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Design AI for My Community: A Case Study of Collaborative Learning in a Freedom-to-Read Summer Camp

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Abstract: Fostering AI literacy among youth from diverse communities with unique values and challenges is crucial. This requires critical pedagogy and education inclusion that empower students—especially those from marginalized backgrounds—to engage with technology meaningfully and address societal inequities. We developed a summer camp with the theme **"**Protect the Freedom to READ**"**. By inviting students to collaboratively design AI for their community, the camp deepened their AI understanding and empowered them to create applications that honor their community's values. Collaborative AI design developed higher-order thinking skills. Additionally, critical pedagogy played a key role in enabling children to apply AI skills toward innovative, community-focused applications, positioning them as advocates for ethical and inclusive technology.

Introduction

Youth from diverse communities need AI literacy, yet many AI learning experiences lack culturally responsive pedagogy, risking alienating learners or reinforcing biases (Vakil, 2018). Critical pedagogy emphasizes meaningful dialogue about technology, empowering students to assess its impact on their lives and communities (Freire, 1970). Integrating community needs fosters critical consciousness, enhancing AI literacy while addressing societal inequities (Kincheloe, 2004). Connecting learning to real-world contexts boosts engagement and action (Okazaki, 2005). By designing advanced technologies, students can create tools that reflect their values and serve their communities, promoting a more equitable technological landscape (Kotturi et al., 2024).

Figure 1

A Handout Outlining the 3-day Summer Camp for Students to Collect Badges from Individual Activities, with a Summer Camp Overvie.

Co-designing AI emphasizes learner agency and real-world impact (Wang et al., 2024), reducing cognitive load, and encouraging critical evaluation of biases (DiPaola et al., 2020). Integrating *community-based co-design* and *critical pedagogy*, we propose an AI summer camp design for middle school students (Fig. 1). We used two existing learning tools to teach technical and ethical concepts related to AI recommendation systems (Zhou et al, 2024; Zhou et al, 2025). The camp theme "Protect the Freedom to READ" served as the guiding purpose for co-design. This case study investigated two research questions: RQ1. How does co-designing existing

technologies transfer AI literacy around AI technology, such as recommendation systems? RQ2. How does design for community informed by critical pedagogy engage students in creating AI technologies to reflect their values and address the unique needs of their communities? We found that co-design transferred students' AI understanding into higher-order learning.

Related work: Critical pedagogy and design for community

Power in society is unequally distributed, often creating persistent tensions between dominant and marginalized groups (Auerbach, 1995). Critical pedagogy seeks to foster critical thinking and raise awareness about social inequities, aiming to encourage democratic participation and social change (Kincheloe, 2004). By questioning established power structures, marginalized groups can reclaim their voices and agency (Freire, 1970).

Integrating critical pedagogy with community-based co-design creates a powerful framework for designing technologies that genuinely serve and empower underserved communities (Kotturi et al., 2024). In this integrated approach, community members are not just participants but active co-designers who collaborate with researchers to identify problems, co-create solutions, and implement technologies that address their specific needs (Coughlin et al., 2017; Wong-Villacres et al., 2022). By fostering open *dialogue*, researchers and community members engage in mutual learning, with each party contributing valuable insights and experiences. Incorporating learners' *everyday life experiences* ensures that technological solutions are relevant and meaningful (Lu et al., 2023). Positioning community members as *agents of change* aligns with the goal of critical pedagogy to cultivate critical consciousness, enabling students to actively shape the technologies that impact their lives. Through *praxis*—the continuous cycle of action and reflection—communities can not only co-create computing solutions but also drive transformative social change. This integrated approach challenges traditional power dynamics inherent in technology design, fosters equitable participation, and develops design solutions that reflect the aspirations and values of underrepresented groups (Winschiers-Theophilus et al., 2013). Our summer camp design embodies this integrated approach by engaging students from underserved communities in a co-designed educational experience centered on the theme "Protect the Freedom to READ." The camp's activities were specifically crafted to align with the principles of critical pedagogy.

Case study

Context and participants

The study took place at a community-based non-profit educational program dedicated to supporting children and families by honoring cultural diversity and promoting community strength. The summer program theme, "Protect the Freedom to READ," aimed to empower students to advocate against book censorship and promote freedom of speech. We integrated a one-week AI literacy camp within this program, reflecting on AI ethical issues in their daily lives and co-designing AI solutions that could protect their community's access to books.

Two learning tools were selected to enhance students' understanding of AI ethics and foundational technical concepts. Each tool supports specific aspects of AI literacy: one focuses on ethical awareness related to AI recommendations, while the other reveals AI systems' technical and mathematical foundations. *BeeTrap* (Fig. 1(A)), a tablet-based Augmented Reality (AR) application (Zhou, et al., 2024), teaches children about AI recommendation algorithms and the filter bubble effect, an ethical issue related to the loss of information diversity in AI recommendations. *Briteller* (Fig. 1(B)), a light-based recommendation system (Zhou, et al., 2025), aids children in understanding data vectors in AI recommendation systems and the dot product, a fundamental mathematical concept for various AI algorithms.

