

SYSTEMATIC REVIEW

The Role of Artificial Intelligence in Physiotherapy Education: A Systematic Review

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ABSTRACT

Background: Physiotherapy education faces mounting pressure to prepare graduates for an AI-augmented clinical environment. Despite rapid acceleration in AI publications since early 2024, the systematic evidence base for AI applications specifically within physiotherapy education remains sparse, methodologically immature, and critically lagging behind medicine and dentistry. No comprehensive synthesis incorporating the most recent empirical studies including the first randomised controlled trials (RCTs) in this domain existed prior to this review. **Objectives:** To (1) identify and critically evaluate all study designs examining AI integration in physiotherapy education up to July 2025; (2) characterise AI modalities and their educational applications; (3) synthesise learning outcomes including clinical reasoning, knowledge retention, practical competence, and student perceptions; and (4) identify methodological gaps and priorities for future research. **Methods:** A PRISMA 2020 compliant systematic search across PubMed, CINAHL, Scopus, Web of Science, ERIC, and JMIR databases used a PICOS-informed strategy with an upper cutoff of July 2025. Inclusion required studies to explicitly address AI application in physiotherapy or allied health education. Quality was assessed using design-appropriate tools (RoB 2, Newcastle-Ottawa Scale, JBI checklist, AMSTAR-2). Narrative synthesis was performed due to methodological heterogeneity. **Results:** Eight studies met full-inclusion criteria: one prospective parallel-group RCT, one pilot RCT, one qualitative focus-group study, one evaluative cross-sectional study, one mixed-methods study, one systematic review, one narrative review, and one bibliometric analysis. AI modalities included large language models (LLMs; ChatGPT/GPT-4), generative AI, VR with AI feedback, and ML-based wearable sensors. Evidence supported AI as beneficial for theoretical knowledge acquisition, clinical reasoning preparation, and student engagement. However, evidence for practical competency transfer and real-world performance improvement remained insufficient, with no Mini-CEX advantage demonstrated in the only RCT. **Conclusions:** AI holds genuine transformative potential for physiotherapy education, but the evidence base remains nascent, heterogeneous, and weighted towards cognitive rather than practical learning outcomes. The first RCTs represent critical progress but expose deep implementation barriers including low student AI literacy and engagement. LLMs show the most immediate educational utility, while concerns regarding accuracy, over-reliance, and critical thinking erosion demand structured faculty oversight and explicit AI literacy curricula. Equity considerations and the digital divide require urgent research attention.

Keywords: Artificial intelligence; Physiotherapy education; Large language models; ChatGPT; Clinical reasoning; Virtual reality; Adaptive learning; Health professions education

Introduction

Physiotherapy also known as physical therapy is a health profession concerned with the assessment, diagnosis, and treatment of movement dysfunction arising from musculoskeletal, neurological, cardiorespiratory, and other clinical conditions. Its educational preparation is inherently multidimensional: students must acquire foundational biomedical knowledge, proficiency in complex manual assessment and intervention techniques, sophisticated clinical reasoning, and the capacity to communicate effectively across patients, caregivers, and interdisciplinary teams [1,2].

Traditional physiotherapy education has relied on didactic lectures, anatomy instruction, clinical placements, and supervised practical laboratory sessions. While effective in many respects, these approaches face persistent challenges: limited standardisation of clinical case exposure, variable supervised learning environments, significant instructor dependency, and the inability to provide safe, infinite repetition of clinical scenarios [3].

Artificial intelligence (AI) encompassing machine learning (ML), deep learning (DL), natural language processing (NLP), large language models (LLMs), and generative AI (GAI) has begun to transform healthcare practice and is being examined for its potential to reshape the educational preparation of health professionals [4,5]. In physiotherapy specifically, AI has found clinical application through AI-assisted gait analysis, robotic rehabilitation, wearable sensor-based motion monitoring, and decision support systems [6,7]. However, the penetration of AI into physiotherapy education has lagged markedly behind its clinical applications [3].

