, cognitive science, learning sciences, anthropology, and sociology. On the design side of the work, researchers draw from the fields of computer science, curriculum theory, instructional design, and teacher education.

Since Brown's and Collins' influential works, the paradigm has evolved primarily as a means for studying innovative learning environments, often including new educational technologies or other complex approaches, in classroom settings. As this form of interventionist research has spread, questions have emerged for which there are not yet clear answers. What exactly counts as design-based research? What kinds of knowledge can design-based research produce? What standards do, or should, exist to judge the quality of design-based research? Such questions are being asked by both practitioners of the approach and observers of educational research (see Kelly, 2003). The articles in this special issue of *Educational Psychologist* extend recent discussions of these questions, both to situate design-based research within a broader context of research on learning and to continue a needed conversation on the nature of design-based research specifically and useful forms of educational research generally.

The articles in this set arise from work supported by an Advanced Studies Institute grant from the Spencer Foundation to a group of early career researchers trained in design-based research methods. Each article in the set addresses various aspects of one central question: How does the effort to design complex interventions influence research? The effort to design complex interventions raises a set of methodological and theoretical issues. One of the most commonly faced methodological issues in design-based research is the tension between making an intervention "work" in a complex setting, which often necessitates changing the intervention as it unfolds (in a way that directly mirrors the dynamic, contingent nature of decision making during teaching), with the researchers' need for empirical control, which argues against changing the planned "treatment." The general issue this raises is one of causal attribution: What makes a particular intervention successful in a particular place? How can what is learned from a particular success be generalized? It has been argued that design-based research can develop different kinds of knowledge, including better theoretical understanding of the learning phenomena addressed by an intervention and knowledge of useful and generalizable design practices (Design-Based Research Collective, 2003; Edelson, 2002). The set of articles in this issue describe how the design-based research methodology can produce such knowledge by raising issues that arise from the influence of design on research and how design-based researchers try to address them.

Hoadley begins by framing perhaps the central issue of any research—the basis on which claims can be warranted. He discusses how the interplay between designing and then studying interventions in naturalistic settings can lead to "methodological alignment." As initially unpredicted observations arise among predicted ones, a design-based research team's methodological approach changes with developing theoretical knowledge, leading to intervention designs that are better fit to their intended setting and to better explanations of how they work. Hoadley frames this notion of methodological alignment in comparison to typical experimental and quasi-experimental designs of educational psychology to separate the methodological threats to validity and reliability faced by any research approach from the issues that specifically face design-based researchers.

Following this are three articles that each take a different slice on how design-based research can contribute to theoretical understanding of learning in complex settings. Each of the articles by Sandoval, Tabak, and Joseph reveal how the design of complex interventions is an explicitly theory-driven activity. Sandoval introduces the notion of "embodied conjectures" to characterize how instructional designs materially embody theoretical conjectures about how people learn. They therefore carry expectations about how designs should function in a setting, and tracing how such expectations are met or unmet can refine the underlying theoretical conjecture. Through a retrospective analysis, he argues that an important way of increasing the rigor of design-based research is for researchers to explicitly map the embodiment of particular conjectures through their design reification and to then design research studies to specifically tests the predictions that result. Such predictions pertain to both outcomes expected from the intervention and ways in which designed scaffolds are expected to function. The need to link outcomes to these expected functions across research iterations is the source of power from this analytic approach.

Tabak considers the theoretical and methodological tensions that arise when complex interventions are introduced into classroom settings. She describes how intangible aspects of interventions, such as designs for particular forms of classroom discussions, blur the boundaries between the intervention and what is typically thought of as "the context." Rather than consider such a blurring as only a disadvantage, Tabak argues that attention to such emergent activity structures is a key element of design-based research and can contribute to the development of theories of contextualization. Her argument is an explicit bridge between psychological perspectives that would, under the guise of experimental control, generally ignore aspects of context outside of the perceived intervention treatment and anthropological views of context that do not attempt to distinguish between "native" and designed features.

Joseph describes how the complexity involved in developing a novel instructional approach and trying to understand its enactment and potential benefits forced choices about which aspects of the intervention became the focus of

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research and which aspects were just "engineered" to work in the immediate setting. This is a common occurrence during design-based research efforts, and such choices arise somewhat unpredictably from the setting of an intervention. Joseph describes how such choices can be theoretically guided and thus contribute to theoretical refinement. In her case, the effort to design an interest-based curriculum for elementary students exposed the limitations to current theoretical ideas of motivation and interest and led to the development of a framework for conceptualizing interest in a "usable" way.

Bell ends the article set by laying out what he refers to as the "grammar and epistemology" of design-based research. In surveying design-based research efforts from the last decade, Bell identifies several variations of the methodology that differ in their theoretical perspective and argues that these differences in underlying theoretical position lead to epistemological differences in the kinds of claims that design-based researchers might try to make and the bases on which they warrant such claims. He argues for the importance of recognizing design-based research as encompassing this variety of theoretical and epistemological perspectives, to both better understand just what design-based research is (or might be) and clarify how design efforts can be better tied to theoretical and methodological considerations. In the end, he argues against a singular definition of what might constitute "scientific" design-based research and for a theoretical, and hence methodological, pluralism to efforts that seek to understand learning and influence educational practice.

In her commentary, O'Donnell considers the methodological issues and approaches sketched by the article set in terms of ideas of quasi-experimental and experimental research design. She critically examines the assumptions about design-based research behind each article and pushes on methodological issues that remain outstanding and hence a threat to the promise of design-based research.

As a collection, these articles depict the unique, evolving, and expanding role of design-based approaches to educational inquiry. They also highlight the pressing issues and future directions currently facing researchers making use of this methodological orientation. We believe that by bringing some much-needed clarity around the nature of design-based research to the broader readership of *Educational Psychologist,* it will fuel productive discussions of research methodology and modes of inquiry currently appropriate for the study of learning.

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