REVIEW

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Integrating simulation, role-play, and technology in physiotherapy education: A narrative review on teaching methods for patient education

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ABSTRACT

Physiotherapists play a crucial role in patient education, as effective communication and educational strategies directly influence treatment adherence, functional outcomes, patient satisfaction, and trust in healthcare services. The increasing global burden of musculoskeletal and neurological disorders has intensified the demand for physiotherapy services, emphasizing the need for graduates who are not only clinically competent but also proficient in patient-centered education. This narrative review aims to synthesize evidence from 2015 to 2025 regarding the integration of simulation, role-play, and educational technology in physiotherapy education, with a particular focus on teaching methods that enhance patient education competencies. Relevant peer-reviewed literature was identified from major academic databases, including PubMed, Scopus, and Google Scholar, and analyzed thematically to examine educational outcomes related to communication skills, learner engagement, confidence, empathy, and clinical preparedness. The findings indicate that simulation-based learning and structured role-play provide safe and experiential environments for students to practice patient communication and education, while technology-enhanced approaches such as virtual simulations and digital learning platforms offer scalable and flexible learning opportunities. Collectively, these methods demonstrate consistent benefits in improving students' ability to deliver clear, structured, and empathetic patient education, thereby supporting readiness for clinical practice. Integrating simulation, role-play, and technology within physiotherapy curricula represents a strategic approach to strengthening patient education competencies and preparing graduates to deliver high-quality, patient-centered, and trusted physiotherapy care in response to contemporary healthcare demands.

Keywords: educational technology, medical education, patient education, physiotherapy education, role-play, simulation-based learning.
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INTRODUCTION

Physiotherapy education plays a pivotal role in determining not only graduate clinical competence but also the quality of healthcare services experienced by the community. As frontline healthcare professionals with sustained patient contact, physiotherapists function as both therapeutic providers and primary agents of patient education, directly influencing patient understanding, treatment adherence, satisfaction, and trust in healthcare services. With the increasing emphasis on patient-reported outcomes and experiences as indicators of healthcare quality, the educational preparation of physiotherapy graduates has clear implications for public confidence in physiotherapy services.[1,2]

This urgency is intensified by the growing global burden of chronic musculoskeletal and neurological conditions. Musculoskeletal disorders (MSDs) affect approximately 1.7 billion people worldwide and account for nearly 149 million years lived with disability (YLDs), making them a leading cause of functional limitation and healthcare utilization globally.[1] In Southeast Asia, an estimated 369 million individuals live with MSDs, reflecting substantial regional public health demands.[2] In Indonesia, 26.74% of workers experience musculoskeletal disorder (MSD) complaints according to the Ministry of Health, while BPJS Kesehatan reported that approximately IDR 300 billion per year was allocated in 2019 to cover major occupational diseases, including low back pain and carpal tunnel syndrome, conditions commonly requiring physiotherapy intervention.[3] These data highlight an urgent need for effective prevention, management, and patient education strategies, positioning

physiotherapists as key contributors to sustainable healthcare delivery.

Evidence indicates that patients who receive clear, structured, and empathetic education demonstrate better adherence to exercise programs, improved functional outcomes, and higher satisfaction with care.[4] Conversely, inadequate patient education has been associated with poor adherence, symptom recurrence, and reduced confidence in healthcare providers. Despite its recognized importance, adherence to physiotherapy regimens remains suboptimal, with only 50–60% of patients adhering adequately to prescribed exercises.[5,6] Communication quality and patient understanding consistently emerge as key determinants of adherence, underscoring that technical proficiency alone is insufficient to ensure effective care.

Traditional physiotherapy education has predominantly emphasized technical and procedural skills delivered through lectures, demonstrations, and clinical placements. While essential, these approaches may insufficiently develop communication and patient education competencies required in real-world practice. Studies report that physiotherapy students and early-career practitioners often demonstrate lower confidence in patient education and behavior change communication compared with examination and treatment skills.[7,8] This gap has implications for patient satisfaction and public trust, as patient education is among the strongest predictors of perceived care quality in rehabilitation settings.[9]

Simulation-based education, role-play, and educational technology have emerged as complementary approaches to address these gaps. Simulation integrates technical, cognitive, and affective learning and has been shown to improve learner confidence, communication skills, and readiness for practice, with outcomes comparable to traditional clinical placements in professional behavior domains.[10] Role-play further supports authentic educational dialogue and reflective practice, with structured interventions improving communication competence and student confidence by approximately 20–30%.[11] However, evidence regarding the combined impact of these approaches on patient education competencies and downstream outcomes such as patient trust and satisfaction remains fragmented. Therefore, this narrative review aims to synthesize evidence on the integration of simulation, role-play, and educational technology in physiotherapy education, focusing on their role in developing patient education competencies and implications for graduate performance and community satisfaction.

