

Designing to Disrupt While Encountering Disruption: Engaging with the Unexpected in Educational Research and Practice

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Abstract: This symposium brings together eleven projects across three continents to examine notions of disruption in educational research. Historically, notions of disruption have pointed to the ways research leverages innovation and transformative practice. However, amid global pandemic and intersecting unrest, the authors in this session recognize the need for deeper conversation across contexts to understand the ways that educational research in the learning sciences can leverage disruption toward transformational learning. To respond to this year's call for building and

sustaining knowledge in community, we seek to foster conversation about the ways that designed for and encountered disruptions act as opportunities for critical reflection and new kinds of engagement in educational research. Together, we examine various notions of disruption as they exist in our disparate work. We seek to provoke meaningful conversations about the ways educational research can embody the contemporary realities of learning with and toward disruption.

Overview and significance

Notions of disruption have been used in educational research to recognize innovation, shift oppressive systems, and engage in transformation of business-as-usual across organizations. Historically, educators and scholars seeking to design and study expansive and liberatory learning environments have characterized their work as a disruption of entrenched systems (e.g., Kafai et al., 2014; Ma, 2016; Nasir & Vakil, 2017; Stetsenko, 2017). However, the global turmoil of recent years — the COVID-19 pandemic, as well as the continuing escalations of the climate crises, white supremacy, and authoritarianism — have sparked ongoing conversations positioning disruptions as forces external to educational settings that must be overcome lest they lead to “learning loss” (e.g., UNICEF, 2021). Recognizing the dichotomy between what we conceptualize as *designed for* and *encountered disruptions*, the scholars in this symposium consider how we might foster dialogue across projects to see both forms of disruption as opportunities for critical reflection and engagement in educational research. Specifically, we look across 11 projects that took place on three continents and within a variety of educational contexts to examine the ways that notions of disruption in education can be not only theorized but also operationalized to change hegemonic expectations of educational systems toward more expansive ways of knowing, doing, and creating.

Responding to the ISLS call for innovative symposia to respond to changing times while building community, we use this hybrid structured poster session to question the ways that both designed and encountered disruptions to educational structures can offer opportunities to co-construct new ways of knowing across intimate networks, learning communities, and institutions. We follow colleagues such as Lopatovska et al., (2022) to consider the ways that young people and their educators are not only resilient but powerful agents of change in the face of challenging circumstances. In this proposed session, scholars draw from sociocultural and constructivist theories of learning, as well as notions of criticality, embodiment, temporality, and design to reconsider the ways that our work can build knowledge and community collectively *because of*, rather than despite, the continuing disruptions in our individual lives and global society. We also examine the ways that different groups of learners, particularly those with historically marginalized identities, have been positioned as disruptive and have experienced disruptions to learning in differing and often violent ways (e.g., Patel, 2015; Tuck, 2009). This session will provide theoretical, methodological, and practical tools that can inform learning sciences research concerned with promoting change in educational opportunities toward more liberatory, participatory, and just futures.

Although the posters feature a variety of methods, all share perspectives that data can and should be representative of the multiple and complex ways that learners and educators navigate the world (Bridges, 2020). This complexity is part of the analysis that examines *designed for* and *encountered disruptions* across projects. While each project investigates notions of disruption, they span different timelines before, during, and after the pandemic. These multiple timeframes also mean that the authors take up a spectrum of perspectives ranging across constructivist, critical, and post-structural epistemologies. Despite these differences, each of the projects suggests new ways of theorizing or operationalizing disruption toward more equitable and transformational ends for learners.

Poster abstracts are listed below alphabetically by first author and referred to here by number in this sequence. Some of the posters, including 3, 4, 6, and 11, examine disruption as an outside-of-project force that asked partners to reimagine what it means to collaborate in the face of environmental changes, including COVID-19 and the climate crisis. Others, including 1, 2, 5, 7, 9, and 10 take up socio-cultural/critical perspectives to question what it means to design learning experiences and environments toward the disruption of traditional systems of power. Many of the posters speak to the tensions in between these perspectives, addressing the ways that both kinds of disruption intersect and reshape educational research. While a few of the authors engage more traditional methods and perspectives around technology and design, all question the ways that young people have been positioned to learn (or not) within traditions of education. Finally, poster 8 pushes critically against other perspectives in the session, questioning the ways that notions of disruption are often embedded in theories of whiteness. These authors offer creative counterpoint, enriching the potential for conversation by posing questions of institutional resistance that requires learning to be theorized as a fugitive act (Patel, 2015) if it is to serve those historically marginalized and barred from educational spaces.

