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“They were learning from us as we were learning from them”: perceived experiences in co-design process

Areej Mawasi ^a, William Penuel^{b,c}, Arturo Cortez^{b,c}, and Ashieda McKoy^{b,c}

^aTechnion, Israel Institute of Technology Haifa Israel; ^bInstitute of Cognitive Science University of Colorado Boulder Boulder United States; ^cSchool of Education University of Colorado Boulder Boulder United States

ABSTRACT

This paper explores participants' perspectives of how they experienced a co-design workshop focused on developing a storyline unit where students can explore foundational concepts of AI. We structured a co-design space: (1) to create opportunities for intergenerational collaboration among educators and young learners; (2) to develop critical perspectives and understanding of AI during co-design. An interview analysis examined what participants valued, relationships they described, and their reflection on this experience in comparison to other similar experiences. The analysis showed that co-design afforded a safe space for participants to contribute to the design process building on their diverse expertise. Implications for intergenerational co-design within settings with asymmetric and distributed expertise will be discussed.

Introduction and background

The past decade has seen extensions of design research beyond classrooms and schools toward creating collaborations with youth, educators in and out of school, and nondominant communities (e.g., Bang & Vossoughi, 2016; Gutiérrez & Jurow, 2016; Gutiérrez et al., 2020). A key feature of such approaches is that they engage participants in the design process in critical discourses, while also imagining new educational possibilities for their learning (Bang & Vossoughi, 2016). One design research approach that supports such goals is co-design.

Co-design is a form of collaboration between various participants and researchers toward the design, development, and study of educational innovations and artifacts (Penuel et al., 2007, 2022). Two major motives of co-design processes are (1) to create conditions for design where diverse expertise can be surfaced, leveraged, and transformed (e.g., Bang & Vossoughi, 2016) and (2) to shift power relations (Huybrechts et al., 2017; Steen, 2013). These two motives challenge researchers to co-design spaces where participants can be positioned as co-designers in the design process (e.g., Mawasi et al., 2022; Penuel et al., 2022). They require expanding the way knowledge is generated and built among participants and researchers in research, as well as creating conditions for agency of participants with more limited authority over the overall process or social power within intersecting systems of oppression. Neither task is easy to accomplish, and well-intentioned efforts to expand participation can lead to participant experiences of exclusion and silencing (O'Connor et al., 2011). Understanding *how* to create more dialogic conditions in co-design across asymmetries of power, age, and expertise, is therefore necessary to understanding if – and when – co-design can avoid this outcome.

Co-designers have devised different strategies to accomplish these aims. To support elicitation of diverse forms of expertise, co-designers have created novel activity structures for eliciting multiple perspectives (Matuk et al., 2016), engaged in mapping values of co-designers (Ryoo et al., 2015), and

structured participation to center the perspectives of marginalized groups and communities (Ishimaru et al., 2018). To help shift power, co-design teams have created intergenerational design teams (Yip et al., 2017), collaborative activity structures foreground equity and justice commitments of the design task (Lee et al., 2022), and deliberative decision-making routines that aim to work toward consensus after eliciting a diversity of perspectives (e.g., Mawasi et al., 2022). In intergenerational co-design, the key to these efforts is anticipating and taking into consideration the way power asymmetries between adults and youth are likely to manifest in interactions (DiGiacomo & Gutiérrez, 2016; Vossoughi et al., 2021). These asymmetries in distributed expertise in intergenerational learning offer a space for development among learners (Vossoughi et al., 2021), which can be facilitated by the construction of a shared zone of proximal development within a group (Newman et al., 1989).

In most co-design projects, while expertise is distributed and often asymmetric, the focal point of design makes it relatively easy to leverage the expertise of participants, because they have some experience with the subject matter. For example, co-design of science instructional materials typically engage educators with expertise in the content, in curriculum, and teaching of science. We know less about contexts where co-design involves content that is relatively new to all participants and that might be judged to be “over the heads” of some participants (e.g., youth) in co-design. In this project, co-design focused on critical and ethical dimensions of AI and technology design impacting non-dominant communities (e.g., bias, surveillance, racism, and representation). Also, the co-design process involved a structure that aims at positioning participants as co-thinkers in designing a curricular unit on this topic. In this study, we contribute to scholarship using participatory approaches of co-design and research that examines the presence of technology in everyday life and how it is impacting nondominant communities rather than privileging technological innovations without an ethical examination (Benjamin, 2019; Noble, 2018; Vakil & McKinney de Royston, 2022). Specifically, we take up how we can deploy different strategies for eliciting relevant expertise and for shifting power relations under such conditions to engage in productive co-design is an open question that we take up in this study.

This paper seeks to understand how participants in a co-design process that is intergenerational and with distributed asymmetrical expertise interpreted their experience of co-design. Here, we define asymmetry through two kinds of differences among participants: age and familiarity with the concepts behind the design of advanced technologies (e.g., artificial intelligence and games). Drawing on Tejeda et al., (2003), Vossoughi et al. (2021) consider asymmetrical relations of a “more expert other” as creating a possible developmental zone, building from Vygotsky’s (1934/1978) earlier work. This consideration helps in positioning participants as co-thinkers who can offer various contributions across activities, recognizing that both young learners and teachers are learning from one another, and shifting roles of young learners and teachers toward a shared activity (Vossoughi et al., 2021). In a constructed zone of proximal development, conceptual change can occur, even when – or rather precisely because – participants bring different perspectives on activity to interaction, and when all of the participants have partial understandings of what they are up to (Newman et al., 1989). In this study, we investigate how participants negotiate different perspectives within co-design, to establish new purposes for learning and possible foci for curricular units, within the context of an effort to broaden participation in the design of materials to support the development of AI literacies among members of historically nondominant communities.

