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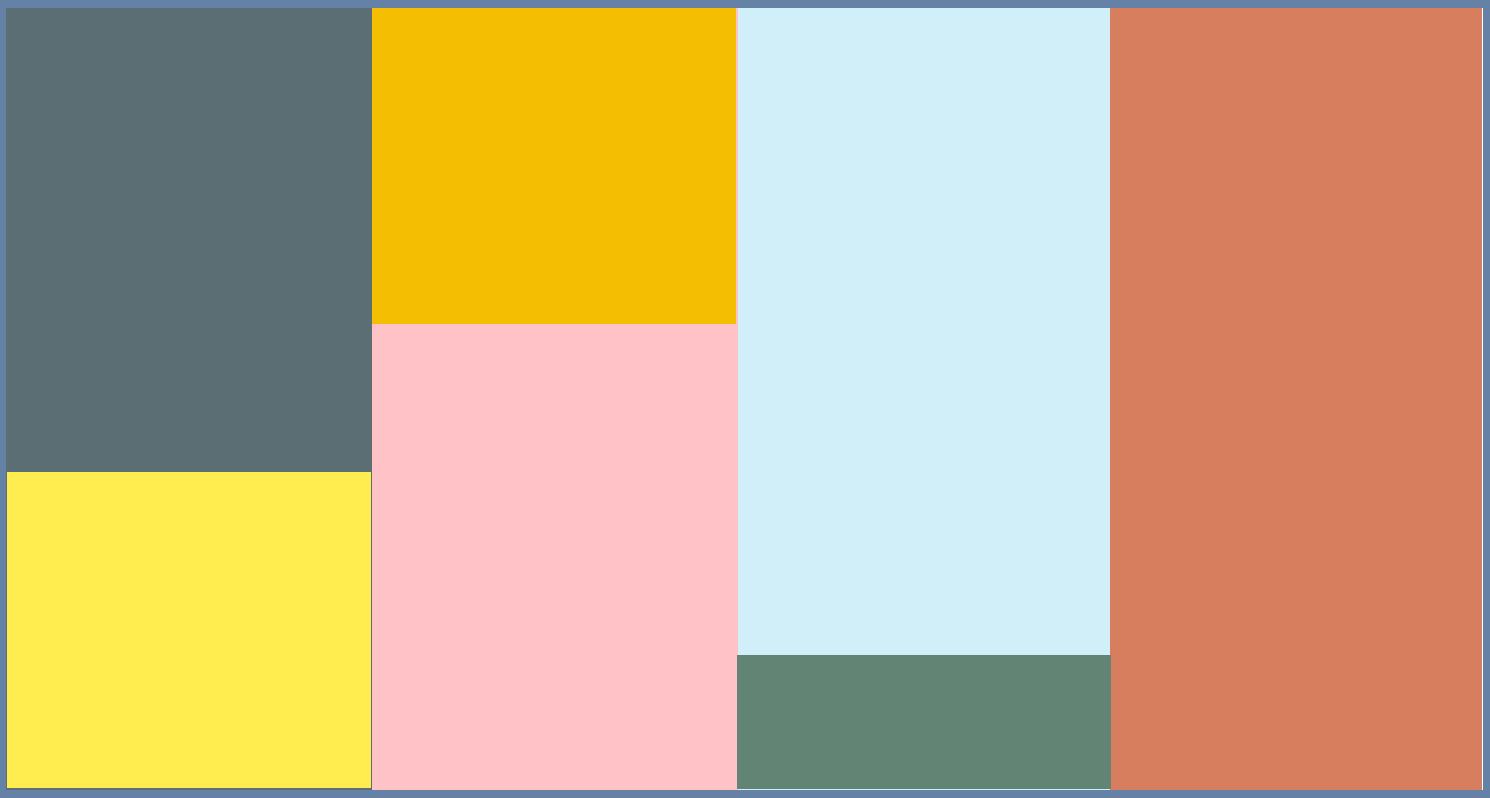
THE CASE FOR COMPONENT-BASED RESEARCH IN EDUCATION

A RESEARCH PARADIGM



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INTRODUCTION

Over decades, pernicious problems have hindered the ability of research to contribute to our nation's equity and improvement goals. These include issues of generalizability, knowledge accumulation, research use, and scaling. As scholars, our approaches to addressing these challenges over the years have enabled us to make only limited progress. This paper, describes an alternative way of doing research, compatible with the field's existing strengths, that may pave the way to address these challenges.

"Component-based research" (CBR) is a paradigm that is oriented toward advancing education improvement by embracing shared language, collaborative knowledge development, shared resources, and analytic approaches driven by meeting the needs of local contexts, conditions, and populations. CBR is grounded in a commitment to doing research that yields specific, actionable steps for practitioners while also supporting ongoing theory development and new insights in the field.

