# Co-design Partners as Transformative Learners: Imagining Ideal Technology for Schools by Centering Speculative Relationships


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## ABSTRACT

Emergent technologies like artificial intelligence have been proposed to address issues of inequity in schools, yet tend to ossify the status quo because they address needs within an already inequitable system. In this paper, we draw from speculative participatory approaches across HCI and the learning sciences, and present a novel approach to co-design that forefronts supporting historically minoritized youth in developing transformative agency to change their schools based on their valued hopes, practices, and concerns. We argue that when co-design spaces forefront relational development, expansive technological objects emerge as a byproduct. We present a case study of expansive dreaming with U.S. historically minoritized students about the use of artificial intelligence to support classroom collaboration. Methodologically, we demonstrate how physically visiting spaces of collective agency serves as a powerful perceptual bridge to imagining joyful, equitable possibilities for schooling. Our approach yields new visions for schooling and new metaphors for artificial intelligence.



## CCS CONCEPTS

• **Human-centered computing → HCI design and evaluation methods**.

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## 1 INTRODUCTION

Equity oriented education researchers frequently interrogate a central question: what counts as consequential learning and who decides what that looks like? US public schools often purport to offer historically minoritized youth the tools to transform their own lives and their communities', but instead tend to implement classroom structures and practices that disproportionately organize around optimizing standardized testing outcomes [36]. In effect, many taken-for-granted school activities flatten and homogenize the valued practices and everyday funds of knowledge that diverse youth bring into classrooms. Designers of emergent technology often come in with equitable intentions (e.g., decreasing the performance gap) but often end up reproducing these hierarchies; for instance, in the artificial intelligence for education space, it is common for researchers to emphasize content knowledge, skills and assessments that privilege single, dominant epistemologies [3, 24, 26, 63, 70, 78]. Undoubtedly technology opens up compelling possibilities for learning, but addressing these fundamental issues requires that co-design researchers support key stakeholders, who bear veritable expertises and complex experiences, in envisioning "expansive horizons" for sociotechnical futures that interrogate taken-for-granted foundations of the institution of schooling [36, 40].

Our focus in this paper is on supporting historically minoritized youth, who experience intertwined exclusionary forces [49] across broader societal contexts and within school structures [22], in the design of new futures for schooling and technology. For brevity's sake, we refer to historically minoritized youth simply as "youth" in the remainder of this paper. The field of HCI and its recent attention to participatory speculative approaches offers a starting point to consider how we might begin to imagine equitable futures for education. These approaches have been shown to provoke interrogations about taken-for-granted assumptions and lead to concrete technical design proposals [34, 41, 74, 80]. Supporting youth in the context of US public schools raises an additional consideration: imagining expansive possibilities for schools not only requires displacing the typical way of doing things in classrooms, but also requires supporting youth in viewing themselves differently relative to other school stakeholders, e.g., teachers, administrators, and other students who are afforded higher status in public schools.

In this paper, we draw from participatory, speculative, and future-oriented design approaches across HCI and the learning sciences to explore our dual goals: (a) imagining expansive, equitable possibilities for schooling with youth and (b) proposing concrete socio-technical possibilities that help to transform existing realities. In both the learning sciences and HCI, co-design methods and approaches commonly have the goal of creating concrete "objects" (e.g., a curriculum or technical product); thus co-design activities prioritize supporting stakeholders in creating those very objects. In this paper, we argue that when it comes to co-designing expansive objects with delegitimized stakeholders who have only ever experienced a rigid institutional contexts, designers must center the identity development of the participants and how they view themselves relative to other institutional stakeholders. By first re-imagining hierarchical relationships, equitable objects (e.g., technological) may emerge, but *as a byproduct* of the relational re-imagination. This reframing is the first contribution of this paper.

However, this approach introduces a key tradeoff: does a relational focus on technology co-design lead to design outcomes that may never be institutionally or technologically actionable? This leads to this paper's second contribution; we mitigate this risk by deriving concrete perceptual bridges [8] from a framework of *transformative agency*. These concrete perceptual bridges help give shape to new school possibilities where new technological tools grounded in re-imagined relationships can be more easily manifested. By transformative agency we mean that youth develop the "initiative and commitment to transform the context(s) of their activity for personal, academic, life in the work force and/or civic ends" [44]. Across existing work on transformative agency, we identified three key elements that shape the creation of co-design spaces. Then, we identify "perceptual bridges" [8] and use them within a novel three-step co-design methodology that align with those elements of transformative agency. We elaborate on this approach and methodology in Section 3.

In summary, our primary interest in this article is to explore the co-design and pedagogical conditions that support youth in imagining possibilities for schools and technology that support their expansive, equitable hopes. Our first contribution offers a key re-framing; co-design spaces in this context must first forefront the development of youth's transformative agency rather than the design of an object. Our second contribution mitigates feasibility concerns that emerge from prioritizing the relational; we derive concrete perceptual bridges based on the transformative agency framework, thereby balancing the goals of relational development with conceiving of concrete, actionable proposals that designers can take towards making those expansive possibilities a reality. Overall, this study most directly contributes to co-designers and educators who are interested in developing equitable technologies for educational environments, with implications for additional contexts that we describe in this paper's Discussion section.

We illustrate this framing and methodology through a case study of the Learning Futures Workshop, which sought to support historically minoritized youth in imagining expansive possibilities for collaboration in schools, and to understand the role of artificial intelligence (AI) in making those futures a reality. As described earlier, historically minoritized youth experience even fewer opportunities for expressing agency; we intentionally worked with youth who are enrolled in schools who disproportionately serve low-income and BIPOC communities. Additionally, we choose AI as an area of focus due to the expertise and interest of the co-design facilitators; our approach is not specific to AI. To support youth in developing transformative agency, we physically took youth partners to a graduate student cooperative house as a perceptual bridge to more expansive forms of collaboration that could happen in schools. In our findings, we demonstrate how participants self-realized themselves as transformative agents over the course of our workshop through the indices of developing transformative agency [39], and how this positioning activated expansive possibilities for schools and technology well outside the prevalent way of doing things inside schools–a novel metaphor based on community oriented practices from the cooperative house. We conclude by sharing empirical and methodological considerations and takeaways for researchers in participatory speculative design who may wish to generalize our approach to other, non-educational institutional contexts.

## 2 RELATED WORKS

We start by sharing perspectives from education and the learning sciences, where the majority of work about co-designing schools has occurred. We provide background about American schools by sharing a key issue of equity found in many schools, and provide two perspectives about how learning scientists have attempted to address that work through close collaboration with youth. We then situate these approaches in the field of HCI, with particular attention towards speculative participatory design.

### 2.1 Inequities within American K-12 Schooling

In this subsection, we briefly describe a long-standing equity issue in American K-12 contexts that was a focal area of investigation in this project: efficiency as a defining parameter in the design of school learning environments and the consequent devaluation of youth agency and voice in key school decision [2].

