

VIRTUAL REALITY IN HUMAN KINETICS AND HEALTH EDUCATION: A TRANSFORMATIVE APPROACH TO TEACHING AND LEARNING

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Abstract

Virtual reality technologies are rapidly reshaping educational landscapes across health-related disciplines. Through a critical examination of literature, this paper considers VR's potential to enhance both exercise knowledge and health literacy within Human Kinetics and Health Education by means of experiential, embodied, and learner-centered pedagogies. It synthesises evidence about VR's instructional effectiveness, mechanisms of learning (embodiment, multimodal feedback, situated cognition), and its implementation challenges (cost, accessibility, instructor preparation, and evaluation) from systematic reviews, randomised controlled trials, scoping and narrative reviews, and discipline-specific VR applications. Major themes include: VR as an active learning environment for exercise physiology and motor skill acquisition; VR's capacity to heighten motivation and behavioural intent through the application of sports psychology principles; and VR's emergent role as a health literacy intervention by staging immersive scenarios that mimic real-world decision-making about disease prevention and self-care. It presents a conceptual framework that integrates the perspectives of Human Kinetics and Health Education, together with policy and curriculum recommendations and an agenda for future research-including rigorous trials, mixed-methods evaluation, and strategies to ensure equitable access. The paper also provided practical guidance to educators, programme designers, and administrators on suggested metrics for assessment, content design principles, and staged implementation pathways. In sum, VR is a promising pedagogical tool-one that can deepen exercise knowledge, improve health literacy outcomes, and catalyze much-needed interdisciplinary collaboration between Human Kinetics and Health Education if thoughtfully integrated.

Keywords: Virtual reality, Exercise physiology education, Health literacy, Immersive learning, Pedagogical design

Introduction

Learning and health literacy are essential with the advancement of artificial intelligence. New pedagogical possibilities of health-related teaching have been generated through the advancement of immersive technologies. Virtual Reality (VR) offers controlled, repeatable and highly multimodal simulations to learners that approximate the physical world without placing learners at risk in the real world. In the fields of Human Kinetics and Health

Education, such affordances directly correspond to disciplinary interests, i.e., learning how the physiological processes work, how to be safe and efficient in movement and learn to be psychologically ready to perform, and to develop the knowledge, skills and motivation to maintain the health promoting behaviour over time.

Virtual reality provides a peculiar gap between theory and embodied practise, which allows learning by doing in digitally mediated spaces that may simulate both physiological and psychosocial aspects of human performance (Makransky and Petersen, 2023; Zhang et al., 2023). An example is that immersive exercise physiology simulations have the capability of visualising real-time cardiovascular responses or muscle activation patterns to allow the student to see invisible processes and give adaptive feedback. Likewise, in sport psychology, virtual training conditions enable implementation of regulated exposure to factors that stress performance abilities, which aid in cognitive-behavioural development of abilities like focus, anxiety regulation and resilience (Stretton et al., 2025; Alkasasbeh et al., 2026).

In the past 10 years, convergence in the evidence supporting VR use in education in health professions and movement sciences has been indicated by systematic reviews and meta-analyses, which demonstrate improvements in cognitive and psychomotor outcomes. Kyaw et al. (2019) established that immersive VR was very instrumental in enhancing the retention of knowledge and the accuracy of the procedures among learners compared to traditional modes of teaching. These advantages are also supported by more recent reviews, in which the presence, interactivity, and feedback are important in maintaining engagement and deep learning (Sung et al., 2024). In the literature of Human Kinetics, Schaerz et al. (2023) have indicated that exercise and sport specific training modules conducted in VR have quantifiable effects on motor coordination, tactical decision-making, and adherence to exercise and they are not just about visualisation, VR is also an experience-based medium of acquiring skills and behaviours.



Figure 1: Example of a Virtual Reality learning environment demonstrating immersive simulation for exercise and health education.

Source: Hernandez, 2019

New studies also indicate that VR can be a key element in health literacy education. VR has been identified as a means to visualise complex health information and create an experiential story through scoping reviews, which are suggested to produce empathy, self-efficacy, and preventive awareness (Skidmore et al., 2024). VR can be implemented to encourage cognitive awareness and affective participation with the help of immersing learners in patient-based or lifestyle-based situations, i.e., cardiovascular risk management or dietary decisions (Nikrouz et al., 2020).

The quality of studies can vary in design, sample size, and fidelity, and synthesising on the meta-level is not an easy task (Lie et al., 2023). Besides, the use of VR in schools is still challenged by the ongoing obstacles in terms of financial availability, technical capabilities, and curriculum orientation (Nugraha et al., 2025). The problem is not only to prove the efficacy but to create sustainable, context-oriented models that will combine VR into pedagogies and institutions in different learning settings (Rao et al., 2025).

