Designing Inclusive AI: Leveraging Universal Design for Learning to Foster Learner Agency and Autonomy

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Abstract

Artificial Intelligence (AI) offers unprecedented opportunities to personalize learning, provide multimodal access, and expand how students demonstrate understanding. Yet, without intentional design, these tools risk perpetuating inequities, particularly for learners with disabilities and those historically marginalized by educational systems. This paper positions Universal Design for Learning (UDL) as a critical framework for integrating AI ethically and effectively. By drawing on evidence of UDL's impact on removing barriers and improving learner outcomes (Browder et al., 2008; King-Sears et al., 2015; McMahon & Firestone, 2024), we propose a UDL-guided AI integration model to amplify equity, agency, and autonomy. Practical classroom strategies, narrative case scenarios, and AI prompt templates are presented to illustrate how educators can leverage technology to foster inclusive, learner-centered environments.

Introduction

AI's rapid emergence in education promises transformative potential—from personalizing instruction to expanding multimodal access and offering learners greater flexibility in demonstrating knowledge. Yet, these opportunities are coupled with significant risks. Without deliberate design, AI systems may replicate systemic inequities, privileging learners who align with normative assumptions while excluding those whose needs diverge (Braun et al., 2023; Baker & Hawn, 2022). Universal Design for Learning (UDL) offers a research-based framework for proactively identifying barriers and designing learning environments that anticipate variability rather than react to it (CAST, 2018). Recent research underscores that UDL-informed AI practices enable educators to amplify inclusion by ensuring tools remain human-centered and support, rather than replace, instructional expertise (McMahon & Firestone, 2024).

Background

UDL is grounded in the principle that learner variability is the norm, not the exception. Its three core guidelines—Engagement, Representation, and Action & Expression—support proactive design that anticipates diverse learner needs (CAST, 2018). The evidence base for UDL is robust, demonstrating improvements in literacy (Browder et al., 2008; Coyne et al.,

2017), science learning (King-Sears et al., 2015; Rappolt-Schlichtmann et al., 2013), STEM readiness (Emerick & Marshall, 2017), and student engagement across contexts (Abell et al., 2011; Katz, 2013). Importantly, UDL also improves educators' capacity to design inclusive instruction (Lowrey et al., 2017; Beck et al., 2014). By combining UDL's proactive, barrier-removing approach with AI's adaptive capabilities, educators can create learning ecosystems that ensure access and choice for all learners.

Equity, Social Justice, and UDL-Guided AI

Historically, educational systems have privileged normative learners along gender, racial, socioeconomic, and ability lines (Evans et al., 2018; Hanesworth et al., 2019). Students with disabilities and other marginalized identities have often borne the additional labor of securing accommodations (Domage, 2017). AI introduces both new risks and new possibilities: poorly designed models may reproduce or amplify these inequities due to biased data or exclusionary design (Pessach & Shmueli, 2023), while intentionally aligned frameworks like UDL can harness AI to expose and address systemic barriers (Graham & Hopkins, 2022; McMahon & Firestone, 2024). When UDL guides AI implementation, educators can ensure technology augments human teaching and centers learner variability rather than suppressing it.

Barrier Removal through UDL-Guided AI

UDL Checkpoint	Barrier Removed	AI-Enhanced Strategy	Example Tools	References
Multiple Means of Representation	Language barriers; inaccessible text complexity	Generate summaries at multiple reading levels; provide real-time translation and captions	Diffit, Otter.ai, Canva MagicWrite	Coyne et al., 2017; McMahon & Firestone, 2024; CAST, 2018
Multiple Means of Engagement	Low motivation; lack of relevance; difficulty with planning	Create culturally relevant scenarios; scaffold executive function with checklists and reminders	ChatGPT, MagicSchool, Khanmigo	Hall et al., 2015; Abell et al., 2011; CAST, 2018
Multiple Means	Rigid	Offer multiple	Canva AI,	Rappolt-

of Action & Expression	assessment formats; limited output modalities	pathways for demonstrating understanding (text, visuals, video, interactive artifacts)	DALL·E, Parlay	Schlichtmann et al., 2013; McMahon & Firestone, 2024; CAST, 2018

UDL-Guided AI Integration Framework

The proposed framework aligns AI affordances directly with UDL checkpoints, ensuring that emerging technologies support inclusive and equitable learning design. By identifying common learner barriers, mapping them to UDL checkpoints, and applying AI strategies, educators can amplify agency and autonomy for diverse learners.