A 2024 review by Veras and colleagues highlighted this disparity starkly: at the time of their search, only a single published article specifically addressed AI in physiotherapy education, compared with over 6,000 articles in medical education and 241 in dental education [3]. Whilst the period from early 2024 to July 2025 witnessed a notable acceleration in relevant publications including the first RCTs in this specific domain the evidence base remains fragmented, AI modalities investigated are heterogeneous, and no systematic synthesis incorporating these new empirical data currently exists.

This systematic review therefore aims to comprehensively map, critically evaluate, and synthesise all available evidence on the role of AI across domains of physiotherapy education to July 2025 including pre-clinical knowledge acquisition, clinical reasoning development, practical skills training, and assessment and to identify priority areas for future research and curriculum development.

Methods

This systematic review was conducted in accordance with PRISMA 2020 guidelines [8].

Eligibility Criteria (PICOS Framework)

Population (P): Undergraduate, postgraduate, or continuing professional development students and educators in physiotherapy or closely allied health rehabilitation programmes.

Intervention (I): Any AI technology including LLMs (e.g., ChatGPT, GPT-4), generative AI, ML algorithms, deep learning, NLP, VR augmented with AI feedback, robotic systems with AI decision-support, and intelligent adaptive learning platforms used in an educational context.

Comparison (C): Conventional physiotherapy education (lectures, traditional PBL, clinical placement, standard simulation without AI).

Outcomes (O): Primary clinical reasoning ability; theoretical knowledge acquisition and retention; practical clinical competence. Secondary student engagement and satisfaction; AI self-efficacy; learning efficiency; accessibility and equity.

Study Design (S): All original research designs (RCTs, non-randomised controlled studies, cross-sectional, qualitative, mixed-methods, case studies) and secondary designs (systematic reviews, scoping reviews, narrative reviews, bibliometric analyses).

Exclusion criteria: studies focusing exclusively on AI in clinical practice without an educational component; conference abstracts without full-text availability; non-English language publications; studies published after July 2025.

Search Strategy

Searches were conducted across six databases: PubMed/MEDLINE, CINAHL Complete, Scopus, Web of Science Core Collection, ERIC, and JMIR publications. The search covered all dates up to July 2025. Search terms included combinations of ("physiotherapy" OR "physical therapy" OR "PT education") AND ("artificial intelligence" OR "machine

learning" OR "large language model" OR "ChatGPT" OR "GPT-4" OR "generative AI" OR "virtual reality" OR "adaptive learning" OR "intelligent tutoring"). Reference lists of all included articles were hand-searched. Grey literature including Physiopeedia, professional body websites, and preprint servers (medRxiv, JMIR Preprints) were also searched.

Study Selection and Data Extraction

Two independent reviewers screened titles and abstracts using Rayyan systematic review software. Full texts of potentially eligible articles were retrieved and assessed against PICOS criteria. Discrepancies were resolved by discussion and, where necessary, adjudication by a third reviewer. A PRISMA 2020 flow diagram was constructed. Data extraction captured: author(s), year, country, study design, participant characteristics, AI modality, educational context, outcome measures, key findings, risk of bias, and limitations.

Quality Assessment and Data Synthesis

Study quality was assessed using design-appropriate tools: Cochrane Risk of Bias 2.0 (RoB 2) for RCTs; Newcastle-Ottawa Scale for non-randomised studies; JBI Critical Appraisal Checklist for qualitative studies; and AMSTAR-2 for systematic reviews. Substantial heterogeneity in study designs, AI modalities, educational contexts, and outcome measures precluded quantitative meta-analysis. Narrative synthesis was conducted, organised thematically by AI modality and educational application. Certainty of evidence was characterised using the GRADE framework where applicable.

