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Establishing and Running Design Teams

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Introduction

Learning scientists have a rich history of designing curricular and instructional resources to support inquiry learning in classrooms and out-of-school settings. To design these curricular and instructional resources, interdisciplinary teams of university researchers have typically collaborated to develop resources and pilot them in classrooms with the aim of studying student learning (Fishman & Davis, 2006). Early design research (e.g., Brown, CoVis, Blumenthal, Palinscar) reflected this emphasis in collaboration and a focus on studying student learning. Although teachers may have been involved in piloting and sharing feedback on the resources (e.g., usability, student interest) in the early years of design research, they were not likely to be privy to information about underlying design rationales for the curricular or instructional resources. Researchers did not encourage much adaptation; in fact, reports from that period suggest that researchers were concerned with potential variation, particularly in how teachers might enact the instruction (Brown & Campione, 1996). While such efforts to rein in variation resulted in high-quality resources, they were not necessarily well-aligned with teachers' professional needs or the classroom contexts in which they taught.

Researchers have increasingly recognized the importance of including teachers in the design of curricular and instructional resources (see Gomez, Kyza, & Mancevice, 2018 for a recent discussion of collaborative design with teachers), and discussing design rationale and limitations. By designing with, not for, teachers, researchers are able to develop resources that will be more usable in classrooms. As researchers have expanded their focus to include inquiry

learning in school and out-of-school settings, stakeholders involved in designing resources for these diverse settings have also expanded. This shift has benefits for the design and use of curricular and instructional resources. Not only are the resources more usable, research suggests that the stakeholders involved have more ownership over the final product (Gomez et al., 2016). Studies have reported additional benefits for participants, such as professional development and learning (Bang, Medin, Washinawatok, & Chapman, 2010; Kyza & Nicolaidou, 2017).

As design-based research continues to establish a foothold within designer-stakeholder efforts, the literature describing these efforts spans many contexts including classroom inquiry activities (Ching, Santo, Hoadley, & Peppler, 2015), inquiry efforts with school administrators, and community organizations (Gutiérrez & Jurow, 2016). These research and design activities examine the curricular and instructional resources that support inquiry, as well as the design processes that led to their development. Studies report stakeholders involvement in the design processes and the ways that organizational roles and constraints impact the process and outcomes (Severance, Penuel, Sumner, & Leary, 2016). Moving beyond the what, i.e., design outcomes, the literature also highlights stakeholders' perceptions of benefits and challenges. While these reports serve an important purpose to guide and inform future scholarship, how to launch a design team, how to support and maintain such a team, are rarely discussed in detail. As designers in the health disciplines have recently noted, have noted, "the *process* of co-creation is as important as any particular products or services generated" (Greenhalgh, Jackson, Shaw, & Janamian, 2016, p. 406). Far too often, many researchers have had to figure out how to facilitate the process of design while doing design work (e.g., Stieff & Ryan, 2016).

This chapter responds to a need for a detailed discussion of how to establish, facilitate, and sustain design teams with stakeholders. We write from the perspective of researchers who are convening and facilitating design teams. The role of researcher as facilitator is consistent with the literature (e.g., Penuel, Roschelle, & Shechtman, 2007). Our stance is that designing curriculum, tools, or instruction without input from teachers, students, community youth and the organizations that serve them, is not far afield from the cognitive laboratory design and testing approach from which much of the field of learning sciences originated (Brown, 1992), and from which it has determinedly moved beyond, philosophically and practically. Designing for, rather than designing with, stakeholders is likely to yield a less than satisfactory outcome in classroom implementation, and is less likely to lead to sustained use in classroom implementation. Ideally at every stage and with respect to the various components of design, including creation of the aim of the lesson (e.g., in inquiry-based curricular materials, "the big idea"), or activity, the storyline, the materials, technology, and assessment, practitioners and other stakeholders, working with researchers, provide ideas and feedback, sharing and building their expertise with researchers. This stance drives the guidance offered in this chapter.

