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Aspiring for Equity: Perspectives from Design of AI Education

Benjamin Walsh, Bridget Dalton, Stacey Forsyth, Ellie Haberl, Jackie Smilack, Tom Yeh
Benjamin.Walsh@colorado.edu, bridget.dalton@colorado.edu, stacey.forsyth@colorado.edu,
eahaberl@gmail.com, Jacqueline.Smilack@colorado.edu, tom.yeh@colorado.edu
University of Colorado Boulder

Helen Zhang, Boston College, zhangzm@bc.edu
Irene Lee, Massachusetts Institute of Technology, ialee@mit.edu

Grace C. Lin, Massachusetts Institute of Technology, gcl@mit.edu
Yoon Jeon Kim, University of Wisconsin-Madison, yj.kim@wisc.edu
Glenda S. Stump, Massachusetts Institute of Technology, gsstump@mit.edu
Andy Stoiber, University of Wisconsin-Madison, acstoiber@wisc.edu
Amal Altuwaiyan, University of Wisconsin-Madison, altuwaiyan@wisc.edu
Hal Abelson, Massachusetts Institute of Technology, hal@mit.edu
Eric Klopfer, Massachusetts Institute of Technology, klopfer@mit.edu
Cynthia Breazeal, Massachusetts Institute of Technology, cynthiab@media.mit.edu

Eryka Wilson, Roozbeh Aliabadi, Jingxian Tian, James Carter
wilson@readyai.org, rooz@readyai.org, tian@readyai.org, james@readyai.org
ReadyAI

Duri Long, Brian Magerko
duri@gatech.edu, magerko@gatech.edu
Georgia Institute of Technology

Glenda S. Stump (chair), Massachusetts Institute of Technology, gsstump@mit.edu
Tesha Sengupta-Irving (discussant), University of California, Berkeley, tsi@berkeley.edu

Abstract: The explosion of Artificial Intelligence (AI) applications along with findings of algorithmic bias toward marginalized populations requires that we redouble our efforts to make AI education equitable to all youth so they can become informed consumers and responsible creators of AI, and can thoughtfully engage with others around equity issues in AI. This symposium focuses on the discussion of five AI literacy programs/projects from across the United States, each attempting to incorporate equity in diverse ways. Together, the five projects explore AI education using multiple pedagogical approaches and learning contexts with unique affordances and constraints.

Symposium focus: Designing for equity in AI education

The concept of equity is laden with multiple interpretations, particularly in the education ecosystem. Within this realm, curriculum providers play a key role in the design of learning experiences and are thus pivotal in ensuring that equity concerns, issues, and topics are embedded into the development and implementation of any curricula. This is of even greater importance in AI curricula considering the increasingly ubiquitous AI applications that affect our daily lives and ethical implications surrounding the AI technologies.

AI education cannot happen without consideration of ethics and equity. However, what this looks like will vary from curriculum to curriculum, and context to context. This brings about the question of how AI learning scientists approach curriculum design. This symposium will bring five curriculum development groups from different organizations and institutions across the United States who are currently developing and researching AI curriculum for K12 education. All five groups identify addressing equity and social justice through the curriculum as one of the goals of their project as well as a design value. As documented and observed similarly in CS education (Santo et al., 2019), equity can mean different things to different people; therefore, how equity is being manifested in these programs and curriculum evidently varies context to context. While there are increasing numbers of projects and initiatives to bring more AI education into K12 settings, the learning sciences' understanding of how we can design AI curriculum for equity and social justice is still nascent. By discussing how each group goes about addressing equity and social justice in their current project in relation to AI

technologies and supporting young people to develop ethical AI literacy, the symposium aims to highlight different design choices and implementations, allowing the community to learn from each group's current efforts and discuss opportunities and constraints of each approach.

Each group will describe how they think about equity in their own work, and how their current effort, both in terms of processes and products, embodies equity within their AI education activities. More specifically, the presenters will address 1) the framing of equity within their program/project; 2) equity as part of curriculum development--what measures were taken to ensure inclusiveness and relevance to the intended learners? 3) equity during implementation--what type of settings, tools, and populations did they aim to serve? 4) equity as part of the assessment process--how did they design assessments to be more equitable? 5) equity as part of teacher professional development--how did they design and implement student facing workshops and teacher professional development with teachers, with communities, and with AI experts? and 6) equity as a content area in the curriculum--how are issues surrounding ethical dilemmas and harms caused by AI technologies embedded within the curriculum?

