Mapping the Complexities and Benefits of Research-Design Partnerships

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Abstract: Increasingly our field is recognizing the necessity of close, collaborative relationships with educators, policy makers, students and other potential stakeholders if our design and research work is to have a lasting and more equitable impact on education. However, this work is not easy or quick, and we lack both detailed examples of how it is done and training for new (and current) scholars in how to do it. This symposium brings together a group of scholars who actively engage in RPPs and DBIR in order to highlight the lessons that have been learned and extend our discourse into the realities of this work, how to prepare students and current scholars to design their work with partners at the center, and how to accurately plan for work that engages stakeholders.

Introduction

Design-based implementation research (DBIR) seeks to address the reality that even high quality, rigorous research in education often fails to transfer across real educational contexts and therefore cannot have a sustained impact on students' learning. In order to address this issue, DBIR places partnerships at the center of the research and design processes, with the goal of creating interventions that are sustainable and adaptable across settings (Penuel et al., 2011). Research practitioner partnerships (RPP) are often formed as part of DBIR work, and position research as a response to needs of practice, rather than to gaps in the literature (Henrick et al., 2016). RPPs are collaborative partnerships between research teams and practitioners, where defining the problem space and designing solutions is a collaborative endeavor.

This type of work is essential as we begin to recognize the limited impact research in our field has had on education (Wise & Schwarz, 2017), and the significant limitations of traditional learning theories and methods in education for creating equitable learning opportunities that are free from oppression and bias (Nasir et al., 2021). Without research and design that is embedded in partnerships with the intended users and stakeholders, we run the risk of being at best ineffective, and at worst, continuing the cycle of oppression and discrimination seen in educational contexts today.

However, as noted by Fishman and Penuel (2018) the long cycles of collaboration and iterative design and implementation studies are at odds with a lot of the typical structures within educational research (e.g. funding cycles, productivity expectations for early career scholars) and there is little formal training for doing this type of work. In addition, while there are some examples of case studies and descriptions of RPPs (e.g. Farrell et al., 2021) and studies that attempt to analyze the design and collaboration processes (e.g. Lawrence & Mercier, 2019; Lawrence, 2020), we still lack frameworks to understand how this work is conducted across cases (Cheng, Clark & Van Horne, 2020) and critical analyses of the implications of our interactions and design processes.

This symposium brings together researchers who are actively working with partners, in DBIR studies and/or RPPs. The papers represent a range of projects and approaches to DBIR and RPPs, and each presents an opportunity to consider elements of this work. Across these papers, we seek to understand how to establish and maintain RPPs (Benichou et al., Mercier), models and frameworks for conducting DBIR work (Ahn et al., Arce-Trigatti), the infrastructure necessary to develop capacity for DBIR work (Mckenny & Poortman), a microanalysis of the design process (Lawrence) and a reflection on bringing children into DBIR practices (Borge). We will seek commonalities across the work, and also to use the different perspectives to identify future directions for frameworks and capacity building activities.

Paper 1: Boundary Crossing Processes in the Forming Stages of Multi-Sector Research-Practice Partnerships: Three Cases of School-Based Citizen Science

Maya Benichou, Yael Kali & Yotam Hod

Citizen science is a genre of research in which stakeholders from different fields of expertise – scientists and non-scientists – work together to advance scientific knowledge with the assumption that science is not the property of experts but should be made accessible to the general public (Shirk et al., 2012). Citizen science projects have been active around the world for many years, however technological advances have recently led to a dramatic acceleration in projects of this kind in diverse fields (Lewenstein, 2016; Sagy et al., 2019). Leveraging the exciting opportunities of citizen science to bring together citizens and scientists, recently we (and other colleagues) expanded on this vision by creating the nationally funded, *Taking Citizen Science to Schools* (TCSS) research center. At the core of the center is a network of research practice partnerships (RPPs) (Hod et al., 2018) that bring together school practitioners (teachers and administrators), policymakers, educational researchers, and active scientists on a number of citizen science projects. To date, over 90 schools and hundreds of teachers have participated, contributing to this network by sharing challenges and best practices, developing curricular materials and activities, and supporting one another as schools enter new relationships that break the traditional boundaries that separated them in the past.