With increasing acknowledgment of systemic racism and biases in our education systems, it is time that education researchers consider the adage: "If you always do what you've always done, you'll always get what you've always got." Inequities in education have been recognized for decades (Fennema, 1979; Ross, 2010) and they persist (Leithwood, 2021; McCoach, 2022). The failure to realize widespread progress is not for lack of commitment or effort. Education researchers and their collaborators have generated an enormous amount of knowledge.

But that knowledge base is diffuse, findings are regenerated, and research use is an ongoing challenge. Furthermore, our current research methods and designs fall short in enabling researchers to ask and answer the complex questions that reflect the multifaceted nature of education improvement.

And yet, while we expect others to change their approaches to teaching, leadership, and management, we hold fast to our assumptions about what research is, what it looks like, the evidence it yields and how it does and does not serve practitioners' needs. It is time to recognize that researchers' work to support change in education includes bringing about changes in ourselves. As researchers work in earnest to bring about improvements, we need to ask ourselves, "What can we do differently?"

WHAT IS COMPONENT-BASED RESEARCH?

Born out of scholarship on mental health improvement, social psychology, psychology, implementation science, diffusion of innovations and more, CBR "unpacks" innovations and other study elements into precisely described parts. Specifically, it calls for systematically disassembling innovations into components that can be examined alone or in groups. It also calls for specific and systematic descriptions of the contexts and conditions surrounding an innovation as well as precise descriptions of beneficiary characteristics (e.g., sociodemographic characteristics, attitudes, self-perceptions, life experiences). And finally, CBR requires precise descriptions of outcomes.

CBR then examines relationships between innovation components (alone or in combination) contexts, beneficiaries and outcomes. It is a way of doing research that can enable researchers to rigorously answer the challenging questions that will move the field toward improvement and more equitable practice: **What parts of a reform work, for whom, under what conditions and for how long?**

CBR does not reside within a particular topic or sector in education and has the potential to support knowledge sharing between otherwise disconnected dimensions of education research as well as research in other sectors. It departs from an approach of creating programs, interventions or innovations (heretofore referred to as innovations), testing and improving them and, if they show promise, "scaling" them. Instead, CBR views an innovation as an assemblage of parts that interact, alone or together, with wide-ranging contexts and beneficiaries. A CBR paradigm positions researchers to embrace the complexity of improving education — rather than reduce it to fit the limitations of our current research approaches. If developed, CBR has the potential to make substantial advances in solutions to long-standing education research challenges (Ferber, et al., 2019; McLeod et al., 2017; Soldner, 2020).

COMPONENT-BASED WORK IN OTHER DISCIPLINES

CBR has been emerging in other fields for some time. In 2005, Choprita et al. created the "distillation and matching (DMM)" model for therapies in mental health, which they described as a "method whereby interventions are conceptualized not as single units…but rather as composites of individual strategies" that could support "subsequent empirical groupings" (p. 6). In behavioral health, Embry & Biglan (2008) spoke about the idea of using "kernels" to "…clarify the active ingredients in existing interventions and contribute to developing interventions that are more efficient and effective" (p. 75). Collins et al, (2014) sought to optimize behavioral interventions, noting that they didn't seek to identify the

single best intervention, but rather "one of the best combinations of components" (p. 239). Others have used and spoken to the merits of component approaches in behavior change, medical clinical practices, and childhood obesity (Almirall, 2014; Riley & Rivera, 2014; Hedges et al., 2020). The intractable problems facing education improvement share fundamental qualities with problems in these fields (e.g., complexity, context dependency). Their work can inform CBR research efforts in education and contribute to creating a foundation for interdisciplinary collaboration.

In addition focusing on CBR as an avenue to effectiveness, researchers have also noted its merits for cost management and decision-making. For example, Collins et al., (2014) suggest that component approaches are more cost-efficient by yielding information about specific components and their combinations rather than whole programs. Embry and Biglan (2008) agree, noting that identifying the "kernels" of behavior-influence agents "may reduce the cost of bringing about widespread use of effective practices" (p. 9). By enabling the field to extract value from research that otherwise may not generate useful findings, and by supporting evidence driven innovation creation and adaptation, CBR can enable researchers to contribute to the education improvement effort from many more research investments.

FOUR CHALLENGES

Component-based research may advance the field of educational research in addressing persistent challenges that stand in the way of improvement.

#1: CBR AND GENERALIZABILITY

How can the field generate research findings that are broadly applicable? A CBR paradigm enables education researchers to consider new ways of organizing findings across studies so that they can be applied in a range of settings with a range of populations.