To effectively bring these pieces into conversation, we engage in a 75-minute innovative structured poster session that will include hybrid and multimodal components alongside traditional posters to allow for participation from across continents. The session will open with a brief introduction, followed by highlights of each poster. There will be two rounds of free-form time during which the audience can engage with the different posters; in each round,

only half of the poster-presenters will be at their posters, to allow presenters to engage with each other. The session will conclude with two discussants, both with extensive research in the learning sciences related to the ideas in the session. Drs. Sherice Clarke and Joseph Polman will offer both provocations and contextualization of the works in the context of the field. There will be ample opportunity for audience active participation during free-form segments, and following the commentaries. We see this session as an opportunity to facilitate necessary conversations responding to the conference theme about how to engage in learning research toward community, while attending to technology, relationality, and the ever-present need to disrupt whiteness toward more expansive ways of knowing and being.

Poster 1: Bilingual practices by indigenous language teachers

Zaynab Gates

In Latin America, home to 42 million Indigenous peoples speaking more than 500 languages (Sichra, 2009), bilingual education is key to protecting Indigenous children's right to learn in their mother tongue. Teaching in Indigenous languages requires, in turn, the preparation of Indigenous teachers who can develop effective oral and written bilingualism in their students. Centering the voice of Indigenous language teachers and drawing from the continua of bilingualism framework (Hornberger, 2004), this study at two teaching institutions in Northern Argentina examined the challenges and strategies Indigenous language (Qom or Wichi) teachers employed to disrupt hegemonic notions of language acquisition that have historically stolen language from Indigenous youth and instead become Indigenous language promoters.

This paper responds to the session call to examine notions of *designed disruption* by theorizing Indigenous methods of storytelling as a means of language preservation that can halt the white supremacy and settler colonialism (Tuck, 2009). The authors will use the poster to explore the ways that Indigenous storytelling can act as a tool to disrupt the loss of culture and transform educational experiences for Indigenous youth. Using Indigenous storytelling interviews (Iseke, 2013) and collaborative analysis of data with Indigenous researchers, this study contributes to understanding motivation, strategies, and concepts used by Indigenous language teachers to persevere in their educational trajectory and to design their learning experiences as Qom or Wichi language teachers.

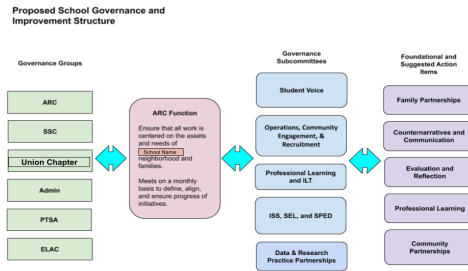
Poster 2: School governance policy for racial justice: Disruption as impetus for policy infrastructuring

Ung-Sang Lee & Marcus Van

This poster presents a case study of efforts to refine the infrastructures (Dantec & Disalvo, 2013; Penuel, 2019) for a research-practice partnership (RPP) between a university and a partnership secondary school serving historically minoritized students to center racial justice. Such infrastructuring led to the formation of new school governance policies that reconfigured the roles of students, teachers, family members, and researchers. This work was situated in a school-university partnership that housed multiple RPPs in their formative stages. The *external disruption* to schooling from the COVID-19 pandemic, as well as broad anti-racist organizing, created opportunities to engage in RPP infrastructuring work framed by three priorities identified by partners: 1) to center anti-racism in the school-university partnership, 2) to align the somewhat disparate RPPs around shared goals and processes, and 3) to deepen the participation of students and their guardians in RPP efforts. In response, over a six-month period, 30 students, guardians, teachers, school administrators, and researchers met weekly in efforts to redesign the school-university partnership infrastructures. The school's Anti-Racist Committee (ARC), successfully reformed governance structures so that ARC members had representation on the School Council. Further, ARC was able to guide all RPPs that took place in the school (Figure 1). ARC members viewed this localized policymaking as a model for broader systemic change and sought to scale the governance policy even beyond the school district.