This paper – which is based on a forthcoming chapter in an edited book about teachers and teacher learning in the learning sciences (Benichou, Kali, & Hod, forthcoming) – zooms into the formation stage of three RPPs that participated in this network, where the first RPP took place prior to the second and third, offering opportunities to redesign the partnerships in the successive round of implementations. The formation stage plays a vital role in creating sustainable partnerships around educational innovations. We focus on the teachers in the formation stage within these partnerships, with an eye on elucidating how the teachers began transcending their existing professional development boundaries. Little is known about the new opportunities for learning and professional development of teachers as part of the multi-sector partnerships between students, teachers and scientists that school-based citizen science affords.

Drawing on extensive field notes, digital communications between the different stakeholders, written reflections, and interviews, we applied a boundary crossing framework (Akkerman & Bakker, 2011) to analyze how identification, coordination and reflection processes took place across our cases. Our research highlights the mistakes made during the first implementation, particularly as part of the coordination processes, that did not fully support the mutualistic relationships that were the goal of these multi-sector RPPs. We show how the nuanced changes made during the subsequent implementations led to far different outcomes, whereby the teachers felt a growing sense of meaning as they expansively framed their work and took productive agency to initiate new citizen science projects in their schools. These insights are important to understand as design-based implementation researchers seeking to foster sustainable partnerships have to negotiate complex, multi-sector relationships in the field (Fishman, Penuel, Allen, Cheng, & Sabelli, 2013).

Paper 2: Developing DB(I)R researcher capacity

Susan McKenney & Cindy Poortman

If design research is to realize its potential contribution to education in general and the learning sciences in particular, then explicit attention must be given to holistically developing Design-Based (Implementation) Researcher (DBIR) capacity. Collaboration between researchers and practitioners is shaped by shared goals and resources, but also by the values, expectations and expertise of the parties involved. For example, early stages of problem articulation and exploration benefit highly from open-mindedness and realism, while one's sense of moral purpose, belief that change is possible, and self-efficacy may prove particularly valuable during the implementation of interventions (McKenney, 2016).

Understanding and accepting the variety of personalities, processes, and convictions present in a particular project is crucial to being able to structure a fruitful process. DB(I)R researchers must be able to do so while they fulfil multiple roles, notably the those of: *Consultant*, *designer*, and *researcher* (McKenney, 2016). While most DB(I)R researchers are afforded formal opportunities to develop their research skills (e.g., through seminars and courses on research design, interview techniques, data analysis, etc.), the consultant and designer skills receive far less explicit attention and tend to be learned informally, at best (McKenney & Brand-Gruwel, 2018). In light of these three roles and four core DB(I)R processes (analysis and exploration; design and construction; evaluation and reflection; and implementation and spread), McKenney and Brand-Gruwel (2018)

describe four foundational competencies that are required to enact each role. *Empathy* is needed, for example, to explore (un)shared goals or becoming exposed to the incentives, motives, and reward structures in different settings. *Orchestration* helps simultaneously attend to research framing, data collection, solution design, implementation, infrastructure woes and stakeholder ownership. Creative and analytical *flexibility* supports optimization of the human and material resources available in ways that remain aligned with instructional goals. Finally, *social competence* includes having a robust repertoire of interaction strategies to be selected as needed.

This paper focuses on the infrastructure that serves DB(I)R researcher capacity building. Here, infrastructure refers to the human, material, and structural features of context which contribute to the development of the four competencies described above and the ability to fulfill the roles of researcher, designer, and consultant, in ways that respond to the shifts in DB(I)R processes through the lifecycle of a given initiative. This prospective analysis is situated in the context of university campus collaborations between DB(I)R researchers and (communities of) teachers in engineering disciplines who share the goals of (1) redesigning courses and degree programs to be anchored in authentic challenges, and (2) investigating how to do so in ways that are effective and enjoyable (Kirschner & Gerjets, 2006) as well as sustainable. Specifically, the paper presents a framework for inventorying assets and needs with regard to the infrastructure for developing design researcher capacity when working in this kind of setting. A key discussion question during the proposed symposium pertains to the applicability of this framework for researcher growth in other DB(I)R contexts.

