Research Statement

My scholarship leverages methods and approaches from the learning sciences, design, and human-computer interaction (HCI) fields to understand how to **co-design equitable technology-enhanced STEM learning environments with communities most impacted by technology**. My research expands previous work on co-design to think deeply about how our co-design practices embed equity. Although past research has focused on creating equitable tools, my research highlights how to **promote equity in the process and the final product.**

My work explores how to choose equitable design methods *and* how they are applied to address critical problems in education. How I make decisions about co-design processes is intentional and reflects the unique needs of the communities who are involved, their historical, cultural, and political contexts, and are flexible to emergent conversations and ideas. My program of research answers equity-related questions about how to make these decisions, how they impact communities during the design process, and how the resulting designs are situated in context. Over the long term, my research drives work in the learning sciences toward democratizing the design process to produce more equitable and inclusive technology-enhanced STEM learning environments. Examples of these contributions include investigating how we name and learn from community driven solutions, positively disrupting power dynamics within design teams, and raising awareness of how trauma and situations that trigger individuals and communities can impact designs and how they are implemented.

Interdisciplinary Research Contributions

I have more than seven years experience leading, organizing, and facilitating co-design activities for NSF, IES, and other grant funded projects, as well as consulting on learning sciences related co-design work. In these projects, I have partnered with a range of communities within and outside of schools, including K-12 contexts (e.g., students, teachers, families), higher education (e.g., faculty, students, course instructors), and organizations (e.g., educational companies and nonprofits). These projects have resulted in scholarly contributions for which I've been recognized across diverse fields including HCI, design, and learning analytics. These fields have unique cultures and traditions, yet my work has been recognized in each. For example, my work received a best design paper nomination in the *International Conference of the Learning Sciences (ICLS)* in 2021. I currently serve as the elected Chair for the *American Education Research Associate's (AERA)* Advanced Technology for Learning SIG. I was an invited panelist at the *Learning Analytics and Knowledge (LAK) Conference* discussing issues of equity in the design process and have been invited to speak on topics including learning analytics, equity, human-centered design, AI-supportive technologies, and design methodologies at a range of institutions include MIT, Carnegie Mellon, Ruhr-University Bochum, among others. **My work has appeared across diverse fields, including the learning sciences** (e.g., *ICLS*, *Computer Supported Collaborative Learning Conference*), **education** (e.g., *AERA*, *Associate of Educational Communities & Technologies*, *European Conference on Technology Enhanced Learning*), **learning analytics** (*Educational Data Mining*, *LAK*), and **design** (*Interaction Design and Architecture(s) Journal*, *International Associate of Societies of Design Research*). Additionally, I have been invited to serve on leadership teams for conferences including the *Educational Data Mining Conference*, *Designing Interactive Systems,* and the *Learning Sciences Graduate Student Conference*. In sum, these experiences illustrate the interdisciplinarity of my work and highlight the contributions of my research and design perspectives within these fields.

Equity-Centric Design Processes

To ensure that technology-enhanced STEM learning environments are inclusive, ethical, effective, and sustainable, we must understand *how* we design with communities. I apply and adapt HCI and design

methods to achieve the goals of all stakeholders and integrate conversations about equity, digital access, and sustainability.

In one example project, I co-designed a dashboard with teachers from rural and urban schools across the United States to support them across modes of teaching during the COVID-19 pandemic. Over a year-long process, I facilitated sessions with 24 teachers using interviews, card sorting, storyboarding, prototyping, and replay enactments. Throughout these sessions, I prioritized the needs of teachers and created a space to design technology that also acknowledged their wellbeing. I did this through intentional interactions during design sessions, such as not forcing a co-design agenda so that teachers had time to reflect and discuss as they needed, and by **choosing methods that acknowledged the trauma** teachers were facing due to the pandemic (Lawrence et al., 2021). Rather than imposing brainstorming activities during an overwhelming time, they evaluated and adapted ideas from other teachers to spark discussion. I used tools that teachers were familiar with, so they had the agency to adapt designs based on their context. One goal of this work was to create a dashboard that scales across contexts (e.g., rural and urban contexts; in person and remote teaching). To account for these **contextual differences**, I used card decks that leverage critical theories to prompt discussion about topics including access (e.g., who cannot meaningfully participate in our activity?) and sustainability (e.g., what is needed to do this activity long term?). Findings from this work highlighted technological *needs*, like seeing what students are doing, real time notifications, and tools for facilitating collaboration, and *constraints*, including technology access for students, teacher load and burnout, and quick transitions between in person and remote learning. Through our process we created and refined a dashboard to account for the needs and constraints that arose from teachers. The contributions of this work were to break down **how we designed equitably and sensitively with those who are experiencing trauma and how we accounted for contextual elements in our designs**.

