Education as Design for Learning: A Model for Integrating Education Inquiry Across Research Traditions

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Abstract/Executive Summary

How can we see education research as a coherent body of inquiry? The naturally occurring diversity of epistemologies and methods give education research the appearance of discord. In this paper, we propose that all of these various methods, questions, and interpretive frameworks of education research share a common commitment to the idea that *education is design for learning.* We begin with a discussion of how recent efforts at the global and national policy levels have sought to position scientific inquiry as the premiere version of education research based on the model of social sciences. We then discuss the role of practical inquiry as a necessary complement to both receive and generate positivist knowledge. The iteration between scientific and practical inquiry describes a path for how scientific and practical work can be naturally linked in an iterative inquiry for improving education processes and outcomes. However, without a critical perspective, this iterative process can become detached from valued social concerns and become an exercise in optimization, rather than improvement. We propose that critical inquiry should be systemically integrated into the design process for researchers and educators to reflect on both the intentions and consequences of the scientific-practical cycle. We then describe how integrating these approaches can show the way toward to a coherent model of education research.

Keywords: education research, design for learning, scientific inquiry, practical inquiry, critical inquiry

Education as Design for Learning:
A Model for Integrating Education Inquiry Across Research Traditions

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Education research has an astounding diversity of methods for inquiry and ways of knowing. Education researchers have eagerly adapted methods and ideas from across the social sciences and humanities to understand and improve the complex conditions for teaching and learning within and outside of schools. The abundance of epistemologies, methods, and fields of investigation employed indicates a vibrant culture of professional inquiry. The promise of education as a pathway to opportunity and social justice continues to spark widespread investment, policy development and advances in practice from around the world. This growing interest in the leading engine of social improvement has resulted in a corresponding increase in the number of scholars drawn to study education. In the United States alone there has been a 65% increase in the number of education Ph.D.'s awarded between 2000–2015.[2] This burgeoning growth in education research indicates the robust interest in the field.

Yet, even as education departments continue to flourish and expand, many are troubled by the perceived lack of agreement on what counts as high-quality research. Critics deride "educationists" who work in "diploma mills" for the lack of rigor in their inquiry and for the quality of their professional preparation programs (Feuer, Towne, & Shavelson, 2002; Levine, 2005). Some researchers have situated the "problem" of educational research in the institutional and political culture of education schools (Clifford & Guthrie, 1988; Powell, 1980). Schools of education are characterized as the "butt of jokes in the university" and portrayed as "intellectual wastelands" (Labaree, 2006, p. 3).

Lagemann (2000) locates the origins of the fractured identity of educational research in the early history of the field. She argues that efforts to achieve respect for this novel field of study led early educational researchers to "emulate their brethren in the "hard" sciences (or at least the

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[2] U.S. Department of Education, Degrees in education conferred by degree-granting institutions, by level of degree and sex of student: Selected years, 1949–50 through 2006–07 (Table 303). http://www.nces.ed.gov/programs/digest/d08/tables/dt08_303.asp; and Table 318.30 Bachelor's, master's, and doctor's degrees conferred by postsecondary institutions, by sex of student and discipline division: 2014-15. *https://nces.ed.gov/programs/digest/d16/tables/dt16_318.30.asp?current=yes*

more developed social sciences)" (p. xii). Educational researchers latched onto prevailing standards of academic quality in other fields in order to legitimize their own work. The search for respect was compounded, according to Lagemann, by the perceived lower status of people attracted to the field of educational research, which fueled the field's quest for legitimacy both in higher education and with the public. Labaree (2006) notes that schools of education historically addressed the needs of academically stigmatized populations such as women, children, teachers, and the working class. The work of these groups, who were often excluded from traditional higher education pathways, reinforced a diminished status for education research compared to other fields of inquiry. The need to apply theory to real, complex practices of teaching and learning made education research too applied to be accepted as legitimate theory; the need to belong to a community of higher education made the work too abstract for many practitioners to readily use. The low status attributed to education research, from both inside and outside the profession, has led public leaders to bypass education research in the resolution of legal disputes, in policymaking discussions, or local school governance issues in favor of experts in disciplines outside of education.

The status of education research and schools of education has led to much soul searching. Some writers have attempted to draw out the defining characteristics of the field in terms of research that is truly educational (Ball & Forzani, 2007); others have pushed the discourse toward defining research in terms of what counts as scientific in other fields (Feuer et al., 2002; Slavin, 2002). Still others draw on a critical tradition that seeks to cast the effects of education into appropriate social, political, and economic contexts (e.g., Apple, 2010; Giroux, 2009; Popkewitz, 2007). The multivocal expression of education research has led to an uneasy state of affairs in which advocates of disciplinary fidelity within education zealously enforce perceived standards of methodological rigor while at the same time questioning the legitimacy of rivals dedicated to alternative approaches. The quest for legitimacy has distracted educational researchers from "pondering what distinctive characteristics might compromise rigor and relevance in this particular domain of scholarship" (Lagemann, 2000, p. xii). The rhetoric of failure, compromise, critique, and lack of quality and prestige pervades arguments for legitimacy.