The principles of scientific management, or Taylorism, has been appropriated from American industry to schools since the early 1900s [6]. Efficiency as an outcome [1] started to play a key role in shaping institutional practices within the "factory production model of education" [6]. Under this model that is widely prevalent today in the United States, students are considered "raw materials" while teachers/administrators are positioned as the workers whose evaluations are based on their efficient compliance with standardized metrics (e.g., standardized testing [7]). Teachers and administrators are the purveyors of valued information while youth are regarded as receptacles with their agency being regularly undermined. As Au points out, surveillance and control are forefronted within this system [6]; the "educational assembly line" must track which students deviate from established levels of "quality." Deficiencies are then made "'visible, individual, easily measured, and highly stigmatized within hierarchical systems of authority and supervision" [55]. Systemic hierarchies born from oppression (e.g., race, gender, class, sexuality, etc.) are deeply embedded in performance-based hierarchies. Through these processes, efficiency for efficiency's sake figures as a key outcome of schooling and numerous instructional

practices (e.g., grades, tracking, instructional periods) oriented towards supporting that goal.

In line with this efficiency orientation, youth agency towards transforming schools from within schools is very limited. Researchers have described how standard schooling practices, discourses, and power structures shape youth agency [30, 51]. As Riggs and Laghout describe, existing policies within schools limit the decision-making agency of certain actors, particularly policies created around "supervision and permission" that structure who decision-making processes ultimately lie with, and how much time gets allocated for decision-making. Nevertheless, studies indicate that urban youth are highly aware of structural explanations of inequity [67] even in this constricting environment. Building on the notion that youth voices must be forefronted in the development of learning environments, the learning sciences has addressed this in two key ways: identity development and youth participatory action research (YPAR).

## 2.2 Developing Transformative Agency (a Learning Sciences Perspective)

Design has been central to the learning sciences since its inception as a field but historically has operated within the confines of existing institutional practices. In recognition of entrenched failures of public school systems to meet the needs of historically minoritized youth, recent methodological contributions [9, 40] have offered ways for both designers and learners to contest and reorganize already inequitable systems. Central to these methodologies is creating the conditions for learners to develop identities as changemakers who "design their own futures" [38]. In the development of this transformative agency, learners contextualize their personal past and presents in broader social and cultural contexts, and reimagine futures for themselves and their communities.

Towards supporting youth in developing transformative agency, past work has taken a number of approaches: blending the everyday with the academic through multimodal text formats [40], historicizing and denaturalizing dominant institutional practices, and creating the conditions for existing technologies towards new ends [40], just to name a few. Recent work sensitizes researchers to the process that learners undertake in the process of developing transformative agency. Gutierrez et al. provide four key indices that mark youth learners' development into becoming historical actors who display many attributes of transformative agency [39]. The first index is the visible experience of a double bind, when youth participants' "cultural resources prove inadequate for resolving a particular dilemma." In response to the double bind, the second index is a "breach in the social order" when youth challenge the status quo individually or collectively. The third index, "cycles of experimentation" occurs through iterative trials by youth as they reconsider the role of tools in their lives and their own positionality within their contexts. The fourth index, the expansion of the object of activity involves interrogating the "purposes and meanings" of an activity. Existing work in participatory design that forefronts participant agency and civics has alignments with this work; the theoretical framing of transformative agency complements those perspectives and offers new considerations for design and analysis rooted in theories of learning and development. For instance, in this paper (see Findings section), we leverage this indicia towards understanding critical junctures in dreaming.

In this body of work from the learning sciences, the focus is on creating the conditions for learners to develop transformative agency, but is seldom applied towards world-building activty around the institution of schooling itself. As we will show in the next subsection, there is a disconnect between participant agency and the imagination of educational institutional possibilities outside of the status quo. Considering concrete possibilities raises its own set of challenges that are not well-addressed in existing methodologies around developing transformative agency.

## 2.3 Critical Co-design of Concrete Possibilities with Youth

Youth Participatory Action Research (YPAR) partners researchers with youth in order to conceive and enact concrete, co-constructed transformations in schools [2, 32]. Researchers who design YPAR spaces commonly center critical perspectives, hoping to disrupt trenchant issues in education that emerge from neoliberal ideologies of meritocracy and individualism [49]. Kirshner notes that "this discourse can sometimes fail to acknowledge that young people's meaning-making, just like adults, is mediated by available cultural tools and ideologies" [49]. In the same study, youth made proposals that increased standardized testing results and promoted narratives of deficit framing (e.g., students blaming poor achievement of others on laziness, etc.). In more technical contexts, the authors of this paper previously demonstrated that while youth engaged deeply on issues of justice in technological contexts, they ultimately proposed artificial intelligence tools "designed for the other," which sought to penalize "underperforming" youth who were holding back classroom progress [21]. Taken together, in YPAR spaces where world-building about schools is central, critically oriented participants and youth commonly re-appropriate dominant practices, even when originally orienting themselves towards expansive possibilities.

Our next section explores how the field of HCI has used participatory speculative design to inspire concrete possibilities, and provides some entry-points to show how developing transformative agency and object design can go hand in hand.

## 2.4 Imagining Socially Just, Sociotechnical Futures in HCI

Towards our goals of expansive, equitable transformations in schools, we have found alignments with recent work in HCI that centers social justice-oriented design research. Researchers in this space are concerned with how power, privilege, and access in a social system are distributed among its participants and how designs attend to the sensitivities and elevate the perspectives of oppressed individuals and groups and their lived experiences [27]. Projects have focused on justice and labor, justice and accessibility as well as racial and health justice, among others [34, 43, 61, 66, 75]. Research practitioners and designers are propelled by the notion that designing is inherently about change and that through design we can recognize the malleability of reality and the possibility of socially just futures [27, 29]. Several workshops over the years have brought together researchers, designers, and community members to share approaches and expertise, develop a common vocabulary,

and facilitate meaningful conversations about the future of social justice aware technologies [14, 33].

We also found alignment between our work and HCI research on and with other marginalized populations such as neurodivergent youth that challenges a reductionist view of design as only interested in mitigating functional needs. Instead, this work addresses how designers can translate the interests of children into meaningful frames of exploration and create the right conditions for children to express their creativity in participatory design [35, 45, 58]. For example, to facilitate creative processes, Makhaeva, Frauenberger, and Spiel (2016) proposed the concept of "Handlungsspielraum" (HSR) to frame the creative process in participatory design as influenced both by structures and freedoms. "Handlungspielraum" is a German compound word that literally translates into: Action-Play-Space [58]. The term can have a range of meanings including scope of action, constraints on action, room for play, etc. We take inspiration from this perspective by making explicit the scopes of action, the constraints, and the room for play that youth may encounter in schools.

To surface and scrutinize social inequalities, social justice-oriented researchers often turn to methods from speculative design and other design futuring approaches [29, 54, 81]. Speculative design creates room for designers and stakeholders to suspend concerns about real-world feasibility of the design and, instead, imagine alternate possible futures that promote a different set of social values or that foreground new social structures and social relationships. While early speculative design efforts have been critiqued for being a practice concentrated among privileged researchers and artists [16, 18, 59], researchers have begun utilizing more inclusive, participatory, and co-design approaches particularly when doing work in collaboration with different types of communities. In practice, participatory design projects relating to social justice-oriented work often take the form of design proposals, design fictions, and conceptual artifacts that imagine just socio-technical futures and technologies that help marginalized communities [34, 41, 74].

Prior work utilizing a combination of participatory, co-design, and speculative methods point to a set of considerations that are important for researchers to think through when engaging this type of work. We briefly articulate how we consider these factors in our particular approach that centers transformative agency as a key goal of design partnerships, alongside the design of concrete outputs and objects.