In this specific study, we worked with a team of educators ($n = 8$) and young students ($n = 5$) to co-select and co-design the launch for a unit centered broadly on the sociocultural, ethical, and political dimensions of AI. In this collaborative process, we created a co-design space aimed at eliciting and making use of all participants’ expertise and supporting joint decision-making regarding the focus and outline of a curriculum unit, while anticipating and seeking to reduce impacts of asymmetries of power linked to age and expertise. In this study, participants’ perceptions of their experiences are the focus of analysis, as we consider their perceptions to be a key indicator of the success of co-design. Our findings are intended to contribute to the existing literature of participatory design in education by identifying moves and activity structures that support intergenerational learning and collaboration in a novel

space for design, AI education. Through this contribution, we invite researchers and educators aiming to integrate AI tools in education or teach about AI to consider the importance of shifting from technocentric approaches toward building infrastructure for AI in education in collaboration with young learners and educators.

Frameworks and activity structures for co-design

Our project relied on multiple frameworks and practices for eliciting and making use of diverse forms of expertise and for shifting power relations within co-design (see Table 1). The aim of this co-design workshop was to establish the focus for a unit focused on developing middle-school students' critical understanding of big ideas related to artificial intelligence (AI). The topic of AI is not typically explored in K-12 schools nor is it part of any adopted educational standards, and understanding the complex algorithms of AI applications is beyond the appropriate reach of middle-school curricula. At the same time, groups like AI4K12 (2020) have articulated conceptual foundations of AI – such as ideas about how computers learn – that can be taught at the secondary level. In addition, AI applications in everyday life are increasingly ubiquitous and used by a wide range of people, and they are in many instances reinforcing harmful practices in policing and housing that disproportionately impact Black, Indigenous and People of Color (BIPOC) communities (Benjamin, 2019; Noble, 2018). This mix of conditions make for an ideal case for exploring co-design under conditions where there may be everyday expertise but limited technical knowledge, and where learning goals are nonetheless consequential for youth today and in the future.

Supporting eliciting, developing, and using expertise for co-design

To develop activity structures that support eliciting, developing, and using expertise in co-design, we draw on sociocultural learning theory. That is, we conceptualized co-design space as a shared learning space, and we drew on the notion of a constructed zone of proximal development from the writings of Vygotsky (1934/1978) and later scholars (Newman et al., 1989; Vossoughi et al., 2021). Following the idea of *constructing* a zone of proximal development (Newman et al., 1989), our aim was to create a system of social activity around common tasks, where different perspectives – and therefore relevant experience and expertise – might emerge, to help us realize a tangible, but not-fully-defined-ahead-of-time innovation. To accomplish this task, we needed to find a way to enlist all participants as learners in an activity and create opportunities for collective negotiation of goals and the object of design. Further, creating a zone of proximal development, we needed to construct opportunities for different participants to teach others what they know in well-timed moments (Vossoughi et al., 2021), whether that was about everyday technologies familiar to youth, or AI concepts that were unfamiliar to participants but not to invited guests. Importantly, we needed to construct this system of social activity in such a way that participants could come to see both student and teacher participants – or ourselves – not through a lens of “ineptness and inability” but through a sense of capability and possibility to imagine different futures (Gutiérrez et al., 2017, p. 30).

Our engagement with sociocultural theory also considers that technologies “are systems that exist in dynamic interaction with learners, tools, norms, histories, methodological procedures, and cultures (Srinivasan, 2018; Dobson, 2019)” (Mawasi et al., 2020, 1617). Our co-design work draws on scholars in the learning sciences, science, technology and society (STS), and human-computer interaction to assert that designing learning experiences for AI in education requires, (a) collaborative work with people intended to use them in their context to redesign and reimagine these artifacts (Benjamin, 2019; Kaptelinin & Nardi, 2006; Srinivasan, 2018), (b) a critical and ethical inquiry of technological artifacts and how they impact nondominant communities and learners (e.g., Philip et al., 2016; Vakil & McKinney de Royston, 2022), and (c) working with young learners and educators to reimagine the design of learning environments (Mawasi et al., 2022).

Preparing participants for co-design

For many educators and youth, participation in co-design activities is unfamiliar and counter-normative. Many experience frustration in the early phases of co-design, as a result (e.g., Penuel et al., 2007). As such, it can be valuable to provide an orientation to introduce participants to the process and the key tools to be used. Two researchers (Authors 2 and 3) organized and co-led a virtual 8-week course in co-designing curriculum according to the curriculum model described below. As part of the course, and in the co-design workshop itself, we organized youth participants into affinity spaces on multiple occasions, where they had conversations with an adult facilitator on the topic at hand. These youth-centered spaces were intended to provide an opportunity where youth could talk with each other and develop ideas for the unit, which were then brought back to the whole group.

Eliciting experiences with everyday AI technologies

Learners are rarely supported to explore new technologies' political and ethical dimensions in technology education (Vakil & McKinney de Royston, 2022). The two authors found intentional engagement with how surveillance technology is used on immigrants offered young learners in one program to engage in philosophical inquiry that deepened their thinking and imagination of technologies and how they related to their lived experiences. For example, they assert relationality "with each other, their community, and the socio-technical artifacts related to immigration in the Chicago area" (p.14) was enacted as a form of ethical sensemaking throughout a process of documentary making of technologies.

Eliciting participants' everyday experiences with technologies can also create a possibility for such a form of inquiry where participants interrogate technologies as sociopolitical artifacts (Mawasi et al., [under review](#)). One of the activities we organized was to select some *everyday technologies* that use AI to help them connect learning about AI to making sense of their everyday worlds. As an illustration, we explored together how and why Google produced different search results for different users even when using the same search terms, based on information about past searches. A significant amount of time was spent on the topic of games—one of the potential design challenges the group was considering as an anchor for the unit. This provided an opportunity for those who played games – which included some educators and some youth – to show their expertise about game plots, racist themes, and tropes in games, and the role of NPCs (non-playable characters) in games. It also provided occasions for young people to show their expertise in how gaming communities are moderated – a practice where AI is used regularly to "flag" potentially harmful comments to human moderators.