Diversity, however, should not be seen as a symptom of discord, dysfunction and dismissal. Instead, the abundance of interests and methodological variation are the signs of an exciting new area for systemic inquiry. How can we, as researchers and educators, build on this organic diversity of approaches and methods to develop a shared research enterprise? This is the situation we consider in this paper. We propose that all of these various methods, questions, and interpretive frameworks of education research share a common commitment to the idea that *education is design for learning.* The three key concepts in our formula are education, design and learning. "Education" and "learning" are related terms; they are not, however, synonymous. *Learning* is a natural human process that happens as people interact with the world and one another. We are always learning, whether or not we are learning what others want us to. Education is a process of creating social, institutional or linguistic arrangements to guide learning toward certain outcomes. Schooling is the most recognizable form of education. Schools are formed when a social group seeks to orchestrate the natural process of learning toward the

mastery of certain content and skills. However, education can also unfold in informal contexts. Jean Lave's classic studies of learning in the apprenticeship of Gola and Vai tailors in Liberia (Lave & Wenger, 1991), or how learning is structured in video game and Internet cultures (Jenkins, Purushotma, Clinton, Weigel, & Robison, 2007), show how non-institutional, informal social arrangements guide learners to develop skills and, in turn, become teachers of others. Education uses social and knowledge resources to focus learners toward valued outcomes.

The new aspect of our formula is the concept of design. We think of education's intentional directing of learning toward certain skills and disposition as the activity of *design*. Design typically involves a plan to create something as well as the action taken to bring something new into the world. Education happens when people design learning opportunities for others. In the early days of education, community elders designed environments to teach important cultural knowledge and skills to the next generation. Gradually, a professional class of educators took on this role and designed school learning environments that included teachers, material resources, curricula, assessments and spaces to guide learning toward valued social outcomes. Formal and informal learning communities similarly orchestrate people, knowledge, social interaction and assessment to direct learning. These environments are *designed* in an effort to ensure that certain outcomes—personal or communal—are achieved. Education is the process of designing formal structures and informal norms and routines to transform learning "in the wild" toward desired learning outcomes or dispositions.

Following this logic, if education is the design for learning, then education research can be seen as the *study* of the design for learning. Instead of treating the efforts of education researchers as wildly divergent and incompatible quests, a design for learning perspective corrals the diverse methods of inquiry in education into the study of how people build, test, assess and critique processes intended to guide learning. In the sections that follow, we argue that by using the organizing metaphor of education as design for learning, we can categorize most approaches to education research efforts into three types:

- *Scientific* inquiry measures the effects of education designs on schools, communities, teachers and, most importantly, learners;

- *Practical* inquiry studies how new designs fit into and shape everyday work, and leads to the design of new interventions, practices and policies, to guide education;

- *Critical* inquiry creates critical knowledge about the gap between design and reality through historical, social, economic, or political frameworks in order to reveal hidden, and often unintended features of new designs.

In an ideal world, each type of research would reinforce the work of the others. Practical knowledge would study the current context of practice and give rise to new designs for learning. Scientific inquiry would measure the results of new designs and would generate data to inform implementation and re-design. Critique would study the fit between education designs and

valued moral and practical principles. Together, these components could create a powerful practical, theoretical and scientific discipline of education inquiry. However, the reality of our fragmented world of education research is that each type of inquiry positions itself as at odds with the other two, resulting in a discordant world in which researchers have great difficulty communicating the validity of their methods and results outside their own communities.

This paper provides a brief overview of each type of education research. We begin with a discussion of how recent efforts at the global and national policy levels have sought to position scientific inquiry as the premiere version of education research based on the model of social sciences. We then discuss the role of practical inquiry as a necessary complement to both receive and generate positivist knowledge. The iteration between scientific and practical inquiry describes a path for how scientific and practical work can be naturally linked in an iterative inquiry for improving education processes and outcomes. However, without a critical perspective, this iterative process can become detached from valued social concerns and become an exercise in optimization, rather than improvement. We propose that critical inquiry should be systemically integrated into the design process for researchers and educators to reflect on both the intentions and consequences of the scientific-practical cycle. We will describe how integrating these approaches can show the way toward to a pathway for systemic innovation in the design of learning environments.

The challenge we consider is how education research can be committed to a shared metaphor of design for learning. We suggest that the seemingly mutually exclusive approaches to education inquiry often presented in the literature might in fact serve as countervailing movements in an iterative design discourse of education research. The scope of this paper is too modest, though, to attempt a representative overview of all topical domains of education research. Many of the examples are chosen from recent debates on the relation among standards, high-stakes testing, and school accountability policies. We realize that this choice limits the range of examples we will use to illustrate our points, but we hope that the resulting discussion provides a sketch of how the streams of education research might work together as a unified approach to education inquiry.

Scientific Inquiry

Scientific inquiry aims to improve the quality of education research by developing methods and practices modeled on quantitative social sciences. Scientific researchers create research designs to measure the causal relation between factors that lead to outcomes. Once causality is determined, scientific researchers try to capture the conditions that lead to the implementation of interventions that produce desired outcomes at scale. They also seek to document how the environmental context influences the implementation of interventions (Duncan & Murnane, 2011). Policymakers have made remarkable progress with defining this form of research as the gold standard for educational inquiry by supporting graduate training in and by privileging this form of inquiry as the legitimate voice of education research.