METHODS

This narrative review was conducted to synthesize current evidence regarding the application of simulation, role-play, and technology-based learning as innovative teaching methods in physiotherapy education, particularly in the context of preparing students to deliver effective patient education. The review aimed to explore not only the implementation of these strategies but also their reported effectiveness, challenges, and educational value within formal physiotherapy training programs.

A comprehensive literature search was performed using four major electronic databases: PubMed, Science Direct, Google Scholar, and ProQuest. The search spanned publications until July 2025. A combination of keywords and Boolean operators was used to identify relevant studies, including: "physiotherapy education" OR "physical therapy training" AND "patient education" AND ("simulation" OR "role-play" OR "technology-based learning" OR "e-learning" OR "virtual patient"). In addition, the reference lists of selected articles were manually reviewed to identify further studies that met the inclusion criteria.

To be included in the review, articles were required to meet the following criteria: (1) focus on physiotherapy education at the undergraduate or postgraduate level, (2) explore interventions designed to teach patient education skills, (3) employ simulation, role-play, or technology-based methods as core instructional strategies, (4) be published in English, and (5) report empirical findings using either qualitative, quantitative, or mixed-methods designs. Articles were excluded if they focused solely on continuing professional development (CPD) without reference to formal academic programs, did not explicitly target patient education as a learning objective, or were opinion pieces, editorials, or conference abstracts lacking full-text availability.

The findings from the included studies were synthesized thematically and organized into three main domains: simulation-based learning, role-play scenarios, and technology-enhanced education. Within each domain, recurring themes, observed benefits, implementation challenges, and impacts on student competence in patient education were identified and critically discussed.

Patient Education in Physiotherapy: Concepts and Challenges

Patient education in physiotherapy is a multifaceted and indispensable component of clinical care, particularly in the management of musculoskeletal disorders and the promotion of long-term self-management. It involves equipping patients with the knowledge, skills, and confidence needed to participate actively in their own recovery and health maintenance. Despite broad consensus regarding its importance, the implementation of effective patient education remains inconsistent. This inconsistency is often attributed to the diversity of definitions, the variability in theoretical frameworks employed, and a range of practical constraints encountered in clinical environments.[12]

Importantly, patient education in physiotherapy is not merely a generic health education activity but reflects the profession's distinctive expertise in human movement and functional performance. Physiotherapists deliver education that is grounded in *movement and function*, aiming to support patients in restoring mobility, optimizing physical capacity, and safely resuming meaningful activities. This includes structured education on therapeutic exercise programs and functional training, ensuring that patients understand the rationale behind interventions and can implement them accurately and safely in daily life.

At the core of contemporary physiotherapy education is a person-centered philosophy, which emphasizes individualized, respectful, and

collaborative interactions between physiotherapists and patients. This approach moves beyond the traditional didactic transfer of information and aligns with adult learning theories, particularly the concepts of self-direction, experiential learning, and critical reflection. Adult learners, including patients, are recognized as autonomous individuals who bring prior experiences and preferences to the learning process. Therefore, physiotherapists are encouraged to tailor educational interventions to patients' unique circumstances and readiness to learn. Boland et al. highlight how applying adult learning principles fosters not only better engagement but also more sustainable behavioral change in clinical practice.[13]

A central concept in contemporary patient education within physiotherapy is the integration of a patient-centric, therapist-driven approach. This model emphasizes designing educational interventions that deeply consider the patient's expectations and encourage their active participation in their care. Effective education involves providing clear explanations of the causes of their condition, offering accessible materials for exercise retention, and fostering a robust patient-therapist relationship, all contributing to improved prognosis and exercise adherence. Patients, particularly those managing chronic conditions like low back pain, frequently express high expectations regarding the educational support they anticipate from their physiotherapists.[14]

From a clinical competence perspective, physiotherapists play a distinctive educational role through several domains. First, they provide exercise prescription education, covering the type of exercise, dosage (frequency, intensity, time, and progression), pacing strategies, and safety considerations such as symptom monitoring and red-flag awareness. Second, they deliver movement- and function-based education, focusing on activity modification and graded exposure to functional tasks to support return to work, sport, or daily roles. Third, physiotherapists increasingly integrate pain neuroscience education, helping patients understand pain mechanisms, reduce fear-avoidance beliefs, and improve self-efficacy, particularly in chronic pain conditions. Finally, physiotherapists commonly deliver education regarding posture, ergonomics, and functional activity strategies, enabling patients to optimize movement efficiency and reduce recurring overload or strain during daily activities.