Five male middle school students, aged 11–13, participated in this study. They worked in pairs using interactive AI tools (BeeTrap and Briteller) to explore AI concepts through embodied learning. In the co-design activity, three students formed one group, and two formed another.

"Protect the Freedom to READ" summer camp design

The camp has two primary goals for children (Fig. 1): (1) to become informed citizens in the age of AI, and (2) to advocate for their community's freedom to read. Students were engaged in *praxis* by first learning AI technical literacy and ethical considerations, then co-designing ideas to improve AI experiences, and ultimately applying AI knowledge in collaboratively designing AI applications to protect the community's freedom to read. Each camp activity actively engages students with *meaningful open dialogue*, connects learning to their *everyday life experiences*, and empowers them as agents of change within their community.

(1) Conceptualization. Day 1 began with an interactive AI workshop. Students discussed their rights to free speech and how AI can protect and restrict these freedoms. Students created team logos to express their identities using generative AI.

(2) Ethical awareness. The second activity of Day 1 strengthened students' ability to communicate about ethical issues in AI systems. Students explored ethical issues such as the filter bubble effect by role-playing as bees through BeeTrap. This activity connected abstract AI ethics to tangible experiences from students' daily lives, sparking reflective discussions on diversity and information access.

(3) Technical AI literacy. Day 2 fostered technical literacy to protect the freedom to read. Through Briteller activities, students learned core technical concepts like data representation and recommendation algorithms. These activities were designed to make complex AI ideas related to everyday life experiences.

(4) Design for community. Day 3 applied these concepts as students collaboratively designed AI applications to combat censorship and protect their community's freedom to read. They presented their projects, received feedback through open dialogue, and reflected on their roles as advocates and agents of change.

Data collection and analysis

Data collection. After each activity, we collected students' co-design artifacts. Given children's limited prior experience with AI and co-design, we used accessible methods: 'layered elaboration' provides a structured approach for iterative designs within a defined space (Walsh et al., 2010); 'storyboarding' contextualizes problems and solutions, making them more accessible for novice designers, and is typically utilized in later design phases (Truong et al., 2006); 'big papers' employs large sheets of paper as a collaborative platform, encouraging idea generation and facilitating a more inclusive and participatory process (Walsh et al., 2013).

Data analysis. We combined thematic analysis and visual content analysis of students' design artifacts. For RQ1, we developed a rubric based on AI literacy and analyzed all the designs to assess how students understood and represented AI concepts. For RQ2, we focused on the final day's co-design artifacts to examine practices in connecting learning to real-world issues, reflection, and demonstrating agency as change-makers. Two researchers independently coded the data inductively, grouping codes into higher-level themes. They met regularly to compare codes, discuss emerging themes, and resolve disagreements.

Results

RQ1. Co-design transfers AI literacy

Demonstrate misunderstanding. Three design ideas revealed students' misunderstandings of AI concepts. For example, Daron misinterpreted the pollen circle as protecting the beehive from the beekeeper, while Ryan was confused about why pollen goes into the beehive and how twisting knobs manipulated light.

Transferring 'understand' into 'apply'. This involves using learned knowledge in new situations. Three design ideas emphasized the practical use of information to solve problems. Ryan developed a sports recommendation system by adapting a similarity-based algorithm from BeeTrap with a content-based approach from Briteller. Daron designed a personal recommender using novel data attributes including favorite food, dream house, and dream state (Fig. 2d). *'Create'* involves synthesizing different pieces of information to produce something original. 13 design ideas demonstrated students' ability to create novel AI solutions. Five ideas addressed gaps in existing designs, such as replacing an artificially movable beehive with a super fly that collects pollen at varying speeds to represent growth and diversity (Fig. 2a). Eight ideas introduced new features to the systems, including algorithms for detecting target attributes (Fig. 3a), concrete representations of algorithm parameters (Fig. 3b), generative AI or collaborative filtering recommendation systems (Fig. 3c), and visualizations of the AI black box, filter bubble effect, and multiple inspection points (Fig. 2b, 2c, 2e).

RQ2. How does design for community informed by critical pedagogy engage participants in creating AI technologies to reflect their values and address the unique needs of their communities?

