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# Neuro-Informed Instructional Design: A Unified Framework

Digital learning environments are essential in higher education, relying on user interfaces and instructional design to deliver content. However, neurodiverse students often struggle due to poor navigation, overwhelming interfaces, and a lack of assistive technologies. These challenges increase cognitive load and hinder academic success, highlighting the need for cognitive accessibility tailored to their needs.

Neurodiverse students frequently experience decreased motivation and underperformance in demanding academic settings. Many digital platforms do not address their specific challenges, leading to increased stress and anxiety. Additionally, the lack of customized assessments and instructional design further complicates their ability to manage cognitive load. Addressing these issues requires a framework that aligns the needs of neurodiverse learners with accessible digital learning environments.

To effectively address challenges faced by neurodiverse learners in online settings, a robust framework is essential. This framework combines evidence-based cognitive strategies and personalized instructional design, utilizing models such as Cognitive Load Theory (CLT) (Wheeler, 2024), the FEDIS+R Model for Instructional Design (LeCunff et al., 2024), the AI-Course Planning Framework (Schleiss, 2025), Universal Design for Learning (UDL) Guidelines (Cast, 2024), and the AI-Driven Cognitive Personalization and Assistance Framework (Ouyang & Jiao, 2021). It includes four interconnected components:

1. Cognitive Load Management: utilizes strategies like information chunking, clear instructions, and visual aids to manage cognitive load
2. Neurodiversity-Informed Design: creates learning environments that accommodate diverse learning styles and strengths

3. Adaptive Learning Technologies: uses AI-driven tools to personalize learning experiences and track progress

4. Continuous Assessment and Refinement: involves ongoing evaluation, feedback, and refinement of the framework for effectiveness

The framework offers significant benefits that enhance the learning experience by managing cognitive load and fostering inclusive environments through neurodiversity-informed instructional design. Adaptive learning technologies utilize AI to personalize support, promote engagement, and ensure data protection, while continuous assessment allows for real-world insights and improvements.

Adopting this neuro-informed approach particularly benefits neurodivergent learners by enhancing self-regulated learning and executive function, ultimately improving emotional well-being and academic performance. The integration of AI in education, exemplified by tools like chatbots and customizable interfaces, can create adaptive learning environments that support cognitive accessibility, showcasing its transformative potential despite being a relatively new technology.

Despite its potential, three main issues hinder the future use of AI-assisted learning:

1. Lack of Neuro-Informed Frameworks: Higher education lacks effective pedagogy for neurodiverse learners, which is marked by insufficient research on their unique cognitive load patterns (Hamilton & Petty, 2023; Le Cunff et al., 2024), highlighting the need for a more inclusive educational approach.
2. Gaps in Instructional Design Research: There is a lack of integration for neurodivergent intelligences and culturally relevant strategies in instructional design (Friedman & Nash-Lukenback, 2023). Also, limited research on scaffolding in online

learning shows a pressing need for better accessibility and accommodations for adult learners (Doo et al., 2020; Kelly, 2024).

3. Novelty of AI-Assisted Learning: The integration of AI in education lacks established pedagogical frameworks, raising ethical concerns about data collection, learners' rights, and information protection (Diaz & Nussbaum, 2024; Johri et al., 2024; Schleiss et al., 2022, 2023).

Integrating AI into education offers exciting opportunities but also complexities that must be addressed carefully. It's essential to consider ethical implications and approach these technologies responsibly to enhance the learning environment, especially for neurodiverse learners. Safeguarding student data and emphasizing transparency are critical for fostering a secure and supportive setting. Raising awareness of AI among students is also important for encouraging thoughtful engagement.

A proposed framework can help create accessible digital learning spaces for neurodiverse learners through effective cognitive load management, neurodiversity-informed design, adaptive technologies, and continuous improvement. As AI becomes integral to education, ongoing discussions and research are vital for ensuring its ethical use. To bridge the gap between theory and practice, challenges posed by the lack of a unified framework for cognitive accessibility in digital platforms must be addressed immediately by educators, researchers, and policymakers.

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