PERSPECTIVE

Constructing inclusive student-centred learning sessions (ISCLS) in physiology: A perspective on using universal design for learning and artificial intelligence in the Indian context

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ABSTRACT

Physiology classrooms are perceived as places where complexity meets curiosity. For many students, the subject is both intellectually exciting and intimidating. In recent years, this tension has become more visible as Indian health professions education moves toward competency-based curricula, with increasingly diverse student cohorts, and widespread use of digital technologies, including artificial intelligence (AI). This perspective paper reflects on a pre-conference workshop at PHYSICON-2025 that explored how universal design for learning (UDL) and AI-enabled tools can be thoughtfully integrated to construct inclusive student-centred learning sessions (ISCLS) in physiology. Rather than presenting a prescriptive model, we attempted to offer a reflective account grounded in cognitive neuroscience, educational psychology, and classroom experiences. We argued that UDL can provide a principled, equity-oriented foundation for addressing learner variability, while AI can serve as a practical means for personalization, accessibility, and formative feedback, while retaining the importance of human educators. The paper situates these ideas within the lived realities of Indian medical and allied health sciences education and outlines future directions for educators seeking to nurture purposeful, motivated, resourceful, and strategic learners.

Keywords: Universal design for learning, Physiology education, Artificial intelligence, Inclusive education, Student-centred learning, Competency-based medical education.

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INTRODUCTION

Teaching physiology often feels like inviting students into a complex conversation between molecules, organs, and lived human experience. For some learners, this conversation is immediately engaging; for others, it can seem abstract and/or overwhelming. In Indian classrooms, this diversity of responses is shaped not only by individual learning preferences but also by differences in language backgrounds, schooling systems, socioeconomic contexts, and access to digital resources.

The recent national shift toward competency-based medical education (CBME) has further sharpened the focus on what students can do with their knowledge, rather than simply what they can recall. Within this evolving landscape, physiology educators are increasingly called upon to design learning environments that are inclusive, flexible, and responsive, while still maintaining disciplinary rigor.

This perspective emerges from a pre-conference workshop at PHYSICON-4 (20 November 2025) on "*Constructing Inclusive Student-centred Learning Sessions (ISCLS) in Physiology.*" The workshop served as a space for collective reflections on how UDL and AI-enabled tools might support more humane, equitable, and effective teaching practices. The present paper extends that conversation into a scholarly narrative, offering insights rather than instructions, and principles rather than templates.

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Learner Variability and the Imperative for Inclusion in Physiology

Anyone who has stood in front of a first-year physiology class will recognize the quiet heterogeneity in the room. Some students arrive confident, fluent in English and the language of science, and comfortable navigating digital platforms. Others carry with them anxieties about English-medium instruction, limited prior exposure to laboratory work, or unfamiliarity with online learning environments.[1]

In this setting, therefore, inclusive education is less about adding special provisions at the margins and more about

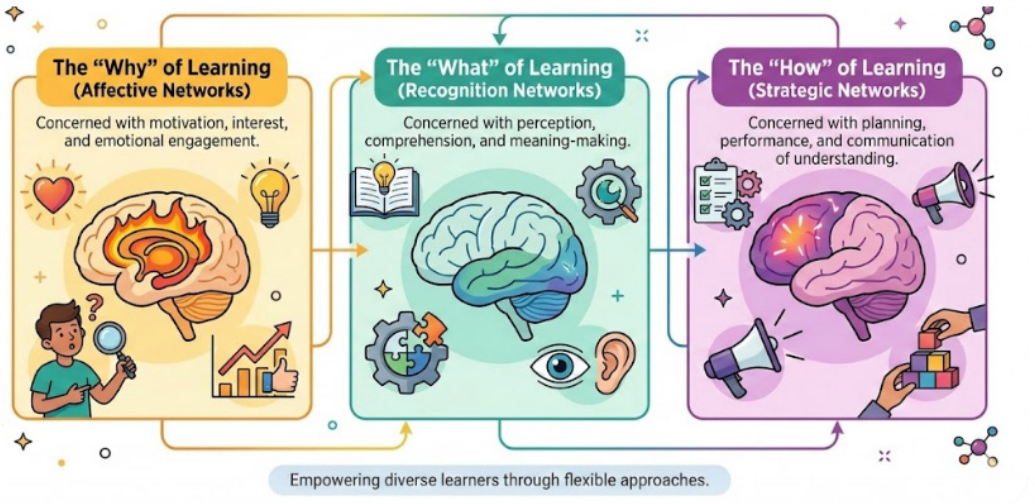

Figure 1: Without the "Why," there is no focus. Without the "What," there is no knowledge. Without the "How," there is no application

rethinking how the centre of the classroom is designed. The ISCLS approach invites educators to see diversity as a starting point for pedagogical design rather than a problem to be managed. When students are given multiple ways to engage with a concept, to make sense of it, and to express their understanding, the classroom becomes a space where differences can coexist productively rather than hierarchically. In physiology, this shift has resonance. Concepts such as homeostasis, neural integration, or cardiovascular regulation lend themselves to multiple forms of representation—diagrams, simulations, clinical vignettes, peer explanation, and reflective writing. So, using an inclusive lens makes this multiplicity intentional rather than incidental.