The concept of high-value physiotherapy (HVP) is increasingly gaining prominence in the field. HVP is defined as care that delivers the most significant value for the patient, where the clinical benefits unequivocally outweigh the costs to the individual or the broader healthcare system. It stands in stark contrast to "low-value" physiotherapy, which yields minimal or no benefit, or where the risk of adverse outcomes surpasses the likelihood of positive impact. Active physiotherapeutic modalities are strongly advocated and supported for the management of chronic pain conditions, including chronic low back pain (CLBP), chronic neck pain (CNP), and osteoarthritis (OA).[15] Crucially, the effective management of persistent pain necessitates a comprehensive biopsychosocial perspective, acknowledging the interplay of biological, psychological, and social factors. However, a persistent challenge identified in the literature is that physiotherapy training may still be predominantly rooted in a biomedical tradition. It can potentially lead to new generations of therapists having limited knowledge of psychosocial influences and, consequently, a preference for a biomedical focus in their follow-up processes. For patient education to genuinely embody high-value principles and be truly patient-centric, physiotherapy education must more strongly integrate the biopsychosocial model, moving beyond a purely biomedical focus. This pedagogical shift is essential for physiotherapists to effectively address the multifaceted expectations of patients, improve adherence to treatment plans, and competently manage complex conditions like chronic pain, where psychological and social factors are as critical as biological ones for optimal outcomes.[16]

Patient education is identified as pivotal for enhancing exercise adherence, which is a key determinant of successful rehabilitation outcomes.[14] Beyond the mere transfer of factual information, effective patient education relies heavily on building a strong therapeutic alliance between the patient and therapist and implementing individualized treatment approaches. It includes fostering shared decision-making processes and ensuring communication and interventions are age-appropriate, particularly vital when working with vulnerable populations such as adolescents experiencing persistent pain.[16] In practice, this also requires physiotherapists to ensure patients can correctly execute exercises, understand progression criteria, and apply ergonomic or activity modifications consistently in real-world contexts.

Although many physiotherapists are familiar with the general principles of adult education, the deliberate application of learning theory into clinical interactions is often lacking. Boland et al. argue that without formal training in pedagogical theory, physiotherapists may rely on intuitive or habitual teaching practices that may not be optimal. This gap suggests a need for structured professional development that includes educational science, particularly the integration of learning theories into patient communication and instructional methods.[13]

Real-world practice environments frequently present obstacles that hinder the delivery of patient education. These include limited consultation time, restrictive reimbursement policies, and a lack of structured education protocols. In private practice, where productivity and service volume are emphasized, the educational component of care may be deprioritized. Moreover, the lack of formal billing codes for patient education in some healthcare systems may disincentivize physiotherapists from investing time in this activity. Wilson et al. underline how these structural barriers contribute to variability in the quality and consistency of patient education delivered across settings.[17]

A significant barrier lies in the varying levels of experience among physiotherapists. Novice clinicians, despite acknowledging the importance

of patient education, frequently report difficulties in its effective delivery and may struggle within disorganized early-career transition programs. Compared to experienced physiotherapists who apply tacit knowledge acquired through practice and focus on key elements like non-verbal communication, novices may exhibit a preference for a biomedical model over the more holistic biopsychosocial approach.[18] This difference in approach can impact the comprehensiveness and patient-centeredness of the education provided. Furthermore, challenges in interprofessional collaboration, such as a limited understanding among physicians regarding the scope of physiotherapy and ineffective teamwork, can hinder the seamless integration of physiotherapy services into primary healthcare. It indirectly impacts the delivery of comprehensive patient education by creating fragmented care pathways.[19] Additionally, a didactic approach to exercise prescription by physiotherapists, rather than one based on shared decision-making, can act as a significant barrier to patient engagement and adherence, as it may not adequately address patient preferences or foster a sense of ownership over their treatment.[15]

Patients' existing perceptions of their condition, their treatment expectations (e.g., a preference for passive, hands-on treatment over active, self-managed exercises), their health literacy levels, and exposure to misinformation significantly influence the effectiveness of clinical management. Fear of movement and concerns about symptom exacerbation also represent substantial psychological barriers to engagement in active rehabilitation. Specific barriers to exercise adherence, a core component of physiotherapy, include a lack of understanding regarding the benefits of exercise, uncertainty about the appropriate type and intensity of exercises, forgetfulness, the perceived burden or complexity of the exercise regimen, previous negative healthcare experiences, and a general lack of motivation. Pain experienced after exercise can also serve as a deterrent, even if it is a regular part of the rehabilitation process.[15]