How do presentations contribute to the aims?

The contribution from Walsh et al. addresses equity and social justice by embedding ethical dilemmas as a core part of their curriculum. They do so with clever use of multimedia short stories woven into nonfiction texts and media to situate learners; their project-based learning approach engages learners in diverse learning contexts from science discovery summer camps to high school English classes. Zhang and Lee offer further insights into the integration of ethics in an AI curriculum by employing design-based research and using conjecture mapping in their theoretical framework to guide the hands-on experimentation and participatory simulation experienced by the students. The project-based learning approach is bolstered with contributions from Lin et al., who introduce a "sandwich" model of a curriculum that starts with grounding the AI topic in an authentic community-based project. They also illustrate the use of remote codesign methods with middle school students to ensure that student voice is heard from the onset of curriculum design. Aliabadi et al. expand our views on implementation with their focus on community organizations, illustrating a means of designing an educational ecosystem that can make the efforts of AI education more impactful and scalable. Finally, Long and Magerko bring AI education to informal learning contexts (e.g., homes and museums) with elements that can be adjusted to fit learner needs. Together, these papers illustrate diverse framing of equity in diverse contexts and will provide the opportunity for rich discussion at the symposium.

Following, we provide a brief description of each of the five AI projects.

A multifaceted approach to designing for equity in the Imagine AI project

Benjamin Walsh, Bridget Dalton, Stacey Forsyth, Ellie Haberl, Jackie Smilack, and Tom Yeh

Purpose

Our team of Literacy, Computer Science and STEM educators and researchers is developing and studying curriculum modules to support middle and high school youth in exploring critical ethical issues related to artificial intelligence. These project-based learning modules are centered around original short stories that feature youth protagonists at the center of AI ethical dilemmas. Students read stories and non-fiction texts and media and build and manipulate simple AI systems. These experiences support rich discussion that combines social concerns with technical understanding. Each module culminates with students expressing their stances on AI ethics issues using digital media, such as comics, videos, and chatbots. We understand AI Ethics as an urgent topic relevant to youths' current and future lives, regardless of whether they envision a career as an AI developer.

A multifaceted approach to equity

Because of the notable tendency of some AI technologies to play a role in reproducing historical injustices (Buolamwini & Gebru, 2018), we argue that providing access to AI ethics education is itself an equity issue. In addition, we will discuss approaches to fostering equity related to curriculum and pedagogy and study. We pay particular attention to the importance of recognizing minoritized voices and youth perspectives on AI and other CS topics (Lee & Soep, 2016).

Equity in curriculum and pedagogy

We utilize a project-based learning approach to curriculum design, emphasizing Universal Design for Learning principles, in order to broaden access and engagement (Walsh & Dalton, in press). We take a Multiliteracies

perspective on literacy learning, attending closely to the role of multiple modes and languages in meaning making, actively welcoming a broad set of strengths, perspectives, and experiences into AI ethics discussions (Smith et. al., 2021). Module content and stories feature diverse individuals and explicitly address issues of bias and transparency.

Equity in research contexts

We believe that teaching AI Ethics requires educators to explore structural inequalities associated with race, gender and social class that are now being extended and amplified by AI technologies (Gebru, 2020). Teachers addressing these topics must be responsive to the experiences and beliefs students bring to class, as well as the constraints and pressures placed upon them by school administrators and local communities. In order to better understand how to support teachers in performing this balancing act we have forged partnerships with schools in rural, urban and suburban communities with students representing multiple ethnicities and language groups. Our research contexts include remote AI Ethics summer camps, high school English and Cybersecurity classes, and middle school Computer Science classes. In addition to surveys, interviews, and class observations, we collect students' multimodal products where they express themselves through image, sound, and text, and use heritage and English languages. This data we gather across these contexts is helping us understand how effective we are in helping students develop nuanced, contextualized understandings of AI ethics dilemmas.

Addressing equity in AI and AI education in the Developing AI Literacy project

Helen Zhang and Irene Lee

Purpose

The rapid expansion of AI is transforming our lives and futures. To ensure that youth can productively participate in this future, they must have knowledge of and capability to work with AI. Furthermore, the ubiquity of automated prediction and decision making is altering society by dictating who has access to information, freedoms, and economic opportunity. Those from historically marginalized communities are at greatest risk of the negative impacts of bias in AI. Thus, access to AI education will dictate who has the power to develop AI technology, and also who will be able to audit AI systems and seek justice for themselves and others. Many of the current methods of AI education, however, focus on mathematical underpinnings of AI, making it discouraging to youth who have been historically marginalized in STEM/CS education. This paper reports how the "Developing AI Literacy" (DAILy) curriculum addresses equity in AI education by incorporating a social justice and ethics lens that supports middle school students to become AI literate.

