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Foreword from *Design-Based Research in Education*

David Reinking

Foreword

A casual stroll through the history of education research may be an informative backdrop for this welcome book and for contextualizing its contribution to design-based research (DBR). Entwined with that history, and I hope also enlightening to readers, is my personal journey as an education researcher interested in literacy who was attracted to DBR shortly after its origins among education researchers in the early 1990s. These histories, the field's and mine, reveal a rationale and justification for DBR and its place within the current landscape of education research. They also illustrate why DBR continues to attract more researchers, to expand the range of its application, and to continue its steady move into the mainstream of education research.

Historically, the major players and relevant developments of what is now the field of education research emerged at the turn of the 19th and 20th centuries.[1] A young John Dewey was already a central figure. His was the iconic voice of progressive education and American pragmatism, and he wrote prolifically, and with deft clarity, about educational practice and research. To Dewey, there was no separation between practice and research. Knowledge isolated from educational practice was inert. To be useful, he argued, knowledge fluidly evolves from and is absorbed into practice.[2]

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[1] For a more detailed account of the much condensed and simplified historical account here, see Lagemann (2000).

[2] For a detailed explication of Dewey's views of research and practice, see Biesta and Burbules (2003).

In his early years at the University of Chicago, Dewey was given the reins of the University's laboratory school along with his wife, Alice, who served as a teacher and principal. The school became a testing ground for their progressive vision of child-centered instruction and their commitment to instilling democratic ideals. Historical accounts suggest that these lofty ideals met the hard realities of day-to-day instruction, and the school was not an unmitigated success. Yet, confronting the inevitable challenges of implementing their vision no doubt honed Dewey's thinking and understanding, as did his close professional relationships with the laboratory school's teachers. Throughout his career, for Dewey, practice was research, and research was practice.

Moving to Teachers College, Columbia University in 1904, where he would remain a professor of philosophy until his retirement almost three decades later, Dewey walked the same hallways with another iconic figure in education research: Edward L. Thorndike. Thorndike, though younger, was already an accomplished scholar when Dewey arrived. He was well on his way to making a name for himself as a psychologist interested in education, and his accomplishments during a long career have led many to identify him as the founder of educational psychology.

But his views about research's role in education and its practice couldn't have been more different from Dewey's. Research in education, Thorndike argued, should be scientific and modeled after the experimental research and statistical analyses in the physical sciences and in basic psychological research. Scientific studies, conducted in a laboratory under carefully controlled conditions gathering quantitative data analyzed statistically, would, he believed, provide scientific guidance for educational practice. Furthermore, he argued, education research and scholarship would not be taken seriously until it adopted a scientific approach—a point of view that some contemporary critics have characterized pejoratively as "physics envy." Regrettably, Thorndike was also an elitist who saw researchers (then, invariably white men) as intellectually superior, and teachers of children (then, invariably women) as lower-level technicians who should follow the dictates of psychological research.[3] He is also reported to have advised his doctoral students that they should not waste their time in schools. A laboratory was their professional home.

As any education researcher of my generation knows, Thorndike's views triumphed over Dewey's for decades,[4] although not entirely intact. Like others pursuing a PhD in education during the early 1980s, my doctoral program was designed to prepare (one might even say indoctrinate) me to become a researcher in the

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[3] In July 2020, Thorndike Hall at Columbia University, named 50 years ago to commemorate his accomplishments, was renamed because of his support of eugenics and his racist, sexist, and anti-Semitic views (see *www.tc.columbia.edu/articles/2020/july/important-announcement-from-the-president—chair-of-the-board-of-trustees*).

[4] Due in some measure to the fact that his son (Robert L.) and grandson (Robert M.) followed in his footsteps, keeping his legacy alive.

scientific mold Thorndike envisioned, but with some key differences. There was an increasing number of women professors and doctoral students, most of us had been classroom teachers, and we at least occasionally did research in schools. Consequently, like my fellow doctoral students, I enrolled in a bevy of courses on statistics, experimental design, and assessment. We didn't always work literally in laboratories (although, as a research assistant, one of my responsibilities was to use sophisticated equipment that collected eye-movement data while "subjects" read texts), but the laboratory was metaphorically how my professors and fellow students approached education research, even in schools. And, I must confess that I was developing a professional aloofness that made me even more an interloper in the classrooms that I *used* for my research. For the first 10 years or so of my career as a university professor and researcher, I dutifully embraced that paradigm with enough success to receive tenure and eventually promotion to the rank of professor.