Simulation-Based Education for Patient Education in Physiotherapy Education

Simulation-based education (SBE) is widely recognized as an instructional strategy that employs realistic analogs to replicate clinical processes or behaviors for teaching and training.[10] It serves to supplement and enhance real-world experiences through structured, interactive scenarios that closely resemble actual clinical environments.[15] Through these simulations, learners are provided with opportunities to actively apply theoretical concepts in practice, thereby fostering the development of clinical competencies within a personalized and methodical learning framework.[10] The pedagogical foundation of SBE is well-supported by experiential learning theories, particularly Kolb's model, which emphasizes the importance of learning through direct experience and reflective processing of those experiences.[20]

A foundational principle of SBE is its capacity to provide a safe, controlled, and low-risk environment. Within this setting, students can practice skills, make critical decisions, and learn from their mistakes without the ethical or safety implications associated with real patients. This setting enables repetitive, focused practice and allows learners to refine their techniques and improve performance over time.[21] An essential component of this process is the feedback delivered by simulated patients (SPs) and instructors, which plays a pivotal role in supporting student growth.[22] Such feedback, often provided immediately and from the perspective of the patient experience, is particularly valuable in nurturing competencies aligned with patient-centered care.[23]

SBE in physiotherapy integrates various modalities, including SPs, role-play (RP), and high-fidelity mannequins, each offering unique benefits for skill development. SPs, as trained individuals portraying clinical conditions, provide authentic feedback that enhances students' clinical reasoning, communication, and professionalism.[22,23] RP, involving peer role assumption, also promotes decision-making and knowledge integration across physiotherapeutic stages.[24] High-fidelity mannequins offer realistic technical practice, particularly for psychomotor skills in critical care settings, though their effectiveness depends heavily on curriculum integration and learning objectives.[25] These modalities are applied across diverse clinical areas such as neurological, musculoskeletal, cardiorespiratory, pediatric, and critical care physiotherapy.[26] Recent study highlighted the importance of developing more specific and contextual clinical scenarios to bridge the gap between theoretical understanding and clinical application.[27] This study recommends the development of simulation scenarios that not only focus on procedural skills, but also include complex case management, such as providing training education that can be given to patients with low back pain,[28,29] management of stroke patients,[30] as well as adjustments to functional activities in patients with musculoskeletal problems, such as knee osteoarthritis.[31] This approach is in line with previous studies, which show that simulations based on a biopsychosocial approach in chronic pain cases are effective in improving students' ability to identify and understand psychosocial factors that influence the patient's condition.[32]

Improvements in clinical reasoning skills, particularly in planning and adapting patient education based on individual patient responses, along with enhanced psychomotor competence and clinical decision-making related to educational strategies, demonstrate the effectiveness of SBE.[10,24] It strengthens professional and behavioral skills, enhances communication within teams and with patients, and promotes interprofessional collaboration.[21,26] Moreover, SBE fosters empathy and patient-centered care by providing students with opportunities to refine their interpersonal abilities in a low-risk environment.[27] These competencies are essential for delivering effective patient education that is both informative and compassionate.

SBE also improves self-efficacy, student satisfaction, and preparedness for clinical practice.[10] Students report greater confidence in clinical skills, assessment, treatment preparation, and communication following SBE participation.[21] By bridging the gap

between theory and practice, SBE enables learners to apply classroom knowledge to practical decision-making, thereby reinforcing learning through experiential and scenario-based approaches.[24] This feedback loop, where confidence leads to deeper engagement, strengthens both technical and behavioral dimensions necessary for impactful patient education.

The consistent focus on psychological and physical safety within SBE highlights its importance in the educational process. This secure atmosphere not only prevents harm but also empowers students to take intellectual risks, engage in critical self-reflection, and embrace mistakes as learning opportunities.[21] This safety net enhances student confidence and enables deeper engagement with complex clinical reasoning and communication strategies. As a result, learners are better prepared to translate their knowledge and skills into actual clinical practice with confidence and empathy.

Moreover, SBE offers the unique advantage of incorporating authentic variability in patient behavior and clinical scenarios. The ability of SPs to adjust their responses according to learner needs and educational goals allows for dynamic and individualized teaching. This flexibility provides learners with exposure to a wide range of emotional, interpersonal, and communicative challenges that may not be routinely encountered in standard clinical placements. Such exposure encourages students to move beyond generic information delivery and instead focus on developing nuanced, empathetic, and tailored communication strategies. Feedback provided from the SP's perspective reinforces the learner's ability to recognize diverse patient experiences and to adapt their educational approach accordingly, which are key attributes for delivering effective and compassionate patient education.[22]