The role of scientific research is to conduct rigorous studies that produce and disseminate evidence of programs and practices that work across variations in context (Feuer et al., 2002). Scientific research focuses on producing predictable, reliable knowledge to guide the work of educators and policymakers. From the scientific research perspective, education is a process designed to produce specified learning and behavioral outcomes. A typical approach to scientific research is to implement an intervention in multiple contexts, and then compare the results of the intervention with a control group to determine intervention effects (Mosteller & Boruch, 2002). This kind of research documents the degree to which established (and novel) processes actually produce outcomes. These types of studies can nominate certain programs for inclusion in sites such as the What Works Clearing House (https://ies.ed.gov/ncee/wwc/) as a way for educators to identify high-quality designs for learning.

Scientific research can also examine the inability of education designs to produce desired outcomes. Scientific research in education is typically paired with a moral imperative to create systems that provide opportunities to learn for all students and families. Studying the disparities of outcomes across education systems, specifically in areas of race and income, provides a compelling moral context for this form of education research. Researchers can discover that local actors lack high-quality knowledge to guide the selection and implementation of programs to improve outcomes. In other cases, education systems lack valuable resources, such as curriculum materials, assessments, or learning spaces necessary to improve learning outcomes. Sometimes local actors themselves are perceived as lacking the skills or resources to appropriately implement programs to improve learning. A high-quality study will document how a given system fails to produce desired outcomes, and will seek to identify the factors that prevent the promise of the system to be realized.

Scientific research typically requires large datasets to generate sufficient statistical power to justify inferences about program effects. This approach often creates a considerable distance between the researcher and the local context of practice. Researchers work under experimental conditions to create the best, most reliable knowledge on how interventions can result in desired outcomes. Policymakers use this knowledge to develop incentives and consequences to motivate compliance with research-based practices. Local actors establish conditions that ensure appropriate implementation of research-proven programs. Researchers re-enter the picture to measure the *fidelity* of program implementation (i.e., the degree to which leaders established the specified conditions for action). Scientifically guided policy work relies on maximizing the fidelity of implementation by reducing unpredictable variation of local actors to undermine intervention effects (Howe, 2004; Olson & Katz, 2001). Schools and local actors are seen as the site for research, and are valued when they recreate, and do not disrupt, the necessary conditions for appropriate implementation.

In many national education systems, the fidelity imperative is an important guideline for all education practice. Unified education systems select the best curricula, provide appropriate training for educators, create learning environments to optimize implementation, and use complex assessment systems to capture outcomes. While decisions about school management

and classroom learning practices are made by local actors, the role of the governmental agency is to guide educators to comply with recommended practices. This approach requires local educators to select the means (programs, assessments, and practices) deemed necessary to produce mandated ends (educational outcomes). It also seeks to establish a public climate that makes it difficult for local actors to resist recommended practices (Slavin, 2002).

This emphasis on local compliance devalues the discretionary role that local actors can play in the uncertain process of improving teaching and learning. As Richard Elmore (2000) framed the "conundrum" of systemic reform,

> Schools are being asked by elected officials—policy leaders, if you will—to do things they are largely unequipped to do. School leaders are being asked to assume responsibilities they are largely unequipped to assume, and the risks and consequences of failure are high for everyone, but especially high for children. (p. 2)

From a scientific perspective, local compliance is considered as a *theoretical* necessity to produce desired outcomes, but it is difficult to rely upon as a *practical* capacity. When scientific policy interventions urge local actors to abandon established practices in favor of research-proven approaches, a variety of incentives or punishments must be provided to encourage compliance (Schneider & Ingram, 1997; Stone, 2002). From the scientific research perspective, local actors are a troubling source of uncertainty in the effort to produce reliable outcomes for all learners.

Evidence for the pervasiveness of the scientific model is reflected in the contemporary transformation of the "best practices" discourse first into "what works" and, more recently into "evidence-based practice." *Best practices* models emerged in the 1980s to describe techniques that produced good results for educators. Researchers collected and wrote about best practices; professional networks and conferences buzzed with the latest, most interesting best practices that emerged from local contexts to address complex problems. The word *practices* was pluralized to reflect a diversity of options. The best practices perspective assumed that practitioners could select from among appealing practices in a particular domain, and after experimenting, could then contribute a "better" variation on the practice. The advent of the *what works* discourse changed the terms of the relation between interventions and local autonomy. An intervention is only included in the What Works Clearinghouse (http://ies.ed.gov/ncee/wwc/) when it meets the standards of (scientific) scientific evaluation:

> Currently, only well-designed and well-implemented randomized controlled trials are considered strong evidence, while quasi-experimental designs with equating may only meet standards with reservations; evidence standards for regression discontinuity and single-case designs are under development.[3]

[3] https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_procedures_v2_1_standards_handbook.pdf (p. 11)

Scientific research is guided by *a priori* decisions about which kinds of knowledge are relevant to guide practice. The stamp of "what works" or "evidence-based practices" provides a quality assurance for the optimal strategies to achieve teaching and learning outcomes. A best practices approach gathers interventions from local practitioners, and relies on professional communities to continuously test the practices in local contexts. The shift to "what works" and then to "evidence-based practice" uses scientific research to test interventions across contexts to determine which interventions can qualify and how these approaches should be used to obtain predictable results.