Then, as occasionally happens when one obtains that level of professional security, and presumably maturity, I began to reflect more deeply on the research methods I had been taught and had used. One event, in particular, was akin to a conversion experience. A conventional experiment I was conducting in a middle school with several doctoral students went disappointingly awry. For example, just before we were to initiate the intervention into a treatment classroom, the school principal decided to move a cohort of academically challenged students into the class. That decision made perfect sense because the teacher was one of the most experienced and successful teachers in the school. But it was disturbingly problematic for our experimental design and statistical analysis. Then, during the intervention, when teachers in the control classrooms decided that the treatment intervention was too appealing to resist, they decided to do it as well, which also undermined the scientific integrity of our experiment.

But, the moment of conversion came during a debriefing with the doctoral students, essentially a "wake" for our failed experiment. During the discussion, we discovered that we had learned much about our intervention, just not in quantifiable terms that could fit reliably into our statistical analysis. For example, it seemed significant that the teachers in the control condition couldn't wait to use it. Then, one of the doctoral students said something I'll never forget. Offered in a spirit of consolation, the student said, "The problem is that the teacher is a nuisance variable." We all paused and looked at each other. That was true in an experimental, statistical sense, but it seemed irreverent. We had all been teachers. Did we conceptualize our former classroom teaching lives that way? What did it say about our research if a teacher was in any sense a nuisance? Shortly thereafter, I read an article in *Educational Researcher* (Newman, 1990) that resonated perfectly with the intellectual and emotional turmoil I was starting to feel. It was my introduction to DBR. But, more history is needed to fully grasp DBR's unique niche in the landscape of education research and why I was attracted to it.

The conceptual appearance of DBR in the early 1990s was preceded by a higher-profile challenge to the use of quantitative experimental methods in education

research.[5] In the 1980s, the education research community ruptured into factions leading to the so-called paradigm wars. Many education researchers found that raw empiricism, coldly formulized in statistical analyses, was at odds with the complex, often subjectively human and sociocultural factors in, with, and around instruction. They gravitated toward naturalistic methods and qualitative analyses using methods imported from the social sciences, often driven by critical theory that focused on issues of morality and power. Much of that research included becoming observers, not laboratory experimenters, in schools and classrooms. If the scientific quantitative experimental approach was guided by a laboratory metaphor, the metaphor for qualitative researchers was a lens through which subjective observations were made. But, like different individuals looking with different lenses at the same object under a microscope, qualitative research was mostly descriptive observation accommodating diverse, and often abstract, theoretical interpretations. But it, too, paved a way for the evolution of DBR, which relies heavily on close observation, but in a much different frame that goes beyond observing and describing.

Heated debates about the legitimacy of these two different worldviews and approaches to research continued into the 1990s. However, as blood pressures lowered and the debates cooled, a rapprochement of sorts took hold, opening the way for some researchers to promote the use of mixed methods.[6] Mixed methods created a middle plank of educational research suggesting that it could take the best of both worlds, quantitative and qualitative, and generate research findings that were richer than the sum of its two parts. It also conveniently side-stepped the epistemological arguments offered to defend either quantitative or qualitative approaches. Instead, it claimed pragmatism as its epistemological foundation[7]—a small, but notable, step toward a return to Deweyan views.

Yet, since Dewey, none of these three approaches and their variations have dealt satisfactorily with the most enduring and central failure of education research. Since Dewey, the education research literature has had a distinctly unimpressive record of positively affecting, or effecting, practice, especially when weighed against mountains of published education research. In every decade during the previous century, it is easy to find laments about this longstanding gap between research and practice. The more disingenuous of these chide practitioners for not paying attention to research, more or less absolving researchers of any complicity.