To situate recommendations on how to establish and run design teams, we begin with a brief background on the rationale for a participatory approach to designing curriculum, tools, and instruction to support inquiry learning. We offer examples of the design teams' constitution and the work of design teams. We then present recommendations based on our own experiences as well as from the work of researchers in the United States and Europe. We have organized these recommendations in four categories: developing project vision and goals, understanding context for design, establishing roles and expectations, and fostering participation. To elaborate on these recommendations, we present examples from design studies that developed and studied

curriculum, tools, and instruction. We highlight issues specific to designing inquiry-based teaching and learning throughout our discussion of the recommendations. Although we center this discussion primarily on the design of inquiry learning environments in K-12 classrooms, we also acknowledge important design work done in community and out-of-school settings. We conclude with some thoughts about what design teams can learn from the process of design and implications for future research on collaborative design processes.

Design Teams and the Role of Participatory Approaches

The central focus of this chapter is starting and sustaining design teams to develop or refine curriculum and instructional technologies in education. We highlight design approaches that are participatory in nature. The studies we cite involve stakeholders (e.g., teachers, students, community members, software designers) with the expertise and knowledge to develop materials that will be usable in specific contexts. Participatory approaches to design, however, have been used extensively outside the field of education. Arising in the 1970's in Scandinavia, a central aim of participatory design was to prepare non-management employees to understand tools and systems (Nygaard & Bergo, 1973). By engaging in design, employees developed conceptual knowledge and language related to technology, and they worked with management to shape the production and use of technology (Nygaard & Bergo, 1973).

In education, the primary aim of participatory design approaches is to design an educational product (e.g., a curriculum) that is usable and useful to educators and learners. The curricular and instructional resources should be locally usable because the educators and learners, or the "end users" of the resources, contributed to their development and refinement. The participatory process intentionally leverages distributed intelligence (Pea, 1993) among the stakeholders on the team. For example, Gomez, Sherrer, Borg, Dowling, and Evans (2006)

described a project to incorporate literacy supports in an existing science inquiry curricular unit. The university researchers brought knowledge of curriculum development, literacy instruction, and the role of literacy skills in science inquiry. Teachers brought extensive experience in working with the student population at the school as well as pedagogical knowledge. One of the teachers, in particular, in the co-design group, "sought to provide challenging texts for students to read" (Gomez et al., 2006, p.34). Similarly, when designing for out-of-school settings, team members might bring knowledge of the community, user design activities, and specific technology integrative expertise (Chang & XXXX). Design teams should involve stakeholders with the necessary expertise to develop usable educational products; the design process needs to draw on stakeholders' respective expertise.

Participatory design approaches anticipate what happens, "in real life" in the field, when everyday users take the artifact in hand. Variation happens. To that end, participatory design approaches guide us to avoid a practice of walling off our theoretical underpinnings. What does it look like when theoretical underpinnings are kept separate from the participatory design practices? When we create our designs "in-house", without participant collaboration, and then share them for a review with practitioners, or simply find sites for trying out the designed tools and materials, we lose the opportunity to share our knowledge, beliefs, and experience about how the theory informs practice with our design partners. It becomes all the more difficult, then, to glean practitioners and stakeholders experiences relative to the theoretical framing that we believe guides the design. Gomez, Bryk, and Bohannon (forthcoming) in an essay examining equity and variation in improvement science reform designs, reminded us of Cornfield's and Tukey's (1954) discussion of challenges to the generalizability and practicality of experiments (and we would extend this to co-designed tools and materials). They noted, "The power of an

experiment's generalizability and practical is only as good the theoretical articulation of the cases, *and the specifiable variation they represent* (our italics) (Cornfield & Tukey, 1954)". Therefore, they urge designers to articulate a "theoretical bridge" -- a set of considerations around expected "patterns of performance, [how they will] unfold, or for whom, and why (Gomez et al., forthcoming). Lacking a theoretical bridge, natural in-the-field adaptations whether large (substantial changes) or minor (in keeping with the intended design) in form, use, or content may, instead be viewed as lethal mutations (Brown & Campione, 1996, p. 291) -- subverting the theoretical underpinnings of the designed artifact. To this latter point, Trigg and Clement (2000) urge us to be willing to see our theories, in design, as inseparable from practice. It is in practice that our theories come alive and are made manifest as designed materials and tools. Participatory design research, they argue, is committed to improving both (Trigg and Clement, 2000).

