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THEORETICAL MODELS UNDERPINNING AI-ASSISTED PERSONALIZED LEARNING IN HIGHER EDUCATION

Abdiganiyeva Nilufar
English language teacher at Specialized Boarding School No. 1 in Termez, Surkhandarya Region, Uzbekistan

ABSTRACT

AI is widely used in higher education to tailor learning. Recent systematic evaluations suggest that AI-based systems that dynamically alter material, tempo, and feedback to individual learners increase academic achievement, engagement, and perceived learning quality. However, technological feasibility rather than explicit pedagogical philosophy sometimes guides system design, risking algorithmic judgments misaligning with educational goals. This essay analyzes the theoretical frameworks behind AI-assisted individualized learning in higher education. Based on recent empirical and review studies on AI-supported personalization, learning sciences, and AI in education, the paper uses constructivism, socio-constructivism, self-regulated learning, connectivism, learning-analytics frameworks, and the "three paradigms" of AI in education to explain AI-driven personalization. Based on this, an integrative model integrates learner-level educational theories with AI learner-modelling and adaption processes and system-level institutional and ethical frameworks. The study claims that theoretically based AI-assisted customization increases learner agency, data transparency, and instructor control in increasingly automated learning settings.

KEYWORDS: Artificial intelligence in education; personalized learning; higher education; theoretical models; learning analytics; constructivism.

INTRODUCTION

Adaptive learning platforms, intelligent tutoring systems, and generative AI tools that customize content, difficulty levels, and feedback have made AI-assisted customized learning mainstream in higher education. Recent assessments show that AI-supported customisation can improve academic outcomes and engagement with proper technology and structure. AI will transform teaching and learning, therefore policy guidelines emphasize that it must be linked with educational goals rather than technological optimization.

Most publications on AI-assisted customisation in higher education focus on system design or tool assessment, with pedagogical principles briefly mentioned or as backdrop. Lack of theory may lead to design decisions that favor predictive accuracy or platform efficiency over learner agency, social engagement, and equity. Recent research in AI and education and the learning sciences suggests connecting AI techniques, learning models, and educators' professional judgment, seeing AI systems as instructional artifacts rather than data-processing engines. Complex ideas like individualized learning involve content adaptation, sequencing, feedback, self-regulation tools, and variable evaluation. AI creates learner models from activity traces, algorithms that identify needs or risks, learning dashboards, and data usage policy frameworks. Such layers may remain broken without a coherent theoretical model. Synthesising the

fundamental theoretical models of AI-assisted tailored learning in higher education, this essay presents an integrated framework for system design, analysis, and assessment.

The study uses conceptual and narrative review. It examines peer-reviewed literature from 2019 to 2025, when AI-supported customization gained popularity in higher education and multiple systematic evaluations and position papers were produced. Recent evaluations of AI-assisted customized learning in higher education, sector assessments, and major AI works in education and the learning sciences are data sources.

AI-assisted customization in higher education papers mostly discuss system design or tool assessment, with pedagogical ideas provided as background. Without theory, design decisions may prioritize predictive accuracy or platform efficiency over learner agency, social engagement, and equality. Recent research in AI and education and the learning sciences links AI methods, learning models, and educators' professional judgment, viewing AI systems as instructional artifacts rather than data-processing engines. Complex concepts like personalized learning require content adaptability, sequencing, feedback, self-regulation, and variable evaluation. AI builds learner models from activity traces, risk-detection algorithms, learning dashboards, and data usage policy frameworks. Layers may stay fragmented without a clear theoretical model. This article proposes an integrated framework for system design, analysis, and assessment based on AI-assisted personalized learning in higher education's core theoretical models.

Study employs conceptual and narrative review. It studies peer-reviewed literature from 2019 to 2025, when AI-supported customisation became widespread in higher education and comprehensive assessments and position papers were published. Data sources include recent higher education AI-assisted tailored learning evaluations, sector assessments, and key AI works in education and the learning sciences.

Most AI-assisted customized learning systems in higher education are constructivist and socio-constructivist, according to research. Learners actively generate knowledge by engaging with activities calibrated to their present level of comprehension, while AI systems change difficulty, give suggestions, or propose resources in their zone of proximal growth. AI-supported systems that organize collaborative activities, propose peer exchanges, and moderate student-teacher feedback are socio-constructivist.

AIED paradigms and learning-analytics frameworks offer theoretical structure to AI and data. Learning analytics views AI-based customization as a cycle of data collection, analysis, and visualization to trigger pedagogical interventions, highlighting interpretable indications and ethical data governance. Ouyang and Jiao's “three paradigms” of AI in education—AI-directed, AI-supported, and AI-empowered—characterize the shifting agency between systems, instructors, and students.

A three-level integrative model of AI-assisted individualized learning in higher education may be created from these threads. Personalization should facilitate meaningful knowledge production, cooperation, and agency for learners, according to constructivist, socio-constructivist, self-regulated learning, and connectivist theories. Learning-analytics and AIED paradigms describe how data, models, and algorithms change and feedback transparently in AI systems. Institutional policy frameworks emphasize equality, ethics, teacher professionalism, and educational goals.

This synthesis shows that AI-assisted customized learning is a set of actions that enacts certain learning and teaching theories. When behaviorist or AI-directed AI systems are built, customization may be simplified to optimizing task and evaluation sequences, with students as data sources. In contrast, constructivist, socio-constructivist, and self-regulated learning models tend to use AI as a partner for discovery, cooperation, and reflection rather than a dominating teacher.

The integrative model proposed in this article foregrounds learner agency and teacher judgment while still recognising the powerful capabilities of AI for modelling progress and predicting risk. This view aligns with learning-sciences-driven approaches that argue for AI systems to be co-designed with educators, using theories of learning to determine what kinds of data are collected, how models are interpreted and which interventions are pedagogically appropriate. Recent reviews of AI-supported personalized learning stress that technical, educational and ethical dimensions must be addressed together, yet many implementations still pay limited attention to issues of bias, explainability and the digital divide, especially in resource-constrained contexts.

Institutional frameworks are also stressed in the approach. Policy guidance suggests that AI should be used to advance inclusive and equitable quality education, which implies that personalization strategies must avoid reinforcing existing inequalities or over-surveilling particular student groups. Clear governance structures, AI literacy programmes for educators and students, and participatory approaches to system design can help maintain trust and ensure that personalization serves educational rather than purely managerial goals. The approach also accepts that empirical validation is limited: many AI-assisted personalization gains are context-dependent and small. Future studies should therefore examine how theoretically grounded designs perform in different disciplinary, cultural and infrastructural settings, including universities in the Global South.

In conclusion, algorithms should not handle customization alone. Instead, educators, designers, and policymakers should use AI systems as educational ecosystems, integrating data practices and adaptive mechanisms with meaningful and fair learning theories. Strengthening AI-assisted personalization theory can help higher education institutions use AI while protecting learner autonomy, instructor professionalism, and social responsibility.

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