For the most part, those who identify as quantitative, qualitative, or mixed-methods researchers have conducted and reported research that is about, and

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[5]For a detailed account and analysis of the 1980 paradigm wars at the end of the decade and three scenarios of where it might lead, including one prediction that suggests an approach similar to DBR, see Gage (1989). Interestingly, all of Gage's scenarios occurred to some extent, but failed to become productively integrated, as he had hoped.

[6]For a detailed history of mixed-methods research, see Maxwell (2016).

[7]For an explication of mixed methods and an epistemological justification for them, see Tashakkori and Teddlie (1998).

maybe in, but not directly for, practice. The boundary between research and practice is more permeable today than the wall that Thorndike advocated, but for conventional quantitative and qualitative approaches, it is nothing like the oneness Dewey saw. For too many researchers, the link between their research and practice remains superficial, at best. For example, it might be limited to a section entitled "Implications for Instruction" tacked on to the end of a research report, or heeding the advice of a mentor to consider how a doctoral dissertation might be published in a researcher journal but then spun into an article for a practitioner journal, or an occasional inservice session after the school day for teachers.

For me, closing this long-lamented gap between research and practice figured prominently in my decision to become a DBR researcher. In that sense, it continues to remind me that it is the most logical and appropriate way to conduct research that meets my, and I think the field's, presumed professional commitment to inform practice. Originally, it responded to my sense of frustration as I came to realize that the methods I had been trained to use cut across the grain of real classrooms and reinforced my aloofness as an education researcher, while suppressing my instincts as a former classroom teacher.[8] It gave me a sense of purpose in my research that was notably lacking earlier in my career.

Admittedly, it also makes me less patient with my colleagues who use other approaches and who sometimes show relatively little interest in how their research informs practice. If professors in schools and colleges of education are not fully engaged in research that directly informs practice, who, we might ask, will do that research? In that regard, a colleague and I (Reinking & Yaden, 2021) have proposed a dynamic continuum along which theory (and research) can be placed to characterize productivity in relation to informing practice. On one end is theory/research that is *scholarship about education.* Those who do scholarship about education focus more abstractly on education as a societal institution, view its practitioners as a group to be studied, and may aspire, but not feel necessarily obligated, to inform educational practice. Such theories, and the research they inspire, often address laudable goals, but they provide little concrete guidance about how to achieve them. For researchers in this realm, education is often positioned as if it were a subtopic of other disciplines (e.g., history, sociology, economics, philosophy, public policy, critical studies). At the other end of the continuum is theory/research for education aimed at determining how those goals can be achieved. Those who theorize and do research in this realm view practitioners as an audience to inform, and they accept a fundamental responsibility to do so. It is at this end of the continuum that DBR exists.

That DBR reunites education research with practice was evident from its conceptual origins, which can be traced most directly to two publications, one by Alan Collins (1992) and another by Ann Brown (1992). Both of these researchers had

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[8]For an argument suggesting that former teachers who wish to become education researchers must exchange their instincts from practical experience for a theoretical orientation, see Labaree (2003).

roots in cognitive psychology and were associated with an eclectic group of noted scholars who represented expertise in diverse fields including cognition, artificial intelligence, textual meaning, computer programming, instructional design, and social anthropology. The thread unifying this group, which founded what is now called the *learning sciences*,[9] was an interest in developing instructional interventions, often with new digital technologies, that could be used effectively in real classrooms. It was out of this amalgam, thanks mainly to Collins and Brown, that DBR was birthed.

Their articles, both published in 1992, were coincidentally complementary. Collins, in a book chapter entitled "Toward a Design Science in Education," outlined the broad parameters of a new methodological approach. Brown's article, published in the then fledgling *Journal of Learning Sciences,* described a more detailed personal journey toward what both she and Collins called *design experiments*. She referred to herself as a "design scientist" who came to realize that the laboratory methods she had used to research and develop a theory of metacognition while reading texts was of little use in studying how that understanding could be translated into instruction integrated successfully into the complexities of classroom instruction.