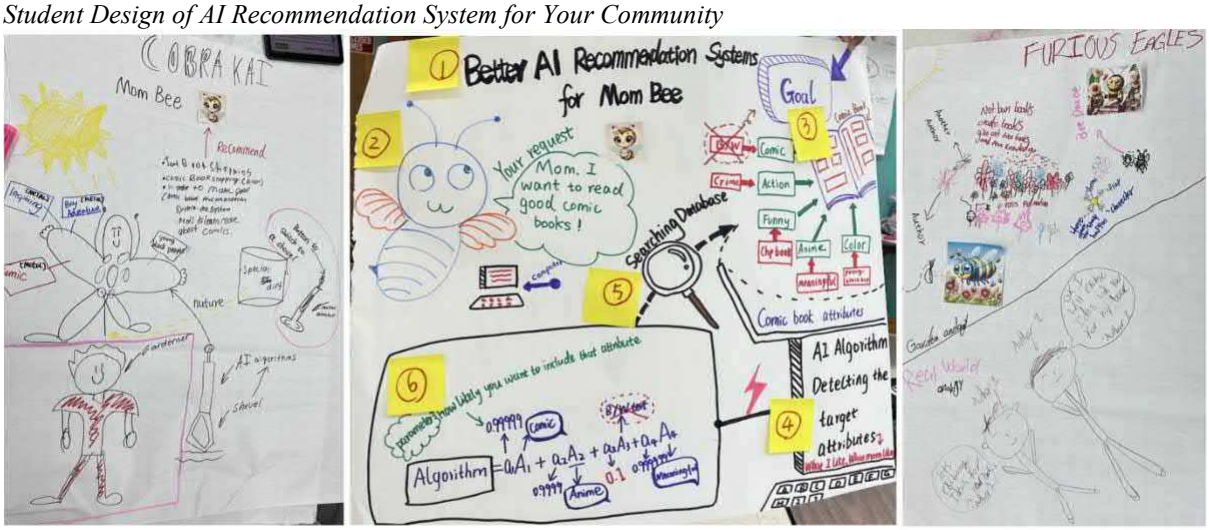
In a vibrant classroom buzzing with curiosity, students engage in a co-design activity. Their task is to imagine an AI that protects the freedom to read. Researchers provided many cards of carton bees for users to pick, including mama bee, papa bee, younger brother bee, and librarian bee to be target users of their designed AI recommender. Researchers guided learners to think about the goals of the design and visual representations.

Design case 1. Jay and Ian, working as Cobra Kai, designed a comic book recommendation system centered on Mama Bee, aiming to match books to both their preferences and hers (Fig. 3). Their system featured a smiling flower with five petals representing themes they loved: inspiring stories, comic adventures, boyhood journeys, and young Black heroes (Fig. 3a). The flower thrived in nutrient-rich soil and sunlight, symbolizing how AI needs the right data and algorithms to function effectively. A key component was the shovel, which operated in two modes: detecting books with the right features and recommending them to Mama Bee.

Although their design was imaginative, Jay and Ian grounded it in real AI principles. Jay, eager to learn the math behind AI, collaborated with a researcher to refine the system's algorithm (Fig. 3b). He listed important book features—such as colorful comics and meaningful stories—and assigned numerical weights to reflect their significance. For instance, comics and anime received high values (0.99999), while black-and-white text was deprioritized (0.1). This process expanded their system while deepening Jay's grasp of AI algorithms, demonstrating how AI can be fine-tuned to balance individual preferences with shared family values.

Figure 3

Student Design of AI Recommendation System for Your Community



(a) A book recommendation system designed by Jay and Ian. (b) The second iteration of the AI recommendation system designed by Jan and Ian. (c) A book generator and recommender by Ryan, Daron, Aden.

Design case 2. Ryan, Daron, and Aden, the team "Furious Eagles," envisioned a world where books flourish like flowers in a vast garden (Fig. 3c). In their model, the librarian bee, symbolizing an AI recommendation system, protects and shares books, especially those at risk of being banned. Other bees, representing readers, visit each flower to collect "pollen" that embodies a book's characters, themes, and stories. When bees meet, they exchange pollen, illustrating how shared knowledge promotes collective learning and enriches recommendations with diverse, underrepresented viewpoints.

Drawing on critical pedagogy, this exercise wasn't about building a real AI but about empowering students to confront censorship through technology. By imagining the librarian bee protecting access to all books, students challenge barriers to intellectual freedom and advocate for systems that value diverse perspectives, ensuring that every book, regardless of its content, has a chance to grow.

Discussion and limitation

Empowering students through critical pedagogy and community-based design. This case study illustrates how critical pedagogy and community-based design empower students to co-design AI applications that reflect their cultural identities and personal interests. By involving students like Jay and Ian, the approach fosters agency, critical thinking, and social action (Le & C., 2016). Co-design also introduced design as a tool for addressing social issues, such as advocating for reading freedom (Hayes, 2011). Integrating their lived experiences enabled students to grasp complex AI concepts while envisioning AI as a means to promote social justice and equity.

Connect co-design with Bloom's Taxonomy of Learning. This case study shows how co-design supports various Bloom's Taxonomy levels (Forehand, 2010). For instance, annotating likes and dislikes fosters evaluation; building a new AI recommendation system helps students apply learned concepts; and brainstorming new design elements enables creation by synthesizing and expanding knowledge.

However, given our small sample size, further research is needed to generalize these findings within the summer camp framework.

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