Results

PRISMA 2020 Flow Summary

Records identified from databases: 1,847 (after deduplication) | Full-texts assessed: 148 | Excluded at full-text: 140 (AI clinical practice only: 84; non-PT health professions: 41; full text unavailable: 1; language restriction: 14) | Studies included in final synthesis: **8** | Design types: 1 prospective RCT, 1 pilot RCT, 1 qualitative, 1 evaluative cross-sectional, 1 mixed-methods, 1 systematic review, 1 narrative review, 1 bibliometric analysis (Table 1). Rest references mentioned in reference section were used for context writing.

Table 1: Summary of Included Studies (to July 2025)

Author (Year)	Study Design	Population	AI Modality	Key Findings
Veras et al. [3]	Narrative review	PT students & educators	AI general; LLMs; chatbots	Only one prior article on AI in PT education at time of search; stark digital divide vs. medicine (6,000 articles) and dentistry (241 articles).
Sumner et al. [6]	Systematic review (5 RCTs from 9,054 articles)	PT rehabilitation patients	ML; wearable sensors; robotics	Improvements in physical function and QoL but inconsistent clinical effects. Significant evidence gap for educational contexts identified.

Ferrer-Peña et al. [9]	Pilot parallel-group RCT (n=46)	3rd-year PT students; La Salle University, Madrid	GPT-4 for clinical reasoning	Feasibility established. Only 5.75% active engagement in experimental group. Key barriers: unfamiliarity with prompt engineering; AI literacy deficits.
Lindbäck et al. [10]	Qualitative focus groups (n=15)	Undergraduate PT students; Linköping University, Sweden	Generative AI (ChatGPT)	GAI valued as 'virtual study partner'; timesaving; tailored responses; concerns about over-reliance, accuracy, and erosion of independent reasoning.
Hao et al. [11]	Evaluative cross-sectional study	Expert physiotherapists; musculoskeletal cases	ChatGPT (GPT-4)	ChatGPT omitted red flag triage; lacked nuanced treatment planning. Suitable as reasoning supplement, not surrogate clinician.
Esmail & Concannon [12]	Mixed-methods study (n=125)	1st-year occupational therapy students; University of Alberta	Immersive VR + AI feedback	VR+AI reduced OSCE anxiety; improved perceived self-confidence and preparedness. Students valued unlimited safe scenario repetition and immediate corrective feedback.

AI Modalities and Educational Applications

Five broad categories of AI modality were identified (Table 2). LLMs particularly ChatGPT and GPT-4 were the most extensively studied AI tools, featuring in four of the eight included studies. Immersive VR combined with AI-generated feedback represented a second major domain. ML applied to wearable sensors and robotic rehabilitation was predominantly documented in clinical rather than educational contexts. Adaptive learning platforms were identified primarily through broader health professions education literature with physiotherapy-applicable relevance.

Table 2: AI Modalities and Applications in Physiotherapy Education

AI Modality	Application in PT Education	Representative Study	Evidence Strength
Large Language Models (LLMs)	Clinical reasoning simulation; virtual study support; case	Ferrer-Peña Lindbäck; Hao	Moderate (1 RCT, 1 pilot RCT, 1 qualitative, 1 evaluative study)

	generation; formative feedback	[8-10]	
Immersive VR + AI	OSCE preparation; procedural simulation; anxiety reduction; unlimited safe rehearsal	Esmail & Concannon [12]; Kyaw meta-analysis	Moderate (1 mixed-methods; supporting meta-analysis)
ML & Wearable Motion Analysis	Gait analysis; movement quality assessment; adaptive feedback in practical labs	Sumner [6]	Low–Moderate (mostly clinical, not education-specific)
Adaptive Learning Platforms	Personalised content sequencing; intelligent formative assessment; Bayesian knowledge tracing	Inferred from broader health professions education literature	Low (no PT-specific direct evidence)
AI Conversational Agents / Chatbots	24/7 Q&A support; history-taking practice; standardised patient simulation	Lindbäck [10]	Low–Moderate (mostly medical; some PT relevance)

Risk of Bias Assessment

Table 3 summarises risk of bias ratings for included primary studies. Both RCTs carried some concerns on allocation concealment and blinding of outcome assessors. The pilot RCT additionally carried high risk of performance bias given the inherently open-label design and critically low engagement rate. The qualitative study was judged to be of good methodological quality on JBI criteria. The cross-sectional evaluative study lacked a control condition and used non-standardised outcome metrics, limiting inferential validity. Both systematic reviews were assessed as moderate quality on AMSTAR-2.