To illustrate her design work, she used an intervention she called reciprocal teaching, a technique to enhance the metacognitive aspects of reading comprehension that arose out of her previous laboratory work. Subsequently, that approach became not only one of the most well-researched interventions in literacy instruction (using conventional experiments and DBR), it also became widely used and laid the foundation for strategy instruction as a domain of teaching reading comprehension. Clearly, from its earliest days, DBR directly informed and influenced instructional practice in a way that other mainstream approaches did not. I believe that it is also noteworthy that DBR is the only methodological frame endogenous to education, not being imported from the physical or other social sciences.[10]

Brown's article is also where this brief history of education research comes full circle. She wrote discursively in her article about the compatibility of design experiments with Dewey's views about education, educational practice, and knowledge. In addition, she addressed how research that involved introducing innovative practices often necessitated addressing the challenge of teachers' natural inclination to resist moving away from established practices, which can be a pervasive issue for DBR researchers. She also made it clear that her work as a design scientist was methodologically neutral in terms of data collection and analysis. Although DBR employs analytical tools familiar to quantitative and qualitative researchers, it repositions those tools within a different epistemology and paradigmatic frame well suited, if not essential, to education. Within the philosophy of science, that frame is an expression of instrumentalism (about which Dewey also wrote), and

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[9] For a history of the learning sciences, see Lee (2018).

[10] DBR has actually been imported from education into other fields of study such as public health political science.

thus methodologically related to mixed methods, although Brown noted that qualitative observations and analyses were necessary.

DBR is not just another approach to collecting and analyzing data. Instead, it offers a different ethos that foregrounds an entirely different domain of research questions. Quantitative experimental methods, guided by a laboratory metaphor applied to instructional options, ask, "How can we identify the best instructional practice?" Qualitative naturalistic methods, guided by a lens metaphor, ask, "How can we deeply understand instructional environments and interventions through systematic observation?" DBR, on the other hand, guided by an engineering metaphor, asks, "How can we gain deep understanding of pedagogy by designing interventions that accomplish valued goals?" DBR embraces any form of data collection and analysis that serves that purpose, typically undergirded by a strong base of experience in classrooms. Consistent with Dewey, DBR blurs the distinction between research and practice, treating practitioners as collegial partners, and sometimes as fellow researchers. It also views classrooms as complex ecologies in which one, sometimes seemingly small adaptation or change can have cascading effects, positively or negatively. This is a dynamic that anyone who has been a classroom teacher clearly knows and understands. Any researcher who does not acknowledge and accept that complexity is either delusional or dishonest, and failing to address that complexity abdicates researchers' responsibility to help practitioners deal with it.

Since its inception and continuing to the present, the community of DBR researchers has grown in number and diversity. Although its core ethos has remained solid, methodologically it has morphed into a diverse array of frames and approaches. For better or worse, they are described with a panoply of terms, several of which are on display in this volume's chapters. Some of these conceptualizations and approaches include Collins's and Brown's original term, design experiment, but now include others as well, such as development research, formative experiment, design-based implementation research, and participatory design research, and may include links to action research and improvement science (McKenney & Reeves, 2020). Arguably, all fit reasonably well under the umbrella of the DBR ethos. Also arguable is that various approaches to DBR are better suited to particular contexts and purposes, which is amply illustrated in the remainder of this book. For example, the chapters that follow illustrate how DBR can be applied somewhat differently to designing curriculum, creating classroom interventions aimed at accomplishing specific goals in different subject areas, initiating large-scale reforms within school districts, conducting effective professional development, and implementing interventions aimed at increasing social diversity. In my view, there is no one correct way to do design experiments, beyond engaging systematically in goal-oriented design that is formative and practically informative, and that generates theories of pedagogy embedded in practice.

This diversity might also be comparable to diverse approaches available within quantitative and qualitative research methods (e.g., qualitative methods include ethnographies, case studies, interviews, and phenomenological approaches). Yet,

the DBR community has not clearly come to terms with firm categories or boundaries that separate them—and perhaps it shouldn't. In fact, in one sense this diversity and continuous evolution are consistent with DBR's ethos. That is, DBR itself might be expected to be designed and redesigned as needed in local circumstances, or as it is applied to new contexts and particular goals. Put another way, we may need to guard against the excesses of what has been called "hardening of the categories."