Often, teachers use curricular materials, and related tools, "implicitly based on experiences and past practices, but not based on intentionally articulated and theoretically grounded principles" (Garcia et al., 2014, p. 494). In addition to more usable curricular and instructional resources, practitioners who participate in design, develop ownership of the resources and knowledge of curriculum design (Gomez et al., 2018). They are aware of the theory underlying the resources, and they can use that knowledge to productively adapt the resources in the future. Both within school and in out-of-school settings, stakeholders and researchers learn by participating in design processes (Bang et al., 2010; Kyza & Nicolaidou, 2017). Participatory design also requires researchers to negotiate issues of values, power, and authority in design (Bang, Faber, Gurneau, Marin, & Soto, 2016; Carroll & Rosson, 2007; Kyza et al., 2017). As Carroll and Rosson (2007) point out, there is a "moral proposition" inherent in

participatory design: the people who will be affected by a design have a right to contribute to its creation. To this end, learning scientists have taken up issues of power and equity in learning and design by involving community members in design (Bang et al., 2016; Penuel, 2017).

In the examples of projects that follow, researchers used a variety of ways to identify and describe a particular design approach: community-based design research (Bang et al., 2016; Bang, Marin, Faber, & Suzukovich, 2013; Bang et al., 2010), critical design ethnography (Barab, Dodge, Thomas, Jackson, & Tuzun, 2007; Barab, Thomas, Dodge, Squire, & Newell, 2004), co-design (Kyza & Nicolaidou, 2017), design experimentation (Herrenkohl, Kawasaki, & Dewater, 2010), co-design (Kyza & Nicolaidou, 2017; Penuel et al., 2007; Severance et al., 2016), participatory design (Cober, Tan, Slotta, So, & Könings, 2015; Kyza & Georgiou, 2014), and research-practice partnerships (Penuel, 2017). While it is beyond the scope of this chapter to define and characterize the similarities and differences between these respective approaches, central to each is that they involve researchers working in partnership with stakeholders to design a curriculum or technology that is locally useful. In this chapter, we focus on what we can learn from the ways these different projects involved stakeholders and the process of facilitating design.

Impetus for the Design Effort

Researchers launch design teams in response to myriad aims and local needs. A researcher's grant funding is often the impetus for forming a team. The researchers' reported aims are often to develop, adapt, or study inquiry curricula aligned with particular instructional reforms or learning standards (e.g., Kyza & Nicolaidou, 2017; Severance et al., 2016). In one multi-year research and design effort, researchers from the University of Michigan School of Education developed a partnership with the Detroit Public Schools District (Marx et al., 2004).

The researchers formed design teams with teacher and administrative partners to create science inquiry curricular materials that were centered in big questions so students would both learn both content and inquiry practices. In other cases, teams form because of a local policy requirement or administrator request. For example, Gomez, Gomez, Cooper, Lozano, and Mancevice (2016) began working with a school after the school's faculty became concerned about the number of students who did not pass an introductory biology course. The principal asked the researchers to work collaboratively with science teachers to help students recover their biology credits and helped to form the design team.

Researchers typically form design teams as a way to involve the population who will use the final products. There are a number of examples in the field of science education. In one example, Gomez et al. (2006) explained that researchers formed a design team with high school science teachers in response to the presumptive literacies (Williams & Gomez, 2002) present in the types of public reports and other trade materials frequently included in inquiry science curricular units. These units included public reports and trade materials as a way to provide more authentic connections to science learning. However, the reports and trade materials included text structures and vocabulary that made them difficult to read, especially for English language learners. The design team worked to identify and refine the text structures and vocabulary to support teaching and learning.

Recommendations for Establishing and Running Design Teams

Expertise in Membership

Design teams need stakeholders with the necessary expertise to develop usable educational products. By involving diverse stakeholders, design teams leverage distributed intelligence (Pea, 1993). When designing for school settings, researchers often involve teachers

as team members (e.g., Kyza & Nicolaidou, 2017; Penuel et al., 2007; Stieff & Ryan, 2016). Teachers can contribute a variety of valuable expertise, such as knowledge of pedagogy, curriculum, learning standards, and students, to the design of curricula and tools. For example, Kyza and Nicolaidou (2017) described a research project that aimed to create an online inquiry learning environment. The researchers worked with science teachers to design a biotechnology and genetic engineering online inquiry for students in eleventh grade. Design teams might also include students, disciplinary experts, software developers, and other technology experts. In the Kyza and Nicolaidou (2017) example, the researchers involved a biotechnology scientist and other experts at different stages in the process. Researchers select team members based on the expertise and knowledge needed to accomplish the project goal.