My future work will continue refining methods and tools to engage in equitable design processes and study how they are used in context. Here, I am interested in two primary research questions.

(***1) How do design processes impact equity for communities?*** My current and future work builds on existing measures for studying the design process (e.g., collaboration and design features; Lawrence & Mercier, 2019; Lawrence, 2020) and explores new constructs like trust, wellbeing, relationships, and sustainability. My goal is to understand how researchers should choose methods to create an equitable process, and how they impact community members.

(2) How can we design innovative technologies that support diverse goals among communities? In the example above, I designed the technology to work across contexts, including communities with and without access to technology-rich learning environments. Currently, we are exploring the impacts of those design decisions in both communities. My future research goal is to design and study cutting-edge technologies that account for **digital access and sustainability among diverse communities**. Adapting technologies that exist in diverse contexts can be innovative by pushing on the boundaries of how technologies have been previously used. I will continue to design innovative technology with communities that can account for their contexts while finding new ways to leverage tools that already exist in their learning environments.

Studying Learning Environments in Context

To evaluate the effectiveness of our design process at creating equitable learning environments, I study final designs **in authentic learning contexts**. I work in both formal and informal learning spaces studying a range of STEM environments including engineering (Lawrence et al., 2021), math (Lawrence et al., 2021), and environmental science (Lawrence, 2018), while also integrating related topics (e.g., social

justice; Lawrence, 2018) and social interaction (e.g., collaboration and play; Lawrence et al., 2021**). My goal is to answer questions about learning, equity, and interaction by triangulating findings and providing nuanced descriptions of how technology is used and adapted in learning environments.**

In one project, called CSTEPS (Collaborative Supportive Tools for Engineering Problem Solving) we created an orchestration tool to support novice, engineering instructors as they facilitate collaborative learning. To evaluate the design process and outcomes of the CSTEPS project, I used a traditional design method, called Linkography, to identify key design features that emerged (Lawrence, 2020). I then used these findings to drive what data we collected and how it was analyzed to explore how these design features manifested in engineering classrooms. Through video and audio data from four weeks in the classroom, log file data from students' and instructors' use of the technology, and pre- and post-intervention interviews from instructors, I was able to evaluate how the decisions made in the design process were operationalized in the classroom. My findings showed that instructors whose values and experiences with collaboration aligned with the team who co-designed the tool, used the technology as we expected which led to improved collaboration for groups of students. Whereas others, whose values did not align with the co-design team, either did not use the technology or used it in ways that aligned with their values (Lawrence, 2020; Lawrence et al., 2021). This is an important finding for **evaluating the effectiveness of the design process, the technology, and the learning interactions** that occurred in the classroom. It shows that even if technology was designed in partnership with users, it does not mean that all users will use the technology in the same way. How instructors adapted the technology based on their values is important to study to understand the sustainability of the technology in context.

Over the next five years, my research will expand my previous work, and answer questions, such as:

(1) How can we scale and generalize outcomes from community-based design research? Outcomes of community-based design work are often created specifically for the context in which they will be applied. I am interested in how we can consider scale from the beginning of projects and how we assess scale in multiple contexts. In the study above, when scaled, the instructors did not use the technology as planned, but that does not mean the technology was not useful in unintended ways. I will explore how users adapt technology to fit their own context and needs, to understand how environments can be scaled. To explore this, I will implement designs within and across settings and explore what features of the environments are used as planned and adapted to understand how we can understand the outcomes of this work both within and across learning contexts.

(2) How can we design tools for teaching and learning that address social justice issues within communities? Building on my work, co-designing technology to teach students about complex topics like climate change, my future work will address social justice topics with communities. One example project, in the early stages for NSF's Racial Equity and STEM Learning program, is looking at how to co-design tools with educators to support unlearning science misinformation that are tied to racist ideologies in rural communities. This project and others will explore how to design sensitively with communities and study the effects of co-designed interventions.

In conclusion, I am a learning scientist and design researcher, working toward equitable design-based research. I create technology that is designed in partnership with communities. I have co-authored work with over 45 researchers (7 who were my mentees) from 11 different national and international institutions and organizations. My collaborators include people from diverse fields including computer science, engineering, philosophy, informatics, and design, and a range of lived experiences such as teachers, students, families, industry professionals, and social workers. I will continue existing collaborations while building new ones to amplify design research with communities.