What are the outputs and outcomes of design? While early articulations of participatory design tend to orient towards creating a technical system as the final output, newer—often community-oriented—research highlights a broader range of outputs and outcomes, including activism and justice-oriented work [77], exploring the potential for alternate types of (social and technical) practices [57], or becoming sites of alternate epistemologies and feminist knowledge production [69]. While speculative methods often produce an artifact as their output, they similarly suggest a broader range of outcomes that might be evaluated, such as whether the outputs represent a successful thought experiment, help people critically reflect, or critically analyze a phenomenon [10, 12, 62]. Building on this work, we are more focused on relational outcomes, particularly understanding if we can create a space for co-design and participatory speculation that supports youth in developing transformative agency. We are still interested in the development of concrete object outputs, but only as a byproduct of transformative agency.

What and how do we design when we speculate? The forms of "what" is designed and practices of "how" it is designed matter as well. Khovanskaya et al. note that critical projects may still take on features of "dominant" design projects in order to be legible to a broader community [48]. Exemplifying this, speculative design projects often take the form of fictional technology "products" which are legible to an HCI audience—though the "fictional product" approach has been critiqued for utilizing a capitalist aesthetic, making it more difficult to question issues of capitalistic power [76]. Recent work has shifted speculative design towards more explicitly questioning and re-imagining institutional power, such as critiquing corporate approaches to diversity and inclusion [23], re-envisioning how institutions might address problems of climate change and sustainability [71], or exploring what future AI work might look like by emphasizing under-recognized forms of already-existing labor [73]. Wong et al.'s (2021) re-orientation of speculative design from product speculation to "infrastructural speculations" highlights an opportunity for speculative design to critique and re-imagine socio-political concerns by explicitly re-imagining socio-technical infrastructures (including social institutions) when creating alternate futures [81]. This paper expands on this line of work by explicitly considering what it means to re-imagine institutions from a position within those institutions.

How do we conceptualize the people involved? Prior research pushes HCI to consider people beyond the role of "users" to highlight the more diverse set of relationships that people have with each other and with technology systems [11, 13]. Specific to participatory speculative design, Farias et al. describe the varying levels of engagement the participants may be afforded in projects, from more "shallow" forms of engagement like non-participation or providing inspiration to designers, to more "deep" forms of engagement such as collaboration and project leadership [31]. For us, many common terms used in participatory or co-design research did not feel fully satisfactory in our particular context. "Participant" seems to uphold a power divide between researchers and non-researchers; "co-designer" seems to emphasize design practices and outcomes over other types of knowledge and expertise that we might want center in the project; "stakeholder" seems to suggest that there is a pre-defined problem that people have a stake in, whereas we are interested in part in questioning the boundaries of how people conceptualize problems in the first place. Drawing on educational research, we find that approaching others as learners, who are actively making sense about complex social institutions and their roles within it, opens up new possibilities for the design and analysis of end-to-end co-design outputs. In this way, we view our work as being complementary to speculative design approaches in HCI that address schools; for instance, Khan et al. use researcher-created speculative design artifacts and semi-structured interviews to generate learnings about the Pakistani educational context [47]. Rather than considering participants' perspectives at a single point in time, we understand learning to occur across space and time, and try to understand how relational-oriented speculative artifacts mediate those learnings. Our methodology further expounds on this approach.

# 3 APPROACH

We propose a co-design approach that supports youth in developing *transformative agency* in the process of re-imagining schools. By transformative agency we mean that youth develop the "initiative and commitment to transform the context(s) of their activity for personal, academic, life in the work force and/or civic ends" [44]. Across existing work on transformative agency, we identified three key elements that shape the creation of co-design spaces. First, co-design partners should be supported in gradual sense-making as they engage in cycles of reconceptualization and re-appropriation across varying social context [39, 56]. Second, youth have experienced devaluing of their everyday ingenuities in both conventional school contexts and broader society, thus particular effort must be diverted towards uplifting them within the co-design space [40]. Third, experiences should be re-framed from one of individual struggle to one of collective agency [65, 79]. In our approach, supporting youth in developing transformative agency is thus one goal of co-design in and of itself. But this goal must be balanced with the intentions to develop concrete world-building opportunities in the context of schooling, which we summarize with three key methodological insights that we describe in the following subsections.

## 3.1 Methodological Insight 1: Perceptual Bridge

In line with the latter two components of transformative agency (i.e., the valuing of the everyday in the context of schooling, collective power), we must offer concrete bridges to futuristic possibilities by physically taking transformative learners to alternative institutional structures that provide concrete examples of how key elements of transformative agency might manifest in schools. This approach builds from HCI approaches which have used speculative approaches as a "perceptual bridge" to challenge the taken-for-granted ways of doing things [8].

When creating speculative artifacts, designers must balance provocativeness and familiarity, creating what has been termed a *perceptual bridge* for co-design partners to conceptually shift from the world they currently live in and experience into an alternate possible world [8]. Perceptual bridges typically serve to support co-design partners in suspending disbelief about speculative possibilities, and has been shown to help support the imagination of concrete future-oriented possibilities [80]. Our goal of supporting youth in developing transformative agency requires that we create a perceptual bridge that helps youth to position themselves in a way where their agency is uplifted in schools.

For selecting an appropriate perceptual bridge that supports youth in re-imagining schooling, the perceptual bridge must be provocative in a way where youth are supported in (a) recognizing that their everyday ways of doing things has a place inside the rigid complex of schools and (b) re-framing individual struggle to one of collective struggle. This led us to look towards cooperative organizations, whose operating model directly contests hierarchical models of authority and puts members in a position where they have a meaningful voice about many aspects of organizational direction. For determining the familiar, facilitators must work within the local contexts salient to the participants.

## 3.2 Methodological Insight 2: Moving Across Contexts

In line with the first component of transformative agency (i.e., re-appropriation across social contexts), we must bring the participants in activities of speculation across *multiple contexts*, such that concrete possibilities may be uplifted, altered, or outright rejected as participants see themselves and others in new ways. Rather than focusing on design within a singular context, past work recognizes that co-design sessions only capture a few snapshots in the lives of young learners. Within these brief glimpses, youth are gradually sense-making over different contexts, as they repeatedly innovate and imagine how various tools can be used to transform their activities in ways meaningful to themselves and their communities. Thus, co-design spaces should support the explorations across time and place.

## 3.3 Methodological Insight 3: Delaying Engagement with Technical Feasibility

Thirdly, we recognize that developing transformative agency and re-imagining spaces of collaboration are heavy lifts for co-design participants. Thus we suspend concerns of technical feasibility during imagining phases, and instead, bring in technical experts to bridge the status quo and the speculative after the speculative worlds and technical tools within those worlds have been constructed. In this way, imagined possibilities are not driven by technical affordances but by youth's hopes and dreams about ideal schools.

## 3.4 Overall Approach

We thus propose a three step methodology that uses the concrete institutions to help move between speculative spaces and lived worlds.

(1) Building out speculative worlds (structures, relationships, and tools) that realize ideal possibilities for learning with the support of institutional perceptual bridges
(2) Partnering with technical experts to demonstrate technical feasibility of tools imagined in speculative space
(3) Re-appropriating tools and structures from speculative worlds into existing lived contexts of schooling

# 4 METHODOLOGY

The purpose of our case study workshop was to surface high-school aged youth's hopes and dreams for ideal collaboration inside of classrooms, and to determine how one emergent technology, artificial intelligence, might help to make those dreams a reality. The case study workshop occurred during April 2022, during the spring break of the local school districts in the eastern region of the San Francisco Bay Area in the U.S. ("East Bay"). Prior to the workshop and following approval by the first author's institutional review board, we collected assent forms and consent forms.