Perspective(s) or theoretical framework

The theoretical framework encompasses two elements: first, integrating ethics into AI curricula motivates learners and enables them to see the relevance of AI (Saltz et al., 2019). Second, pedagogical strategies such as hands-on experimentation and participatory simulation can make AI concepts accessible and engaging for a wide range of students (Squire & Klopfer, 2007).

Methods

Using the Design-Based Research approach (Design-Based Research Collective, 2003) and conjecture mapping (Sandoval, 2014) as the overarching methodology, the research engages in iterative cycles of design and development of DAILy while conducting research to determine the impact of the program (see Figure 1 for the conjecture map of DAILy). This paper reports the analysis and findings from the first design cycle.

Data sources

The quantitative data included student responses to a test, administered before and after a DAILy camp to all participating youth that examined their understanding of AI concepts, attitudes toward AI, and career awareness. The qualitative data included observations, interviews after the camp, and student work.

Results and conclusions

We found high engagement of students with all activities addressing ethics issues. Female students of color were especially active in the investigation and discussion of fairness and the ethical implications and bias of AI. Furthermore, participatory simulations and hands-on investigations were found to be highly engaging. The pre/posttest showed that students developed an objective view of AI and were able to articulate the positive and

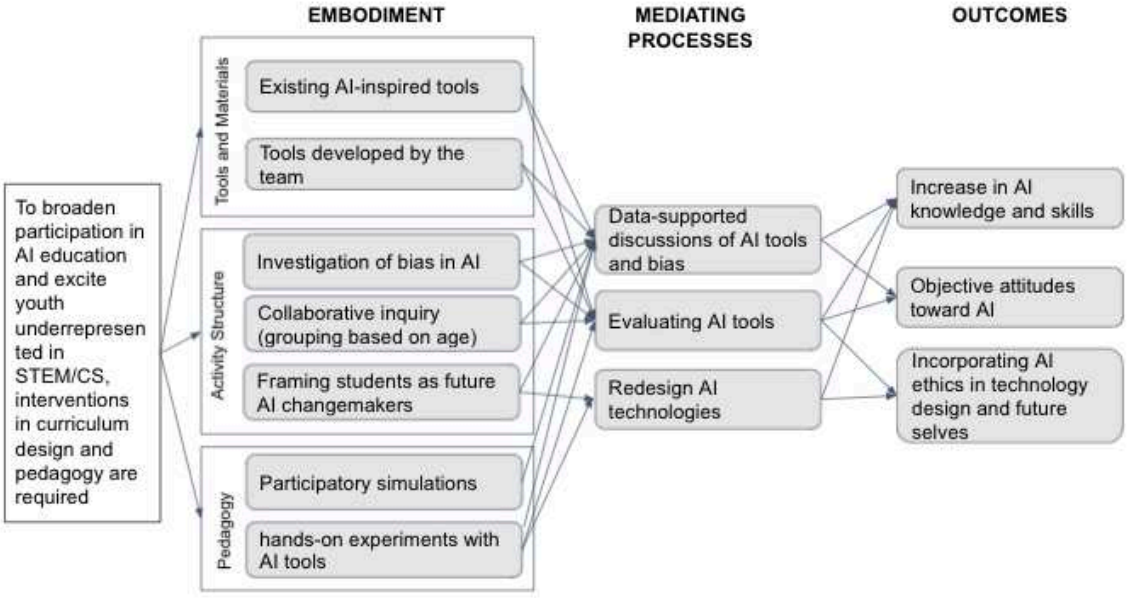
negative potentials of AI tools. The interviews showed that students were able to connect AI ethics to everyday use of technology, technology designs, and their ideation of future selves.

Scholarly significance

Our work contributes to the AI education field by demonstrating that interactive pedagogy approaches and interweaving ethics within AI curricula can engage all students. The emphasis on AI's ethical and societal implications resonates with previous research that students from historically marginalized groups are more drawn to STEM/CS programs that teach the content through social justice lenses (Mark et al., 2013; Vakil, 2018).