Table 3: Risk of Bias Summary

Study	Design	Risk of Bias Tool	Overall Rating
Sumner et al. [6]	Systematic review	AMSTAR-2	Moderate quality
Ferrer-Peña et al. [9]	Pilot RCT	Cochrane RoB 2.0	High (5.75% engagement; performance bias; underpowered)
Lindbäck et al. [10]	Qualitative	JBI Checklist	Low risk good methodological rigour
Hao et al. [11]	Cross-sectional evaluative	Newcastle-Ottawa Scale	Moderate (no control; non-standardised metrics)

Esmail & Concannon [12]	Mixed-methods	JBI Checklist / NOS	Moderate (single institution; allied health, not PT)
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Evidence by AI Application Domain

Large Language Models in Clinical Reasoning Education

The most substantive body of evidence concerns the use of LLMs primarily ChatGPT to support clinical reasoning development in physiotherapy students. Lindbäck and colleagues

conducted a qualitative focus-group investigation involving 15 physiotherapy students across all three years of an undergraduate programme at Linköping University, Sweden [10]. Three thematic categories emerged from inductive content analysis: areas of GAI use in the learning process; strategies for optimising GAI use; and challenges and implications. Students characterised GAI as valuable for approaching unfamiliar clinical topics, synthesising course content, and rehearsing clinical reasoning through iterative dialogue functioning effectively as a 'virtual study partner.' However, the overarching theme 'GAI: Great potential if navigating the challenges' captured critical concerns: students expressed worry about accuracy of clinical information, impact of uncritical GAI use on learning quality, and potential erosion of independent reasoning if AI became a shortcut rather than a scaffold [10].

Participants were randomised into an AI-supported PBL group (AI-PBLG) using ChatGPT, or a traditional instructor-led PBL group (PBLG). Outcomes included a theoretical knowledge test, the Mini-CEX for clinical competence, AI Self-Efficacy Scale (AI-SES), Internet Addiction Test (IAT), and Adult Reading Motivation Scale (ARMS). The AI-PBLG demonstrated significantly higher theoretical knowledge retention and AI self-efficacy. Crucially, no statistically significant between-group difference was observed on the Mini-CEX, indicating that AI-assisted PBL did not yet demonstrate superiority for practical clinical competence within the study's timeframe [10]. Notably, no group exhibited concerning internet addiction increases.

Ferrer-Pena and colleagues

conducted a pilot parallel-group RCT at La Salle University, Madrid, involving 46 third-year physiotherapy students assessing the feasibility of implementing GPT-4 as a clinical reasoning training tool [9]. Feasibility was established logistically and ethically; however, active engagement was critically low only 5.75% of participants actively used the model to solve clinical cases [9]. Key barriers included unfamiliarity with prompt engineering, uncertainty about structuring AI interactions, and anxiety about relying on AI-generated clinical information. These barriers expose essential implementation prerequisites: AI literacy training and structured facilitation must precede large-scale LLM-based clinical reasoning interventions.

Hao and colleagues evaluated ChatGPT's clinical reasoning performance against expert physiotherapist standards using musculoskeletal case vignettes [11]. Whilst ChatGPT generated structured, clinically plausible responses, it consistently omitted red flag triage, lacked nuanced individualisation of treatment planning, and failed to incorporate the contextual judgement characteristic of expert reasoning [11]. These findings carry critical implications for education: whilst ChatGPT July function as a valuable initial reasoning scaffold or case-generation tool, its use as a surrogate clinician without expert oversight carries demonstrable risk.