## 4.1 Workshop Participants: Historically Minoritized Youth

The workshop was held in-person at UC Berkeley's School of Education and ran for three consecutive days. The workshop ran for eight hours each day, and youth were compensated at $18.50/hr

for their participation. The workshop was planned and facilitated by three researchers, two of whom had spent extensive time in the East Bay, while the other researchers was a collaborator from another state. Facilitators and planners were experts across learning sciences (a discipline within education) and computer sciences. Like the youth, all the facilitators are people of color (two Asian American, one African American) and two of the facilitators were formerly K-12 teachers. Facilitators and planners of the workshop came into the workshop with past experience designing spaces of dreaming with youth, and came in with hopes of fostering a critical space where dreaming beyond existing inequitable practices was not only encouraged, but normalized.

We centered recruitment around three programs: two local public high schools and a STEM afterschool program serving primarily low-income, youth of color in the East Bay. These programs, which the first author had past relationships with, were chosen because they mostly (or in some cases, exclusively) served BIPOC and low-income communities in the California East Bay. The workshop was advertised as a workshop on Artificial Intelligence (AI), and we recruited students based on their expressed interest in learning more about AI; no other prerequisites were stated. During this process, we selected 15 youth based on the degree to which they expressed enthusiasm for AI. All selected participants identified as people of color. Seven self-identified as males, seven self-identified as female, and 1 self-identified as non-binary. Six of the students had previous relationships with facilitators, having participated in past events together that explored tensions between racial justice, technology, and schools. In this paper, we always refer to students by pseudonyms.

## 4.2 Workshop Overview: Dreaming across Time and Space

We describe below the structure of our three-day workshop. In our planning process, we noted that many of our youth were high-school aged and considering possibilities for higher education after they graduated high school. Thus, for a perceptual bridge, we selected a cooperative student housing organization associated with UC Berkeley, a public university located in the East Bay; we anticipated that many of the youth were considering lifestyles for after graduation, and that college housing would likely be top of mind.

*Workshop Day 1*: Facilitators provided an overview of the workshop, and led an opening activity that surfaced youth's experiences collaborating with others from the youth's everyday experiences. Next, the facilitators offered some framing around collaboration in order to support future discussions: this framing highlighted the desirable outcomes of the collaboration (e.g., efficiency, teamwork, mutual respect). Next, we walked to the nearby **student cooperative house**. The youth were greeted by several house members, given a tour of the house common spaces by a house member, and were invited to interview a number of house members who were standing by in the space. These house members included long-time and new housemates, as well as current cooperative house "managers", elected house members who served specific roles inside the community. After the tour, youth shared noticings and wonderings from the day in small groups, and then anonymously completed exit tickets with feedback from the day's events.

*Workshop Day 2*: Our second workshop day transported youth to their **speculative, fantastical ideal space of collaboration**. Youth were given the prompt: "What kinds of collaboration/learning spaces do you want in the future world?" Youth were specifically asked to start by considering the purpose of the world, followed by relationships, fantastical tools and technologies, and processes. We note that at this point in the workshop, no specific technology or technological affordances, including AI, had been raised in discussion. After being split into three groups by facilitators (their groups for the rest of the day), youth were given everyday dollar store materials as building blocks for their ideal future: popsicle sticks, toy figurines and dinosaurs, pipe cleaners, plastic bowls, feathers, toy cars, etc. After spending 45 minutes constructing the world, youth shared their ideal worlds by constructing a narrative for the imagined world, and asked questions about their worlds to each other.

Next, the facilitators gave a short lecture about artificial intelligence (AI), the first mention of AI at any point in the workshop. This lecture highlighted the basic mechanisms behind empirical model training and broke down the technology into three parts: data collection, model training, and inference. Researchers illustrated AI's affordances through the use of PredPol, an AI-based system that had previously been sold to Oakland police department which helped predict hotspots for crime [68] (Oakland being an example of a local city in the East Bay region). Researchers also used this case study to provide youth with a sociotechnical perspective around AI, e.g., highlighting how AI models can emphasize racial biases held by society at large [15]. Facilitators then led an activity where youth (in small groups) discussed where they encountered AI in their every day. In addition to providing this context, facilitators shared the imagined tools created by youth with experts in natural language processing, computer vision, and generative AI. Experts then explained to participants which of their proposed fantastical tools could soon be technically feasible through recent advancements in AI capabilities, although they did not go into details about the technical peculiarities.

*Workshop Day 3*: The beginning of day 3 focused on the design context of the youth's **high school classrooms**. Youth were once again divided into three groups, this time based on the school or program they were coming from. Facilitators asked the youth: "Consider collaboration happening in your high school: how is that collaboration shaped by specific valued purposes, institutional structure, relationships, tools/technology, and physical space? How are these different from the ideal collaboration spaces you constructed yesterday?" Youth discussed amongst themselves and wrote their answers to the questions on large pieces of poster paper. The next part of the workshop sought to more meaningfully bridge the gap between their speculative and ideal worlds, by bringing in experts in natural language processing and artificial intelligence; these experts explained to youth some of the more recent developments in AI, particularly around large language models and generative AI. Facilitators started by giving an example of how these new technologies under development might make some of the speculative AI from the previous day feasible. In each of their small groups, youth drew pictures of their speculative technology from Day 2 of the workshop. In the ensuing discussion, facilitators made salient the design context of youth's **high school administrations**, asked

the youth how these speculative technologies might fit within their existing schools and influence the in-school collaborations they had surfaced earlier in the day. In the final activity of the workshop, youth filmed video messages to their school administrators: "What would you want your teachers, school leaders, and administrators to know about the technologies that you have created over the course of this workshop?"

### 4.3 Data Collection and Analysis

Video and audio were recorded for all three days of the workshop, and pictures were taken of all the artifacts that were created along the way (e.g., poster presentations, ideal collaborative materials from everyday spaces, etc.). Following the workshop, researchers transcribed the recordings. The research team watched the recordings and read the transcripts together. In the design of the workshop, the researchers had paid particular attention to making salient everyday forms of collaboration that are uncommon in schools. During collective data analysis efforts, we immediately observed a connection between the cooperative house, the *Live, Love, Light* device proposed by youth, and the resultant youth agency to transform their schools with the help of the *Live, Love Light* device. In order to better understand how the perceptual bridge of the cooperative house supported the construction of new worlds and supported youth agency in transforming schools, we engaged with the framework of transformative agency to better understand the role of the cooperative house in developing youth agency and envisioning concrete, technology-supported changes to schools.

We began by coding the transcripts for the indices of becoming a historical actor [39]. For the first index of identifying a "double bind", we identified moments where youth participants identified dilemmas in the construction of new worlds. When looking for these dilemmas, we paid particular attention to moments where values and the imagination of concrete possibilities came into tension. After we coded for double binds, we coded for youth's responses to specific those double binds and determined whether they constituted a "breach in the social order" within the social hierarchy schooling. Going into the analysis, we identified relational hierarchies identified by youth previously in the workshop (e.g., between students and teachers), and noted when particular proposals came to challenge those hierarchies.