The case illustrates the ways efforts to disrupt policy contexts in the face of unexpected disturbances, such as the COVID-19 pandemic, can support educational change that privileges minoritized school stakeholders and the assets they bring to bear. Such forms of participation serve as fertile ground to disrupt traditional notions of educational policy making. As such, universities and policy makers are encouraged to consider how policy making intersects with RPPs and how such intersections may advance justice-focused educational change.

Figure 1
ARC School Governance Proposal



Poster 3: Remote Classroom Research Toward Equity during the COVID-19 Pandemic Tomohiro Nagashima, Gautam Yadav, Vincent Alevan

School classrooms are a critical part of learning sciences and technology research that aims to understand and support learning in an *authentic* learning environment. However, during the COVID-19 pandemic, K-12 schools in the U.S. were forced to make a transition to “emergency remote learning” (Khlaif et al., 2021), where students and teachers were required to continue their teaching and learning remotely, at least to some extent (e.g., hybrid teaching). While this drastic change in schools led to issues that made teaching and learning challenging, especially amongst students and families in under-resourced communities, it also offered new opportunities to make sense of the realities that students, their families, and teachers were coping with during their teaching and learning activities. To align with this session’s examination of *external disruption* that catalyzed educational change, we ask: What can the the COVID-19 pandemic teach learning scientists as they continue to collaborate with school partners in times of crisis?

We propose that remote classroom studies can help advance the learning while proactively promoting equity in educational technology research during such a crisis. Although remote classroom research on learning technology (i.e., observation through a video conferencing platform while students are using the technology) can be challenging, it has potential to offer new opportunities for learning and participating in research in remote and under-resourced communities that may not have been accessible for partnerships with researchers before the COVID-19 pandemic.

During the COVID-19 pandemic, we conducted nine classroom studies remotely in five states in the U.S. These studies created opportunities for partnerships with educators in rural and remote areas that had been unavailable before the pandemic and offered a window into students’ learning by allowing for study of unmoderated home learning. Analysis of teacher interviews from these experiences led to the development of a framework for conducting remote classroom research on learning technology (Nagashima et al., 2021), which can be used to help researchers address equity and logistical issues when planning and conducting classroom research on educational technology remotely. In the proposed poster session, we will discuss the possibility for this framework to act as a *designed disruption* of more traditional notions of classroom research and the ways that remote engagement in learning research might offer more equitable perspectives on the learning communities in rural and remote areas.

Poster 4: COVID-19 opportunity for transformation within research-practice partnerships Robbin Riedy, Kristina Stamatis, Caitlin Farrell, Paula Arce-Trigatti, Alison Fox-Resnick, William R. Penuel

Research-Practice Partnerships (RPPs) have potential to “support the mutual learning of partners to change practice while continuously adapting to turbulent environments of schools” (Penuel, et al., 2021). However, as the COVID-19 pandemic and its intersections with political unrest and police violence created one of the most turbulent environments schools in the U.S. have ever faced, many RPPs found themselves struggling to continue pursuing collaborative goals (Ishimaru et al., 2022). In this poster, we explore data from 24 RPPs to understand the ways that members characterized their work together amid these global *encountered disruptions*. We ask: What are the characteristics of RPPs that leveraged the COVID-19 pandemic toward transformation?