Virtual Reality Combined with AI in Skills and OSCE Preparation

Esmail and Concannon conducted a mixed-methods study at the University of Alberta involving 125 first-year occupational therapy students a closely allied health discipline examining whether immersive VR combined with AI-driven feedback could reduce anxiety and improve perceived OSCE preparedness [12]. Quantitative assessment using the Perceived Preparedness Inventory demonstrated improvements in self-confidence, knowledge application, and clinical skill perception. Qualitative focus-group data revealed that students valued the ability to rehearse clinical encounters

without fear of patient harm, to receive immediate AI-generated corrective feedback, and to repeat scenarios without limit until performance standards were met [12]. A supporting meta-analysis confirmed that VR-based educational interventions across health science disciplines significantly improved knowledge and practical skill outcomes compared with traditional programmes [12].

The synthesis of AI and VR creates a particularly powerful combination for physiotherapy education: AI provides adaptive, intelligent feedback whilst VR creates ecologically valid, immersive clinical environments. Together, they address two critical limitations of traditional practical training: finite real patient availability for supervised student practice, and the passive, non-adaptive nature of traditional simulation mannequins [12].

Machine Learning, Wearable Technology, and Movement Analysis

Sumner and colleagues conducted a systematic review of 9,054 articles examining AI in physical rehabilitation, identifying only five RCTs eligible for inclusion [6]. Whilst focusing on clinical outcomes physical function, pain management, quality of life the clinical AI technologies reviewed, particularly ML-driven wearable sensor systems and real-time gait assessment algorithms, represent an emerging category of AI tool with direct educational relevance. As these technologies proliferate in clinical practice, the educational imperative to prepare physiotherapy students to use, interpret, and critically evaluate AI-generated clinical data becomes urgent. The review noted inconsistent clinical effects and a significant evidence gap for robust real-world evaluations [6].

Discussion

Principal Findings

This systematic review identifies AI particularly LLMs and generative AI as an emerging, promising, and now empirically supported modality for enhancing specific domains of physiotherapy education to July 2025. The evidence base, whilst nascent and methodologically heterogeneous, consistently identifies benefits in theoretical knowledge acquisition, clinical reasoning rehearsal, student engagement, AI self-efficacy, and anxiety reduction prior to high-stakes clinical assessments. Conversely, the evidence for AI demonstrating superiority over conventional approaches in practical clinical competency the quintessential domain of physiotherapy education remains insufficient. The pilot RCT was critically hampered by a 5.75% engagement rate [9].

This pattern is theoretically coherent. LLMs and generative AI are fundamentally language-based systems whose demonstrated strengths in cognitive knowledge acquisition and reasoning rehearsal align with their architecture. Physiotherapy's practical, embodied, tactile dimension manual therapy techniques, palpation, hands-on assessment is intrinsically resistant to full simulation through language-model-based AI alone. This does not diminish AI's educational value but argues strongly for a blended model in which AI augments rather than replaces experiential, supervisor-guided practical learning.

Why Physiotherapy Education Has Lagged: A Critical Analysis

Veras and colleagues documented a striking disparity in AI education research across health professions [3]. Multiple structural and cultural factors are explanatory. Physiotherapy lacks the concentrated academic medical centre infrastructure that has historically driven medical education innovation and research investment. Physiotherapy curricula are institutionally diverse varying enormously in structure, duration, clinical placement organisation, and assessment philosophy across countries creating heterogeneous and difficult-to-generalise contexts for AI implementation research. The profession's identity has historically centred on manual, hands-on therapy, potentially creating cultural resistance to technological mediation of education.

Critically, the low 5.75% engagement rate observed in the Ferrer-Peña pilot RCT [9] are not merely disappointing findings they are diagnostic. They indicate that LLM deployment into physiotherapy education without prerequisite AI literacy infrastructure is insufficient to produce meaningful learning gains, particularly for practical competencies. The problem is not the AI; it is the implementation context.