Co-learning AI concepts through well-timed teaching events

To facilitate our collective learning about AI, we invited early-career AI researchers to join the design team. Importantly, these were not core members of the research team facilitating the co-design, and we introduced the AI researchers as people who could help us understand some basic AI concepts about how a computer can learn (e.g., to recognize and classify words and images, to interact with a game or a person). Of relevance is that none of the facilitators had more than a basic understanding of AI concepts, and we shared this with participants; one of the educators in the group did have expertise but had never taught the concepts to students.

We asked visitors to the workshop questions to help clarify our own understanding about how AI works within the kinds of contexts we were considering for the unit (e.g., within game design). We asked some of these researchers to be part of the workshop, where they organized learning stations where participants could interact with different AI technologies, including an interface for training data to classify sentiments (Druga et al., 2019), and a social robot (Bishop et al., 2021). These spaces introduced participants both to AI applications and to activities that could be used to help teach AI concepts. Importantly, these were also well-timed pedagogical moments (Vossoughi et al., 2021) that

included some direct teaching of AI concepts to participants, so that we could gain a sense of some of the ways we might introduce AI concepts to students through the unit.

Supporting power shifting in co-design

Our understanding of power is that it inheres in relations among people and institutions and is not something that individuals “possess” so much as enact (Foucault, 1980, 1991). In co-design in educational spaces, then, shifting power entails shifting relations among people and institutions, such that the kinds of knowledge and expertise they bring can be elicited and further developed in ways that open up new possibilities for teaching and learning (Bang & Vossoughi, 2016). It requires the establishment of new forms of solidarity – particularly with the hopes and visions of young people – that work against forms of educational practice that reproduce inequities (Philip et al., 2022).

Negotiating learning goals

In our design process, one way that we sought to shift power relations was to put learning goals for units on the table for clarification and deliberation. Drawing on Engeström’s (1993) definition of object as the major problem space in which teachers and young students’ activity is directed toward, these goals served as an object the co-design process was intended to help transform and realize through their design. That is, participants engaged in identifying the larger purposes for which the curricular unit could be oriented. For example, the unit could be designed to advance technocentric approaches to AI or to center principles of justice and equity within the context of AI infrastructures. Here, we point to how the co-design process could open up opportunities for young people and adults to make sense of and interrogate the impacts of AI across a variety of contexts.

In other work, this takes the form of “unpacking” or analysis of disciplinary learning standards (Mawasi et al., 2022). In our case, the process began with an analysis or “unpacking” of learning goals, which for this project were to engage students in critical investigations of concepts and practices in artificial intelligence (AI4K12, 2020), as well as a set of goals related to engaging students with issues of algorithmic (in)justice as articulated by science and technology studies scholars (e.g., Benjamin, 2019; Noble, 2018). These were “expert texts” brought in and then annotated, critiqued, and discussed by participants, on the way to articulating learning goals for the unit. Social annotation is a tool for allowing people to “speak back” to texts and share their thinking easily with others (Kalir & Garcia, 2021), and that is how we positioned the activity for participants – as a review of potential learning goals that were worthy of their discussion but also critique.

As part of the process, and to help build solidarity with students, we brought in student survey data collected prior to the meeting to discuss and consider in deciding on a focus for the unit. The survey presented students with candidate design challenges related to the broad conceptual idea for the unit (how computers learn), and students rated how interesting each candidate challenge would be to them, as well as how important it would be to their communities to work on solutions to that challenge. Members of the research team initially created tables of results to show results broken down by race and gender, with instructions to participants in the workshop to discuss what they saw, centering the concerns of racially minoritized students and non-male-identified students, and draw inferences from the data about what foci might best engage students owed an education debt by society (cf. Ladson-Billings, 2006).

In deciding on goals, we brought to the foreground our values as designers and invited participants to bring in theirs. A key goal that we shared was a commitment to focusing on a design challenge or issue that would allow students to grapple with matters of algorithmic injustice they might encounter through interacting with technologies familiar in their everyday lives. For us, this goal was grounded in valuing learning that supports students’ critical digital literacies while imagining new ways of thinking about technology teaching and learning with them (e.g., Philip et al., 2016). We elicited and foregrounded values of participants by recognizing what they found unique about this experience from

their perspective, to whom and with whom they describe they are designing, or why they are joining this co-design space.

Choosing a phenomenon and using a storyline

A key aspect of our co-design process is the approach we have taken to curriculum design, which itself supports agency for participants in co-design with respect to deciding on a focus and sequence for instructional activities. In developing curriculum units, we have adopted a model for the curriculum called *storylines* (Reiser et al., 2021). When applied in a context like ours, a storyline unit begins with the presentation of a design challenge to students that makes clear what issues are at stake for students and for whom. Students first explore a sociotechnical phenomenon that gives rise to the need for design, attempt to make sense of it, and as a class, come to agreement on a set of questions that, together, the class needs to answer to explain the phenomenon and develop a solution to the design challenge. Over the course of a storyline unit, students pursue these questions through investigations they help plan, sensemaking, prototyping, and testing of design solutions (Figure 1). Thus, in a storyline unit, power is shifted within the classroom, such that educators and students partner on the direction the unit will take for a given phenomenon or design challenge.