Paper 3: Centering Race in DBIR: Methodological Choices and Internal Work
June Ahn, Kimberly Gomez, Ung-Sang Lee & Christopher Wegemer

In this paper, we share our current experiences and insights from a DBIR project that is focused on centering racial consciousness and anti-racist goals. DBIR as a methodology focuses on developing mutually beneficial research agendas with partners, co-designing these research activities, developing solutions, and iteratively testing and improving upon these joint endeavors (Penuel et al., 2011). In our work, we are developing up to 6 partnerships with local schools in Southern California, using a DBIR approach, but exploring how processes unfold and might be facilitated in ways that bring race and anti-racism to the forefront. Our work addresses recent calls by Doucet (2019) and Kirkland (2019) for community engaged researchers to attend to critical issues of who is at the table when developing partnerships, what questions are posed and which are pursued, and to re-imagine the solutions that we design to address key obstacles to racial justice.

Drawing upon a dataset of field notes, reflective memos and team documents, as well as artifacts from the DBIR projects, we will shed light on how the project teams were: (1) initially structured with careful attention to understanding the racial histories of different partners, including ourselves as researchers, and how these histories shape DBIR work at the outset; (2) how jointly negotiated foci of work were developed as a partnership, with an eye towards how different design goals are reshaped when thinking through the lens of anti-racist goals and outcomes; and (3) how the focus of design efforts shift from tools or organizational strategies, to re-designing relational ways of partnering and mobilizing for root issues that more directly impact racial justice. We argue that a racially conscious DBIR methodology requires attention to new facets of practice, that extends and enriches racially neutral processes. A key need in the field is to better articulate how **partnership infrastructures** (Penuel, 2019) and **the relational moves we make** (Hennessy, Howe, Mercer, & Vrikki, 2020) within partnerships, combine to develop DBIR projects for racially equitable aims.

Finally, we will work from the notion of anti-racist, DBIR partnerships, to illuminate how partnerships can observe impacts. Specifically, we hone in on how DBIR partnerships can aim their designs and change efforts on (1) the perceptions that partners express about racism and equity, (2) how partners talk to each other as they do their joint work, and the language they invoke which can reveal their underlying frameworks about race, and (3) how DBIR teams can be positioned within organizations – such as K-12 schools – to best facilitate specific actions (policy, programmatic, or behavioral) that partners ultimately enact, which can also reveal the changing and underlying frameworks at play. The contribution of this conceptual framework is to inform more precise conjectures about how design, implementation, and research can be utilized towards racially just change in local partnerships.

Paper 4: Children as transformational agents in the co-design process
Marcela Borge

In previous work designing technologies to enhance science and collaborative learning, my colleagues and I have often worked with learners of all ages as co-designers or as part of participatory design to help inform design processes in ways that better meet their needs (Borge & White, 2012; Borge & Shimoda, 2019).

Collaborative design of this kind is quite common in HCI and learning sciences related fields, but the purpose of the design is on the end-product, i.e., what the designer is creating (Abbas, et al., 2018; Rosson & Carroll, 2002). With some notable exceptions, such as the work of Yip and colleagues (Woodward et al., 2018; Yip et al., 2013; 2016) fewer researchers focus on other import and aspects of the co-design process like the process of co-design itself or how/what participants learn from the process.

The focus on the process of co-design is of particular interest to me and my research group, because my area of expertise is on collective regulation processes and how individuals and groups reflect on processes for the purpose of improving upon them. However, much of my work has been informed by the work of scholars who lie on the more cognitive end of the learning theory spectrum (Pandero, 2017; Wecker & Fischer, 2011; Winne & Nesbit 2009; White & Frederiksen, 1998). As such, I have historically approached such work from a top-down model, where the goal, even during co-design, was to show participants optimal processes as defined by my group and partner with them to enhance how well my interventions pushed them to use and imitate these processes.

Recently, I have come to realize that this approach to co-design serves me and my group more than it serves the children we work with. Over the last six years my research group has been working in partnership with children ages eight to twelve as part of a design-based afterschool maker space. During this time, our emphasis on the project has shifted from co-design for the purpose of creating more equitable and engaging after-school spaces that help children "optimize" collaborative processes to co-design for the purpose of critical reflection as defined by Paulo Friere (1996).

Critical reflection shares many commonalities with the classic regulation literature; they both view awareness and self-reflection for the purpose of action as an essential aspect of learning. However, critical reflection does not use reflection as a way for learners to compare their actions to models that researchers define as "optimal" for the purpose of getting users to better align with those models. The purpose of critical reflection is for learners to become aware of the artificial designs around them (Simon, 1968) and how they interact with them for the purpose of transforming those designs to better meet their humanistic needs. Thus, reflection becomes a means for learners to engage in sense-making about their world and the ways they behave within it for the purpose of self-empowerment.