#2: CBR AND KNOWLEDGE ACCUMULATION

How can the field do a more effective job of accumulating knowledge within and across dimensions of education research? A CBR approach, supported with structures such as taxonomies and powerful databases, has the potential to support a systematic, cumulative body of knowledge that grows over time. ,

#3. CBR AND SCALING

How can education research contribute to powerful innovation spread and endurance? The CBR paradigm supports innovation customization and research-informed adaptation that may lead to more equitable education improvement opportunities.

#4: CBR AND RESEARCH USE

How can education research findings be more usable for educators, policy-makers and other stakeholders? Rather than identify models and processes for using research findings as we understand them now, CBR reconceptualizes the nature of the findings themselves. Organizing findings through a component-based lens has potential to make findings more applicable, accessible and more functional.

CBR AND GENERALIZABILITY

Maximizing return on education research investments

For the last two decades, the US Department of Education has held the randomized controlled trial (RCTs) to be the gold standard of rigorous education research (Tseng & Coburn, 2019) with grant programs that offer more funding for interventions with "higher quality" (i.e., RCT) evidence. While RCTs may have strong internal validity and serve the important purpose of establishing causality in well-controlled settings, when it comes to external validity, there isn't a clear pathway for moving an innovation that showed promise in an RCT to actual practice in the field. These limitations have emerged in other fields (Lawson, et al., 2018; Waters et al., 2011) as well as in education (Gutiérrez & Penuel, 2018). Joyce and Cartwright (2019) noted, "there is a big step between "it works" and "it will work here" (p. 2). As researchers, we must ask: How we can get more from our research investment?

While many have made the case for generalizability of findings from experimental approaches (e.g. Tipton & Olsen, 2018), others have made a similar case for the trustworthiness and application of findings resulting from qualitative approaches (e.g., Caminati, 2018). However, it is important to note that generalizability challenges are methodologically agnostic. In their book, Generalizing from Educational Research, Ercikan & Roth (2009) note that, even though experimental approaches are often associated with generalizability and qualitative approaches with more limited application, "the quantitative-qualitative distinction does not correspond to the presence and absence of generalizability (Ercikan & Roth 2006b)." Rather, they argue that the goal of research, regardless of methodology, is to provide policy makers, administrators, and teachers with knowledge that is "sufficiently general" to indicate trends and "sufficiently specific" to enable application to local needs. CBR may be one of the ways to reach this goal.

CBR AND RESEARCH USE

Making research more usable

It is well known that research use, or what some call the use of "research evidence" has been a perennial problem in educational scholarship (Tseng & Nutley, 2014; Farley-Ripple, et al., 2020). This challenge has been explained with a variety of reasons. Some point to researchers' choice of research topics, saying that the topics are not relevant to practitioners. Others suggest that researchers don't know how to communicate or collaborate with practitioners. Still others blame the practitioners themselves, suggesting that practitioners should apply research findings more readily or that they simply don't want to make changes in their practices. And others point to the locus of power and control in the entire education research endeavor.

Several approaches to addressing this problem have emerged over the last decade. We have seen the growth of Research Practice Partnerships (RPPs), Design-Based Implementation Research, and Networked Improvement Communities all responding to the importance of working closely with practitioners to solve problems that are meaningful to them. These approaches show promise, but the close, internally collaborative nature of the work doesn't necessarily focus on dissemination or knowledge accumulation in the field.

Rather than create new ways to use research evidence as it is, CBR aims to **change the nature of the evidence itself** so that it is more usable. One can hypothesize how RPPs or DBIR partnerships might be able to use the evidence that comes from accumulating knowledge on components to build locally relevant innovations with elements that will work in their conditions with their learner populations. Should the field of education research choose to develop the technological and conceptual infrastructure to engage in CBR, it can be possible.

CBR AND KNOWLEDGE ACCUMULATION

Specifying innovations and collaborating with co-created taxonomies

Our current methodological tools for accumulating knowledge —meta-analyses and meta-syntheses— capture a specifically bounded body of work that occurs during a particular time period, resulting in insufficient actionable information. The underlying focus on whole interventions creates a challenge for knowledge accumulation. Chorpita et al. (2005) note that research focused only on whole interventions rather than components means that knowledge accumulation "begins anew" (p. 8) with each instance.

A CBR approach could make progress toward two fundamental barriers to knowledge accumulation in education research: poorly specified innovations and language misinterpretation. Calls for better specified interventions have emerged in other fields for some time (e.g. Shepperd, et al., 2009) and have been called for in education as well. For example, in a 2010 meta-synthesis on the impact of inquiry instruction on student outcomes, the authors excluded hundreds of studies because the intervention was only described as "inquiry instruction" and nothing more. To meaningfully synthesize findings, the authors had to develop a framework that deconstructed the general word "inquiry" into components, define each component, and then use the components as a basis for organizing the synthesis (Inquiry Synthesis Project Center for Science Education, EDC, 2006). The field of education tends to describe interventions with broad labels (e.g., problem-based learning, internship, personalization) without clarifying what these labels mean, sometimes communicating past one another with shared terms that have different underlying meanings and vice versa.

