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Editorial

Rethinking medical education: technology, reflection, and learner development

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Historically, medical education was built on the systematic transmission of scientific knowledge and clinical principles. This foundation remains essential. However, contemporary healthcare requires professionals who can do more than recall information. They must make decisions in uncertain situations, collaborate across disciplines, evaluate their own performance, and continue learning throughout their professional lives. In response to these professional demands, medical education has increasingly reconsidered both its educational goals and approaches to learning design and evaluation. Greater emphasis is now placed on active learning, clinical reasoning, reflection, and the development of professional identity. The focus has gradually shifted from what teachers provide to how learners engage with and use educational experiences. The eleven articles included in this issue address diverse aspects of this changing landscape, including artificial intelligence, digital learning environments, clinical skills education, reflective practice, and learner psychology. Although the studies differ in their specific aims and methods, they raise several several common questions. How can educational innovations be introduced responsibly? What conditions allow them to become part of routine educational practice? And how can educators better understand the learners who engage with these approaches? However, the effectiveness of educational interventions is often determined less by their initial design than by the complexity of their implementation within real educational environments. Implementation challenges frequently arise from faculty workload, limited resources, institutional priorities, and competing demands within clinical environments. Similarly, even well-designed educational strategies may have limited effects if learners are not prepared to engage with them effectively. Understanding these interconnected factors is essential for achieving educational changes that are not only innovative but also sustainable.

Technology-enhanced learning and the need for meaningful integration

Digital technologies are now part of everyday discussions in medical education. Artificial intelligence, mobile applications, online learning platforms, and gamified approaches have moved beyond the stage of being viewed as novel experiments. Many educational institutions are exploring how these tools can be incorporated into teaching and assessment. The current challenge is to determine how these technologies can be incorporated in ways that produce measurable and educationally meaningful benefits.

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The systematic review and meta-analysis of artificial intelligence applications in medical education provides a useful example of both the potential and the uncertainty surrounding emerging technologies [1]. Across the included studies, AI showed promising performance in selected knowledge-based tasks, and some have reported improvements in learning outcomes when AI-supported tools are introduced. However, enthusiasm for AI currently exceeds the strength and consistency of available evidence. Small samples and heterogeneous designs limit the certainty of current conclusions. At the same time, the practical challenges faced by clinicians highlight the need to explore how AI may support learning and healthcare delivery when implemented responsibly. Beyond measuring performance, future evaluations need to consider whether Artificial Intelligence (AI) helps learners develop clinical reasoning, maintain critical thinking, and use technology under appropriate professional guidance.

The study of Quick Response (QR) code-based laboratory instruction offers another perspective on technology integration [2]. The intervention was associated with improved practical performance, usability, and learner experience. However, as a pilot study with a limited sample, its main contribution lies in demonstrating feasibility and identifying areas for further investigation rather than providing evidence for immediate large-scale implementation.

The randomized trial examining gamified Electrocardiogram (ECG) interpretation training among intensive care nurses also reported favourable outcomes compared with conventional lectures [3]. These results suggest that gamification may be useful, particularly when gamified activities are aligned with clearly defined educational objectives. However, the reasons for these observed benefits require further investigation. Whether improvements are mainly related to engagement, additional practice, game elements, or aspects of instructional design requires further exploration.

The comparison of online and face-to-face clinical training highlights another important point about the role of technology in health professions education [4]. Digital formats can improve accessibility and flexibility, but they cannot fully reproduce the complexity of clinical environments. Patient interactions, teamwork, professional communication, and exposure to real clinical uncertainty remain essential parts of professional learning. Rather than replacing clinical experience, technology is likely to have its greatest value when integrated with supervised practice, thoughtful curriculum design, faculty preparation, and ongoing evaluation.

Bridging simulation, practice and curriculum priorities for clinical competence

Although technological advances have created additional learning opportunities, clinical competence continues to develop through repeated engagement with authentic clinical situations. Technical performance is only one part of being clinically competent. Effective communication, clinical judgement, confidence, situational awareness, and the ability to respond to changing circumstances are equally important components of professional practice.

The study comparing simulation-based training with supervised clinical participation for endotracheal intubation skills among acute care nurses provides an important example of this relationship [5]. Simulation creates a safe environment where learners can practise procedures repeatedly, receive feedback, and improve their technical skills before encountering real patients. Clinical participation, however, introduces elements that cannot be fully reproduced in simulated settings. Learners must respond to uncertainty, interact with patients and healthcare teams, and apply their skills within the complexity of actual care. In this study, supervised clinical participation resulted in greater improvements in knowledge, attitudes, and procedural performance. These findings do not diminish the educational value of simulation; rather, they demonstrate that simulation and workplace-based learning serve different but complementary purposes.

The evaluation of a female-oriented emergency medical services training programme illustrates the importance of careful curriculum development [6]. The programme was associated with positive learner responses and immediate learning gains based on Kirkpatrick's framework. However, the small

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number of participants and the lack of a comparison group limit the conclusions that can be drawn about its effectiveness.