Design teams work to develop and study inquiry learning in out-of-school settings too (Bang et al., 2016; Bang et al., 2013; Bang et al., 2010; Barab et al., 2007). When designing for out-of-school settings, researchers have partnered with a wide variety of community members. Bang et al. (2013) described a community-based design research effort with an afterschool science program for Indigenous youth in Chicago. As a community-based design effort, the researchers believed it was important for the Indigenous community to be included in design decisions related to education for Indigenous youth. Bang et al. (2013) explained that design team members included Indigenous community elders, parents, teachers, community content experts, other experts, interested adults, and youth.

To identify and select team members, researchers have reported different strategies. Some projects involved screening potential participants to determine if they had the interest and expertise to participate (e.g., Stieff & Ryan, 2016). Stieff and Ryan (2016) explained that researchers in the Connected Chemistry project interviewed teachers to select participants who

wanted to be involved and were interested in working collaboratively. Kyza and Nicolaidou (2017) described a co-design project in which they reviewed teacher applications to select participants based on their knowledge of science and technology, as well as their teaching experience and interest in participating in co-design. Being a member of a design team typically involves an extended time commitment (Penuel et al., 2007). It is an additional work responsibility for participants. By inviting participants who have the expertise and interest for the work, then projects will be more likely to sustain involvement over time.

Developing a Project Vision and Goals

Before design teams can begin the iterative work of developing, enacting, and refining an instructional tool or curricular innovation, participants need time to develop a shared vision for the work. Researchers often facilitate conversations for participants to learn about the experiences, expertise, and interests of all team members (Cober et al., 2015; D'Amico, 2010). Writing about community-based design research, for example, Bang et al. (2010) described meeting monthly or bimonthly with a team of community stakeholders to establish a shared vision and goals for a science curricula in an out-of-school setting. The team focused on understanding science issues in relation to participants' histories and experiences during the first year of the collaboration.

Researchers have a purpose in mind when forming a team. This purpose might originate with the researcher, a funding institution, or local stakeholders. If the project is grant-funded, then there is likely a proposed project outcome. A characteristic of designing with stakeholders, however, is that the process might unfold in unexpected directions (D'Amico, 2010; Penuel et al., 2007). For example, practitioner stakeholders, given their knowledge of the context, may have particular concerns for the design direction. The LeTUS project is an example of the way a

project focus can shift based on participants' interests, needs, and expertise (D'Amico, 2010). The LeTUS project involved partnerships between universities and school districts in Chicago and Detroit to develop curriculum and teacher professional development (D'Amico, 2010). As with other projects cited here, researchers began early meetings with a focus on understanding the stakeholders' points of reference, expertise, interests, and needs (D'Amico, 2010). Researchers had to be open to shifting the project focus, within the parameters of the NSF funding, based on these conversations with educators. In retrospective interviews about the project, they reflected that curriculum became a greater focus than they had originally anticipated (D'Amico, 2010).

Design is time intensive work. Taking the time to develop shared vision and goals for the project is a critical first step to build trust among participants. Researchers might also consider holding meetings in district and school offices (D'Amico, 2010), spending extended amounts of time in a setting (Barab et al., 2007), and providing volunteer services to the community (Bang et al., 2013). These activities can help to build and foster trust.

Understanding Context for Design

Taking the time to learn more about a design context is important to the design process. Researchers need to learn about the context in which people will enact the curricula or use the tools. Regardless of the model or approach, there appears to be consensus that learning about context is an important aspect of a design process (e.g., Barab et al., 2007; Penuel et al., 2007). What is often less explicit in the literature are descriptions and characterizations of the current practices, educational initiatives, resources, norms, and routines of the settings in which a curriculum or tool will be used (Penuel et al., 2007). This knowledge is important for designing

inquiry learning opportunities as well as for creating opportunities for all team members to engage in the process (Penuel et al., 2007).