This work acts as a secondary analysis of interview and survey data from 24 RPPs in which 112 members provided self-evaluations of their partnerships across five dimensions of effectiveness and equity (Farrell et al., 2022). We frame this analysis with theories of active waiting (e.g., Lee et al., 2020), which refer to the planning and action that can take place during periods of turbulence and offer a way to theorize the characteristics that supported some RPPs in leveraging *encountered disruptions* toward more transformative goals (Tanksley & Estrada, 2022). Our data illustrate in RPPs that aimed to improve traditional measures of school success; many partners said their work was delayed during the pandemic. In some cases, the pandemic reinforced a sense of futility. As one partner said, “COVID has shown that a lot of things in our society are broken.” However, in RPPs that had focused their work on disrupting

traditional power relationships in education, many partners said the urgency of the pandemic energized their work. In these RPPs partners spoke of developing more empathy for their colleagues while revising the ways their work could transform education. This kind of active waiting meant partners acted toward change, even as their intended work was disrupted due to COVID-19.

Given initial analysis, we conjecture that RPPs' stances towards how they achieve their objectives — through either working within traditional measures of educational success or attempting to disrupt the system all together to create new models of educational equity—influenced how they approached the period of active waiting during the pandemic. This paper contributes to the objectives of this symposium by exploring the ways that RPPs were able to navigate their work and relationships in the midst of *encountered disturbances* and addresses the conference theme by examining the ways RPPs can leverage disturbance and change toward transformational community learning.

Poster 5: Memes in memory institutions: Youth interests and literacies as encountered disruption in design-based cultural heritage work

Emily Oswald, Line Esborg, Palmyre Pierroux

Cultural heritage institutions face changing expectations about engaging with and representing diverse constituencies, including young people. While many museums and archives have developed projects and programs that involve collaboration with new audiences, these activities can reproduce the very power dynamics they seek to disrupt or introduce disruptions that institutions are poorly equipped to engage with productively. How can museums develop new knowledge practices needed to become more just, democratic and participatory institutions?

Building on a previous study (Oswald, Esborg & Pierroux 2022) of youth, memes and memory institutions, this poster explores an encountered disruption in New Voices in the Archive, a youth engagement program at the Norwegian Folklore Archive. Aiming to expand the representation of young people in the archive's collections and their participation in institutional practices, the program was developed through a university-initiated, design-based collaboration (McKenney & Reeves 2019) involving educational and cultural heritage researchers and young people (ages 16-19) from Oslo, Norway. The study involved three interventions over the course of approximately one year. During the implementation of the second intervention, researchers identified young peoples' knowledge of internet memes (Shifman 2013) as a potential focus area for the third intervention.

To explore how the New Voices program resulted in the emergence of novel and participatory knowledge practices at the Norwegian Folklore Archive, we propose that young peoples' interest in and knowledge of internet memes can be conceptualized as an encountered disruption within a design-based research process. We describe how researchers responded to initial references to memes during in-person meetings and the ways in which the task of selecting and contextualizing memes supported the young people's agency by demonstrating their literacy with memes as a genre of digital media. We argue that New Voices, a program designed to disrupt the archive's established approaches to collecting folklore, was successful in large part because the ways researchers' and young peoples' engaged with this encountered disruption.

Poster 6: Frames of the planet: Climate justice in the science classroom

Sushil S

The latest report by the Intergovernmental Panel on Climate Change (IPCC) projects some damage to human systems and ecosystems in the near future if we fail to limit the global temperature level increase to 1.5 degrees Celsius above pre-industrial levels (Pörtner & Roberts, 2022). At the same time, around 84% percent of the children in the ages of 12-14 years across the world are enrolled in schools, with younger children enrolled at even higher rates (UIS, 2019). However, particularly in early grades, while there is some evidence of strong scientific teaching, the "overall picture of understandings of scientific inquiry is not what is hoped for after completing 6 years of elementary education in any country" (Lederman et al., 2019, p. 486). Worldwide, there is a prevalence of compulsory school attendance laws that suggest that schools must take an active role in attending to and planning for *encountered disruptions* such as climate change. Recognizing the precarious situation of young people in the world due to the impending impacts of climate change, this study examines how teachers draw from their own knowledge and potentially reach beyond pedagogy and content in order to shape students' frames of the planet.

