Leveling the Playing Field:
Designing Equitable AI-Mediated STEM Learning for Girls of Color – Game-Based Approaches to Identity and Agency

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ABSTRACT

This article explores how culturally relevant, game-based learning integrated with artificial intelligence (AI) can foster identity development, belongingness, and agency among girls of color. Drawing from a design-based implementation research (DBIR) study within the Girls Who Game program, 12 fourth- and fifth-grade students engaged with platforms like Ready Player Me, ThingLink, Hero Forge, ChatGPT, and Canva. These tools supported digital storytelling, 3D modeling, and critical exploration of representation and bias in AI. Anchored in Self-Determination Theory (SDT), Critical Digital Literacy (CDL), and Culturally Relevant Pedagogy (CRP), the program created a liminal "magic circle" of play and inquiry where students designed inclusive futures. Findings highlight how culturally responsive AI tools and outputs can shift students from passive users to empowered co-creators, fostering epistemic agency and STEM motivation. This article offers theory-grounded implications and a vision for equitable, identity-affirming AI ecosystems in K-12 education.

INTRODUCTION

Learning ecologies are undergoing rapid transformation, fueled by the growing integration of artificial intelligence (AI) into classrooms across the globe. While AI promises new forms of engagement,

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automation, and customization, it also introduces heightened risks for equity, particularly when tools are developed without attention to cultural inclusion, representation, or student agency. Algorithmic biases embedded within AI systems mirror societal injustices, disproportionately affecting students navigating educational marginalization (Boateng & Boateng, 2025). As Buolamwini and Gebru (2018) demonstrated, commercial AI classifiers often exhibit inaccuracies that are race- and gender-based. These consequences can extend to classroom tools, potentially replicating and even amplifying existing exclusions rather than mitigating them. While some AI tools prioritize standardization and scalability, this intervention centered on identity, belonging, and co-design. Students customized avatars and designed digital worlds while conducting structured bias audits of AI tools, openly critiquing limited representation, and proposing inclusive redesigns. These experiences illustrate the role of epistemic agency in helping students interrogate the assumptions embedded in AI and advocate for systems that reflect their lived realities. Such moments foreground the challenge of delivering scalable AI solutions that address equity concerns and reinforce the need for fostering epistemic agency, whereby learners interrogate and reshape algorithmic outputs. The problem space addressed here is the emergent terrain of equitable AI in K-12 education. Unlike domains with a long arc of cumulative research, this area is still in formation, with limited precedent directly linking generative AI, identity development, and culturally sustaining pedagogy. As such, the immediate task is to delineate what is possible to be known at this stage, rather than to summarize an already mature field (Greeno, 1998; Penuel & Gallagher, 2017). Moreover, despite the promise of AI in education, many schools in the 2025 academic year currently prohibit student use of AI tools in classrooms, often due to policy lag, academic integrity concerns, or uncertainty about equitable implementation (Axios, 2025). This contested reality further underscores why exploratory work is needed to define the contours of the field. This chapter argues that by centering identity, motivation, and critical digital literacy in the design of AI-integrated learning environments, young learners, especially girls of color, can be empowered as co-creators rather than consumers of educational technology.

The spring of 2024 brought together university researchers and a teacher in a New York City public elementary school in Queens, New York, to explore a transformative question: What if AI in the classroom served not merely as an automated tutor or engagement gimmick, but as a living laboratory for cultural affirmation, critical inquiry, and student agency? The exploration of this idea was made possible through the *Girls Who Game* program (Dell Technologies, n.d.).

Girls Who Game (GWG) is an extracurricular program developed through a partnership between Dell Technologies, Microsoft, and Intel. Initially conceived in 2021 as a program to spark interest in science and technology through game design and digital media, GWG provides opportunities for girls in grades 4-8 to explore STEM through game-based learning, primarily utilizing Minecraft, mentorship, and real-world challenges aligned with the United Nations' Sustainable Development Goals (United Nations, n.d.). With over 130 participating districts across North America, the program has evolved to incorporate regional competitions and professional development for educators. Because the field is emergent rather than cumulative, case study methodology through this program is particularly well-suited to illuminate its contours. With over fifty combined years of classroom experience, the authors recognize that detailed, context-rich accounts are indispensable in surfacing the opportunities and challenges students face when encountering AI tools for the first time. Case studies provide the depth and contextual sensitivity needed to surface dynamics that broader methods often miss, offering early insights that help scaffold the evidence base for an emerging field (Yin, 2018).

The eleven-week cycle described here represents a customized iteration within a larger framework, distinguished by its explicit focus on AI equity. Twelve fourth- and fifth-grade girls of color engaged with AI-