As part of this symposia, I will provide examples from our club to show how and why we have gradually made this change based on our growing awareness of our young learners' needs. I end by discussing how we can push Frierre's work towards promoting digital literacy for the purpose of empowering the next generation of technology designers and users. My aim is to help young learners become more aware of how technology is shaping their world and help them and us better understand how they can transform these interactions for the better.

Paper 5: Examining design-based implementation research through linkographic analysis
LuEttaMae Lawrence

There has been much work describing the foundation of DBIR research, including the importance of building relationships, building capacity, attending to sustainability, co-constructing designs iteratively, among other high-level factors (Penuel et al., 2011; Sabelli & Dede, 2013). While this is a widely used methodology in the CSCL community, open questions remain regarding how nuanced practices and decisions in DBIR are made to produce interventions. Innovative learning takes place during the design process, and researchers rarely document or assess this to the same extent as other forms of learning (Kali, 2016). Examining the interactions in the design process can inform how to improve our processes, share insights about scaffolding collaborative conversations, and provide rich examples to scholars learning to collaborate with communities. Responding to the call for more in-depth analysis of collaborative design processes (Kolodner et al., 2016), I examine how an interdisciplinary team of researchers and users designed a collaborative orchestration tool.

In this study, I examine interactions, design ideas, and collaboration within a design brainstorm meeting of eight team members from four disciplines, two of whom were part of the design community and six from the research team. Members of the team had been collaborating within a DBIR project for several years leading up to the meeting, with the broader goal of improving collaborative problem solving in engineering higher education courses at a midwestern university in the United States. The present study describes the collaborative process to create an orchestration tool to support novice, engineering instructors as they facilitate collaborative learning. To explore the co-construction of designs, I used a traditional design method called Linkography to assess the design process at a fine-grained level by visualizing relationships of "design moves" during collaborative design

discussions (Goldschmidt, 1992). This analysis examines, patterns of interaction within discussions to understand how ideas were generated and taken up, and by whom.

In total, 1,984 turns of talk were analyzed in the design process from a three-hour design meeting. Fifty-nine critical moves emerged, defined as turns that were linked to by more than 10 other turns of talk, and the quality of interconnectedness and collaboration fluctuated throughout the meeting, but was overall high (see Lawrence, 2020). Through this analysis, I identified a pattern of interaction, wherein one turn of talk generated a high density of linking, showing that this discussion was highly connected. Through thematic analysis of these patterns of interaction, three themes emerged during the meeting, including segmented, intersected, and integrated areas. Segmented areas were patterns of interaction that were isolated design discussions that did not build on multiple areas; these areas had fewer critical moves and lower levels of collaboration. Intersected areas were patterns of interaction that were linked by one bridging turn of talk. These areas of talk had a wide range regarding quality of collaboration and design ideas that emerged. Integrated areas were interaction areas that were highly convergent conversations. Integrated areas had two to thirteen areas overlapping and had more critical moves and higher collaboration compared to segmented and intersected areas. This analytic approach allowed me to explore how the design process occurred and analyze how the team adapted ideas over time at a fine-grained level. My findings highlight the context around productive and unproductive design discussions and share importance insights for facilitating design meetings with diverse perspectives including scaffolding discussions with common goals, reflecting on tensions in the moment, and documenting ideas to scaffold integrated conversations.

Paper 6: The ebbs and flows of a multi-year DB(I)R project
Emma Mercier and the CSTEPS team

In an ideal situation, a design-based implementation research project emerges from a joint vision between groups of researchers and practitioners, who remain involved in the project throughout, and where the practitioners remain involved in the education context after the project has finished. However, this is not always the case. In this reflective analysis of a multi-year project, we will explore the fluid nature of DBIR in a university context, noting the standard of DBIR sometimes slipped more into a simple DBR project. The goal is to identify processes that fostered true collaboration across the groups, issues that stalled the collaboration and principles to embed in future projects.