Despite these benefits, current limitations in research design, small sample sizes, and a lack of standardized outcome measures restrict the generalizability of findings. Most studies assess low-level outcomes, such as satisfaction, rather than long-term behavioral change or patient results.[21,25] Furthermore, the high cost of SP programs, lack of faculty training, and insufficient funding remain significant implementation barriers.[22,23] Students also report anxiety during SP-based assessments, which highlights the importance of psychological safety and preparatory experiences for optimal learning.[26]

Importantly, while SBE is an effective supplement, it is not yet supported as a replacement for clinical hours in physiotherapy education. For SBE to move beyond its current supplementary role, there must be a coordinated effort from professional institutions to promote standardized methodologies, secure sustainable funding, and invest in comprehensive faculty development.[28] Without addressing these interdependent challenges, the full potential of SBE to enhance patient education and long-term clinical outcomes will remain unrealized.

Implications Simulation-Based Education for Physiotherapy Curriculum Design

The integration of innovative teaching strategies such as SBE into the physiotherapy curriculum requires structured and theory-informed frameworks to ensure pedagogical coherence and alignment with learning outcomes. The PIER framework, including planning, implementation, evaluation, and revision, provides a comprehensive model for embedding simulation throughout physiotherapy education.[26] It begins with thorough needs assessments and curriculum development that is responsive to institutional and societal demands, establishing tailored learning outcomes. The implementation stage emphasizes structured pre-briefing and debriefing activities led by trained facilitators, while continuous evaluation ensures relevance and adaptability. This approach supports the development of communication, empathy, and behavior change skills, which are essential for effective patient education.[26,29]

Conducting comprehensive needs analyses is vital for aligning simulation content with real-world demands. To ensure maximum educational impact, best practices such as pre-briefing and debriefing must be implemented effectively.[26] Skilled facilitation enhances reflective learning and strengthens students' ability to analyze their actions and improve future performance.[29] The use of validated and standardized outcome measures is also essential for assessing the effectiveness of simulation-based learning. Emphasis should be placed on evaluating behavioral and practical competencies rather than relying solely on knowledge and satisfaction scores. Additionally, interprofessional simulation supports the development of communication and collaboration skills crucial to team-based patient care.[30]

Despite these strengths, significant challenges limit the widespread adoption of innovative teaching methods. These include financial constraints, insufficient faculty training, and a lack of robust evidence demonstrating long-term effectiveness.[22,28] Moreover, current evidence supports SBE as a supplement rather than a replacement for direct clinical education. Therefore, curriculum design should prioritize balanced integration, aligning student needs with institutional resources and ensuring coherence across learning modalities.[28,29]

Role-Play as an Experiential Learning Strategy for Patient Education in Physiotherapy Education

Role-play is an active learning method categorized under experiential learning. Within the context of physiotherapy education, it serves as a valuable approach for training students in patient interactions through simulations of realistic clinical scenarios. This method offers students the opportunity to practice delivering health education, communicating effectively, and cultivating empathy before entering actual clinical practice. Such training is essential, as physiotherapists are responsible not only for providing physical interventions but also for educating patients about their medical conditions, treatment options, self-care techniques, and strategies for preventing long-term complications.[31]

The implementation of role-play involves a series of structured stages designed to enhance practical communication and patient education skills. First, the lecturer or facilitator prepares clinical case scenarios that are relevant to conditions students are likely to encounter. Students are then

divided into small groups and assigned specific roles, such as physiotherapist and patient, while other group members act as observers who provide feedback. During the role-play session, students simulate patient education interactions based on the given scenario. This is followed by a group discussion and reflection session facilitated by the lecturer to evaluate performance, identify errors, and improve communication and education techniques. The process also incorporates peer feedback and self-reflection to reinforce understanding and strengthen students' self-efficacy in delivering effective patient education.[33]

According to Forbes (2017), role-play enables students to confidently practice explaining medical information in plain language, respond appropriately to patients' emotional reactions, and adapt their communication styles to suit individual needs and backgrounds.[32] For instance, in a role-play scenario, physiotherapy students may be tasked with explaining the importance of a post-stroke exercise program to an elderly patient or providing ergonomic education to an office worker experiencing back pain.[24] Additionally, role-play scenarios can include a patient with low back pain requesting passive therapies. Here, the student must educate the patient on evidence-based active management (e.g., staying active and performing exercises).[34] Another scenario might involve a patient who is afraid that exercise will worsen their pain; in this case, the student practices pain neuroscience education and pacing strategies to reassure the patient and encourage gradual activity. A third scenario could involve a patient non-adherent to their home exercise program, prompting the student to employ motivational interviewing and goal-setting techniques to identify barriers and boost adherence.[35] These situations allow students to immerse themselves in clinical realities they are likely to encounter in practice, while simultaneously building the confidence to convey health information in a clear, empathetic, and patient-centered manner.[36-37]