The hope for scientific research in education is to bring some measure of predictable quality into the ever-changing context of education practice. Just as medical practitioners are expected to prescribe treatment based on their understanding of the latest academic research, education practitioners are asked to employ field-tested curricula with fidelity. The public expectations for social uplift via education has created a scientific research community focused on finding scalable solutions for improving outcomes for all learners. Both the public and policymakers seek reliable criteria to determine what constitutes high-quality teaching and learning in and out of schools. This struggle to improve schooling in measurable ways is embedded in volatile political struggles over how (and whether) schools can address chronic social and racial inequalities and continue to serve as an engine of economic growth. The scientific perspective frames education research as a technical matter that draws on the rich tradition of social scientific methods to determine the most effective means to achieve agreed-upon learning goals. Scientific research aims to cut through the murky, contested sociocultural issues that cloud discussions of quality in education in order to determine what works for all learners at scale. By defining education as a technical matter of optimizing interventions across contexts, scientific inquiry seeks to define education research as a field that produces the knowledge necessary to guide policy and practice.

Practical Inquiry

A goal of education research is to describe the kinds of knowledge and supports educators use in their practices. Educators design education contexts to improve teaching and learning. Practical inquiry seeks to understand these efforts by describing how educators design environments to meet the needs of teaching and learning. Practical research focuses on how local actors orchestrate education interactions for learning. Practical researchers attend to the ideas and tools that *radiate from* the local context of action. The scientific focus on providing evidence for the quality of interventions does not provide sufficient knowledge or skill to competently establish quality contexts for education (Erickson, 2005; Gee, 2005). The "what works" model fostered by scientific research does not provide sufficient guidance to shape a practical "best practice" world. Because only a small part of education work involves measurement and intervention implementation, practical research must document and support a much wider range of design practices (Erickson & Gutiérrez, 2002).

The idea that practitioners—and learners—mainly serve as threats to the fidelity of implementation has led to the observation that the scientific model adopts a "deficit model" of learners and learning. A deficit model assumes that learners contribute little aside from

compliance to their learning process, and that the goal of teaching is to cultivate knowledge and skills that are absent in the cultures of learners (cf. Moll, 1990; Valencia, 1997). A practical research perspective considers deficit thinking as an inappropriate frame for student learning (Harry & Klingner, 2006; Tejeda, Espinoza, & Gutiérrez, 2003). Scientific inquiry adopts a deficit perspective toward the practices of teachers and school leaders as well (Stein, 2004). It considers the local skills and abilities of educators as noise that needs to be filtered out in order to study the true effects of an intervention. Practical research thus seeks out noise as a signal to trace how teachers and learners navigate the contexts in which the interventions are carried out. When existing practices are treated as noise to be reduced or eliminated so that what works can be properly implemented, we lose the opportunity to track the "funds of knowledge" critical for understanding how learners draw on prior experiences to make sense of new knowledge and skills (González, Moll, & Amanti, 2005).

The goal of practical research is to study how teachers and learners create and navigate learning environments. Practical education research adopts a constructivist perspective on research and design. Constructivist theories of learning suggest that people build new understanding on prior knowledge and experience (Kafai, 2014). From a teaching perspective, if we know what and how learners know, new processes can be shaped to accommodate prior understanding. This constant, iterative interaction among learners, teachers and the context is difficult to capture in the design of an intervention. Implementation, from a practical perspective, is the opportunity to observe how educators and learners select from the different features of an intervention to create a learning connection. Practical researchers begin their work by studying how local teaching and learning practices unfold. A practical perspective suggests that we need better approaches to studying practice *as a necessary condition* for improvement. Practical research is needed to understand why a certain practice is considered as a possibility in a certain context, and why it is not considered on other occasions; why some communities of practitioners rely on a well-established set of organizational routines that another group considers anathema; and how accounts of expert practice can be reframed as possibilities for new approaches. Practical researchers must be able to understand how myriad aspects of discourse and environment "hang together" for local actors, and, more importantly, to trace how learners make their way through complex spaces.

Our category of practical research brings together epistemological and methodological traditions that may not recognize their kinship. Practical research includes many varieties of qualitative research, such as case study (Stake 1995) and ethnography (Van Maanen, 2011). It includes phenomenological studies that document how events and actions actually unfold as well as grounded theory approaches that build theories to describe why actions occur (Denzin & Lincoln, 2011). It also includes quantitative methods, such as latent class analysis (Collins & Lanza, 2010) and machine learning (Bishop, 2006), that document patterns in large datasets. Practical research also includes traditions that build on insights about existing practices to build new approaches to the design of learning environments. For example, design-based research builds artifacts and learning environments to test hypotheses about practice (Design Based Research Collective, 2003), while social design experiments draw on local actors' expertise for

the development of new learning environments (Gutiérrez & Jurow, 2016) and methods such as improvement science (Bryk, et. al. 2015) and usability testing (Nielsen & Mack, 1994) use data generated by design processes to optimize innovations. Each approach shares a commitment to draw on insights about current practices as a pathway to knowledge and design.

