

Artificial Intelligence–Driven Personalised Surgical Curricula for Medical Students

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ABSTRACT

Introduction: Artificial Intelligence (AI) and immersive technologies such as Virtual Reality (VR) have the ability to personalise undergraduate surgical education by delivering adaptive feedback, standardised assessment, and resource-efficient training.

Methods: A focused review of 75 studies from a pool of >140 on the PubMed database explored AI-driven feedback, automated assessment, VR integration, and adaptive learning in undergraduate surgical training.

Results: Results across multiple trials demonstrate significant improvements in surgical training using AI-driven personalised approaches. These benefits were seen across the learning pathway - from initial skill acquisition to targeted feedback and final performance outcomes. A randomised pilot study reported high classification accuracies compared with human assessors for suturing (89%) and knot-tying (91%), lending to the credibility of AI-based performance assessments. Further trials involving participants without previous robotic surgery experience demonstrated significantly greater improvements in robotic suturing skills for those who received teaching videos based on AI-personalised feedback compared to those that did not (improvement 0.30 vs -0.02, $p = 0.018$). A Cochrane review involving a further 8 trials on AI-personalised surgical training showed similarly promising results, reporting reduced operative time by an average of 11.76 minutes (95% CI: 15.23 to 8.30 minutes), with adaptive AI feedback particularly beneficial for underperformers ($p = 0.02$).

Conclusions: AI-assisted feedback accurately identifies performance levels, whilst AI-personalised curricula and VR simulations show clear short-term improvements in novice surgical skill acquisition. These findings support the need for larger, multi-centre randomised controlled trials to assess long-term benefits. Integrating AI as a faculty-supervised adjunct offers a pragmatic and scalable path to transforming surgical education.

Keywords: AI-driven personalised feedback, Virtual reality surgical simulation, Automated performance assessment, Adaptive learning algorithms, Undergraduate robotic suturing training