Choosing a phenomenon itself presents an opportunity for participants in co-design to exercise agency in ways not typical in curriculum projects. A typical relationship of educators to curriculum materials is one of “following” what an outside group has decided for the focus and sequence of lessons (cf., Remillard, 2005). Students, in this typical relationship, are expected to follow goals set by the curriculum and participate in ways fully directed by the teacher. In our co-design process, however, we provide an opportunity for participants to choose the focus of the unit, after clarifying key learning goals for units and experiencing different candidate phenomena as students might (Mawasi et al., 2022; Penuel et al., 2022). Students, through enactment, further give shape to the course of the unit through their own questions.

These data, along with possible design solutions, are reviewed by co-design teams before selecting a focal design challenge and then “testing it” by presenting the challenge to the entire team, with team members playing the role of students. The co-design process next provided templates for developing a storyline – an outline of the flow of a unit from the student point of view – and lessons that follow particular routines. A major departure of the storyline from popular lesson plan templates for units (e.g., Understanding by Design; Wiggins & McTighe, 2005) is that the template requires co-designers



Figure 1. Example of questions generated collaboratively by participants to drive learning forward in the process and address what questions students might ask about a phenomena with discussed in the co-design session (Day 2).

to imagine and write out the flow of a lesson from how a group of students might experience it. Learning goals for each lesson are expressed in terms of “what we figure out,” that is, in terms of how students in the classroom, working together collaboratively, might go about answering a question they had about the design challenge, and what answers they might come up with. It requires empathy for students’ experience and anticipation of students’ knowledge building in ways that are intended to build solidarity with students. A key strategy in supporting this aim is to invite co-design participants to step into “student hat” (Lowell & McNeill, 2020), by which we mean we invite them to role-play or imagine themselves as if they were students coming into the lesson.

The current study

In this paper, we present the analysis of interviews conducted with participants of the workshop to address the following major research question:

How did participants experience the distribution of expertise and being in an intergenerational environment in co-design?

The analysis focused on the following sub-questions:

- (1) *What are the values that participants perceived were reflected in the co-design process?*
- (2) *What kinds of relationships did this co-design process afford or constrain for participants?*
- (3) *How did it compare to other similar experiences they were part of in terms of building with others and youth?*

To address these questions, we conducted a series of semi-structured interviews with 12 of the 13 participants in the co-design workshop. In this paper, we used an inductive approach to identify topics and then deductively major themes derived from the participants’ perceived experiences about building ideas and knowledge collaboratively in the co-design process.

Methods

This qualitative study focused on the experience of educators and young high-school students who participated in a five-day co-design workshop aimed at developing and designing an AI unit that centers on issues of algorithmic justice in AI and technologies. In this section, we describe the context of this study and participants, co-design activities that were the focus of interview with participants, instruments we used to examine participants’ experience in co-design activities using interviews as an instrument, and the analytical approach used to examine their experience.

Participants

The co-design process included the following participants: eight educators and five young high-school students who participated for the 5 days in the workshop. We the authors were four facilitating researchers for the co-design workshop. Our role as researchers in this co-design process was to (1) design the co-design workshop activities, tools, and participation, (2) facilitate the workshop activities, (3) maintain an active communication with participants during the workshop to adapt our activities, and (4) participate in co-design activities with participants. We also invited five guests from AI and AI education to share their expertise with co-designers and a district representative from each of our two partnering districts to join as well. The latter representatives were STEM (Science, Technology, Engineering, & Mathematics) curriculum leaders in their respective districts. The participants were recruited through our network of partners in this large project and completed an application process into which all were accepted volunteers. Educators who participated in these sessions had varied expertise, backgrounds, and interests in AI

and technology. For example, there were teachers interested in educational technology generally; only one taught relevant subjects as part of their job. Educators' backgrounds and disciplines varied. They included teachers of High School English Language Arts (ELA), Middle school World Geography, Middle School Math, History, and after-school education programs focused on Media Literacy and Agency. One teacher identified as Black, one as African American, one as Black/Mexican, one as Black Latino, one as Latinx, and three as white.

Five high-school students joined this co-design process. These students were recruited through their teacher, one of the co-design workshop participants and based in Arizona. There were two students going into the 11th grade, two students going to the 10th, and one going into 9th grade. Two students identified as Hispanic, two identified as Hispanic/Latina, and one did not report their race or ethnicity.

The rationale for creating an interdisciplinary and intergenerational design team emerged from our goals. First, because AI is not formally in the curriculum, we knew we needed to design with teachers from different disciplinary backgrounds to develop connections to existing standards in the discipline, if the unit would be taught. Standards are a key driver of what teachers believe they can teach in the classroom in the U.S. (Polikoff, 2021). We invited young learners because we wanted to co-design activities that emerged from their interests through intergenerational deliberation. Our past efforts to include a youth perspective through interest surveys (Penuel et al., 2022), we believed, would not be sufficient as a means to generate content that would be compelling to youth. We built from similar efforts in co-design, in our motivation and approach, in bringing youth in as partners in the design process (e.g., Wilkerson, 2017).

While our study is relatively small, in terms of numbers of participants, this is a fairly typical size for a design effort of this scope (see examples from special issue of *Cognition and Instruction* on co-design, 2022). Small teams offer a way to "keep everyone together," as well as opportunities to engage more deeply with one another in interactions than in large groups.

Data sources

To address questions raised in this paper, one researcher conducted interviews ($n = 12$) with educators ($n = 7$) and high-school students ($n = 5$) 2 to 3 months after the completion of the workshop. The median length of interviews was 24.65 min (SD = 5.62 min). The interviews were recorded and transcribed using professional transcription services. One researcher reviewed the transcription for accuracy. All interviews were conducted online due to COVID19. Interviews took place 2 months after the co-design workshop was completed, we invited all participants for interviews. We sought to create some distance from the workshop, to give participants time to be able to make sense of and contextualize the experience. To facilitate recall of these activities, we structured interview questions around specific activities and elements of the co-design workshop.