Practical research seeks to disclose how actors navigate and alter the specific environments of their practice. A challenge for practical research is to identify the *significant* structures, actors and strategy that matter for improving teaching and learning. Significance, in scientific research, is considered an aspect of the relationship between factors and outcomes—a finding is significant when analysis shows a legitimate connection between the predictor and the outcome. In practical research, significance is a measure of the degree to which actors make sense of their situation. Practical research attempts to capture the contexts, structures, and practices that make local action significant. When researchers enter a vibrant learning environment, they can quickly become overwhelmed with the sheer variety of tools and interactions. Determining which features of the environment are regarded as significant for local actors is an important step in describing relevant practice. Documenting the significant practices/contexts of typical practitioners reveals occasions for authentic pedagogical opportunities to expand local horizons of investigation. Studying what expert practitioners perceive as significant provides insight into which features of local contexts can be highlighted, enhanced, or eliminated, and how best practices mitigate obstacles and find opportunities in contexts that thwart similarly situated colleagues. The challenge for practical research is to identify the *significant* structures, actors, and strategies that matter for improving teaching and learning.

Albert Borgmann's (1984) concept of "focal practices" is useful to illustrate the goal of practical research. Borgmann suggests that we are surrounded by taken-for-granted tools that shape the contexts of our lives. Focal practices are formed of tools-interaction networks that direct our activities toward significant concerns. Borgmann uses examples of everyday focal practices such as running and dining to show how we organize networks of tools and actions to achieve our ends. Focal practices fit practical research because they address how we arrange our tools and the routines and social networks through which we engage in teaching and learning. Because focal practices illustrate how we organize the world to achieve our ends, we can compare how actors organize their worlds around focal practices to highlight the variations in how similarly situated practitioners perceive significance.

Researchers in education have long engaged in methods that seek to capture these kinds of focal practices. Deborah Ball and her colleagues (Ball, Hill, & Bass, 2005; Lampert & Ball, 2005), for example, study how teaching math problems acts as a focal practice to unpack and make public the strategies and prior knowledge teachers bring to bear in their teaching. Julian Orr (1996) takes a similar approach to investigating how Xerox technicians repair machines. Orr uses the "war story" as focal practice to explore how technicians determine and resolve significant aspects of repair problems. Investigations of focal practice phenomena can also be seen in cognitive ethnographies that investigate how local actors use tools and social interaction to create networks of meaning. Hutchins' (1995, 1996) seminal work in distributed cognition, for

example, examines how understanding individual cognition alone is insufficient to explain complex technological tasks.

Research on computer-based cognitive tutors and user testing illustrates another path toward studying focal practices. Design-based educational research generates rich models of existing understanding as a consequence of developing efforts to improve learning. Cognitive tutoring (for an overview, see Koedinger & Corbett, 2006) develops a model of student understanding in order to appropriately customize lessons. While the aim of building tutors is to improve math learning, an important consequence of tutor design is deeper insight into how students organize knowledge and experience prior to intervention. Testing cognitive tutors typically involves some form of *usability testing*, an iterative process that generates data on design quality from the user perspective. Usability testing provides important data to refine intervention design, while at the same time allowing designers to construct powerful cognitive and behaviorist models of how users encounter new tools. In other words, design and usability testing can be used to reveal existing focal practices. Insights generated by usability testing are often regarded as a kind of residuum generated on the way toward the genuine research end (i.e., improvement), and thus rarely reported as research findings. Practical inquiry explores these residual insights of design to uncover the significant characteristics of focal practice.

Borgmann's analysis suggests that identifying focal practices can reveal focal tools, or artifacts, as significant objects that connect us with our world. In education, artifacts serve as mediational means (Wertsch, 1993) designed to influence teaching and learning. In education, local actors use artifacts such as programs, policies, and procedures to create learning environments to improve teaching and learning in schools (Spillane et al., 2004). Artifacts such as curriculum packages, daily schedules, faculty professional development programs, literacy assessments, data warehouse systems, and union agreements can be found in any school context. Artifacts can be received (or inherited) from outside the school context, or can be designed by local actors (Halverson, 2004); they are used to begin, accelerate and assess change processes (Halverson, 2007).

All artifacts are the result of design. Designers build *intentions* into artifacts in the form of *features* that will hopefully guide use. Education artifacts, such as assessments, textbooks and curricula, include features such as prescriptions for practice, resources to support intended use, consequences for appropriate implementation, and suggestions for how to organize practices. For example, educators design master schedules that include features such as assignments for teachers and students, plans to organize space and instructional time, and provisions to allow teachers to engage in collaborative planning. Users, on the other hand, perceive artifact features as *affordances.* Affordances reflect how users make sense of artifact features. In the example above, the master schedule affords teachers knowing where and when to teach, and guidelines for students on how the instructional day is organized. The gap between features as designed and affordances as perceived is where much of implementation research occurs. Users typically read artifact affordances in terms of prior knowledge, experience, and desires. Designed features intended to promote collaboration, such as common planning time to design solutions for shared

problems of practice, invite educators to take care of new idea development in the course of demanding teaching schedules.

