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Impact of Virtual Reality and Haptic Simulators in Dental Education and Training Among Dental Students: An Umbrella Review

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Abstract

Objectives: To synthesise and critically appraise systematic reviews evaluating the impact of virtual reality (VR) and haptic simulators on dental students' learning outcomes in preclinical and clinical education. Methods: Three databases were searched from January 2011 to June 2025. Eligible evidence comprised only systematic reviews (with/without meta-analysis) published in English which focused on undergraduate or postgraduate dental students using VR, haptic, or integrated VR–haptic simulation for skills training. Two reviewers independently screened records, extracted data, appraised methodological quality using A MeaSurement Tool to Assess systematic Reviews 2 (AMSTAR 2), and calculated the Corrected Covered Area (CCA) to assess citation overlap. Results: Six systematic reviews met the inclusion criteria; one included a meta-analysis reporting a significant performance advantage after haptic-simulator training, albeit with very high heterogeneity (I^2 = 92%). Across reviews, VR–haptic training was consistently associated with improved preclinical performance (accuracy, error reduction, efficiency) and greater learner confidence, with the strongest evidence in restorative dentistry and supportive signals in endodontics, implantology, periodontics, paediatric dentistry, radiology and oral & maxillofacial surgery. Methodological confidence was limited: AMSTAR 2 ratings were low to critically low. Overlap analysis indicated moderate redundancy (CCA = 6.05%), suggesting some recirculation of primary trials across reviews. Conclusions: VR and haptic simulators confer meaningful advantages for preclinical acquisition and learner confidence in dental education, but certainty is tempered by methodological weaknesses and substantial heterogeneity. Their optimal role is as high-fidelity adjuncts within blended curricula. © 2026 John Wiley & Sons A/S. Published by John Wiley & Sons Ltd.

Author keywords

dental education; haptic simulation; systematic review; umbrella review; virtual reality

Indexed keywords

MeSH

Clinical Competence; Computer Simulation; Education, Dental; Haptic Interfaces; Humans; Simulation Training; Students, Dental; Virtual Reality

EMTREE medical terms

clinical competence; computer simulation; dental education; dental student; haptic interface; human; procedures; simulation training; virtual reality

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