The protocol included questions designed to elicit participants' experience of the workshop, how it compared to other activities like it, key moments of the workshop, and the ideas they were exposed to or developed as part of the workshop. In addition, we asked participants about the agency they felt in the process and insights they gained from it. For example, the interviewer asked participants to reflect on how might they describe the co-design workshop to a colleague or a friend who was not there, if and how the co-design process met one of its major goals "to give participants a say" in building the storyline unit, key moments for them during the workshop, and new ideas that came up to them during or after participating in the co-design workshop.

During the interviews, the interviewer took detailed notes of each of the participants' responses, which served as the basis of coding, as described below. Finally, for this current study, we also used our notes and artifacts from the workshop (e.g., slides, Jamboards, and agenda) to generate descriptions of how activities were enacted to help contextualize participants' answers to our questions.

Table 1. Co-design workshop activities: Aims and structures.

Aim	Activity Structures
Clarifying purposes	Engaging with everyday technologies Unpacking AI goals together (subgroup)
Organizing for intergenerational design	Storyline course Organizing small groups where youth worked together as a group
Learning about AI	Identifying AI experts to join space Stations for learning

Analytical approach

To address our primary research question, we focused our analysis of interviews on (1) participants' reflections of values reflected in the co-design, (2) relations they described as were afforded or constrained in the co-design workshop, and (3) how this experience compared to other experiences they had in relation to work with others and building collaboratively.

First, one researcher reviewed notes from all interviews to immerse themselves in the data. To sensitize themselves to the data, the researcher read each interview in its entirety, then question by question across all interviews. Next, the researcher wrote descriptive memos of responses to each question to highlight potential areas of focus for coding. This allowed for noticing of initial commonalities and differences among participants. For example, many of the participants say they appreciated the focus on games, but one participant who was disappointed that the goals that emerged did not focus on coding. Another pattern was that many adult participants compared co-design favorably to other professional development, whereas youth compared the experience to school learning.

As a next step, we conducted an inductive analysis (Thomas, 2006) that aimed at identifying categories (codes) of responses (Saldaña, 2015) related to the three sub-questions: participants' experience of values enacted in the space, relationship dynamics during co-design, and their experience in building with others in comparison to other experiences. Each interview was then coded using a scheme developed by the first author. From that initial coding, we deductively developed a set of four superordinate categories that would eventually become the basis for identifying themes in the data: values in co-design, relationality in co-design, uniqueness of experience, and building collaboratively. These developed categories connect to the purpose of the co-design framework we described earlier, focusing on learning as a sociocultural process that enables relations building, collaborations, and enactment of values throughout the design process. Next, we created sub-categories under each one of these four categories to provide further details of participants' stances toward these topics (see Table 2). Then, for each interview, we created a summary table where each category and sub-category included examples from the interview. In the next coding cycle, one researcher (the first author) organized emerging sub-categories into a codebook that included definitions and examples. Finally, research team members discussed examples to derive key themes from the coding (Thomas, 2006). Throughout our discussion as a team, we discussed how best to represent interview responses that belonged to multiple coding categories. Guided by the research questions and the coding process, we organized the findings under four categories where we supported each with sub-category examples from the data of teacher and young learners' interviews.

Findings: participants' experience of the co-design workshop

In this study, we aimed to study how participants experienced the distribution of expertise and being in an intergenerational environment in co-design from their perspective. We focused on what examples of values participants described, the relationships they described, and how they compared their experience in co-design with other experiences of design and learning. We develop an argument for the claim that participants perceived the co-design as a learning space where they built collaboratively while developing relations among one another and enacting values of care and respect to one

Table 2. Major categories and sub-categories of coding.

Values reflected in co-design	Showing respect for one another. Welcoming space for participants	Participants viewed and positioned as valued co-designers
Relationality in co-design	Building relations	Care for/with others
	Participants positionality	
	Safe space	
Uniqueness of experience	Who is involved	
	Intentions of co-design	
	Disrupting status quo of curriculum design practices	
Building collaboratively	Ideas collaborative building	
	Building relations	
	Building ideas from multiple resources	
	Possibilities for using ideas developed during co-design	

another. Such a claim is supported by participants’ reflections on their experiences of the co-design process. Here we organize our findings under four themes related to participants’ experience of the co-design process from the interviews: Values reflected, Relationality, Uniqueness of experience, and Building collaboratively. In this section, we describe these findings and support them with examples from interviews with educators and young students.

Values reflected in co-design

We found that participants saw some different values reflected in the co-design process, as reflected in their interviews: showing respect, welcoming one another, valuing co-designers, and care for/with others.

Multiple participants described that the co-design space was one where participants *showed respect for one another*. Participants said that care and respect were values evident among teachers, researchers, and young students in ways that ideas were taken into consideration and invited in the space, and participants’ backgrounds and prior experiences even as non-experts in the subject matter were respected. For example, one teacher mentioned, “we were treated like professionals the whole time. . .it felt like it was leaning into everyone’s different expertise.” Notably, this teacher was someone who did bring significant expertise as a technology instructor in their school, specifically related to AI. Another participant commented that “we respected other people’s opinions,” amidst a great “diversity in not only age groups, but backgrounds.”

This respect among participants and researchers was also fundamental in creating a *welcoming space for participants*. Participants said that researchers welcomed contributions from participants and appreciated their various expertise. In addition, they said that the space encouraged question-asking, and they said that the activities afforded varied ways for participants to contribute (e.g., either in small groups or large discussions or chat or through artifacts and tools). For example, one teacher said,

To me also, the things that just stick out, everyone was like very open and respectful, and we had a couple laughs, we had some fun. And so to me, the other big thing was the groups that we were working with were also incredibly giving and insightful. And when we asked questions, when we spoke in breakout rooms, it was just really nice to kind of be able to share perspective. And that was something that stood out to me as well.

