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COMMENTARY AND OPINIONS

Boundaries, uncertainty, and action: a complexity-informed perspective for health professions education

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Limites, incertitude et action : une approche fondée sur la complexité pour la formation des professionnels de santé

Introduction

Health professions education is organized around clarity. We define competencies, map curricula, standardize assessments, and establish milestones because learners and patients deserve coherent, accountable systems. Yet the clinical learning environments in which these structures operate rarely behave in linear or predictable ways. They are shaped by relationships, histories, competing priorities, workload, culture, and continual adaptation. Complexity theory offers educators a language for this reality and, more importantly, a different way to act within it.[1,2]

I argue that the value of complexity theory is not that it gives educators greater control, but that it helps us act more wisely when control is limited. Three ideas are especially useful: boundaries, emergence, and adaptive action.

First, we should treat boundaries as interfaces rather than walls. Health professions education is full of boundaries: between professions, specialties, learners and teachers, classrooms and clinics, and education and patient care. These distinctions help us organize work, but learning often occurs precisely where they meet. A resident simultaneously belongs to a training program, clinical team, specialty culture, hospital, and personal social world. What happens in one domain can quickly reshape another. A moment of disrespect during rounds may alter whether a learner speaks up later; a hospital policy may inadvertently change bedside teaching. Transitions themselves may therefore be-

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come opportunities or threats depending on context and relationships.[3]

Second, complexity directs our attention to emergence. A learning environment is more than the sum of its curriculum, faculty, assessments, and learners. Its culture emerges from repeated interactions. Learners notice what teams reward, tolerate, ignore, or punish. They learn whether uncertainty can be acknowledged, questions are welcomed, and vulnerability is safe. These micro-interactions are difficult to standardize and sometimes difficult to measure, yet they may shape professional identity as powerfully as formal teaching. Self-organization does not mean that culture appears spontaneously; it means that patterns arise from many interacting forces rather than from a single curricular directive.[1]

This perspective should change how we approach educational improvement. In complex systems, an intervention is not simply inserted into a stable environment; it interacts with that environment and is changed by it. An initiative that succeeds in one residency may fail in another because trust, workload, incentives, relationships, or institutional history differ. Evaluation therefore should move beyond asking only, "Did it work?" and examine how an intervention worked, for whom, under what conditions, and with what unintended consequences.[4]

The danger, of course, is paralysis. If every outcome is context-dependent and every action may have unintended effects, complexity can become an excuse for vagueness or inaction. It should not. A complexity-informed educator still makes decisions, sets standards, and accepts accountability. The difference is epistemic humility: we act provisionally, observe carefully, learn continuously, and adapt responsibly. Complexity-informed work therefore favors feedback loops, local adaptation, and attention to changing patterns rather than assuming that fidelity alone guarantees success.[5]

We should not use complexity theory merely to rename difficult problems. Its practical value lies in changing our questions. Instead of asking, "What intervention will solve this problem?" we might ask, "What conditions are producing this pattern, what small change might shift those conditions, and what will we watch for next?" Health professions education does not need less structure. It needs structures held with enough humility to recognize that learning occurs within living systems. Our task is not to simplify complexity away, but to engage it without becoming overwhelmed by it.

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