In this study, I take up Goffman's (1974) notion of frames as the multiple ways that individuals construct, organize, and differentiate meanings of their lived experiences. I examine the ways that teachers drew upon their own knowledge of science and its application in their own lives and cultural backgrounds to understand how they shape

student framings of climate change. Data collection took place through qualitative inquiry into a high school earth science teacher's pedagogical practice. The data for this study, collected over two units across 8 weeks, include conceptual interviews, classroom discussion transcripts, and field notes to examine how the science teacher's frames traveled through their planning, teaching, and reflection as they taught two different units. Additionally, the data also include student conceptual interviews at the beginning and end of each unit to examine connections between how the students' frames shifted through each unit with and against the frame deployed by the teacher. This study adds to the literature of how frames are deployed by teachers and learned by the students in the classroom. Findings from this study can inform further research and action on how researchers and teachers might redesign and disrupt unsuccessful or limited processes of constructing scientific knowledge in the classroom to make way for knowledge that engenders actions towards climate justice worldwide. Reframing scientific inquiry toward more action is a necessary step in research and classroom design if we are to use collective action to address and disrupt the disaster that climate change and global warming currently promise.

Poster 7: Re-imagining learner identification with discursive protocols in times of change Stephen Sommer

This ongoing research project explores notions of *designed disruption* within the process of unlearning, reimagining, and cultivating belonging as high school students (re)discover how they identify as learners through multiple iterations of structured community presentations of learning (POLs). This study took place at an independent, tuition free school for "students who were not otherwise finding success" in traditional learning contexts (school website). As a move to disrupt students' experiences with traditional schools, three times each year across their multi-year tenure, students organize a POL of their own human development. These POLs act as interactive portfolios in which students present examples of both their academic and personal growth. Students then use a discursive protocol based upon exhibitions of learning (Sizer, 1992) to engage in structured discussions with peers, teachers, and community members. These conversations take place in multiple rounds over two or three days. Throughout this discursive process of presentation and then in the subsequent fielding questions from community members, students come to recognize sites and experiences of growth beyond the confines of the classroom (Tracy & Robles, 2009).

In this study, I examine the process through which learners develop identifications (e.g., Polman, 2011) and how that process is supported and enabled through the designed structure of the POLs, the investment and sense of belonging in a committed community of learners, and multiple opportunities to engage in this performative ritual (e.g., Bucholtz & Hall, 2005). This multi-year ethnographic study draws data from video recorded POLs, interviews with students, faculty and school designers, as well as an analysis of student generated artifacts including visual aids, letters to community panelists, personal reflective essays, and guided prompts such as "I used to be...but now I am." My findings indicate that throughout the process of engaging in POLs, students recognize and articulate an expansive view of learning that is attentive to their full self well beyond a narrow assessment of gaining or retaining academic content. Additionally, findings suggest that the POL experience empowers young people to recognize sites of their own learning and increase agency in exploring and articulating their evolving identities. This paper has potential to support understandings of designed disruption by bringing youth voice to bear on the ways traditional learning design requires disruption to support the development of learner identifications.

Poster 8: Plática as circle and crossroad: Fugitive counterstories of cḥi em author: Fugitive cḥi em apapachando

Trang Tran, Marlene Palomar, Adria Padilla-Chavez, Ashieda McKoy, Brenda Aguirre Ortega, Fabiola Palomar, Trang B. Tran

Patel (2016) reminds us that learning is, at its core, a fundamentally fugitive act. In this paper, we push back against the notions of disturbance included in this session. Identifying as first-generation femmes of color, our endeavor to seek doctoral degrees in the field of education has faced enduring opposition. These include institutional resistances to change and difference; curricula and pedagogies that reinforce white supremacy, oppression, and trauma; and personal interactions that left us with feelings of tokenism, isolation, invisibility, and invalidation (Harris, 2016; Hubain et al., 2016; Patel, 2015). In addition, systemic pushback has created disruption against heterogenous ways of knowing and has historically forced learners towards a dominant, assimilative culture. In this reality, our group strategically fled from institutional hostility to seek a counter space. Fugitive wellness is an act of self-preservation and political warfare (Lorde, 1988, p.130). Our *fugitive wellness* has been grounded at the crossroads of healing, *hermanidad*, and quenching desires for dignity. In an alternative space we have created, imagined, embodied, and nurtured an environment for safety where we allowed ourselves to be vulnerable; this is where we laid a foundation

for critical dialogues and collective sense-making of our own experiences, intellectual survival, and our futures in the academy. We seek to develop *fugitive practices* (Patel, 2019) to defy and disrupt individualistic, competitive, and linear trajectories of achievement—ones that are perpetually reproduced in our academic institution. Our practices redefine learning through a lens of solidarity where learners are attentive to each other’s emotional and spiritual health. As a group, we become a beacon of hope for one another.