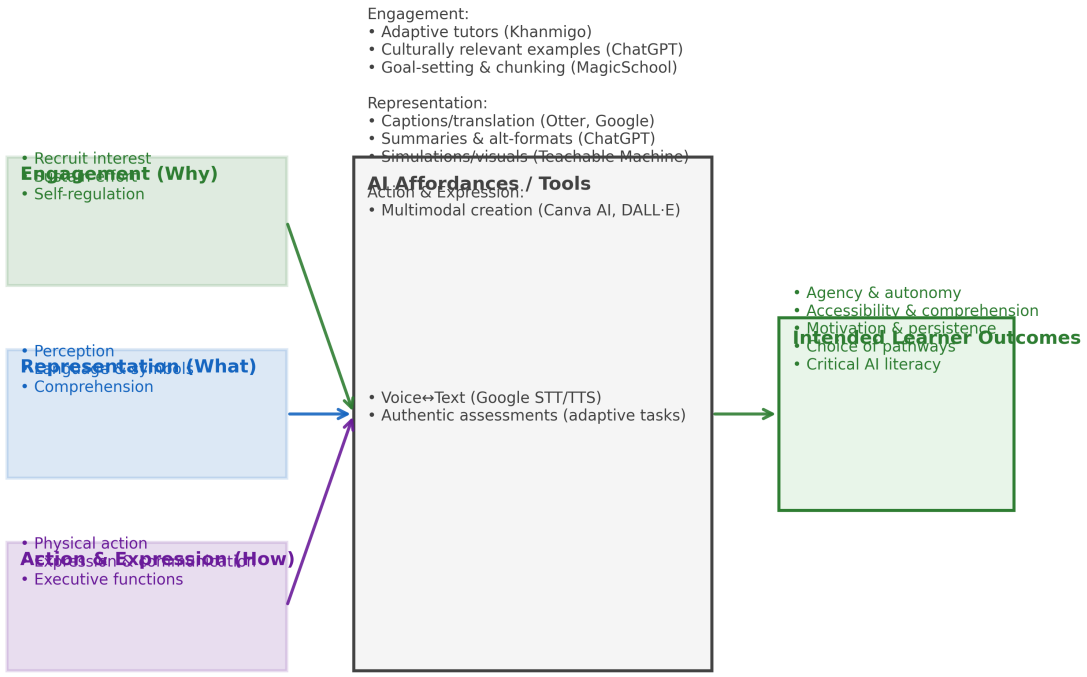

Figure 1. UDL + AI Integration Framework aligning AI affordances to UDL checkpoints.

Classroom Applications

AI tools can operationalize UDL principles in tangible ways. For instance, real-time captioning and translation tools support multilingual learners, while generative AI systems such as ChatGPT enable educators to quickly produce multimodal content tailored to varied comprehension needs (CAST, 2018). Adaptive platforms like Khanmigo scaffold learner

persistence by aligning task difficulty to readiness levels (Hall et al., 2015). Together, these applications illustrate the synergy between UDL's proactive barrier removal and AI's capacity to expand access.

Use Case Scenarios

Scenario 1: Multilingual Learners in Middle School Science

Ms. Rivera, a seventh-grade science teacher, notices that her multilingual students struggle to follow lab instructions written in English. She integrates AI translation and captioning tools to render instructions in Spanish and Vietnamese while also generating AI-supported visual diagrams of the process. As a result, all students engage in the lab simultaneously. By aligning with UDL's principle of Representation, Ms. Rivera removes language barriers and ensures equitable participation.

Scenario 2: Executive Function Support in Project-Based Learning

In a high school history class, Mr. Johnson assigns a long-term research project. Several students with executive functioning challenges fall behind. Using an AI planning assistant, Mr. Johnson generates personalized timelines and checklists. Students gain confidence as they meet incremental goals and track their progress. By embedding UDL's Engagement guidelines with AI tools, the teacher scaffolds persistence and self-regulation, enabling students to succeed without stigma.

Scenario 3: Choice and Agency in CTE Assessment

In a welding course, students must demonstrate mastery of safety procedures. Rather than relying on a single written test, the instructor offers options: students may write a reflective essay, design an AI-generated infographic, or record a demonstration video with AI-powered captions. By providing multiple means of Action and Expression, the teacher ensures assessments honor student strengths while maintaining rigor and relevance.

Fostering Agency and Autonomy

These scenarios underscore how UDL-guided AI fosters learner agency. When students are offered choice, supported in planning, and provided with multimodal resources, they gain ownership of their learning. AI enhances UDL's aim of cultivating purposeful, motivated, and strategic learners (CAST, 2018), equipping students with the tools to self-direct, critically evaluate AI outputs, and demonstrate mastery in authentic ways.

Ethical and Responsible AI

While promising, AI must be integrated responsibly. Educators should evaluate AI systems for bias, safeguard student privacy, and maintain transparency. Grounding adoption in UDL ensures technology enhances human-centered practices and preserves learner autonomy (McMahon & Firestone, 2024).

Conclusion and Future Work

AI holds immense promise for inclusive education when guided by UDL principles. Through evidence-based frameworks, practical strategies, and real-world use cases, this paper demonstrates how UDL-guided AI integration removes barriers and amplifies learner agency. Future research should expand cross-context pilots to evaluate outcomes across diverse educational settings.

Appendix: Scenario-Specific AI Prompts

• Scenario 1 (Representation): "Translate these lab instructions into Spanish and Vietnamese, then generate a labeled diagram at a seventh-grade reading level."

• Scenario 2 (Engagement): "Given this project brief, produce a timeline with milestones and checklists suitable for a 10th grader with executive function challenges."

• Scenario 3 (Action & Expression): "Offer three options for demonstrating safety procedures mastery: a written essay rubric, an infographic outline, and a video script with captions."

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