Returning to my personal history, I remain engaged in an ongoing journey in contemplating the totality of DBR—one now approaching three decades. Semi-retirement provides even more time for reflection. It has been a rewarding journey that has included conducting and publishing DBR studies, serving as an editor and reviewer of DBR manuscripts, coauthoring a book about DBR, and the gracious invitation to write this foreword. It also includes reading journal articles and books, such as this one, where I learn how others have interpreted DBR and applied it in different ways and in diverse contexts. Invariably, I have learned, and continue to learn, something new from each experience in my own research and writing, from serving on many doctoral dissertation committees guiding a DBR project, and from engaging vicariously with the work and thinking of DBR colleagues such as the editors of and contributors to this volume. I am continuously learning its subtleties and refining my own understandings.

In that vein, occasionally I list 10 personal things I think I know or value about DBR. Each list is never quite the same or in the same order. I have found this exercise also useful in teaching graduate courses on DBR. During a semester, I ask students to develop and update a list of 10 things they think are particularly unique, valuable, and personally attractive about DBR. Here is my personal list on this occasion, no doubt influenced by having read this book:

1. *DBR is guided by an explicit goal.* A goal not only gives concrete purpose to a research project, it anchors coherence (but see also item 2). Interestingly, when I require my students to develop a one-sentence goal, they find it quite challenging. It can take me hours to satisfactorily hone the wording of an overarching goal for a study. But, the process of doing so is an important and insightful step. I also insist, for them and for myself, that a goal be justified in the literature and often in the realm of democratic values à la Dewey.

2. *DBR makes space for the unexpected.* All instructional moves, from the mundane (e.g., changing a seating arrangement) to the more profound (e.g., engaging in less teacher talk), have unintended as well as intended consequences. My data collection and analysis always include a category for unintended consequences, so I attend to that reality. It can inform a current study and may lead to further research. It also makes me wonder, especially with regard to those who use medical research as a model for education research, why education researchers don't specify the possible side effects of our "treatments."

   3. *DBR foregrounds consequential validity and case-to-case generalization.* These could be separate items, but they are related. Experimental studies seek to balance internal validity (setting up an experiment to make valid causal connections) and external validity (experimental tasks like those occurring naturally). But, increasing one often decreases the other—a catch-22. External validity isn't an issue for DBR. It is always conducted in naturally occurring complex learning environments. Neither is internal validity, because it is nigh impossible to identify precise causal chains among the many interacting variables in classrooms. Instead, DBR seeks consequential validity (Messick, 1992), achieving valued goals more or less reliably and in the process identifying consequential (i.e., influential), not unequivocal causal variables. Likewise, experimental studies seek generalization from a sample (a few representative cases) to a population (everyone who might use a particular intervention). DBR seeks case-to-case generalization (Firestone, 1993), which essentially means that the more a teacher's situation (i.e., case) is like the one in a particular DBR study, the more likely findings will hold (again, like a medical doctor diagnosing a case). That means replication is particularly useful and important in DBR, which is another idea that could be a separate item in this list.

   4. *DBR offers recommendations, not prescriptions, for practice.* This aspect counters the conceit, most evident among quantitative researchers, and policymakers looking for final answers, that the object of education research is to identify best practice for every teacher anywhere (Thorndike's legacy lives on). Most prominent is the U.S. Department of Education's What Works Clearinghouse, which, from a DBR perspective, might be recast as "What It *Takes* to Work Clearinghouse." Using research findings as dictates removes all of teachers' professional judgment from the equation (see item 10). I have written elsewhere (Reinking, 2007) that the concept of best, or so-called evidence-based, practice, is unreasonable and should instead be a quest to determine good and better practice.

   5. *DBR reveals and naturally attends to failure, treating it as data that open up possibilities for deep understanding.* Engineers, as designers, systematically investigate failure (e.g., wind tunnels that determine conditions that will lead an airplane's wing to fail). Failure does not have to be manufactured in DBR research. It happens naturally. As Decker Walker (2006) has argued poetically, our goal as design-based researchers is not to create an intervention that is immune to failure, but one that might fail more gracefully. A major historical limitation of education research is that there is virtually no systematic analysis of failure, which, since failure is routine in the physical sciences, calls into question whether education research is truly scientific.