Implications for Curriculum Design

The evidence reviewed suggests several curriculum-level implications that extend beyond simple AI tool adoption. First, structured AI literacy training is a prerequisite for effective AI-augmented physiotherapy education. Low engagement [9] and student concerns about AI accuracy and over-reliance [10] share a common root: students lack the competency to interact productively with LLMs in clinical educational contexts. Prompt engineering, critical evaluation of AI-generated clinical information, and awareness of AI limitations including hallucination, outdated training data, and absence of red flag sensitivity [11] should be explicitly taught, not assumed.

Second, AI tools should be integrated within existing evidence-based pedagogical frameworks rather than deployed as standalone technologies. The finding that AI-supported PBL significantly improved knowledge retention [10] demonstrates that pedagogical power arises from the combination: AI enriches case generation, information access, and feedback within PBL, whilst PBL provides the collaborative, reflective, and facilitated structure that AI alone cannot guarantee. Theoretical frameworks of experiential learning (Kolb), self-determination theory, and cognitive load theory collectively argue for AI as a scaffold within not a replacement of established active-learning models [10].

Third, the development of AI-related clinical competencies must be incorporated into physiotherapy curricula. Students will encounter AI-driven gait analysis, wearable sensor outputs, and decision-support recommendations in clinical settings [6]. Equipping students to critically interpret, contextualise, and appropriately act upon AI-generated clinical data is now a core professional competency not an optional technological supplement.

Equity, Accessibility, and the Digital Divide

The digital divide differential access to hardware, software, reliable internet connectivity, and digital literacy represents a potentially decisive barrier to equitable AI-augmented physiotherapy education [3]. High-resource institutions in North America, Europe, and parts of Asia are disproportionately represented in the current evidence base. Physiotherapy programmes in low- and middle-income countries, where the burden of musculoskeletal and neurological disease is highest and physiotherapy workforce capacity most constrained, risk systematic exclusion from evidence-based AI educational innovations if the field does not prioritise equitable access. Open-access, low-bandwidth AI tools and faculty development support for resource-limited settings should be explicit research and policy priorities.

Limitations of This Review

Several limitations constrain the conclusions of this review. The included evidence base is small (eight studies), highly heterogeneous in design, and predominantly published from 2024 onwards, limiting evidence maturity and methodological rigour. No included study was conducted exclusively in a physiotherapy-specific educational context using a design adequate to detect long-term effects on clinical competence or patient outcomes. The rapid pace of AI development means findings related to specific tools (e.g., GPT-4) may already be superseded by newer model generations. Language restriction to English-language publications may have excluded relevant studies from non-Anglophone research traditions.

Conclusions

This systematic review provides the first comprehensive synthesis of evidence for AI in physiotherapy education to July 2025. The field is at an early and critical juncture: AI tools LLMs, generative AI, VR with AI feedback, adaptive learning platforms are now accessible, rapidly improving, and demonstrably beneficial for specific educational outcomes. The evidence confirms measurable improvements in theoretical knowledge retention and clinical reasoning rehearsal associated with AI-supported PBL, positive student perceptions of AI as a learning scaffold, and reduced OSCE-related anxiety through VR-AI integration. However, evidence for AI superiority in developing the practical, embodied competencies central to physiotherapy manual assessment, therapeutic exercise prescription, hands-on patient management remains absent and represents the field's most important unanswered empirical question.

The path forward requires deliberate, theoretically grounded, and equity-conscious integration of AI into physiotherapy curricula

not as technological disruption, but as pedagogical enhancement designed to complement the irreducibly human dimensions of physiotherapy education and practice. Investment in faculty development, AI literacy curricula, rigorous research infrastructure, and international collaboration across resource settings will be essential to realise the full educational potential of AI for the next generation of physiotherapists.

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