Next, for each double bind and breach of social order previously observed, we identified the third index (cycles of experimentation): moments where youth experimented with (or did not experiment with) different possibilities to sustain and develop the "breach in social order" identified. Finally, when the cycles of experimentation resulted in interrogating the "purposes and meanings" of their existing classroom activities, we coded those utterances as the fourth index: an expansion of an object of activity. These were identified when outcomes identified by youth as being characteristic of schooling (e.g., efficiency) were contested or bridged with additional outcomes We observed these sequential indices typically occurred in different parts of the workshop and broke our data into two phases, before conducting a thematic analysis in each of the phases.

## 5 FINDINGS

In this section, we break our workshop down into two key phases. The first phase operates in the context of a fantastical design space, where youth are tasked with creating their ideal collaborative environments. In the second phase, youth considered the realities of schooling today and considered how their (previously created) speculative possibilities might shape their existing experieneces in schools. Overall, there are three specific design contexts that we made salient: the ideal collaboration context (in phase 1), the educational classroom context (in phase 2), and the educational administrative context (in phase 2). Within each of these phases, we structure our findings around identified themes. We choose to present these findings sequentially as a case study, as we believe that this best illustrates youth's progression towards developing transformative agency, a key goal of our work. Through our sharing of these findings, we carefully detail moments that we identified as representative of the indicia for developing transformative agency: the double bind, the breach of the social order, cycles of experimentation, and expansion of activities. Figure 1 demonstrates the progression taken by youth over the course of the phases for one speculative AI tool imagined by youth, the *Live Love Light* device. Over the course of this findings, we will refer back to Figure 1.

### 5.1 Dreams of Fantastical, Ideal Collaborative Spaces

*5.1.1 Comfort and Vulnerability as Key Goals of the Collaborative Space.* The first theme that emerged in our analysis was that youth's ideal collaborative spaces forefronted *comfort and vulnerability* as the key guiding outcomes. These feelings were often embodied in the physical setup and speculated tools created in their ideal worlds. In one group, one youth Karl declared "maybe have a safe space that represents a bunch of feathers, to represent, like, comfort" and in the meantime, started to create a nest of feathers firmly in the center of their ideal world. This space was later elaborated on by Asia, who described it as "A place where people can go to confer. Where you don't dread it." Karl added, "You don't have to worry about people judging you for your thoughts and ideas."

In the other group, youth erected in the middle of their ideal collaborative space a dome elevated by blocks, adorned with feathers, which they called the *Dreamcatcher* (see Figure 2). In creating a narrative around the structure, Stanley spun a tale: "We have a big table which is a communal table wanting to chill, whatever, you go into rooms and spaces where they have feathers, which collect dreams on top. Each dome collects the dreams so you can see what you are both paying attention to. You can make a deeper connection with everyone in the room, and we keep them safe in the feather instead of the cloud." Much like the other group's feathery beds, the youth's speculative *Dreamcatcher* tool facilitated the vulnerable sharing of ideas and dreams.

A third group proposed a speculative game show called *the Survival of the Collabest* (Figure 3) that critiqued the competitiveness and typical relational toxicity of game shows. Rather than competing as an individual or against other teams, the youth imagined a show where teammates created the conditions for each other to thrive in while completing challenges on the game show, e.g., "they have to tickle an orca but they need to work together in order

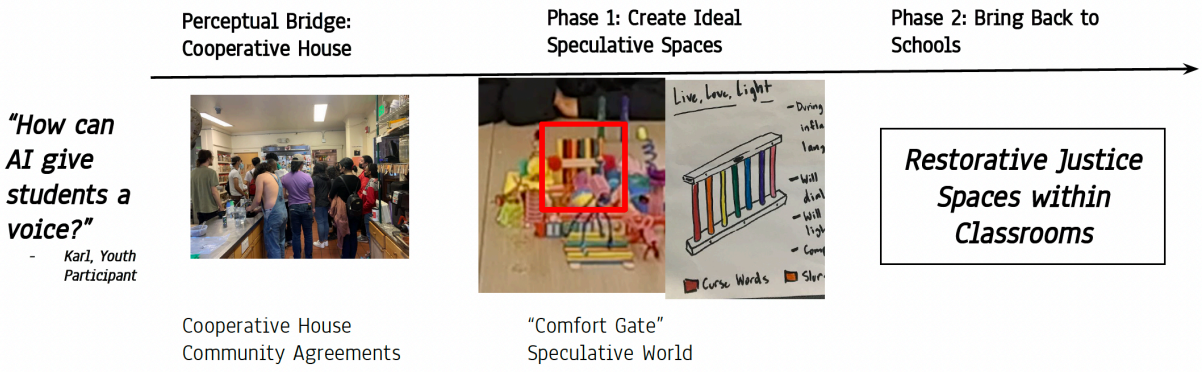


**Figure 1: Over the three phases of the workshop, youth experienced, imagined, and designed speculative and alternative worlds that they felt would address a key issue of concern that was particularly well-articulated by Karl: "How can AI give students a voice?"**


**Figure 2: Dreamcatcher domes with feathers that catch the dreams of youth.**

for the orca to be taken down." Winners of the game show were assessed based on their mutual support and assistance rather than individual achievement.


**Figure 3: The "Survival of the Collabest" is a reality TV show where participants have to collaborative to win. This imagined world was built from everyday inexpensive materials**

The youth's shared commitments to the relational elements of collaboration, which occurred without any particular prompting by facilitators, set the stage for the second theme we identified in the construction of ideal worlds.

*5.1.2 Safety as Contested.* Across our workshop context, a key contestation was how to keep the world feeling safe. This question emerged when youth toured the cooperative house, even before entering the activity of building their ideal collaborative spaces from everyday materials. As members of the cooperative house explained that over seventy students share a confined house space, several youth simultaneously shouted their disbelief and peppered the house members with questions about how household utilities were shared: "where's the TV?" "How many parties have you thrown?" Regarding the Internet, they asked: "How? Just.. How? It's gotta be like 10 wifi boxes!!" "How slow is the wifi?" Others asked how conflict was resolved in the house and one house member introduced himself as an elected "Community Builder" manager who helped to mediate conflict. As the Community Builder described, "There's more to community building than conflict resolution. We also do proactive community building. The main one is community agreements. We do this at the beginning of the semester, it's like, we live here, what do we want the rules to be like, what do you do with your dishes, what if you make a mess in the kitchen. Those are important but are small fries compared to like: 'How do we handle conversations on accountability? How do we handle conflict?' The community agreements are posted on the wall over there!" Youth participants better understood the purpose of the collective agreements when, for instance, Denzel asked: "how long are you allowed to take a shower for?" The Community Builder explained that this was collectively agreed upon in the community agreements process. Overall, the members of the coop repeatedly emphasized that they had the agency to transform the house how they saw fit: "At the end of the day, this is your house." The leftmost image in Figure 1 shows the youth interviewing house members in the cooperative kitchen.