A study conducted by Nestel and Tierney (2007) revealed that 96.5% of 284 student participants reported that role-play enhanced their cognitive and emotional engagement in the learning process, while also helping them develop reflective skills. This suggests that students not only perform actions based on theoretical knowledge, but also critically evaluate their performance and consider how patients might realistically perceive their approach.[37] Similarly, research by Jihan *et al.* (2023) demonstrated a significant improvement in students' performance when engaging in role-play with simulated patients, as indicated by a paired t-test result with a p-value of 0.00. Students also expressed a preference for using simulated patients in role-play, as the feedback they received helped them identify personal areas for improvement and build self-confidence.[38]

According to Smith *et al.* (2017), experiential learning methods such as role-play assist physiotherapy students in developing effective communication skills without the fear of causing harm to actual patients.[33] As such, role-play can be effectively integrated into physiotherapy curricula to promote student engagement and facilitate the practical application of knowledge in patient communication. In a separate study, Javaherian *et al.* (2020) reviewed the use of simulation, including role-play, in physiotherapy education and found that these methods enhanced students' clinical skills, communication abilities, and motivation. Simulation also offers a dynamic and safe learning environment that enables students to practice patient care more effectively. Systematic review findings further support that the use of simulated patients (SP) and role-play helps reduce anxiety and boosts student confidence in clinical settings.[22]

According to a study conducted by Shane *et al.* (2020), participation in role-play simulation programs significantly improved physiotherapy students' performance in terms of accuracy, quality, and realism when portraying patient roles. These findings support the effectiveness of role-play as an experiential learning strategy in physiotherapy education, particularly in enhancing students' communication skills and empathy toward patients.[39] This aligns with research by Philips *et al.* (2017), which demonstrated that the implementation of role-play using simulated patients (SP) was highly feasible, with a participation rate of 100%, retention of 95%, and a survey response rate of 85%. Following the intervention, students showed a significant increase in confidence and preparedness for clinical practice ($p < 0.001$) and reported high satisfaction with SP sessions (average rating of 9.3 out of 10).[40]

Despite its various benefits, the application of role-play also presents certain challenges. Some students may feel embarrassed, awkward, or uncomfortable when asked to act as either the patient or therapist in front of their peers (feelings that may hinder full engagement in the simulation). In this context, the role of the facilitator is crucial in fostering a safe and supportive learning environment. Facilitators should establish clear guidelines to promote mutual respect and confidentiality and clearly communicate the educational objectives, ensuring that students understand role-play not merely as a game, but as a professional and meaningful training exercise. Furthermore, it is essential to provide constructive feedback following role-play activities, allowing students to reflect on their strengths and weaknesses and to develop concrete strategies for improvement.[41-42]

Technology-Based Learning Method for Patient Education in Physiotherapy Education

Technology-enhanced learning is a modern approach increasingly adopted in physiotherapy education, particularly to improve students' competence in patient education. Advances in digital technology in health education have opened up various opportunities to create learning processes that are more interactive, flexible, and tailored to students' needs. The types of technology used can include blended learning designs, flipped classroom models, distance learning, interactive websites or apps, and student-produced videos.[43] More comprehensive technologies, such as virtual reality, serious games, and telehealth simulations, can also be employed. These technologies serve not only as means of delivering content but also as platforms for training communication skills, conveying health information, and developing virtual

empathy.[44] Furthermore, technology also plays a role in training clinical reasoning specifically for patient education not merely in conveying information. For example, the use of virtual patients (virtual patient simulations) places students in interactive clinical scenarios that require them to adapt their educational approach to individual patient characteristics (e.g., age, health literacy level, comorbidities), thereby reinforcing clinical reasoning skills in the context of patient education.[45]

Blended learning design combines online and face-to-face instruction to maximize student understanding. According to Adje et al. (2023), a blended learning course for physiotherapy students successfully reduced kinesiophobia and shifted participants' attitudes toward patient care.[45] Moreover, Marques-Sule et al. (2023) found that blended learning significantly enhanced students' knowledge, ethical competence, and gender equity, as well as boosted their motivation and satisfaction compared to conventional methods.[46] This suggests that the blended learning approach not only effectively hones conceptual understanding but also enriches essential soft skills related to patient education, such as gender sensitivity and clinical communication ethics.[47]