Such early evaluations are useful because they provide information about feasibility, acceptability, and areas that may require refinement before broader implementation.

Clinical competence also includes areas that have sometimes received less attention in health professions curricula. The study of Iranian nursing students found limited knowledge of palliative and end-of-life care despite generally positive attitudes toward this area of practice [7]. This gap between attitudes and preparedness is important. Valuing a professional responsibility does not necessarily mean having the knowledge, communication skills, or confidence required to perform it effectively. Structured educational experiences are needed to bridge this gap. These findings reinforce that clinical competence cannot be reduced to a checklist of technical skills. Rather, it emerges from the interaction between educational objectives, assessment approaches, and the complex realities of clinical practice. Preparing graduates for contemporary healthcare therefore requires more than adding individual educational activities. It requires curricula in which different elements of learning are connected and directed toward the competencies expected of future practitioners.

Reflective practice and the learner behind the curriculum

Curriculum design and teaching approaches influence learning, yet students exposed to the same educational environment may demonstrate markedly different developmental trajectories. Learners enter educational environments with different cognitive approaches, motivational resources, and levels of reflective engagement. These characteristics shape how they engage with learning opportunities, interpret experiences, and develop professionally. Consequently, learner characteristics have become an increasingly important consideration in curriculum planning.

The role of reflection in professional development is illustrated by the study of narrative medicine among surgical interns [8]. Participants described reflective writing as a way to better understand patient encounters, become more aware of their emotional responses, strengthen professional identity, and develop a more patient-centred approach to care. The study also drew attention to the conditions needed for these benefits to occur. Supportive faculty, sufficient time, and institutional recognition were important factors. Reflection is unlikely to become a meaningful part of professional education unless the surrounding learning environment supports it. Further insight comes from the study using the Kember Reflection Questionnaire [9]. The findings suggest that reflection is not a single ability that develops uniformly. Rather, it includes different dimensions that may require different forms of educational support. Clinical exposure alone does not necessarily produce reflective practitioners. Learners need opportunities to examine experiences, receive feedback, and discuss clinical situations in ways that encourage deeper understanding.

Attention to how learners regulate their own motivation is also important. The instrument developed to assess motivational self-regulation strategies among health sciences students provides educators with a means of exploring how students manage their learning behaviours and maintain engagement [10]. Such information may be useful not only for identifying students who need additional support but also for designing educational approaches that better respond to individual differences.

The cognitive aspects of learning deserve similar consideration. A study of medical students in Pakistan found an association between cognitive distortions, including catastrophising, and academic performance [11]. Although the cross-sectional design prevents conclusions about causality, the findings highlight the possible influence of students' interpretations and thought patterns on how they experience academic pressure and the challenges of professional training.

These findings highlight that learner-centred education requires more than structural adjustments to curricula and schedules. It requires educational environments that recognize learners as active participants in their own development and provide opportunities for reflection, self-regulation, and meaningful engagement. A deeper understanding of these processes can help medical educators design

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programmes that support not only knowledge acquisition, but also the personal and professional development of future healthcare providers.

Interpreting the issue toward evidence-informed educational change

Collectively, the studies in this issue highlight a central question: how can educational innovations move from promising interventions to sustainable practice? The answer requires attention not only to the effectiveness of individual interventions, but also to the institutional and contextual factors that influence implementation.

A recurring theme across these papers is the continuing need for stronger evidence. Artificial intelligence, gamification, and other technology-supported approaches have shown encouraging results, but their effectiveness may vary considerably depending on learners, educational contexts, and the way these tools are incorporated into curricula [1–3]. Further research across different settings will be necessary to clarify where these approaches provide the greatest benefit and where their limitations should be recognised.

The experience of implementing educational innovations is equally important. A well-designed intervention does not automatically become a successful educational programme. Faculty readiness, institutional support, available resources, and alignment with existing curricula all influence whether new approaches can be sustained over time. The studies addressing narrative medicine, competency-based education, and clinically integrated learning illustrate this broader reality [5–8].

The role of learners is another central consideration. Educational outcomes are influenced not only by what is taught but also by how students engage with learning opportunities. Reflective capacity, motivational regulation, and cognitive characteristics affect the way learners respond to educational experiences and should therefore be considered when designing future educational strategies [9–11].

Although the studies in this issue come from different countries and healthcare systems, many of the challenges they describe are shared. Educational priorities are shaped by local circumstances, yet health professions programmes everywhere face a similar task: preparing practitioners who are capable, reflective, and able to adapt to the changing demands of healthcare.

Sustainable educational innovation requires more than promising interventions. It depends on institutional capacity, faculty engagement, adequate resources, and continuous reflection on educational practices. The future of medical education will not be determined by technologies such as artificial intelligence, gamification, or QR-based learning alone, but by how effectively these approaches are integrated into meaningful educational relationships and authentic clinical learning environments. Rather than focusing solely on tools, medical educators should continue to emphasize the principles of effective teaching, learning, and professional development. Together, these studies illustrate that the future of medical education will depend not only on developing new educational strategies, but also on understanding how those strategies fit within real learning environments and professional practice.

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