Figure 1

Conjecture map of DAILy curriculum



Responsible AI for computational action: Fostering AI literacy in middle school students

Grace C. Lin, Yoon Jeon Kim, Glenda S. Stump, Andy Stoiber, Amal Altuwaiyan, Hal Abelson, Eric Klopfer, and Cynthia Breazeal

Purpose

The Responsible AI for Computational Action (RAICA) curriculum for middle school students integrates Artificial Intelligence, Computational Thinking, Information and Communications Technology, and Design Thinking. RAICA aims to transform students from AI consumers to conscientious AI contributors who can create AI applications with positive social impact. A key mission of RAICA is inclusion with a focus on equity; the curriculum seeks to serve students from diverse backgrounds whose needs may otherwise be ignored or excluded, especially those who are traditionally marginalized in STEM and CS fields.

The modular RAICA curriculum model takes on the metaphor of a "sandwich." It takes a project-based learning (PBL) approach with each sandwich centered around a driving question and project theme. Ethical thinking is interwoven throughout instead of singling out ethics and biases as stand-alone units. The curriculum provides an opportunity to envision a new model of embedded assessment that supports iterative design thinking processes while providing evidence for AI literacy development. RAICA assessment embodies constructivist and situated cognitive learning principles (e.g. playful, socially mediated); it positions learners as reflective and critical leaders of their own learning, scaffolding them toward sensemaking with multiple forms of evidence that reflect diverse epistemological orientations and local norms and cultures.

Approach to address equity concerns

In the design of the curriculum, we turned to questions from equity scholars who urge the STEM education field to ask, "How do dominant narratives in STEM education position students of color as the taken-for-granted beneficiaries of educational policy, new curricula, or equity scholarship in STEM?" (Vakil & Ayers, 2019, p. 452). Our response to this is to actively co-construct the curriculum with traditionally marginalized students rather than treating them as passive (or "taken-for-granted") recipients or beneficiaries. This conviction is the driving force behind our painstaking approach to codesign with middle school students.

Furthermore, equity scholars voice concerns with representational politics, where STEM education and careers are positioned as the avenue that racially minoritized students *should* pursue, which is also problematic because it does not take into account students' own thoughts and relations to STEM learning (Sengupta-Irving & Vossoughi, 2019; Vakil and Ayers, 2019). Our codesign and project-based learning approach address this concern. Instead of determining top-down what students should do, we explicitly involve students to solicit their ideas of what they think is important to them and what they *want* to do.

Methods

To ensure that the questions posed within modules are relevant to students' lives, their communities, and the broader world, we employ codesign as a research method to engage middle school students and teachers. This method not only allows youth and teachers' voices to be expressed in the framing of our curriculum, but also provides insights into potential content, language use, and structural modifications. To date, we have held a two-week codesign camp with nine students recruited from a Title 1 public school with a large (>90%) Hispanic/Latinx population. We have gathered students' design journals, projects, other artifacts, and video recordings of the sessions.

Results and conclusions

Analysis of codesign camp data identified potential topics to include in future sandwiches, exemplar project ideas, and concrete suggestions for the framing of Driving Questions. Additionally, analysis of the video data promises to provide insights into productive facilitation techniques for this age group, as the power dynamic inherent with adult presence may make it challenging for students to open up and be candid. We plan to apply these insights to the next round of codesign sessions.

Scholarly significance

We employ the deepest level of participatory design with students, wherein they go beyond providing mere feedback as informants; instead they are actively co-creating with developers (Martens et al., 2019). Although previous research has highlighted the use of codesign or participatory design in student empowerment and incorporating student voice (Bovill, 2020) or codesign with teachers (Van Brummelen & Lin, 2021), ours is the first that we know of that codesigns with middle school students in the area of AI education. We anticipate our findings and approach can lead to a more equitable, authentic, and inclusive AI curriculum.

Community-powered problem solving with AI: A case study of Boys and Girls Clubs

Roozbeh Aliabadi, James Carter, and Joel Wilson

Purpose

Can local communities and the after-school spaces promote inclusive AI education? There is no doubt that communities have some of the essential qualities and expertise, and the development of AI skills is nurtured through community organizations and outdoor spaces (Touretzky et al., 2019). We explore how to equip our communities with tools, training, and spaces that promote the full breadth of the AI learning/teaching ecosystem in local communities. We believe schools could also learn from being more open and flexible learning centers with access to quality materials and care in the transition from STEM to STEAM by promoting community-powered problem solving with AI (Wang & Chiang, 2020).