Flipped classroom methodology assigns video lectures or digital materials as independent pre-class work, while classroom time is devoted to discussion and collaborative practice. Røe et al. (2019) found that implementing a flipped classroom in a physiotherapy course improved students' exam performance compared to conventional methods. Most students also reported a more positive learning experience, particularly due to increased autonomy and flexibility in learning, as well as active interaction with instructors and peers. This approach stimulates higher-order cognitive engagement by focusing class activities on clinical problem-solving and case discussions, thereby helping students develop critical thinking skills and deepen their clinical application.[47]

Distance learning has become increasingly common, especially during the COVID-19 pandemic. Etoom et al. (2023) reported that most physiotherapy students rated the overall quality of distance learning as good, yet paradoxically, their satisfaction levels were low. Factors such as instructor support, material relevance, and prior experience contributed to this satisfaction.[48] Soundy et al. (2021) investigated the use of e-learning-based distance education to enhance physiotherapy students' therapeutic communication skills. In that study, 39 students received an e-learning intervention focused on managing difficult patient communications. The results showed a significant improvement in students' perceived ability to handle complex clinical communication situations after the e-learning program compared to before the intervention. This research demonstrates that, even when delivered entirely online, distance learning can still strengthen essential communication competencies in physiotherapy students for patient education.[49]

Interactive websites and mobile applications leverage multimedia and the accessibility of technology in learning. In the study by Marques-Sule et al. (2023), the use of interactive websites and apps was a key component of the blended learning intervention. Students accessed patient education materials and interactive modules online that were designed to boost engagement and comprehension. This study confirms that interactive websites and applications can be as effective as or even superior to traditional methods for enhancing both knowledge and practical skills among students. Such digital media help learners internalize patient education concepts in a flexible, adaptive manner that accommodates individual learning styles.[46]

Another innovative approach involves having students produce their own instructional videos. Video creation compels them to apply and visualize clinical knowledge while receiving feedback from instructors and peers during the review process. In the unique method reported by Ravat et al. (2021), physiotherapy students were assigned to create videos of their patient management during hospital clinical placements. Working in pairs, they filmed their interactions and then presented the videos to the class for discussion and evaluation. Although the study's primary outcome was improved theoretical exam scores, student-generated videos actively fostered communication, patient-education, and instructional skills, while also developing reflective abilities through peer feedback. This approach blends self-directed learning with targeted collective feedback to deepen patient education competencies. Reviewing recorded interactions through video reflection encourages students to engage in self-assessment of their communication skills and educational strategies, thereby supporting reflective learning and continuous improvement in patient education competencies.[50]

Virtual reality (VR) technology provides immersive 3D simulation environments for student training. A systematic review by Lucena-Anton et al. (2022) reported that VR/AR teaching models achieve learning outcomes and student satisfaction comparable to traditional methods. In other words, their effectiveness is equivalent. Nonetheless, the researchers encourage incorporating game elements into VR/AR modules to enhance interaction and active learning. By replicating real clinical scenarios, VR has the potential to facilitate physiotherapy skills practice in a safe and engaging way, particularly when augmented with feedback and gamification features.[51]

Serious games integrate game elements to achieve clinical learning objectives. For example, Molina-Torres et al. (2021) in Spain developed an escape-room–based assessment as a serious game for physiotherapy students in a geriatrics course. Fifty-six students participated in an exam presented as an escape room, which was designed to embed case-based problem-solving. Although the study did not directly measure patient education skills, its results showed that students who took the exam in this format experienced lower test anxiety and found the learning experience more enjoyable than with conventional testing. This finding highlights the potential of serious games to foster an active learning environment that can indirectly enhance students readiness to interact with and educate patients.[52]

Telehealth simulations teach students how to deliver physiotherapy services remotely. A review of telehealth curricula

in Australia showed that implementing online modules and simulation activities positively impacted physiotherapy students' knowledge, skills, and self-efficacy in telehealth competencies. Martin et al. (2022) implemented a telehealth curriculum with 72 physiotherapy students, consisting of 19 hours of online modules and 6 hours of telehealth simulations (including role-plays and simulated patient consultations). The results demonstrated significant improvements across all telehealth competencies, knowledge, technical skills, self-efficacy, and intention to apply telehealth in clinical practice. This evidence confirms that telehealth simulations are highly valuable for preparing physiotherapy students to educate patients online, a capability that is increasingly relevant in the digital and post-pandemic era.[53] Specifically, telehealth simulations provide students with opportunities to practice remote consultation communication and clinical decision-making in the absence of physical contact, thereby refining verbal communication strategies, the use of clear and precise language, and the ability to adapt patient education when physical examination is limited.[54]

Future Directions and Research Limitation

A significant research gap exists in specifically examining the differences in patient education skills, behaviors, and practices based on a physiotherapist's level of experience. Although evidence suggests meaningful distinctions between novice and experienced physiotherapists, the developmental trajectory of patient education competencies across different career stages remains insufficiently understood. While experienced physiotherapists demonstrate a more comprehensive and nuanced approach to patient education, and novices actively seek continuing education to develop these skills, there is limited empirical evidence mapping how these competencies evolve over time. The literature suggests that experienced physiotherapists apply "tacit knowledge" acquired through practice, which allows them to perform complex tasks efficiently and focus on key elements like non-verbal communication.[18] However, how this tacit knowledge is progressively acquired and translated into patient education effectiveness remains underexplored.