Practical research considers how educators and learners navigate learning spaces as the primary unit of analysis. Education, from a practical perspective, is an endlessly iterative interaction between teaching, learning and content orchestrated through diverse and complex learning environments. These environments include material aspects, such as artifacts, and are also irreducibly social interactions of people with varying interests and practices. If scientific research considers education as a delivery mechanism for valued content, practical research considers education as a social process where actors build relationships to support complex communicative action. The goal of practical research is to identify the significant focal practices and artifacts that shape how learning unfolds, and to understand how teachers and learners make sense of their experiences in designed opportunities for learning.

A practical research agenda assumes that, in our continuing search for solutions to the problems of teaching and learning, we have rushed past careful consideration of the actual practices we wish to change. This ignorance is apparent in our knowledge of the everyday practices of educators. In the policy research community, for example, we have many models for how education practices *should* unfold, and equally many detailed accounts of how education practices are hopelessly broken, corrupted or misguided, but we lack adequate knowledge of how teachers actually do their work. A practical research agenda seeks to marshal appropriate qualitative and quantitative research methods to fill in these gaps in our knowledge of leadership practices. Practical models do not seek to supplant scientific work. Instead, practical models seek to provide more detailed descriptions of the world scientific theories of action seek to change.

An early benefit of greater access to practical knowledge may result in more "educative" policies that better anticipate and facilitate the conditions for implementation (Cohen & Barnes, 1993). The real potential for practical research, though, is to generate new approaches to addressing the problems of education that are grounded in the practice of expert educators. Practical narratives of expertise can situate best practices in recognizable contexts so that novices can draw on and extend local knowledge and expertise in change efforts. Generating viable opportunities for change, by exploring how focal practices are situated in expert practices of teaching and learning, can show how education is itself capable of generating models to solve its own problems.

Critical Inquiry

The rich traditions of critical and historical inquiry have long constituted much of the research landscape in education. These traditions resist a totalizing definition of education as design. A critical perspective, for example, casts doubt on the scope and legitimacy of scientific and practical analysis models as the defining characteristics of education research. A design model might merely be the latest in a long list of efforts to technologize education research in order to obscure the underlying social forces at work in contemporary education discourse (cf. Apple, 1996; Giroux, 2009). The scientific-practical reduction of education research to the "objective" selection of proven means and the neutral "description" of existing practice makes it

increasingly easy to marginalize those who continue to investigate the interests such policies serve. Critical race theory, for example, argues that policies typically underplay the role of race in policy artifacts designed to promote economic opportunity, and that the role of the researcher is not to show how the policies can be optimized, but to bring the tacit assumptions and implications of race and equity to light for public consideration (Ladson-Billings & Tate, 1995).

Historical research in education also calls the scientific and practical models of education research into question. Historical inquiry shows how contemporary design efforts can fail in familiar ways. For example, Nelson's (2005) description of how efforts to address issues of equity and learning in the Boston public schools struggled in the 1950s and 1960s serves as a cautionary tale for current federal efforts to influence education in local contexts. Historical inquiry also brings to light the contrast between the assumptions of prior eras to ours. Rudolph (2002), for example, shows how 1960s educators assumed that the power of science (and scientists) to transform our lives could also transform classroom practices. These cultural assumptions seem far away from the contemporary reduction of science learning to literacy development in elementary schools driven by accountability requirements. The rich, evocative contextualization of historical research calls into question the rather mundane proposed reduction of education to a quasi-technical matter of describing how local actors choose means and how researchers measure ends.

These critical and historical perspectives re-introduce a social, political and economic depth missing from the scientific-practical design perspective. Scientific research focuses on the outcome of education interventions; and practical work focuses on describing the context of practice. Critical research helps us to frame the larger social and historical contexts in which education designs are situated. Critical inquiry introduces a *hermeneutic* dimension that situates design and use in a lifeworld. Research uses theoretical frameworks to interpret the assumptions made by designers and to contextualize findings about the effects of interventions. Here we (briefly) highlight three areas where critical hermeneutics deepen our understanding of the "education as design for learning" metaphor: problematizing *intentions*, highlighting the distinction between *features* and *affordances*, and problematizing *outcomes*.