Perspective(s) or theoretical framework

This study takes a project-based learning approach and focuses on the assessment of three areas of competency in AI: application of AI, computational thinking, and innovation and impact (Wangenheim et al., 2018).

Methods

To explore the question, we have designed an ecosystem of recruiting, training, and deploying local community members to teach in local Boys and Girls Clubs in the eastern United States. Furthermore, we have developed a 16-week module of AI classes focusing on the five big ideas in AI. To date, we have pilot-tested the program at four local Boys and girls Clubs in the eastern US where a diverse student population participated in an 8-16 week camp. We have gathered student's projects and artifacts along with teachers' feedback and observations.

Results and conclusions

Initial results of pilot data suggest several areas of improvement in the current project-based learning cycle of professional development, lesson plans, and structuring project-based learning teams based on age and gender. Factors attributed to engagement tend to increase as students perceive project-based learning's link to problems and issues faced in the local communities.

The role of equity in designing co-creative, embodied AI literacy activities for informal learning spaces

Duri Long and Brian Magerko

Purpose

We will discuss the role of equity in our research on designing co-creative, embodied AI literacy experiences for informal learning spaces. We center our discussion on a set of three different AI education activities we have designed for family group learning in home environments and museums. We draw on findings from a codesign study conducted with family groups in a museum (Long et al., 2021a) and user studies conducted to evaluate the efficacy of the activities with families in their homes (Long et al., 2021b; Long et al., 2022). Issues of equity play an important role in the framing of our work, our curriculum design and implementation, and the content of the activities we develop. Specifically, we focus on three key ideas—equitably defining AI literacy, reaching a broad audience via informal learning contexts, and using co-creativity and embodiment as equity design considerations — that frame how we address equity in our work.

Equitably defining AI literacy

One important aspect of equity in AI education is ensuring that learning experiences are both useful and accessible. We have conducted codesign activities with family groups to learn about their priorities and interests, and we will discuss how our findings have informed our definition of AI literacy as a set of skills that can be useful to learners in their everyday lives. We have also designed our curriculum and content to be accessible to learners with no prior knowledge of computing or AI. We will present three different activities that we have developed and describe how the content and curriculum is intended to reduce intimidation, build on learners' existing knowledge, and address equity-related issues.

Reaching a broad audience via informal learning contexts

We focus on designing learning experiences for informal learning contexts such as at-home learning, after-school groups, and public spaces like museums, art events, or parks. Introducing AI education in these contexts has the potential to expand equity by reaching learners who may not otherwise seek out opportunities to learn about AI (Falk et al., 2007; Rosin et al., 2021). Our aim is to develop an AI learning ecosystem that can engage learners across a variety of informal learning contexts. We have developed activities with scalable components that can be adjusted according to learners' needs (e.g. "unplugged" activities that require no access to technology that can be scaled up to museum installations). We will present the activities and discuss how we designed the content/materials to adapt to different implementation contexts.

Co-creativity & embodiment as equity design considerations

We utilize embodied interaction, collaboration, and creativity as three key design considerations in our AI literacy activities. We focus on incorporating co-creativity and embodiment because they have previously been shown to be effective at engaging and fostering learning gains and interest development in groups without prior knowledge of AI/CS (Sulmont et al., 2019) and groups that have been historically marginalized in STEM--specifically girls (Magerko et al., 2016; Werner et al., 2004; Guzdial, 2013; Buechley et al., 2008) and African-American students (Magerko et al., 2016; Eglash et al., 2006). We discuss how we have implemented each of these design considerations in our curriculum and content and reflect on their impact on learning, interest development, and equity in practice, drawing on findings from user studies we have conducted.

Significance of the contributions

The five projects illustrate how learning scientists in AI education are designing to address equity in this burgeoning domain. Although the varied approaches bring about different challenges and opportunities, it is clear that there is much more work to do, both to define and achieve equitable education in this realm. Including voices historically underrepresented in technical fields like AI will be imperative to reach these goals. AI education is destined to influence future generations as knowledgeable consumers and ethical creators of AI applications; thus, it is of utmost importance that we collaborate and grow as a community to learn how we can design AI curricula that are equitable and promote social justice.

Audience participation plan

This session will be conducted as a panel discussion, with five presenters, a chair, and a discussant. After an introduction to the session by the chair, each presenter will give a brief, 5-minute overview of their project/program. The discussant will then synthesize current challenges and provoke discussion highlighting affordances and constraints of each program. The remaining time in the session will be allocated to audience comments or questions.

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