In reflecting on challenges to enacting inquiry-based learning, Edelson, Gordin, and Pea (1999) emphasized the importance of understanding resources and scheduling in the instructional setting. It might matter whether students have access to computers in the classroom and whether those computers have reliable connection to the Internet (Edelson et al., 1999). Similarly, it may matter whether instructional periods are 40 minutes or 180 minutes (Edelson et al., 1999). One way for teams to develop this understanding of the instructional setting is to hold meetings in the classrooms and other spaces where teachers, students, and other community members will enact curricula and tools (Cober et al., 2015). It may be productive to spend time in these spaces; however, Penuel et al. (2007) recommended that co-design take place outside of participants' work contexts so they are not distracted by their daily professional duties. Regardless of the context of team meetings, participants need to attend to the local setting in addition to the proposed learning goals when designing curricula and technology (Edelson et al., 1999). Design teams will be more likely to create a curriculum or tool that can be used in current contexts if they attend to the constraints and needs of teachers, students, and community members (Edelson et al., 1999; O'Neill, 2016).

Researchers need to understand schools, museums, and community organizations as contexts for learning; they also need to consider the ways these contexts can impact team members' participation in the design process (Severance et al., 2016). District and school calendars will affect when teachers can participate in the process and the pacing of design cycles (Penuel et al., 2007; Stieff & Ryan, 2016). Researchers will also want to consider how they enlist the support of administrators (Stieff & Ryan, 2016) and facilitate opportunities for participants to

work together (Severance et al., 2016). The literature on design teams highlights visible and invisible professional hierarchies that may affect how team members interact (Severance et al., 2016; Stein & Coburn, 2010). In teams with teachers and students, for example, students might look to teachers as having the authority to respond (e.g., Stieff & Ryan, 2016). Teachers might defer to researchers as experts. Community members might be skeptical of researchers' stated intent to work collaboratively. Collaborative work requires researchers to rethink their relationship with practitioners and other stakeholders (Stein & Coburn, 2010). By attending to context in these ways, researchers can ensure that all team members can participate and contribute their expertise to the design process.

Establishing Roles and Expectations

Although team members might be initially skeptical about their role on the design team (Druin, 2002), each participant has unique and valuable expertise to contribute to the process. Participants likely bring different workplace experiences and norms to the project (Penuel et al., 2007). To ensure that all participants can fully participate, it is important to explicitly engage in conversations about roles, expectations for the design process, and the day-to-day work of team members (Druin, 2002; Penuel et al., 2007), while acknowledging the individual demands participants face in their lives. Researchers often take on the task of facilitating these conversations among participants (Stieff & Ryan, 2016; Penuel et al., 2007). They may use a variety of protocols (Stieff & Ryan, 2016) and design practices (Bang et al., 2016) to guide the discussion and encourage participation.

The ways researchers introduce the design project can impact how team members contribute and interact. In describing a co-design project to develop a technological tool, Penuel et al. (2007) explained that researchers wanted to include teachers as co-designers. They were

aware that teachers felt excluded from past efforts to integrate technology in classrooms. To be clear about their intentions, researchers shared their core commitments and research questions with the teachers. The researchers' core commitments included that they would attend to the community members' concerns and learn from the co-design process. Researchers explained that they did not have the answers to the research questions; they would answer the questions alongside the teachers and other team members. By having these conversations about the research questions and core commitments, researchers presented themselves as fellow learners. Researchers will need to continue to attend to how participants are involved in the design work and assigned tasks throughout the process (Stieff & Ryan, 2016).

Depending on the model or approach to design, there will be differences in the work expectations and design-making process. Some models or approaches involve distributing different responsibilities in the design process. As part of the Connected Chemistry Project, for example, Stieff and Ryan (2016) wrote that there were three subgroups within their "work circle" configuration: development, evaluations, and teacher implementers. Researchers, teachers, students, and software designers were part of these subgroups, and each subgroup had different responsibilities at different stages of the design process. Other models or approaches involve participants in all aspects of the project. As part of a community-based design research project, Bang et al. (2010) described how the project involved community members throughout the design and research process. Community members helped to identify and define problems and how to address those problems. They were central to enacting the design as well as collecting and analyzing data. Bang et al. (2010) characterized this level of community involvement as a basic principle for community-based design.