We disrupt this session through collective and creative autoethnographic work. In this symposium, we will use artistic portrayals of selves as data to reflect on our group’s engagement with different modalities during meaning-making, storytelling, and writing. As we frequently find each other in counter space to process, affirm, and devise strategies for wellness, we explain how such fugitive practices took place in various mediums of human communication, including poetry, imagery, sound, sensory, emotion, and movement. Such multimodalities have been important for how our group makes available physical, mental, and emotional support for each other as we sustain this sacred fugitive counterspace. Such processes of joy and strength have sustained our collectivity and offered nutrition—like *apapachos (hugs)*--for our souls.

Poster 9: “It was nice to know that they felt the same things we did”: Disrupting generational hierarchy and mental health stigma in a youth program through adult facilitator vulnerability

Sari Widman

To address the mental health crisis that has increasingly gained attention following the COVID-19 pandemic, educators must move beyond traditional notions of social-emotional learning (SEL) and invest in collective intergenerational work that is designed to disrupt oppressive systems that contribute to mental-unwellness (Jagers et al., 2021; Rosen et al., 2021). Prefigurative practices of relationship-building, that put into practice caring relations to disrupt hierarchies, are core to justice-oriented learning and collective social movements (Uttamchandani, 2021). Here, I look at the role of “check-ins” as a prefigurative relationship-building practice in a youth leadership program.

The program engaged BIPOC youth who identified as facing a variety of mental health challenges, as being neurodivergent, or as having queer identities. Interviews were conducted with 7 of 11 youth participants in June 2022 following the first months of the 1.5-year program. There were six adult facilitators (including the author), who regularly attended sessions and provided support. The program was designed to create social change by engaging youth in collective art making around issues of mental health to disrupt cycles of intergenerational trauma and strengthen networks of community care. Check-ins were conducted at the beginning of each weekly program session to give youth and adults the opportunity to share about their lives and emotional states. Based on analysis of interviews with youth to understand their perceptions of adult facilitators’ participation, I found facilitators’ vulnerability during check-ins helped to disrupt generational hierarchy, stigma, and traditional narratives around mental health.

While youth consistently talked about the importance of check-ins for feeling less alone in their experiences and creating a safe environment, the process of opening up was gradual. One youth, who described opening up during check-ins as shifting from their least favorite to favorite part of the program, said that facilitators modeling openness and vulnerability helped her feel comfortable doing the same, “It’s okay to you know, not be okay. It’s okay to open up.” Youth also described adult sharing and “being themselves” as creating a sense of safety in the space that built connections between their experiences as teenagers and those of the adults. This sense of relatability and connection shifted ideas of differences between how adults and teens might experience mental health challenges. As one youth put it, “It was nice to know that they felt the same things we did, even though they were adults, you know, like the generational gaps didn’t really change anything.” Youth also expressed that adults sharing was “eye opening.” One described hearing that teen mental health struggles were “just a phase” and so thought adults “don’t have any issues.” Disrupting this idea of mental health struggles allowed youth to revision their own experiences. This poster unearths the potential for *designed disruption* of the hierarchical and linear narrative of youth as struggling and adults as authoritative figures who have things figured out.

Poster 10: Disruption of Gender Representation in Computational Toys and Kits for Young Children from a Design Perspective

Junnan Yu

While the importance of introducing computational thinking (CT) to young children has been widely acknowledged, inequities persist as CT is accessible differently along gendered lines. Despite these inequities, early childhood is fertile ground for cultivating young people’s interest in computing and has even been found to hold potential in

mitigating gendered stereotypes around coding and robots (Bers, 2017; Clements & Gullo, 1984; Papert, 1980). Computational toys and apps, also called coding kits, are the major media for children ages seven and under to engage in coding and CT (Yu & Roque, 2019). Although many coding kits are available, much remains unknown regarding their impacts on young children, especially how they may welcome participation from children of different genders.