While initial evaluations of innovative teaching methods, such as the PACE curriculum and virtual patient simulations, show positive impacts on student learning outcomes and attitudes, there is a critical need for research that assesses their long-term effectiveness and the actual transfer of learned skills to authentic clinical practice.[55–57] Concerns about a potential reduction in hands-on experience in natural settings when using virtual reality and simulations further emphasize this gap. Although short-term educational benefits are frequently reported, evidence regarding sustained behavioral change and clinical performance remains limited. The ultimate goal of health professions education is improved patient care and professional competence in practice. However, there is a potential disconnect between short-term student satisfaction or performance in educational settings and the actual, sustained impact on clinical behaviors and patient outcomes over time. Therefore, longitudinal and practice-based studies are essential to determine if these methods lead to sustained improvements in patient education delivery and, ultimately, patient outcomes in real-world settings.[58]

The identified challenges in adopting digital technologies, such as inadequate infrastructure, a lack of organizational support, and technological illiteracy among lecturers, highlight a significant need for research on effective implementation strategies at a systemic and cultural level. The barriers to technology adoption are not solely technical but also deeply rooted in organizational factors and human factors.[59] Furthermore, the need to cultivate readiness for change, requiring comprehensive technical, educator, and pastoral support during the transition to new pedagogical models, reinforces this multifaceted challenge.[59] This underscores that the provision of new technologies alone is insufficient to ensure meaningful educational transformation. The complex interplay between social structures, human behaviors, and technological systems creates a socio-technical gap that must be explicitly addressed for successful, sustainable innovation. Future research should therefore examine organizational readiness, leadership engagement, and change management strategies as key determinants of successful technology-enhanced education.

There is a clear recommendation for more qualitative studies to gain a deeper understanding of the facilitators and barriers to intervention implementation and the prediction of outcomes, particularly in complex clinical areas like persistent pain management.[16] This extends to understanding the nuanced dynamics of how patient education is delivered and received, and how innovative teaching methods are integrated into diverse educational contexts. Qualitative inquiry is particularly valuable for capturing contextual complexity and stakeholder perspectives that are not readily accessible through quantitative approaches. Qualitative methods, such as semi-structured interviews and thematic analysis, have already demonstrated their value in uncovering rich themes and perspectives from patients and physiotherapists, such as barriers to adherence and communication dynamics.[14] This highlights that quantitative data, while valuable for measuring outcomes, often falls short in explaining the underlying human experiences, perceptions, and contextual factors that drive or impede patient education and educational innovation. Accordingly, future research should prioritize qualitative and mixed-methods designs to explore the lived experiences of patients and physiotherapists, the challenges and successes of implementing innovative teaching methods, and the cultural and contextual factors influencing their adoption and effectiveness.

CONCLUSION

Patient education is a vital component of physiotherapy practice, requiring not only scientific knowledge and technical skills but also effective and empathetic communication strategies. To meet these demands, innovative learning methods such as simulation, role-play, and technology-based learning play a crucial role in comprehensively

developing the educational competencies of physiotherapy students. These three approaches complement one another: simulation provides realistic clinical experiences, role-play fosters empathy and confidence, and technology supports flexibility and a deeper understanding of educational content. By systematically integrating these methods into the curriculum, physiotherapy education programs can more effectively prepare graduates to deliver patient education that is not only technically accurate but also patient-centered, empathetic, and evidence-based.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

ETHICAL APPROVAL

Ethical approval was not required for this study.

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AUTHOR CONTRIBUTIONS

I.B.A.P.M. performed the conceptualization, methodology, supervision, project administration, and funding acquisition; M.V.W.Y. performed the conceptualization, investigation, resources, data curation, and formal analysis; A.A.B.P.I. performed the investigation, data curation, and writing—original draft; K.L.A.D. performed the investigation, data curation, and writing—original draft; P.A.W. performed the data curation and writing—original draft; N.A.T.M.K.A. performed the data curation and writing—original draft; N.L.A.S. performed the writing of the original draft and reference management; I.G.P.S. performed the methodology, validation, formal analysis, writing—review and editing, and final approval.

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