Universal Design for Learning: A Neuroscience-informed Framework

UDL is often introduced as a set of principles, but in practice, it functions more like a way of thinking about learners. Drawing on insights from cognitive science and neuroscience, UDL recognizes that learning is mediated by distributed, interconnected neural networks rather than by a single, uniform pathway.[2]

These networks are commonly described in three broad dimensions (Figure 1).

Thus, UDL is the framework that ensures all three are addressed for every learner.

For physiology educators, this triadic framing often resonates intuitively. There are a variety of students we often overlook. One may appear disengaged but may not necessarily lack ability; rather, it may be a matter of a sense of relevance or confidence. Another may understand a concept when it is explained verbally, but struggles to interpret a complex diagram or graph when asked to recall it in an examination. UDL encourages educators to either observe or anticipate such variability and to design learning experiences that offer more than one entry point into the subject.

This approach shifts attention away from "fixing" students toward examining the barriers in teaching methods, materials, and assessment practices. In resource-constrained settings, this reframing can be both empowering and pragmatic, as it focuses on design choices rather than deficit narratives.

Student-centred Learning and the Role of the Educator

Adopting a student-centred stance in physiology does not mean abandoning structure or disciplinary standards. Rather, it involves reimagining the educator's role as one of guide, designer, and reflective partner in the learning process.[3]

Within the ISCLS framework, educators are encouraged to articulate clear learning goals, but to remain flexible about the paths students take to reach them. Small-group discussions, peer teaching, low-stakes formative assessments, and reflective activities can sit alongside more traditional lectures and demonstrations. Over time, this blend of approaches can help students develop not only conceptual understanding but also confidence in articulating their reasoning and learning from one another.

Such practices align closely with the broader aspirations of CBME, particularly in relation to self-directed learning, collaboration, and professional identity formation. In this sense, the physiology classroom becomes an early site where students begin to practice the habits of mind expected of future healthcare professionals.

Artificial Intelligence as an Enabler of Inclusive Pedagogy

The presence of AI in education often evokes both enthusiasm and unease. In physiology teaching, AI-enabled tools can offer tangible benefits when used thoughtfully. Adaptive platforms can provide students with targeted practice questions based on their performance patterns. Simulations can make invisible processes—such as ionic fluxes or pressure-volume relationships visible and

interactive. Speech-to-text and text-to-speech tools can reduce language and sensory barriers that might otherwise limit participation.[4]

From an educator's perspective, learning analytics can serve as a reflective mirror, highlighting which concepts students revisit frequently, where they tend to disengage, or which assessment items consistently cause difficulty for them. Used ethically, such data can inform adjustments in teaching strategies rather than serve as instruments of surveillance.

At the same time, the Indian context calls for a measured and critical adoption of AI. The regulatory body has yet to provide clear directives on the ethical and responsible use of AI in teaching, learning, and assessment. Unequal access to devices, bandwidth, and institutional support can inadvertently deepen existing inequities. ISCLS therefore treats AI not as a central pillar, but as a supporting scaffold—one that should always be complemented by low-technology, human-centred alternatives.

ISCLS in Practice: From Design to Reflection

In practical terms, ISCLS is best understood as a cyclical process rather than a fixed model. Educators begin with proactive design, anticipating learner variability and potential barriers. This is followed by implementation, where multiple forms of engagement, representation, and expression are offered in the classroom. The cycle concludes with reflection and redesign, informed by student feedback, performance data, and the educator's own observations.[5]

Typical strategies are shown in Figure 2.

Over time, these practices can contribute to the development of what UDL describes as "expert learners"—students who are purposeful, motivated, resourceful, and strategic in their approach to learning.

Indian Context: Aligning ISCLS with National Educational Reforms

Physiology education in India is currently shaped by three converging policy and practice frameworks: Competency-based medical education (CBME), regulatory guidance from the National Medical Commission (NMC), and the broader vision of the National Education Policy (NEP) 2020. Together, these reforms emphasize outcome-oriented learning, learner autonomy, ethical professionalism, and equitable access to educational opportunities.[6]

Since CBME proposes developing observable competencies rather than passive knowledge acquisition, the ISCLS model offers an effective mechanism for translating competencies into everyday classroom practice by embedding flexibility into how students engage with learning, process information, and demonstrate understanding of complex physiological processes that are essential for comprehending clinical concepts later.