In this study, I seek to understand how designers might use *designed disruption* as a means of reimagining expressions of gender equity in computational toys and coding kits. This perspective is critical because children start to conceptualize gender at approximately 18-months (Martin & Ruble, 2004; Rubegni et al., 2019; Weisgram et al., 2014) and may have already formed the stereotype that boys are better at programming than girls as early as six years of age (Martin et al., 2016). Further, children's gender conceptualization can impact their engagement with toys—for example, avoiding toys that do not fit with their formed gender identity (Carter & Levy, 1988; Weisgram et al., 2014)—which can perpetuate inequities in access to CT. Creating gender-inclusive coding kits are especially important to disrupt gender stereotypes about computing and welcome participation from children of different genders, particularly given that computing is already a field heavily dominated by males (Hill et al., 2010). However, no studies have examined gendered design features in coding kits and so few guidelines exist for designing gender-inclusive coding kits and broader learning technologies for young children.

This poster will examine gender representations in coding kits for young children and present a framework for *designed disruption* of traditional computational kits and toys. Specifically, I will (1) present a developing framework to evaluate and disrupt gender-related design features in toys for young children and employ the framework to analyze how existing coding kits represent genders; (2) discuss the ways young children (target users of coding kits) and their parents (gatekeepers of coding kits) assess the gender orientations of some representative coding kits. This poster contributes to the symposium by raising notions of gender in discussions of disruption and presenting a potential framework that can be used as design guidelines when designing for disruption in computational settings.

Poster 11: The effects of educational technology games on students' conceptual understanding of algebra in the context of COVID-19 pandemic

Jenny Yun-Chen Chan, Avery H. Closser, Vy Ngo, Hannah Smith, Allison S. Liu, Erin R. Ottmar

Prior work has shown that middle schoolers struggle with algebra (Kieran, 2006), but educational technologies, such as DragonBox12+ (Liu et al., 2015) and From Here to There! (Decker-Woodrow, in press) have potential to disrupt this struggle by engaging students in game-based (Connolly et al., 2012) and embodied learning (Abrahamson et al., 2020) to support students' algebraic performance. Uses of technology became even more important during the *encountered disruption* of the COVID-19 pandemic when students were often receiving inconsistent instruction in mathematics. However, it remains unclear *which* aspects of algebraic knowledge are impacted most by these technologies. Leveraging data collected during the 2020-2021 academic year, we aim to advance understandings of whether these technologies improve students' *conceptual knowledge*, *procedural knowledge*, and/or *procedural flexibility* in algebra during these kinds of *designed disruptions* of traditional educational instruction.

Using an experimental design study with pre- and post-tests, we found that seventh graders significantly improved and maintained learning gains on conceptual knowledge throughout the technology-based interventions (Pretest: $M=46\%$; Posttest: $M=53\%$). However, they did not improve on procedural knowledge (Pretest: $M=55\%$; Posttest: $M=51\%$) or procedural flexibility (Pretest: $M=52\%$; Posttest: $M=44\%$). This pattern of results was consistent for students across interventions, suggesting that while these technologies may support conceptual understandings in algebra, further work is needed to explore how technologies might support student learning of algebraic procedures.

These findings have implications for research on the educational impacts of the COVID-19 pandemic and ways to support algebraic learning through technologies beyond educational disruptions. Specifically, DragonBox12+ and From Here to There! can engage students in algebraic learning and improve conceptual understanding. These gains are worth noting given the drops in math performance among U.S. students during the pandemic (NAEP, 2022). Both may help students engage with mathematical content and foster their positive attitudes towards math especially during educational disruptions. Supplementing middle school algebra curricula with game-based technologies may provide additional opportunities for students to deepen their conceptual knowledge. This poster contributes to the symposium by raising issues of impact within designed disruptions of traditional teaching, particularly when intersected with other *encountered disruptions* that may necessitate the use of technologies for learning.

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