   6. *DBR is intellectually stimulating, because it requires creative, diagnostic problem solving.* DBR researchers are inevitably problem solvers. They must continuously be attuned to the question "What is really happening here?" because making reliable, stable predictions associated with teaching is incredibly difficult, if not impossible.

Instructional environments are unbounded spaces that entail radical uncertainty in the domain of "wicked problems" (Kay & King, 2020). They entail diagnosis and creative thinking about solutions, and diagnostic thinking has been argued to be more generative, divergent, and creative than causal thinking (Sloman & Fernbach, 2017). In DBR, there are invariably multiple challenging obstacles to achieving success, and thus is fertile ground to learn something that no one has seen clearly or thought about before. I think of the scene from the movie *Apollo 13* with the three astronauts trying to make it back to Earth in their damaged spacecraft and running out of oxygen. The chief engineer on the ground gathers his team, saying we must figure out how to make this fit into that using only this, while throwing a box of miscellaneous items found on the spacecraft onto a table. It is a great analogy for DBR. Designing instruction is engaging because it is difficult, but potentially deeply revealing.

7. *DBR looks beyond effectiveness to aspects such as appeal and efficiency—and importance* (Reigeluth & Frick, 1999). Put simply, what good is an intervention that results in measurable gains in learning or competence in a skill that is unnecessary, that is implemented in a way that practitioners and students/users dislike, or that requires so much time and resources that it is completely unfeasible? What can work (under controlled conditions) isn't always important, and doesn't always work under less than ideal conditions in a way that is completely satisfying to those who must implement it.

8. *DBR is productively theoretical.* Some critics have unfairly criticized DBR for being atheoretical, that is, only aimed at designing something that works. That criticism is no more valid than saying that the Wright brothers' efforts to design an airplane were atheoretical (Stokes, 1997). They knew well and used Bernoulli's theory of lift in their design, but their genius was to build a machine that would enable controlled flight, consequently founding the field of aerodynamics. Similarly, and just as important, DBR produces theories that are more productive. They inherently test existing theory in practice and generate new pedagogical theories that are more immediately applicable to practice. These new theories have been called "local" or "humble" or even more modestly labeled not as theories but as "assertions" or "conjectures" (Bell, 2004; Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003). They must necessarily be so because they are contextually contingent, which makes them productively useful to practice in the spirit of instrumentalism.

9. *DBR is about infidelity, not fidelity.* No, not that kind. Fidelity means prescriptively (see item 4) following an instructional protocol precisely without variation (think recipes). It is promoted as a necessary and desirable aspect of experimental studies. It is also one of two convenient "excuses" offered when a so-called evidence-based intervention doesn't work: (1) lack of fidelity, or (2) not enough time applying fidelity for the expected effects to appear. Any teacher knows that good instruction needs to be adapted to particular students, the instructional context, available resources, and so forth. So do DBR researchers. That reality means

infidelity is necessary and useful, and, more importantly, informative. Fidelity is a fantasy and a product of conceptualizing classrooms as laboratories (Thorndike's legacy).

10. *DBR respects and values the professional judgment of practitioners.* A common narrative trope is a supervisor, senior military officer, and so forth, who has little experience but who thinks they know more than the longtime repairman or noncommissioned officer engaged in day-to-day practice (Thorndike, again). One of my greatest assets as a DBR researcher has been having the good fortune to be married for 45 years to a highly successful, and well-loved, elementary schoolteacher. She has been a sounding board and reality check for my theoretical musings and interpretations of research.

Readers of this book will get glimpses of these personally attractive and useful aspects of DBR and many others that might be listed. The editors have assembled a group of contributors who are well positioned to share their ongoing work using DBR and the insights they have gained along the way. The contributors include seasoned researchers who, like me, came to know, understand, and use DBR after many years of conducting and publishing research within more established paradigms of education research. Others are mid-career, and a few are newer scholars who have used DBR in their dissertation studies and who are now building their careers around DBR research. Collectively, they and their respective chapters testify to the attraction of DBR and to how it has slowly, but steadily, moved into the mainstream of education research. This book is an important milestone in that historical progress.

DAVID REINKING, PhD
University of Georgia

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