Problematizing Intentions

Critical research problematizes the concept of intentions. Intended uses are inscribed into interventions in the form of directions or incentives to guide proper use. In most cases, though, artifacts are shaped as much by the social context of development as by the designer's intentions. Critical theorists document how common beliefs about the nature and purpose of education, or the desired goals for school systems, are developed through public discourse or through economic and social conditions. Every education design includes unstated intentions shaped by economic and racial epistemologies that are not typically brought to light through scientific and practical research. Nichols and Berliner (2007) for example, develop a counter-narrative that casts doubt on the stated theory of action at work in national high-stakes accountability policies. The traditional design of accountability policies claims that content standards and shared, high-stakes assessments are developed to guide schools toward improving learning for all students and

families. Nichols and Berliner analyze how the tacit linkage of assessment with political and social consequences in the design of accountability policies leads schools toward cheating, narrowing the curriculum, and engaging in test preparation rather than instruction. Their critical perspective demonstrates how the contrary assumptions built into accountability policies undermine their possible success. Critical research excels at exposing the tacit strands of intentionality at work in the education designs.

Textbooks provide another example of how artifacts carry mixed messages about how to shape education. Textbooks explicitly address what needs to be taught and learned and also convey a raft of tacit content about social and cultural expectations of what it means to be a learner (Bernstein, 1990). Critical theorists have long studied the tacit features of curriculum dissemination via textbook publishing and distribution, and have documented a hidden curriculum that enables the reproduction of social and economic status (e.g., Anyon, 1981; Apple, 1988). Further, the traditional characteristics of artifact types can override innovative features intended to shape practice in new ways. While a new series of textbooks might promise to organize disciplinary knowledge in novel ways, its traditional features, such as pagination, static imagery, and mass production, constitute a tacit feature-set of textbooks as status quo knowledge artifacts. New media researchers take a different approach to considering the formal feature-sets of established media by studying how access to learning can be organized in entirely new ways, such as affinity groups (Gee & Hayes, 2010) or participatory cultures (Jenkins et al., 2007). Uncovering the underdeveloped and tacit characteristics of curriculum has proven to be fertile ground for critical inquiry.

Problematizing Outcomes

Critical research also challenges what counts as an outcome. As described above, the measurement of causal inferences from artifacts to effects is a defining characteristic of scientific research. Much debate in scientific research is focused on the methodological issues of ensuring the conditions under which inferences can be drawn from test scores; much of the practical discussion is focused on creating the conditions for appropriate implementation. Critical researchers investigate what test scores actually measure, and whether these measures capture what we mean by education success. Researchers from a variety of traditions have critiqued how statewide standardized tests are used to measure student learning (e.g., Koretz, 2008; Nichols & Berliner, 2007; Noddings, 2007; Ravitch, 2010). Critical researchers critique the relation between the practices of standardized testing and the needs of learners. Nieto (2009), for example, describes how the needs of English language learners can be corrupted by pressures to meet accountability outcomes. Popkewitz (2011) is engaged in a related inquiry about the mismatch between the items used to measure skills in the PISA exam and the actual disciplinary practices in which these skills are rooted. Critical inquiry creates room for reflective re-consideration of the relation between authentic learning contexts, socially valued outcomes, and mandated standards for curriculum and assessment.

At another level, critical arguments examine the legitimacy of using any universal measure of education. This rich tradition of critique is rooted in Dewey's (1915) account of designing

learning environments for student inquiry. Grounding learning in the experience of the learner, rather than the organizational requirements of what needs to be learned, continues to provide a compelling counter-narrative to the standards movement in school reform. Nussbaum (2010), for example, defends the humanities by contending that teaching children to be compassionate can provide a necessary counterweight to the dominance of economic values and the professionalization of education. Murnane and Levy (1997) use economics to present a counter-narrative of "new basic skills" that argues that the kinds of knowledge we currently measure are not appropriate for a digital workplace. Jenkins et al. (2007) argues that "participatory cultures" shift the focus of learning from measurement to authentic engagement with distributed, interest-based communities of practice. Each of these inquiry trajectories problematizes the conventionally accepted narrative of how to measure the quality of education efforts.

Critical research questions the apparent clarity of intentions, outcomes and descriptions offered by scientific and practical research. Surfacing the tacit intentions, unstated features, and unanticipated consequences of design can serve a corrective role in education research. Reflective investigations of the conditions and outcomes of design create a "space" for inquiry, grounded in the experience of current efforts, in which new avenues for investigation can emerge. Historical research provides another dimension for reflection on design by showing how similar (and dissimilar) efforts have unfolded. This can open a reflective space for researchers and practitioners to consider the limits of current efforts and can raise awareness of new ways to design education. Integrating a critical dimension shows education research can serve as a process for understanding current practice and also become a generative source of new possibilities for design.

Education as Design for Learning

We have argued that the pursuit of knowledge around education as design for learning can unify disparate approaches to inquiry in education. While learning happens naturally through everyday interactions, education involves the design of learning environments that aim to achieve specific goals via specific means. Educators use, create, alter, adapt, and ignore artifacts to create systems to support learners to attain specific goals. Scientific inquiry assumes a *positivist* approach to research that emphasizes the application of established social scientific statistical procedures to discern the effects of education designs. Practical inquiry aims for a *phenomenological* approach to how educators design and live in the systems that support everyday work. Critical inquiry provides a *hermeneutic* perspective to situate designs in social, cultural and economic contexts, and generates new ways of understanding the process of education as a whole.