A second example is from a young student who mentioned, “I feel like it was a safe and comfortable environment to share,” she said in response to interview question that the space is welcoming:

INTERVIEWER: Can you tell me more about this? What made it for you a safe space or why?

INTERVIEWEE (student): I would say it was welcoming. Even from the start, we felt the energy that people gave. It was very positive. We all were there for a reason. We were all there to learn and collaborate, and you can feel that from the first day.

Peers played a key role in creating the space. As mentioned in the previous examples, teachers and young students said they felt welcomed to share, contribute, and ask questions among each other even when things were unclear to them. Even when participants said they had limited expertise in the domain being considered for the unit, they felt listened to. For example, one teacher described, “I didn’t have a lot of background in the gaming, never played a game ever on my computer or any of those devices, but yet I still felt like what I was sharing was valid and that it was accepted and that was embraced, and people still learned a little bit from me.”

In this sense, participants said they were also *viewed and positioned as valued co-designers*, through the respect of researchers shown to participants, researchers setting up norms and space for collaborations among participants and emphasizing the value of varied voices, views, and perspectives for creating new kinds of curriculum together. For example, a student described, “just feel like you’re not being excluded in any way. Like you’re welcome to the conversation.” One teacher described a key valuable moment for them was when others validated their perspectives, but also the space offered opportunities to grow beyond their own perspectives. They said, “To me, getting those outside perspectives in many ways. . . . On the one hand, they validated some of my opinions. On the other hand, they challenged me to kind of expand my horizons about what curriculum planning could be.”

The intentionality in representing varied perspectives and involving their voices in the co-design process also provided a space where participants talked about *care for/with others*. Here we mean creating intergenerational relationships with others in the co-design space and larger ecology of the work they do. Multiple teachers emphasized that young people were welcomed into the space, and their belonging was cultivated. For example, one teacher said,

I think bringing in youth is step one. And so we had young people in the space, so that’s always nice. They usually don’t get a seat at the table in curriculum design or this type of work, so I was happy to see that. I do think that we needed to push a little bit further in building a space that they felt a sense of belonging in and that felt relevant for them.

Relationality in co-design

Participants observed that relationships evolved in the space, and they said that co-design was a safe space to build relationships with people with different kinds of expertise and ages. These relationships developed between participants also included thinking collectively and individually about communities they work with (e.g., teachers, parents, students, and communities of color). Participants described their relationship development through examples of building relations, describing the co-design as a safe space for collaboration, and positionality of participants.

When *building relations* in the space, participants said facilitators encouraged and designed for communication among all participants. Such interactions supported participants to learn about one another and build relations with one another. For example, a student asserted, “I really liked how we could interact with other people and learn more from them [working together in groups].”

Participants said that the co-design workshop was a *safe space* where they could “take risks without feeling embarrassed.” A key part of that for participants was that participants felt they could seek help and pose questions, without the risk of being judged. For example, one teacher who acknowledged they do not have expertise in AI, said “it gave space for everybody else who didn’t know and knew they didn’t know and felt uncomfortable by the fact they didn’t know, to kind of grow.” This teacher also said, “There’s something powerful that I can’t put my finger on about the fact that none of us are experts in this and we were still all able to move through it together.” When describing how they felt in the environment, a student mentioned “great experience,” the interviewer asked him to elaborate more and describe what they mean by “safe space:”

INTERVIEWEE (student): In what sense? It would be a safe environment for us to share our own ideas and not be judged to share our own ideas.

INTERVIEWER: Yeah. You mentioned safe space, what do you mean?

INTERVIEWEE (student): Safe space? As I said, you wouldn't be judged. You could share your own idea, your own views, your own perspectives about what the teachers were saying or the professors were saying to us, and we could share what we thought was wrong or what we thought was right. And then we wouldn't be judged because they know we have different perspectives or ideas from them.

As described earlier, the space brought participants with diverse and varied expertise and experiences to the space. We found that this diversity and variety allowed for fluid positionalities to be enacted and at the same time disrupted relations between teachers, students, and researchers. In other words, *the positionality of participants in relation to others* took different forms depending on type of activities and discussion topics. For example, when discussing some topics like games, a teacher positioned themselves as a learner, while students positioned themselves as teachers. Participants noticed the intentional efforts by designers to create opportunities for young people to develop as leaders in the effort. For example, one teacher mentioned,

I think we tried to add some elements of that, where we had specific breakout rooms for them, but I do think we almost needed the young people to drive the work, to be at the forefront of actually giving us content or giving us what is relevant, and then to, I don't know, be team leads almost even.

Another example came from a student who said,

... [T]he teachers or—not teachers, the professors—would learn from us in the workshop. They would learn from us as well since we had different minds. As we said before, or as I said before, we have different minds and therefore, we have different views on things, different perspectives. And so they would learn our perspective and we would learn their perspective on things.

Relationship to other experiences

In analyzing how participants compared co-design to other experiences, one aspect of experience pertained to the redistribution of power in the context of knowledge building. Participants' experience of the co-design process and outcomes was described as different from other experiences in educational settings or professional settings (like curriculum design, professional development) when it comes to *who is involved in the co-design* process (e.g., diverse people, including students) and the *intentionality* in co-design method (e.g., using storyline approach). For example, one teacher said in other experiences he has done academic lesson planning with teachers, yet, this space was different because of the community and approach of planning, referring to the *storyline*. This teacher said,

Definitely, I'll start with that community because I think having community and having students really does make the difference. I would also say that for me, from a planning perspective, it's definitely the way that we kind of reverse engineered it. I've done backwards planning before, but this almost seemed like a step further, which was backwards planning to get to a question that was, I would say, really fantastic and culturally responsive in thinking about how the students would see that and how the communities would see that, versus we like to talk a lot about that when we do academic planning. But also in academic planning, we tend to get bogged down a little bit more, I would say, in state standards and stuff like that.