Similar concerns emerged when youth started to create their ideal speculative collaborative spaces. Two of our groups approached this through technical means: a "good vibe checker" and a "comfort gate." Here, we focus on a vignette involving the "comfort gate", a tool constructed out of differently colored popsicle sticks that would light up when a norm was violated. In describing the tool, one youth Asia stated: "So these two people are having a conflict, right? He called this one short and took it to heart. So they are sent to the conflict resolution room to settle their beef. They go in, they first land in the feather pit which represents being comfortable and

being in a safe space. Over here we have a magic fence. Each little stick is a light, and it lights up when it detects vicious language. This one lights up when you say a curse word. This one lights up when you say a slur. It's meant to hold you accountable." Soon after this activity, youth re-named the comfort gate to *Live, Love, Light* (LLL). In the middle image in Figure 1, we show the initial *LLL* built in the ideal collaborative world and a more formal prototype drawn on poster paper by youth. For ease of understanding, we refer to the comfort gate as the *LLL* device going forward. When asked by facilitators to describe how their proposed technology would be used in their speculative space, participants of the groups made proposals consistent with dominant policing practices (e.g., authoritative individuals who enforce hard and fast rules), and tried out language from the cooperative house.

KARL: if we have a space like this we have to have ground rules and someone is going to have to enforce them! … Yeah they try to make sure that everyone stays respectful. If someone makes the [Live, Love, Light] flash, they tell them please don't do that

ASIA: Like a community builder?

ROLANDO: It would probably have to depend on the people in the community honestly. Because I don't think it could be a safe place with people recording each other and someone enforcing all the rules.

Here, a double bind (the first index of developing transformative agency) emerged. On one hand, youth worried their goals of comfort and vulnerability would be disrupted by a disrespectful youth; thus having rules and a rule enforcer would be necessary to hold on to their initial goals. On the other hand, as Rolando described, from his own experience within his own communities, surveillance and enforcement creates its own sense of danger. Within this double bind, well-established practices (e.g., policing practices) were deemed inadequate to resolve the dilemma. Additionally, we see the emergence of terminology from the cooperative house: a community builder. While Asia's initial remark confused the authority of the community builder, it demonstrated that the visit to the cooperative house remained salient to the speculative process. Later, she gradually made sense of it by discussing the connection between rules and the biases of the individuals who enforce the role. That discussion led to the following interaction, where the facilitator asks the youth about the *LLL* device:

FACILITATOR: So we have this magic panel of lights that lights up when someone says something that goes against the norms. How do you choose what each of the lights are?

ASIA: Abiding by community rules that are stated by everybody? Sometimes you go into classrooms and the first day of schools and they set community rules. Everyone is contributing to the conversation

KARL: maybe for like specific situations people could before they could talk about something they could set the norms for something that are outside of the preset ones. Like please don't bring something I did a year ago. Or don't make fun of my hair. Something like that.

Over the course of this discussion, this group of students reconstructed the relationships around the *LLL* device: rather than having their speculative technology enforce norms, the *LLL* device serves to hold them accountable to norms that *they themselves created*, a key idea that they learned in the cooperative house. This conceptualization of the *LLL* device breached the social order (the second index of transformative agency). Fundamentally, it challenges the deficit-framed ideologies that frame non-conforming individuals as being unable to care for themselves; instead, they have an equal voice in conceiving their governance. This concrete technical tool and the relational structures that surround it are directly inspired by the collective, agentic practices from the cooperative house.

## 5.2 Bringing Ideal Collaborative Spaces into Existing Schools

In the second phase, we worked with youth to explore how those speculative tools might translate into their actual classroom experiences. Over our analysis of this second phase, we identified two key themes in the problems experienced by youth in schools that occur across two social contexts: difficulty in getting work done (i.e., classroom efficiency) and frustration with school administration's inaction in injustices experienced by youth. In diving into both of these themes, we show youth engaged in the next two steps of developing transformative agency: cycles of experimentation and expanding the object of activity. Prior to these activities, researchers consulted with experts in machine learning and natural language processing and learned that some version of the *Dreamcatcher* and *LLL* (introduced in section 4.1) could be made possible in the near future. Thus from the outset of this activity, facilitators dispelled youth's concerns about technical feasibility by concretely showing how cutting edge technologies had specific affordances that would make versions of their proposed tools a reality in the near future.

*5.2.1 Addressing Efficiency in Classrooms.* Many of the youth's responses fell into the category of efficiency and urgency around completing schoolwork. Karl captured this sentiment and considered how AI might support this concern: "I was thinking, you know how everyone has a hard time studying for tests? I feel like an AI could help you with homework or study for a test. It would be pretty cool"; many other youths proposed similar proposals that emphasized the completion of tasks in classroom spaces. Over the course of the discussion, facilitators urged youth to consider how their speculative technologies and structures might be able to help mitigate some of these issues. This task often proved challenging. Stanley, who had previously helped to design the *Dreamcatcher* technology, exemplified this hesitation towards bringing the speculative into the actual: "it's just more imaginative." Prior to this discussion, facilitators had emphasized that many of their technological proposals were feasible with AI, so we infer that Stanley is referring to the prospect of using something as unacademic as sharing dreams in standard schooling settings.

At various points in the workshop, facilitators challenged the dichotomy between the speculative worlds and imagined worlds. In one instance, a facilitator bridged the gap by arguing that the Dreamcatcher is not incompatible with the goals of school: "your dreams help you do better on your homework!" We found that facilitation moves that demonstrated compatibility between speculative

worlds and schools were generative towards creating speculative proposals that straddled the line. After the facilitator's prompting, Michelle proposed: "Can't [the dreamcatcher] replace the white board for example? Cuz if you are saying you are imagining your dream and let's say your dream is to get help on your homework, can't it play hand in hand?" In another moment, another youth, Alana, proposed one way that she envisioned the *LLL* device could be used towards the goals of efficiency: "*LLL*, you know how it's a language thing it could help with supporting people. Supporting like if they have any disability or don't understand social cues, help them understand there could be like different you know how different lights light up for different words, could also light up on different social cues." We view these patterns as being part of the third index of developing transformative agency, Cycles of Social Experimentation. When assessing their personally created speculative devices within the context of schooling, youth – such as Alana and Michelle – iterated through rejection and experimentation until they expanded the object of activity in schools: the fourth index of becoming a historical agent.

Some cycles of experimentation did not result in an expansion of the activity. Rochelle stated: "I think the study buddy would be a little bit more important in a sense, because the LLL is just identifying different types of tones and words that you are saying so it could play a part in it and it could pick things up, or let's say you could add a feature where if it asks you a question and you don't answer it right, one of the lights could turn red. So they could play hand in hand – but I feel like the study buddy would be more in demand than the *LLL* because it's students. They have a very specific purpose in mind: to help you be more efficient."

*5.2.2 Addressing Harassment in Schools.* A second key issue that emerged when moving across to the context of schooling was youth's frustration with not being heard by administrators over issues that affected their well-being and safety. Rather than discussing how their expansive hopes for AI would support learning inside classrooms, youth honed in on a key theme: their lack of agency as students, and how administrators do not listen to their hopes and dreams. As Marlen described, "The community, the students, and staff the admin should work together to give voices to the students and not be silenced. Cuz I know for a fact they tried to silence people who came out with stuff that [school] has done. Blatantly ignored them multiple times." Thus the central question became, as Karl articulated "How can AI give voice to the students?" Thus began multiple cycles of experimentation, as youth imagined how their school realities would change if their speculative tools are leveraged. One group argued that the previously proposed *LLL* technology could support students in being effectively heard during Restorative Justice Circles between students and teachers. In creating a message to their administrators, the youth created a video with the following video message:

> To [anonymized school] admins. We present to you the live love light. This invention helps to settle civil disputes and support restorative justice. LLL can detect tone, read emotions, and help maintain healthy relations during conflict resolution. Due to a rise in conflict this year, we believe that LLL can peacefully mitigate these situations. As much as we believe LLL can help, admin you need to realize that some things can't be helped by simply talking it out. There needs to be consequences for people's actions as much as anything else

This video message illustrates the expansive uses the youth envision for their speculative technologies, while at the same time exposing a key tension: that at its core, technology is no replacement for institutional accountability. In this process, the youth expanded the object of their activity (the fourth index), as youth shifted their imagined purposes and meanings of schools. Rather than being a site where they absorb content and comply with school policies, they surfaced resistance as a meaningful act, in the service of a sense of peace and meaningful restoration of youth rights.