In school settings, students are another important, but frequently overlooked, stakeholder group. Druin (2002) described four possible roles for students to play in designing technology: user, tester, informant, and design partner. These roles can be described along a continuum regarding the degree to which students are involved in the design process. In the user role, children use the technology and adults study how they use it. In a modified user role, children use the technology and provide adults with feedback about the affordances of the tools (e.g., Richards & Gomez, 2010; Gomez & Lee, 2017). In the design partner role, children are full participants and stakeholders in the design process. Druin (2002) explained that researchers may select different roles for children based on their goals, resources, and timelines. Georgious and Kyza (2014) reported on an effort to include students in the design process related to the PROFILES Cyprus professional development program. They posited that students should be part of the design of science instruction to ensure it addresses their needs and interests. Working with teachers to co-design an inquiry learning environment, Georgious and Kyza (2014) reported that some of the teachers asked for their students' perspectives on the characteristics of the ideal learning environment for chemistry. Barton and Tan (2009) reported that they included students in a design process to increase students' engagement in middle school science. They worked with students and teachers to adapt lessons to incorporate a set of pedagogical strategies for connecting home and school. They asked the students to share their experiences related to a particular unit; they also asked students to share what they thought their peers needed to know on the topic. After each lesson, students participated in a focus group interview to offer their feedback on the lesson.

Grant and budget responsibilities are another important factor related to the project structure and decision-making. Shrader, Williams, Lachance-Whitcomb, Finn, and Gomez

(2004) described the challenges inherent in collaboratively designing curricular materials when funding constrains content and form. Similarly, in describing the co-design project, Severance et al. (2016) explained that the design process was not fully democratic because the researchers were accountable to a funding agency for project outcomes. In contrast, Bang et al. (2010) described a community-based design research project that was funded by a grant with three budgets. The researchers did not control all of the budget responsibilities. This structural decision was an intentional effort to address power and equity in institutional relationships (Bang et al., 2010).

Fostering Participation

Throughout the design process, researchers need to attend to ways to support participation of all team members. But not simply participation. It is important to create opportunities for people to work together, especially because participants do not likely work together in their day-to-day professional lives. Researchers can create these opportunities by articulating a design process and allowing that process to take the project in unexpected directions (Cober et al., 2015). It is especially important for participants to see that their ideas are valued (Cober et al., 2015). One exciting approach to explicitly building opportunities for ideas to be recognized as valuable is idea elaboration. In Druin's (2002) work with children as design partners in the University of Maryland's Human-Computer Interaction Lab, an important part of the design process with involved a steady development of an initial seed idea. When either a child or adult shared an idea with the team, the other participants would then build on that idea. Writing about the Connected Chemistry Project, Stieff and Ryan (2016) explained that they also worked hard to show teachers and students how their recommendations contributed to the designs. Researchers held meetings in schools and district offices to highlight how the teachers'

and students' recommendations contributed to the artifacts. They acknowledged all participants on print materials.

Enactment seems to be an especially valuable component of the design process (Cober et al., 2015; Kyza & Nicolaidou, 2017). Kyza and Nicolaidou (2017) described a co-design process that involved multiple stages: initial design, first enactment, redesign, and second enactment. They highlighted a design principle that the co-design process should include both design and enactment phases. These cycles of planning, enactment, and refinement can allow teams to become clearer in their theories for how a tool or curricular resources will lead to the intended outcomes (Ko et al., 2016). A teacher is better able to inform the redesign if they have participated in the design and enactment phases. Penuel et al. (2007) suggested that opportunities to test designs through enactment allow team members to take ownership of the designed artifact. It can also be motivating for participants to work together with a shared interest on improving learning environments for students (Cober et al., 2015; Herrenkohl et al., 2010).

Diversity and Inclusion as a Social Good

In his acceptance speech, after receiving the 2007 Nobel Peace Prize, Vice President Al Gore quoted an African proverb, "If you want to go quickly, go alone. If you want to go far, go together." Here we are reminded of the power in moving outside of individual strengths, instead leveraging the power and the presence of the few or the many. In design, leveraging the power of the few or many, through consciously attending to diversity and inclusion in selecting design team composition, offering the possibility of creating a designed context that represents part of a social good. In Ancient Greece, philosophers characterized a social good as something that offers a significant and positive benefit to many people. Why does diversity matter for design teams? We draw from a 2017 Interaction Design and Children Conference workshop on Equity

and Inclusivity (Sobel, Kientz, Clegg, Gonzalez, & Yip, 2017) which noted that "[t]hese issues—equity and inclusivity— complement each other as we can use equitable practices and approaches to promote inclusion in our designs and methods." Boivin et al. [9] suggest diverse partnerships require consideration of credibility of each voice, legitimacy of knowledge each person brings and contributes, and paying attention to power. We suggest that inclusion benefits team members, and benefits the designed product through the representation of diverse experiences and perspectives.