Further, some participants argued that the co-design process *disrupted the status quo* with respect to power relations and curriculum. For example, one teacher, when asked if they would recommend this session to other educators, said,

Because it disrupts. . . it disrupts power dynamics. It disrupts our notion of what curriculum can be and look like. And then I think ultimately it infects the K-12 space with something that actually seats or has the potential to seat young people as co-conspirators in developing their own learning.

This alternative possibility was also shared by students, who experienced the opportunity to build with teachers and have a say on the curriculum design process as a unique learning opportunity in which,

“they [the teachers] were learning from us as we were learning from them” reflecting on the difference between power dynamics they often have with teachers versus during the co-design session.

Another commented that the process offered a different model for curriculum that put students’ ideas and questions at the center of teaching and learning. For example, one teacher said one of her highlights of the co-design process is the method toward thinking of students’ questions (i.e., “how we create a student-driving question board”), the co-design method planning, the teacher described “it’s just changed the way that I think about lesson planning in general and designing, particularly with outcomes for students.”

Building collaboratively as a process and outcome

Participants described the co-design space as one where they were *building together*. This notion of building together is expressed through examples of collaborative building of ideas, building relations, building ideas from multiple resources, and thinking of the possibilities to use ideas they developed during the co-design process in the future.

Participants described the co-design space as affording *collaborative building and thinking with others* and *building relations* among participants through interactions during activities. Interviewees recognized that the process of building together involved them exchanging and navigating their varied expertise, experiences, and voices toward building a new curriculum unit. Importantly, the value of building together was enhanced by the presence of a diverse group of participants who shared some cultural repertoires of practice with one another. One teacher, for example, described that an essential aspect of building with other participants was having people with varied expertise yet also a representation of people of color:

I also think there were quite a few people of color in the room. I, personally, as a person of color like when I’m designing, I like to be around other people who look like me and who have other experiences like me and it always enriches the session just like immediately.

This example calls out this educator’s positionality as a person of color and at the same time her appreciation of diversity in who is designing in this co-design process.

Additionally, one student described an example where participants constructed an idea when exchanging perspectives and discussing, this example not just illustrate the notion of building together, but also building together with youth ideas in particular,

The discussion boards we did on the Jamboards, we all put our thoughts into it, and we could see clearly our different perspectives of it. When we were saying stuff, the adults branched off what we were saying. So they understood where we were coming from and they started discussing more about it, so we added more into the conversation.

Participants described *connections among ideas* that were constructed with other participants and researchers. The participants described content-related ideas (e.g., learning about racism in games), learning about co-design structure and process as a methodology and ways to use materials and tools used in activities. One idea that resonated with multiple participants is learning about sociopolitical dimensions of AI, such an idea was constructed in discussions among participants and researchers. As a teacher put it,

For example, the way there was that woman who did this research about how the facial recognition software mostly only worked on white faces, because of the data set was from only white faces and things like that. The way because the data that the AI uses is from our racist history, it is reproducing that *racism in a way that’s neutral*, because it’s a computer program, that was a big take away from me.

Secondly, through the building of ideas, participants also built connections between technology design and class and race dynamics in everyday life. A student said,

So I thought that it was all preset to think the same thing, but actually in reality, when you would go to different cities, like poverty in the game and a really wealthy city, they would have different interactions with the cops.

I think it was just really important to me because at the time, Black Lives Matter was a really big thing. Stop Asian Hate was a big thing, too, and they still are. They're really important. And I just feel like it was just a useful thing for me to learn that it's not just in real life. It's also in video games.

Participants recognized that the *ideas taken up in the space reflected views of different group members*. When asked about where they thought the ideas discussed came from, one teacher said, “Probably a combination, so researchers and their roots, but also what students were interested in or had experience with prior knowledge in, but also teachers and what they might want to explore as a teacher.” Another teacher said, “I think we were given a framework of what this process is and what it can look like. But I did feel like we had the power to remix that.” And a student said, “I think we probably all learned this as a group, because maybe a lot of people didn’t know about it.”

Discussion

This paper aimed to explore ways in which participants experienced a co-design process and navigated the distribution of expertise and building in an intergenerational space, where the goals were to elicit and use expertise of diverse participants and shift power relations. Below, we relate the key themes from participant experiences to our key aims of eliciting and using participant expertise and shifting power relations in co-design.

Supporting eliciting, developing, and using expertise for co-design

One of the qualities of experience that participants pointed to as supporting them being willing to contribute ideas was the sense that it was a “safe space” to share ideas. The importance of such safe spaces resonate with other findings about co-design about building trust when collaborating together (e.g., Vakil & de Royston, 2019). Conversely, the lack of safety can perpetuate feelings of isolation, particularly for people of color (hooks, 1994). Participants pointed to design elements in ways that led them to feel as though the co-design was a safe space to share, discuss, be vulnerable, and acknowledge when they were not expert in an area. These included the use of anonymous Jamboards for recording questions and ideas, the use of breakout rooms where youth could meet together, and structuring of opportunities to learn about AI.

Participants also reported that the researchers’ openness was a key disposition that facilitated sharing of different ideas and building together. In this way, the study illustrates one way that researchers can show up within participatory design spaces in ways that embody the ideal of holding our theories and past findings lightly as possibly – but not necessarily – useful for current design efforts. Such a stance is often difficult for scholars to take: it requires a different relation to participants, where anyone can be seen as a “theorist” or “practitioner” or even “student” in the space (Bang & Vossoughi, 2016). In a way, this is also a shift in power – initiated by the researcher – to give space for others to take up these different roles.

