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Algorithmic Belonging: The Influence of AI-Personalized Learning on Student Inclusion, Identity, and Participation in Diverse Classrooms

Nyiramukama Diana Kashaka

Faculty of Education, Kampala International University, Uganda

ABSTRACT

Artificial intelligence (AI)-personalized learning is often promoted as a way to match instruction to learner differences, yet its educational value should not be judged only by efficiency or test performance. This narrative review uses algorithmic belonging as a conceptual lens to examine how AI-personalized learning may shape students' inclusion, identity, and participation in diverse classrooms. Across the reviewed literature, personalized and AI-supported systems are typically associated with adaptation, feedback, recommendation, and learner support, while belonging research emphasizes acceptance, recognition, cultural affirmation, and meaningful participation. Direct studies that explicitly connect AI personalization with belonging remain limited; most available evidence must therefore be synthesized from adjacent work on AI in education, personalized learning, school belonging, culturally relevant pedagogy, and diverse-classroom participation. The literature suggests that AI personalization may support inclusion when it increases access, responsiveness, and student agency, but it may undermine belonging when it stereotypes learners, obscures decision rules, or reproduces cultural and linguistic norms that marginalize some groups. The strongest implication is that personalization should be treated as a social and ethical design problem, not merely a technical one. AI systems are most likely to support belonging when they are explainable, fair, culturally sustaining, and embedded in teacher–student relationships that affirm identity and widen participation.

Keywords: artificial intelligence; personalized learning; belonging; inclusion; identity; participation; diverse classrooms; culturally relevant pedagogy; algorithmic bias; educational equity

INTRODUCTION

AI in education is increasingly framed around personalization: systems diagnose performance, recommend resources, adapt task difficulty, and automate feedback for individual learners [1-12]. Reviews of generative AI and AI-enabled education describe substantial opportunities for support, interaction, and adaptation, but they also emphasize risks related to opacity, over-reliance, fairness, and the uneven educational effects of AI across contexts [1-5]. At the same time, the personalized-learning literature shows that the term itself is broad and sometimes conceptually unstable, covering adaptive tutoring, recommendation systems, learner profiling, and flexible instructional design [6-12]. What this literature rarely centers is whether students feel recognized within these systems. In belonging research, school belonging is commonly understood as the extent to which students feel accepted, respected, included, and supported in the school environment [13,14]. Meta-analytic evidence further shows that belonging is associated with motivational, social-emotional, behavioural, and academic outcomes [15,16]. Parallel work in culturally relevant and culturally sustaining pedagogy argues that educational environments should not simply accommodate difference at a superficial level, but should affirm and sustain students' language, culture, and identity in the learning process [17,18]. This review therefore uses the term algorithmic belonging as a heuristic for asking whether AI-personalized learning helps students feel that they matter, are fairly represented, and can participate without being reduced to data categories. This is not yet a settled construct in the literature; rather, it is an interpretive bridge across several bodies of work. Studies on Black, Latino, immigrant, and refugee learners suggest that belonging is shaped by racial/ethnic identity, teacher student relationships, culturally responsive teaching, and school climate [19-23]. More recent work on culturally digitized pedagogy and participation in diverse classrooms

suggests that digital learning spaces must also be examined as cultural spaces, where design choices can either widen participation or silently reproduce exclusion [24,25].

Thematic synthesis

1. AI-personalized learning has mostly been studied as an instructional optimization strategy

The strongest evidence base in AI-personalized learning still concerns achievement, engagement, and efficiency rather than inclusion or identity. Meta-analyses of intelligent tutoring systems report generally positive effects on learning outcomes [6,7]. Studies of adaptive and personalized learning also suggest that tailoring content or examples to student interests can improve relevance and performance [8-10]. More recent work shows that AI-enabled recommendation systems can support engagement, motivation, and outcomes in specific settings such as flipped classrooms [12]. Together, these studies indicate that personalization can help students access instruction at a more appropriate level or through more relevant pathways. However, they do not by themselves show that learners feel more respected, recognized, or socially included. This distinction matters. A system may be instructionally effective while still being socially alienating. If personalization is based on narrow behavioral traces, rigid learner categories, or opaque recommendations, students may experience adaptation as surveillance or sorting rather than support. Reviews of explainable AI, algorithmic bias, and FATE scholarship in education repeatedly warn that educational AI can inherit and amplify existing inequalities if design and deployment are not critically examined [3-5]. Thus, the question is not whether personalization "works" in a technical sense, but for whom, under what assumptions, and with what consequences for participation and identity.