This paper reflects on a seven-year collaboration with an instructional team in engineering, focused on redesigning core, required undergraduate courses. The collaboration began as two separate endeavors: 1) a DBR project focused on creating CSCL tools to support the creation of joint representations during collaborative problem solving and 2) a college-level strategic initiative to embed innovative pedagogies in required introductory courses. The DBR project was funded in the second year of the pedagogic initiative, and through a series of serendipitous events, a funding stream dedicated to moving projects from exploratory to development phases and commitment across both groups, the endeavors merged, at times, and in pieces, in such a way as to allow for true collaboration around various aspects of the reform and research processes.

The instructional team consisted of a rotating set of faculty members, with varying degrees of experience and enthusiasm for teaching introductory courses and engaging in pedagogic reform, and due to the reform process, additional support from teaching faculty on content development. In addition, discussion sections were taught by graduate and undergraduate student teaching assistants, who were employed for one or more semesters, often until graduating. The research team consisted of faculty in education and engineering, graduate students, mostly from education, and undergraduate students, primarily from engineering. There was some intentional overlap between the two groups, with a small number of Teaching Assistants hired as Research Assistants during key semesters of the project, and members of the instructional team joining the research team formally during the second half of the project. In addition, one Teaching Assistant moved to education to complete his doctorate, while another continued to work on course content with the research team after graduation. Collaboration occurred at various levels, in large groups, but also in smaller working groups.

Recognizing the importance of not just describing collaborations, but creating frameworks to draw comparisons and critiques across projects (e.g., John-Steiner et al., 1998; Wasser & Bresler, 1996) this paper reports an analysis, based on calendar entries, meeting notes and project plans and report documents. We will first describe the timeline of the project, then identify patterns that emerged over the timeline of the project and finally identify themes from these patterns. These themes are: 1) The importance of time, openness, autonomy and belonging to DBIR projects; 2) The importance of examining difference circles of collaboration, particularly in relation to understanding how different elements of the work were completed; 3) The central nature of ongoing reflection on interpretation of reform experiences from multiple perspectives; 4) Relationship development and

career transitions in higher education and 5) The co-existence of pedagogic reform and innovative educational technology research.

Paper 7: Lessons Learned from the National Network of Education Research-Practice Partnerships

Paula Arce-Trigatti

The National Network of Education Research-Practice Partnerships (NNERPP) is a professional learning community of education research-practice partnerships (RPPs) based at Rice University. Launched in 2016, NNERPP was created in response to a need for a permanent infrastructure that would allow for ongoing RPP-led learning and support. With NNERPP serving as a key mobilizer of RPP-based knowledge, the network helps catalyze the ongoing development of individual partnerships and the advancement of the field as a whole through four main activities: curation, teaching, leadership, and brokering. An annual forum brings members of our community together to share, workshop, and teach about lessons, challenges, and experiences from their RPP work. Recognizing the need to build and share a strong and robust knowledge base, NNERPP maintains an online repository and a quarterly magazine which serve as channels of communication between various actors in the RPP space sharing new insights, responses to pressing topics, and identifying community-wide challenges.

RPPs can take on many forms and pursue diverse goals, involving a wide array of representatives from research, practice, community, and everywhere in between. This feature is both a strength, in that strong partnerships typically follow the mantra of "form should follow function", and also a challenge, in that it makes learning across partnerships more complex. We have found, for example, that trust building and relationship development, co-production in the research process, and logistical aspects of the work related to project management are all processes that interact with characteristics of partnerships including the number and types of stakeholders represented, the history of the relationships among stakeholders, forms of power/authority across the partnership, etc. It has, notably, proven beneficial to have RPPs of various and diverse forms in conversation with each other, in order to spark new ways of thinking about the work.

Another challenge for the learning community is to collectively understand what it means to be "successful". These definitions emerge from characteristics of the partnership including the longevity of the partnership, what goals were named and whether they were achieved), whether and to what extent their work resulted more narrowly in research use, whether and to what extent student outcomes were impacted, whether district processes were changed, etc. Subsequently, partnerships vary in *how* they measure impact and/or value of their work. Some RPPs have used the framework proposed by Henrick et al (2017) as a starting point, others have developed their own surveys, and some use self-report, asking their partners what's working. The variation in partnership structures, approaches, and ways of documenting their value make the identification and aggregation of best practices challenging.

This poster will present examples of various models of RPPs, focusing on the collaborative processes that have been useful in various contexts of partnerships and how partnerships have judged their success. We will explore how and why particular characteristics and goals of partnerships were critical in shaping the ways illustrative partnerships have conducted their work.

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