The findings underscore the power as well of a design team that is itself racially diverse, when working to disrupt historical and continuing exclusion of racially minoritized adults and youth from design. When participants of historically minoritized and nondominant communities are invited into spaces where they talk about systematic injustice and share their hopes as individuals and part of a collective, not just the “openness” of researchers and educators to learn from and with is essential, so too are the presence of people who “look like me.” This extends beyond representation as well. It is also how participants are genuinely positioned throughout the co-design process in relation to researchers and how the expertise and knowledge they co-construct is taken up at later stages of co-design.

Disrupting power dynamics

Partly as anticipated, the use of a structure of a “storyline” to organize design disrupted for educators what is more typical in a curriculum process. While educators referenced a familiar method of design (“backward design;” Wiggins & McTighe, 2005), they contrasted the approach there to the one we employed, as being much deeper and leading to an outcome of a more culturally responsive unit. Further, educators contrasted the process to one that was driven by externally driven standards, where teams of teachers can get “bogged down.” In this way, teachers in the space asserted authority over something – standards—that usually has authority over their own decisions (cf., Polikoff, 2021) in developing the outline for the unit.

In addition, the accomplishment of a sense of community among designers appeared to help disrupt some typical power dynamics in design. Our findings in interviews where participants reflected on their experiences affirmed that intentionality in design offers opportunities to experience different kinds of relationships had. We intentionally established norms and activity structures for engagement and participation. In these activities, we highlighted the importance for centering youth voice toward supporting intergenerational learning, as well as the goals of justice and equity in the design of activities through participation and content discussed. We asked participants to be present, lean into challenges, listen, ask questions, and watch for opportunities to “step up and step back.” Such norms and participation structures are consistent with other efforts to create a humanizing co-design process (e.g., Potvin et al., 2021) and humanizing online learning spaces (e.g., Mehta & Aguilera, 2020) where relations building among participants can be a process and outcome of co-design (Bang & Vossoughi, 2016).

The experience of youth in the setting, as well as adults’ perceptions of them, speaks to the potential of shifting power relations in intergenerational design, as well as the importance of structuring participation so as to develop and value the voices of participants as teachers and learners. In the co-design workshop, youth participants had the opportunity to be experts – in games, in cultural practices surrounding games and in everyday technologies – in ways that allowed them to demonstrate their expertise and teach others. They also had space to generate ideas on their own, before sharing to the whole group. Importantly, the young people were not asked to “show up” as adults but as themselves (Gutiérrez et al., 2019; Vossoughi et al., 2021).

Conclusion

The study findings attuned to what participants appreciated and valued in the co-design process are reflected in our analysis of their perceived experience of co-design. The findings of this study point to ways co-designers can structure intergenerational interaction with young learners as a space for collaborative learning for exploring desired educational possibilities. Additionally, research on co-design processes can help us understand better how to disrupt power dynamics among participants and create possibilities for participants who have varied positionalities and ways of knowing and being to build knowledge collaboratively. In this work, we build on a sociocultural learning theory, to consider co-design as a social, relational, cultural, and ethical learning experience (DiGiacomo & Gutiérrez, 2016; Vossoughi et al., 2021). That is, a participant's experience extends beyond the individual learner toward collective ends within the learning activity of the co-design. These co-design efforts focused on supporting young learners and teachers to engage in developing a curricular unit that is centered on critical perspectives of AI technologies. Such a co-design process as a learning experience created conditions and structures for participants that often do not exist in their schools (Severance et al., 2016), as it involved them in intergenerational learning process, as well as a process where they could make decisions about learning goals and objectives around AI in education.

Throughout this co-design process, we intentionally asserted the role and contributions of participants in building the main storyline for the unit. We also clarified at multiple points how the co-

design process and outcomes could be leveraged for future iterations of this study and the design of curricula for real-world implementation in classrooms. This intentionality created possibilities to engage in a meaningful co-design experience where its processes might be taken up in future co-design efforts and where its products would be taken up in these young learners' and teachers' communities.

Toward this end, we assert that this article contributes to the theory of co-design and relations development in learning spaces in several ways. The analysis of participants' perceived experience and our co-design framework approach presents three considerations. First, the article recognizes intentionality with respect to both structure and dispositions of scholars in the co-design process is essential for participants to feel safe and engaged. Second, it underscores the concrete value of diversity in design teams in creating a space where people feel comfortable building together. Third, it shows the power and possibility of combining joint learning opportunities with co-design, to help enable new possibilities for curriculum.

In this paper, we attended to the experience of educators and young participants in the co-design process as it is narrated by them. We acknowledge the limitations of this study in terms of the short timescale for the co-design process and relatively small (if typical) sample size of the study. Yet, such examination of participants' experiences from their perspective made it possible for us to identify what participants valued in this co-design process and whether our goals of intentionality in design were also noticed by them. The findings of this paper are an initial step toward future work that aims at analyzing participation structures and moment-to-moment engagement in the co-design workshop as a collaborative learning space. That is, future work can and should examine connections between participants' experience and their actual engagement in situ. Such an analysis will enable us to identify how and when certain activities design structures mediated generative and consequential knowledge co-construction.

Future work should also examine participants' critical perspectives on AI technologies as enacted during this co-design process (Mawasi et al., in review). Finally, despite our focus on participants' experience in co-design of an AI in Education curricula than their perspectives of AI or learning of AI, we hope this work supports AI in education research through providing co-design tools that help in setting up conditions and structures that make it possible for young learners and educators to be positioned as collaborators in the process of building AI infrastructure in society and engage in critical manner with such increased integration of AI tools in their schools and everyday lives.

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ORCID

Areej Mawasi  <http://orcid.org/0000-0002-7141-4302>

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