2. Belonging is a relational and cultural outcome, not just an individual feeling

The belonging literature shows that inclusion cannot be reduced to individual satisfaction or motivation alone. Foundational work describes belonging as feeling accepted and supported at school [13,14], while meta-analytic evidence links it to motivation, emotional adjustment, behaviour, and academic performance [15,16]. This means that any educational technology claiming to personalize learning must be evaluated against a broader standard: whether it strengthens or weakens students' connection to the classroom community, teachers, peers, and learning tasks. Belonging is also patterned by race, ethnicity, migration background, and school context. Research on African American and Latino adolescents shows that school belonging is closely tied to academic adjustment and school experience [19,20]. A social-belonging intervention improved academic and health outcomes for minority students in a landmark experimental study [21]. More recent longitudinal evidence suggests that school belonging can mediate the effects of racial/ethnic identity on achievement and emotional well-being among Black and Latinx adolescents [22]. These findings imply that belonging is not peripheral; it is one of the mechanisms through which identity-related processes shape learning outcomes.

3. Algorithmic belonging depends on whether personalization affirms identity and widens participation

From the perspective of culturally relevant and culturally sustaining pedagogy, educational design should validate students' cultural resources rather than treat them as deviations from a norm [17,18]. Applied to AI-personalized learning, this suggests that personalization should not merely adjust pace or difficulty; it should also avoid erasing students' languages, histories, interests, and ways of participating. When AI systems personalize examples, recommendations, or pathways in ways that connect meaningfully with learners' worlds, they may help students experience school knowledge as more accessible and more "for people like me." When they ignore culture or standardize identity into narrow profiles, they risk doing the opposite.

Recent scholarship helps extend this argument into digital contexts. McDaniel's notion of culturally digitized pedagogy emphasizes that digital literacies and learning designs are always culturally mediated [24]. Likewise, Ialuna and colleagues found that culturally responsive teaching and positive teacher-student relationships are linked to school belongingness in ethnically diverse classrooms [23]. Piekut's work on diverse classrooms shows that participation can remain constrained even where teachers intend inclusion, because institutional narratives still shape whose experiences count [25]. Read together, these studies suggest that algorithmic belonging is strongest when AI tools are mediated by culturally responsive pedagogy and relational classroom practices, not when they operate as isolated personalization engines.

4. The main risk is not personalization itself, but inequitable personalization

The critical issue is whether AI systems personalize in ways that are fair, explainable, and agency-preserving. Bias reviews in educational AI warn that predictive and adaptive systems can reproduce historical inequities through biased data, proxy variables, and hidden decision rules [4,5]. Explainability matters because students and teachers need to understand why certain content, pathways, or judgments are being produced [3]. Without this transparency, learners may be positioned as passive recipients of algorithmic decisions, which can undermine trust and participation. For diverse classrooms, the implication is clear: equitable AI-personalized learning should be evaluated not only through performance metrics, but also through belonging indicators such as perceived recognition, fairness, cultural relevance, and opportunity to participate. A personalized system that raises scores while narrowing voice or deepening stereotype threat should not be treated as fully successful. The next generation

of research should therefore move beyond outcome-only studies and ask whether AI-mediated personalization helps students feel that they are included in the knowledge practices of the classroom and not merely managed by them.

CONCLUSION

This review suggests that algorithmic belonging is a useful way to rethink AI-personalized learning in education. The current evidence base shows that AI personalization can improve access, engagement, and sometimes learning outcomes, but it also shows that belonging, identity, and participation depend on social climate, cultural affirmation, and relational trust. Direct studies linking AI personalization to belonging are still limited, so the field remains conceptually underdeveloped. Even so, the available literature supports a clear conclusion: AI-personalized learning is most educationally valuable when it is explainable, fair, culturally sustaining, and embedded within teaching practices that affirm students' identities and expand participation. Future research should explicitly measure belonging outcomes alongside performance, especially in classrooms serving culturally, linguistically, and socially diverse learners.

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