Over the past decade, researchers aiming to build and support design teams are reflecting on personal, professional, and community concerns about the limitations of designed efforts that lack representation from multiple constituents, and the limitations of designed products that fail to reflect representation from multiple perspectives and experiences. Our design community is also recognizing our responsibility in activity making space for diverse representation - social, economic, ethnic, religious, linguistic, community, and related considerations - in design team membership (Penuel, 2017). Diversity in representation on design teams can be deliberate sought and strategically leveraged. Characterizing their pioneering work with Quest Atlantis, Barab et al. (2004) described the effort as critical design ethnography grounded in an inquiry approach to instruction. They suggest that it is helpful to address/reflect on the social implications/agenda of design. To understand the contexts for which they hoped to contribute design, the researchers spent an extended period of time in the Boys and Girls Club and schools, learning about the spaces (2004). They considered the Club and school staff, students, and parents their co-designers, and they developed an agenda with these practitioners and youth. Because they spent an extended amount of time at the site, which was not their initial plan, they developed an understanding of what participants/collaborators wanted the outcomes to be. This critical

approach to design led to the development of social commitments and critical commitments that were then build into the design. These commitments informed the collaborative design process with teachers and children as they collectively sought to understand what children would find interesting and what features would make the program usable for teachers.

Conclusion and Future Directions for Research

We began this chapter with a set of claims about the benefits of leveraging a participatory approach to designing curriculum, tools, and instruction to support inquiry learning. We have described considerations of design team composition and work. We offered recommendations for organizing and facilitating design teams, presented in four categories: developing project vision and goals, understanding context for design, establishing roles and expectations, and fostering participation, and highlighted issues that often emerge. We provided examples based on our own experiences as well as from the work of researchers in the United States and Europe, and particularly focused on design studies that developed and studied curriculum, tools, and instruction in both formal and informal contexts. Here, as we close this chapter, we offer some reflections about what design teams can learn from the process of design. We also suggest some paths for future research on collaborative design processes.

Design, as a practice, aims to create knowledge, and support knowledge use. In our view, the best examples of design team efforts keep relationships (Gomez, Rodela, Gomez, & Pressman, under review) in the first position, and context (Barab & Squire, 2004), and usability (Dede, 2005), at the center of the work. When planning for, and creating design teams, attention to concerns such as (1) who is being invited to participate, why, and how will that person(s), because of possible experiences and training, likely shape the direction of the designed effort; (2) in what ways are participants helped to feel valued in the effort, e.g., are they able to see

evidence of their expertise in the design process and/or designed product as it is evolving; (3) with an aim to create a colleagueship amongst team members, is time and effort being devoted to teasing out the differences in how team members people understand "commonly understood" pedagogically, epistemological, and socio-emotional concepts? A lack of shared language, awareness of differences, and efforts to build shared understanding can fracture the design effort; and lastly (4) in facilitating and maintaining effective design team processes, is attention being given to how all design team members are contributing to an understanding of the features of the learning context for satisfactory implementation? Working successfully with others, as in most relationships, requires attention to shared values, shared vision, regular communication and regular contact.

Future research into design team creation and facilitation would benefit from attention to identifying how the elements described above, serve to create strong and effective design team relationships and usable products that are successfully implemented in the learning contexts. While we recognize that the designed tool, product, and its implementation are essential, we encourage research that attends to what is being learned from different stakeholders on the design team, how do their experiences become evident in the process and designed product, what is the researcher learning about the context, that would not have been know-able without the design team member(s), what differences are evident within and between people who seem to share the same backgrounds - how might the intersectionality of race, gender, social class, community, and other elements that constitute humanity (Crenshaw, 1989) be a factor in design team effectiveness, and in what way does the researcher iteratively learn from attention to these issues, as she moves from design effort, to the next effort to create, facilitate, and participate in design teams? These aspects of the experience of facilitating and participating in design teams

have been sorely neglected in the literature. Given the increased role of participatory design and design team creation and activities for effective implementation, it is our hope that future researchers will attend to these issues.

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