Naturally, specifying interventions in a meaningful way requires common language. While there have been calls for common language in education over the years (McDonald et al., 2013; Culatta, 2016), we have no shared ontologies or taxonomies to support this need. Taxonomies, however, have been used in other fields. In the area of juvenile justice, Lipsey (2009) used a component approach to create a taxonomy of juvenile offender program characteristics, subject characteristics, outcome effect sizes and other variables. In the area of childhood obesity, Hedges et al. (2020) developed what they refer to as "taxonomic meta-analysis," to "allow for the synthesis of learning across seemingly idiosyncratic interventions." (p. S2-1). Even in education over the years, some have done work to specify educational components (Deno, 1979; Gersten et al., 2009; Author et al., 2020). While we all have our favored terms and our own ways of defining them, the time may have come to give them up to make room for something new — a shared language we all can use. Other fields have done it, and so can education.

CBR AND SCALING

Spreading innovations with principled adaptations

The field of educational improvement has long called for replicating innovations. Underlying this goal is often a premise that scaling with fidelity is of the utmost importance because it is the best pathway for realizing positive outcomes of an innovation that has been shown to work in another setting. However, it is widely recognized that fidelity of implementation rarely (if ever) happens (Century & Cassata, 2016; Chorpita, 2005), and it is important to acknowledge that while a fidelity orientation has its purpose in innovation development, it shouldn't necessarily be the intended goal in scaling. If an innovation yielded effects in a particular setting under particular conditions, it is likely that educators would need to adapt the intervention when the conditions are different.

When the merits of systematic adaptations are not recognized, they happen in ad hoc ways that may turn an innovation that shows promise in an RCT into one that fails to yield the desired outcomes or, even worse, results in negative outcomes. In response to this problem, some have called for developing new methods of analysis for studying adaptability and scalability (Dede, 2006). Sabelli and Dede (2013), for example, suggest that education reformers replace the word "replication," with "translation" (p. 475), a concept calling for making adaptations based on actual contexts and conditions. With CBR-based knowledge accumulation about components, contexts, and populations and data about their relationships to, and roles in outcomes, CBR may be able to support these kinds of evidence-based principled adaptations and achieve increased effectiveness with spread (Embry & Biglan, 2008). A CBR approach supports the abilities of researchers and their collaborators to adapt existing interventions so that they align with local contexts and populations. As Abry (2015) noted, components help to "optimize interventions" (p. 320) and "inform refinements…to strengthen effectiveness and provide guidance on what to prioritize" (p. 321).

According to Zomahoun et al., (2019) the World Health Organization defines "scaling up" as "deliberate efforts to increase the impact of successfully tested health innovations so as to benefit more people and to foster policy and program development on a lasting basis" (p. 1). The Center for the Study of Social Policy concurs, noting, "…we need evidence not only to help choose what to do, but also to support the continuous adaptation and improvement needed for any significant effort to produce results" (p.4, 2017). Informed by knowledge of current contexts and conditions, stakeholders can use CBR-based knowledge, to identify needed adaptations at the outset, and to establish a foundation for evidence-based continuous improvement through adaptations over time. CBR may enable education stakeholders (researchers, practitioners, policymakers) to engage in what Craig and Petticrew (2013) called the "best practice" of developing innovations systematically.

COURAGE, PERSISTENCE AND WILL

Giving something up to make room for something new

Generally speaking, approaches to generating and disseminating evidence to the field are oriented around dominant research and evidence-building norms such as reducing complexity, prioritizing causality, and expecting replication with fidelity. Despite their merits, these norms are not responsive to the reality of education as experienced by educators, students, and families with varied demographics and cultures, varied staff and financial capacity, and other localized conditions that shape the educational experience.

To realize the potential of a CBR paradigm, our field needs to get comfortable with the discomfort of exploring alternatives to familiar ways of doing our work. For a CBR approach to succeed, we need to be more collaborative, more directly communicative with one another, and willing to create cumulative and shared successes. In addition to these attitudinal shifts, we need to exercise our collective creativity to develop new tools and develop an CBR infrastructure including taxonomies and ontologies, computing power and customized databases, and pioneering methodological advances. While perhaps idealistic on first glance, working to shift to a CBR paradigm wins over the alternative: doing what we have been doing for decades. The question is, do we have the courage, persistence and will?

I became involved in education research in 1987 and I see the same challenges I came to understand then, continuing today. We cannot go another 35 years and find ourselves in the same place, yet again. I have long said when working with collaborators and clients that “hope is not a strategy…it’s good, but it’s not a strategy.” So now, in the absence of any current strategy underway to explore the possibilities of CBR for the field, I have hope that eventually we will create one together.

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