## 6 DISCUSSION

Our central hope in this study was to build a co-design context that supports historically minoritized youth in imagining sociotechnical futures for schooling that uplift their hopes, dreams, and ways of acting. Our case study illustrates a first effort. Our workshop supported youth in traversing a number of existing, fantastical, and liminal contexts, leading to youth demonstrating the four indices of transformative agency. Our perceptual bridge of a cooperative house proved sufficiently provocative yet familiar, supporting youth at critical junctures (marked by our transformative indica) of becoming transformative agents mobilizing towards healing, joyful futures. From their new positionality as a youth who deserved to have an equal voice as adults in educational contexts, youth re-imagined their relationships with teachers and administrators and proposed a few novel AI-based tools (the *LLL* device and the *Dreamcatcher*) which would help them in their goals.

Designers have long developed co-design spaces that forefront the agency of co-design partners. Past work created the conditions for individuals to view themselves as "inventors" [17, 46], while more recent work understands design itself as a form of civic engagement where the design outcome is of less importance [25]. In this paper, we show how concrete tools imagined by participants play a crucial role in mediating the development of their own identity as transformative agents. Analyzing this process through the lens of historical indices sensitizes us to the power of alternative perceptual bridges, and also opens up two key questions that we consider here. First, how does our framing of youth as transformative agents shape how we view the empirical "outputs" of our study, and what might that tell us about the challenges of building concrete, futuristic worlds that do not yet exist? Second, our choice of a cooperative house as a perceptual bridge was critical for our workshop; what implications does this have for the creation of future participatory speculative contexts, and how might our approach generalize beyond the specific issue of youth agency in US schools that we explore in this case study?

### 6.1 Re-imagined Institutions (Empirical insights)

Over the course of becoming transformative actors between the three design contexts featured in our workshop, youth continually re-imagined their own roles and positionalities relative to the role(s) their imagined AI tools would play in their lives. In the initial

speculative space with everyday objects, the *LLL* device kept the group safe from community members who disrupted the lives of others. Within the classroom space, the *LLL* device was imagined to support the relationship of students with disabilities. Within the broader context of schools, the *LLL* device supported the youth in advocating for themselves in changing the institution of schooling.

We start by observing that no single design context supported youth in navigating all four indicia becoming a transformative agent. Our initial speculative activity led youth to surface a double bind and a breach of social order, but the cycles of experimentation and the expansion of the object did not occur until speculative artifacts were brought into the context of schools. Indeed, it was the explicit, hyper-local constraints of the schooling context that led to a contestation and expansion of existing activity. After all, in an entirely speculative context, participants retain more agency; unlike schools, the constraints seem fluid.

Next, across these contexts, the relational issue that the *LLL* was envisioned to address varied significantly. At some low-level technical and functional level, the *LLL* device remained the same: to keep collaborators accountable to a set of norms. Initially, the device was seen to resolve issues between students and other students, then students with disabilities and other classroom actors, and finally, between students and school administrators. With each evolution comes serious implications for how technologists and education researchers take on the development of the *LLL* device, as key assumptions about the "end-user" shifts dramatically in each case.

In co-design spaces that have an intention of producing concrete outcomes, often it is assumed that the output of a co-design activity is final and ready to be acted upon. While there is value to this approach, our empirical findings trouble the divide between the tools that technologists build and what can count in co-design as "output" and the tools that technologists build. As we show, even over the course of a 3-day co-design session, youth's output was actively under revision as they made sense of, adapted, and re-imagined their relationship to digital tools and other actors. If we take on solely the products of a co-design space, not only are crucial learning opportunities lost to co-design participants, but also it raises key questions about how well the co-design's partners proposal reflects their intentions, messy and contradictory as they may be. This question is particularly salient when it comes to partnering with young people where significant changes occur on a short-time scale around their values, needs, and dreams. Our findings suggest that researchers should engage co-design participants across multiple contexts, over longer periods as much as possible, with a particular attention towards youth's ever-shifting perspectives. However, we caution that youth development is not linear, steady, or predictable; new techniques and analytical tools must be developed around how to meaningfully take on the dreams of young people.

Our perspective viewing youth's learning and dreaming across multiple contexts also provides insight as to why imagining new worlds is challenging in the first place. Researchers in HCI have long been interested in understanding what expands and narrows the imagination about futures. Recent work has illustrated how broader cultural issues (e.g., race and class) narrows possibilities for utopian futures [42]. While the workshop methodology supported youth in developing transformative agency and novel AI tools to support their agency, our empirical analysis also provides insights into the challenges of imagining far-away, socially just worlds. When double binds (the first index of transformative agency) emerged (e.g., how to ensure that ideal cooperative spaces feel safe), breaching the social order was a non-trivial task. We saw that youth did not dismiss contestations to the social order on the basis of any moral or ethical stance, but instead based on concerns about social feasibility. In effect, status quo practices were problematized, but also positioned as the only reasonable way forward. In other words, we see how the familiar effortlessly saturates dreaming, while alternative possibilities require significant conscious effort to sustain and build upon.

This framing introduces a particular ethical quandary for co-design researchers: how do we support a co-design partner in navigating the tensions and contradictions between their immediate needs and their expansive hopes? Relatedly, when building critical speculative co-design spaces, how do we understand the "outputs" of a co-design space when they may not reflect youth's expansive hopes – merely the immediate structures and practices that are salient in the co-design space? These tensions appear particularly strongly in the context of schooling where youth's future hopes for success (e.g., financial) are perceived to be tied to their achievement in inequitable practices like standardized testing [5]. Our approach of institutional perceptual bridges may offer a way forward, but still leaves open some questions. In our case, the perceptual bridge of a community builder happened to offer a best-of-both-worlds solution to the double bind raised by youth, but what happens when a best-of-both worlds alternative possibility does not so readily exist? This question warrants study in future work.

## 6.2 Role of Familiar (Methodological Insights)

Like prior work [52, 72, 84], we found that the speculative worlds imagined by the youth participants are liminal—existing somewhere between the real or feasible, the fictional or imaginary, somewhere between dominant institutional practices and alternative ones. Our case study shows that the second and third indicia of transformative agency – breaching the social order and cycles of experimentation – are critical junctures where there are entanglements between the feasible and imaginary, and between the dominant and alternative. Engaging in the liminal space of speculative worlds can help hold space for exploring possible alternatives, while acknowledging the real needs and stakes that exist in people's social worlds. However, we reflect that this liminal space does not exist a priori on its own. Rather, it has to be encouraged, maintained, and created. We reflect on choices made by the researchers in the design of the experiences and workshops, and the role of the facilitators in creating the conditions to explore these liminal spaces. We present these as recommendations for future designers and researchers, and point out some limitations and open questions that appear in our approach and analysis.