NMC's highlighting the importance of early clinical exposure, integration across disciplines, and the thoughtful use of educational technology to support active learning has been complemented by ISCLS that enables physiology educators to design learning experiences that are clinically contextualized, digitally supported, and responsive to individual learner trajectories. The UDL emphasis on multiple means of engagement, representation, and expression aligns closely with CBME's focus on formative feedback, reflective learning, and progressive entrustment.

NEP 2020 adds a broader, equity-oriented lens by advocating for inclusion, multilingualism, and reducing structural barriers in higher education. In this context, the rural–urban digital divide remains a critical consideration. While AI-enabled tools and digital platforms offer new possibilities for personalization and accessibility, their benefits are unevenly distributed across institutions with varying levels of infrastructure and connectivity. An inclusive ISCLS approach, therefore, calls for deliberate low-technology and offline alternatives—such as printed multimodal resources, peer-facilitated small-group learning, and community-based case discussions—to ensure that innovation does not inadvertently widen existing gaps. Taken together, these national priorities position ISCLS not merely as a pedagogical innovation, but as a contextually

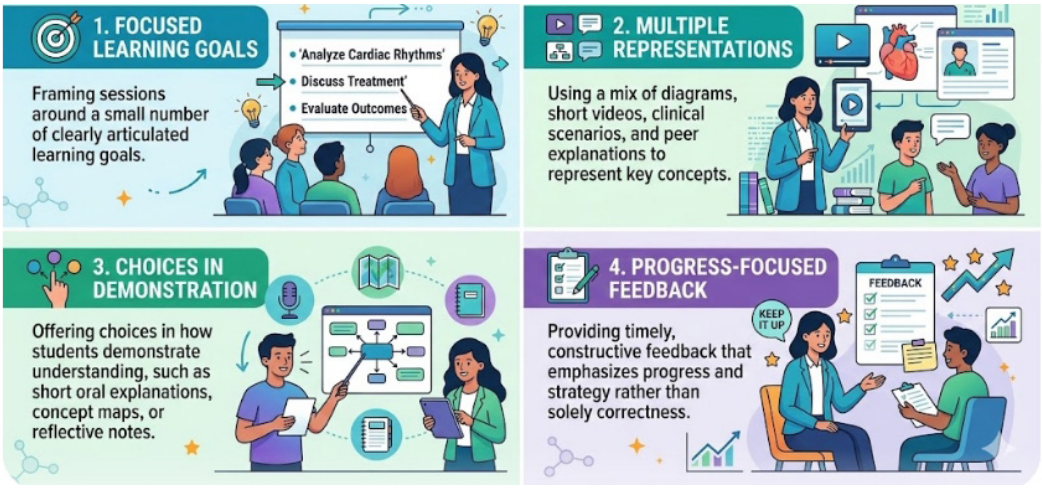

Figure 2: Typical strategies

grounded response to India's evolving vision for socially accountable, learner-centred, and technologically supported health professions education.

Implications for Faculty Development and Institutional Policy

The shift toward inclusive, student-centred, and technology-supported teaching is as much a cultural change as it is a methodological one. Faculty development initiatives—such as workshops, mentoring programs, and communities of practice—play a crucial role in helping educators move from awareness of UDL and AI to confident, reflective application. At the institutional level, policies that support accessible digital infrastructure, ethical use of student data, and recognition of innovative teaching practices can create conditions in which ISCLS is not an individual experiment, but a shared institutional commitment. Curriculum review processes that explicitly consider inclusivity and learner variability can further embed these values into the formal structures of medical and allied health sciences education.

Future Directions

There remains a need for systematic, context-sensitive research on the impact of ISCLS in Indian physiology classrooms. Mixed-methods studies that combine learning analytics, student narratives, and performance outcomes can offer richer insights than any single metric alone.

Collaborative initiatives across institutions—particularly those spanning urban and rural settings—may help to surface both the possibilities and the constraints of inclusive, AI-supported pedagogy. Such collaborations can also foster a national community of practice around physiology education, where strategies and reflections are shared rather than developed in isolation.

CONCLUSION

The convergence of UDL and AI within the ISCLS framework offers a thoughtful response to the evolving demands of physiology education in India. By attending to learner variability, using technology with ethical care, and embracing a reflective, student-centred teaching stance, educators can create classrooms that are both academically rigorous and humanely inclusive.

In doing so, physiology teaching moves beyond the transmission of concepts toward cultivating learners who are curious, resilient, and prepared to engage with the complex social and scientific realities of healthcare practice.

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AI USAGE DECLARATION

Nano Banana was used to create the figures; Grammarly was used for grammatical corrections.

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