Considering education as design for learning points toward how each tradition can contribute strengths to improving education research as a whole. Let's take the example of research in reading education. Scientific researchers measure which reading program produces the most robust third-grade learning gains across education contexts. Practical researchers report that practitioners struggle to supplement basic curricula with narrative-based lessons that engage students in sense making around content areas. Critical researchers analyze how current reading

assessments reproduce a two-tiered education system in which poor students are taught basic skills while affluent students engage in creative inquiry. A design-based approach can bring each inquiry thread into proper focus. Each research type considers design at a different grain size. Scientific researchers consider the effects of the individual artifact (reading program) on the learner; practical research explores the connection of the given artifact with other tools in the local system of practice. Critical research considers the motivations for implementing basic-skills artifacts in the social system as a whole. Asking each genre of research to consider practice from the perspective of the other would open new kinds of research questions.

A recent large-scale study of Response to Intervention, a widely used set of strategies for differentiating instruction in American schools, found that students in a treatment group had lower reading test scores in some conditions compared to those who receive traditional instruction (Balu et al., 2015). Scientific researchers identified this finding in the context of a large-scale research design. When research traditions work in tandem, practical investigation could explore the conditions under which students learn at the classroom level and could suggest new instructional designs to optimize outcomes. Critical researchers could interrogate whether the outcomes specified by the intervention could ever measure skill development expected from struggling readers, and could speculate on new directions about how we should structure learning environments around engagement or equity. Committing each tradition to a focal practice could help scientific researchers pose new kinds of study designs; challenge practical researchers to problematize their own (often tacitly ideological) assumptions about appropriate educational practices, and push critical researchers to make substantive contributions to new directions for designing everyday practices of teaching and learning.

Currently, education research traditions seem to generate mutually exclusive paths of inquiry. Without a common context for inquiry, we are left with a fragmented, suspicious discourse in which disagreement often devolves into acrimonious questioning of legitimacy. The divergence of traditions leaves each approach unable to address its own deficiencies. The methodological focus of scientific research, for example, can produce carefully measured effects of artifacts irrelevant to actual contexts of practice, and the post hoc focus on measurement of existing artifacts leaves scientific researchers unable to generate the next generation of education innovations. Practical researchers can get lost in describing the intricacy of everyday processes and lose sight of the connection to system effectiveness or the moral context of practice. Critical inquiry can spin off into self-referential communities concerned with incessant internal critique in favor of opportunities to uncover new forms of practice. We suggest that linking divergent approaches to inquiry may not only correct the deficiencies of each research type, but might lead to a wider discourse in which the extraordinary fertility of education research can be generated, implemented, tested, and critiqued at scale.

What is the price of leaving education research in its current fertile yet fragmented state? A massive $4.4 trillion global industry has emerged to produce artifacts that shape learning environments around the world (Strauss, 2013). Companies fund and use research to support claims that their curricula, assessments and technologies produce the outcomes specified by

policymakers. This shadow world of creating knowledge to sell education products dwarfs the funding and influence of academic education research. Our fragmentation, as a field, prevents us from making a difference in how knowledge is produced and circulated to improve education at scale. The people who work hardest to generate insights about the quality and equity of teaching and learning are often left out of the design conversation.

Fortunately, there are important movements occurring within the world of education research to bring knowledge to bear in large-scale design efforts. The Connected Learning alliance, for example, brings together researchers, educators and policymakers to use new media technologies that create distributed learning environments that draw learner interests, build personal relationships, and that support equitable opportunities to learn for all students.[4] Connected Learning uses concepts and methods from design-based research to experiment with how digital technologies can be orchestrated to improve learning (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). Design-based research methods bridge the gap from practical to scientific research by using theory to build interventions that generate rich data on the process and outcomes of learning to refine artifact development. Design-based research systemically tests the fit between theory and practice by positioning educators and learners as co-investigators, comparing multiple innovations, integrating multiple forms of expertise in the design and testing process, and supporting iterative, data-driven product development. (Collins, 1992). Networked improvement communities, for example, use the ideas of improvement science, grounded in design-based research, to create communities of educators and researchers in collaborative design work (Bryk, 2014). Networked improvement communities are being organized around the world to solve problems or practice in community college instruction, creating equitable learning opportunities, personalized learning, and the redesign of special education. These kinds of efforts provide important precedents for a world of education research where scientific, practical and critical inquiry are brought together to inform designs to improve teaching and learning at scale.

We have proposed that putting design at the center of methodologies for education research accomplishes the following: identifies three types of inquiry (scientific, practical, and critical) and outlines how these approaches can contribute toward a common whole. If we can agree on defining education as design for learning, then we might be able to motivate education researchers to understand their work in terms of a broader project. Rather than lead with methods (for example, hierarchical linear modeling, case-studies or ideological critique), we propose that researchers use design as a metaphor to align their work with alternative research traditions. We hope this model can build a conversation about shared enterprises and identify what makes education research a unique field of inquiry. The struggle to improve teaching and learning everywhere, for all learners, distinguishes education research from the social sciences and the humanities. Education researchers would do well to draw upon the work of peers across traditions to build a discipline that will be contribute to our global aspirations for education.

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[4] https://clalliance.org/about-connected-learning/

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