*Balancing Participant Identity Development and Object Development:* Methodologically, our workshop design was oriented towards designing a learning experience for youth rather than specifically conceiving of a concrete output. In taking on our approach, a co-design creator might be concerned that concrete objects might not

emerge. This is a risk we explicitly acknowledge but deem acceptable for two reasons. First, expansive changes to schools require bottom-up engagement and buy-in; if participants do not see themselves as disturbers of the status quo, the "outputs" will likely underdeliver on their promised transformations. Secondly, when young people start to see themselves as having transformative agency, new technological possibilities emerge; our case study of the Futures of Schooling Workshop exemplifies this rich opportunity. The youth-created expansive technical designs (e.g., the *LLL* or *Dreamcatcher*) bear very little resemblance to current educational technologies), such as intelligent tutoring systems (ITSs), MOOCS, and multimedia environments, which mainly focus on content knowledge, skills, and assessment [26, 78] usually via one-on-one interactions (e.g., solving problems, viewing content, taking quizzes, and receiving corrective feedback). More expansive and immersive technologies, such as simulations, educational games, and augmented-and virtual-reality do aim to transport youth outside of the confines of the classroom, but the focus is still very much on learning and assessment of content and skills [63, 70]. Some computer-supported collaborative learning (CSCL) technologies aim to improve collaboration among students, but the emphasis is on the mechanics of collaboration (e.g., shared tool use (e.g., [24] ) or the cognitive aspects of learning [3], rarely on promoting social interactions. Going forward, how might we mitigate the risk that concrete, near-term possibilities do not emerge from our approach? In our empirical results, we described how youth expressed particular relational desires around their hopes for schooling, and differentiated those from the explicit tools they conceived of in response to those relational desires. Instead of directly reacting to the exact proposed tools, how might technical and educational designers instead support young people in considering how near-term technical and educational innovations might address their relational desires? We plan to investigate this question in our future work.

*Experiences with Existing Alternative Worlds Before Design:* Engaging participants, non-designers, and designers in imagining alternative worlds can be challenging; design researchers have developed worksheets [42], card decks [20], and other brainstorming activities [50, 82] to help with ideation in participatory speculative projects. Rather than using these existing brainstorming tools as a starting place for exploring alternate worlds, we leveraged the perceptual bridge of a cooperative house, an alternative (i.e., non-dominant) social structure that currently exists and has a long history in the East Bay. Towards our goal of supporting youth in seeing themselves as having transformative agency, the cooperative house and its concrete set of practices and relationships effectively supported youth in breaching the social order and social experimentation (the second and third indicia). In addition to being provocative by embodying key elements of transformative agency, it felt familiar to our high-school aged youth as evidenced by them actively imagining themselves in the house as an alternative to more common college-level housing options (e.g., dormitories). In general, for projects where transformative agency is a desired relational outcome of the co-design context, cooperatively organized institutions may be a powerful perceptual bridge; designers would likely benefit from choosing a cooperative institution that addresses the key values, issues, or contexts under interrogation. For instance, while our co-design space surfaced institutional structures with historical relations to racist policymaking (e.g., policing in classrooms), we did not directly build from youth's direct experience of racism within schools. To imagine utopian worlds without racism, the perceptual bridge of some cooperative organization is still likely to be helpful, but creators of co-design spaces might instead physically bring their participants to a cooperative organization where issues of racism and anti-blackness are explicitly interrogated. We see our approach as potentially complementary to speculative toolkits created by researchers to imagine new, anti-racist worlds [19]. Future work may explore how other types of speculative toolkits like worksheets and card decks might be used in conjunction with experiencing a cooperatively organized institution–perhaps creating a worksheet or brainstorming activity for youth to do during a physical site visit. In addition, building on prior work using literary fiction as as a resource for speculation[53, 60, 85], future work may also explore the potential of using media depicting cooperatively organized institutions as a perceptual bridge, such as having youth read and discuss a piece of speculative fiction that depicts these types of alternate social structures.

*Emphasis on feasibility:* In being able to see themselves within the alternative worlds, this exposure helped participants understand key concepts that might be easy to brush off or view as infeasible. Much prior research creating speculative worlds de-emphasizes feasibility as a way of prompting people's ideation and creativity beyond dominant ideologies. Sometimes ambiguity about the technical feasibility of a design concept is used to create a space for reflection and discussion [37]; other times the technical underpinnings of a design concept are feasible but the social values that they promote are fictional or intentionally provocative [28]. Our workshop builds on our understanding of the role of feasibility: we show that participants' construction of expansive speculative worlds can be supported by demonstrating social feasibility (e.g., showing that alternative social institutions are possible) and by being ambiguous initially about technical feasibility. When the speculative worlds have been constructed and the speculative world is juxtaposed against the existing institution, showing that the technology (or an approximation of the technology) is within existing technical capabilities helps to maintain the liminality that a speculative alternate world was also possible and worth creating and discussing.

*Facilitation moves*: When supporting participants in realizing their expansive dreams, we found that the gravity of dominant institutional practices is such that the co-design structure of the workshop alone was insufficient to sustain expansive dreaming. Prior research using participatory and speculative design methods has highlighted that the design of workshops activities alone is not enough to create a generative space for participants; the facilitators' language, prompts, responses to participants' questions, and social understandings of local contexts also help create the conditions for participants' imaginations [4, 64, 83]. We reflect on two key facilitator moves that we found useful in our workshop, which helped support sustained dreaming from the participants. First, when dominant institutional ways of doing things surfaced (e.g., policing-type practices or efficiency-centered designs), facilitators would suggest considering how things would work within alternative or speculative worlds that they had previously interacted with. Critically, facilitators did not advocate for the use of those

alternative spaces, merely invited their consideration. This move builds on suggestions in prior literature for facilitators to prompt participants to reflect and consider ideas without necessarily advocating for a "good" or preferable idea. [4, 83] Secondly, when participants declared that the speculative worlds were impractical and did not address their near-term material needs within existing worlds, facilitators invited the participants to deconstruct the binary between imagined worlds, and to imagine how worlds may be compatible. While the second facilitation move proved to generate expansive technical possibilities, we note that in our workshop, it tended to appropriate expansive ideas into existing institutional worlds. In the future work, we encourage facilitators to sensitize themselves to the indices of transformative agency (particularly the second and third indices), and be prepared to step in when they see participants attempting to breach the social order or experiment with possibilities over varying contexts of design.

## 7 CONCLUSION

This paper is the product of a workshop that supports youth of color in dreaming and designing socially just schools. We hoped the space would support participants in grappling with ideological tensions between the stickiness of the inequitable status quo and the elusiveness of speculative possibilities. Youth imagined worlds where they could be recognized in their entire humanity but also grappled with how those imagined worlds aligned or contradicted their near-term needs in schools, ultimately illuminating hopes that were complex and unfinished. We anticipated going into our workshop that this messiness requires an enormous amount of sense-making both for the youth and us as researchers; thus we conceptualized co-design partners as learners and transformative agents who are actively developing identity to change the status quo *and* as designers who create tools to mediate their own learning and world-changing capacity. Of course, we do not expect this process to happen over a single interview, a 3-day workshop (like the one we conducted), but over a lifetime across time and space that we as researchers are unlikely to ever have full visibility into. However, as designers and educators ourselves, we can only hope that our work contributes to their development in profound and unpredictable ways going forward, moving towards joyful new worlds as transformative agents.

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