The current papersummarises the emerging information on the application of VR as a disruptive learning strategy in the framework of Human Kinetics and Health Education and offers a theoretical and practical model of achieving increased knowledge of exercise, psychomotor skills, and health literacy in undergraduate education. It uses interdisciplinary approaches of exercise physiology, sports psychology, educational technology, and public health education to analyse how VR can be utilised as an accelerant of experiential and embodied learning in health sciences programmes in the 21st century.

Definitions and Conceptual Foundations

i. Virtual Reality and Extended Reality

Virtual Reality (VR) is the representation of immersive computer-generated environments in the form of a head-mounted display (HMD) or room-scale systems that substitute the sense of presence by replacing the input of the senses (Murray, 2020). VR falls in a wider Extended Reality (XR) family which encompasses Augmented Reality (AR) and Mixed Reality (MR) (Stanney et al., 2021). Embodied learning tasks in educational applications VR is frequently used with interactive controllers, haptic feedback and telemetry to form embodied learning tasks (Xu et al., 2022).

ii. Health Literacy among Higher Education Learners

Health literacy is frequently understood as the power to search, interpret, assess, and apply health-related information to make informed choices (Nutbeam& Lloyd, 2021), broadly described; other recent health literacy models). Health literacy in higher education encompasses both discipline-specific (e.g., interpreting exercise instructions, physiological signs) and general (e.g., how to access services, how to prevent diseases and illnesses) competencies.

iii. *Human Kinetics: Knowledge and Learning Exercise*

Human Kinetics is the science of human movement that includes subfields like exercise physiology, biomechanics, motor control, sports psychology and sports administration (Hoffman, 2009). Human Kinetics Educational outcomes in Human Kinetics are theoretical (e.g., cardiovascular responses to exercise), procedural (e.g., prescription of exercises) and psychomotor (e.g., safe lifting technique) knowledge (Porcari et al., 2015).

Theoretical Models between VR and Human Kinetics and Health Education

i. *Situated Cognition and Experiential Learning*

The experiential learning cycle that was introduced by Kolb (2009) (concrete experience → reflective observation → abstract conceptualization → active experimentation) fits VR quite well. Students are able to encounter simulated exercise conditions (concrete experience), think with inbuilt instructions, derive conceptual information and reuse in recurrent virtual experiments. Situated cognition is contextual focused on learning; VR generates high context cues that aid transfer.

ii. *Embodied Cognition and Motor Learning*

Embodied cognition is a theory suggesting that cognitive activities are influenced by the body and sensorimotor experiences. VR may also offer multisensory feedback and repeat practice of movement patterns, which are safely repeated and accelerate sensorimotor adaptation and retention of skills in motor learning. Research in sport-specific VR training demonstrates that there is a transfer of perceptual and decision-making skills to the real world (Witte et al., 2025).

iii. *Behaviour Change and Self-Efficacy Models*

Motivation, self-efficacy and outcome expectancies have an effect on health behaviours. VR interventions are able to manipulate motivational affordances, such as gamification, goal-setting, immediate feedbacks, and create mastery experiences, which enhance self-efficacy and, therefore, behavioural intentions and potentially the actual physical activity in the real world (Yadav et al., 2022).

Evidence Base: What the Research has Revealed

This part summarised both recent and current systematic reviews and some of the empirical studies found on VR in health education and Human Kinetics.

i. *Virtual Reality in Healthcare and Health Professions Education.*

SR and meta-analyses indicate that VR has the potential to enhance knowledge and skills better than conventional approaches in a range of fields of health (Kyaw et al., 2019; Sung et al., 2024). These reviews constantly identify moderate positive impacts on post-intervention knowledge and procedural skills, but the strength differs depending on the discipline and quality of the study. Outcomes are mediated by factors of implementation (e.g. fidelity of simulation, interactivity).

ii. Virtual Reality and Exercise/Physical Activity Interventions

Virtual Reality and XR-based exercise programmes have been studied within the Human Kinetics as motivating physical exercise, improving motor skills acquisition and providing sport-focused perceptual training. Schaerz et al. (2023) reported XRE (extended reality exercise) able to enhance enjoyment and adherence in young people; other researchers have compared the physiological load between VR exercise and conventional cardio physiological exercise with mixed results depending on modality and intensity. These works demonstrate that VR has the ability to generate significant physical activity and may be utilised to promote fitness and practise a skill.

iii. Virtual Reality in Accommodating Diverse Health Care Requirements

New scoping reviews also point to VR as a prospective tool that can be used to enhance health literacy through simulating illness experiences, empathy, and self-management activities (Skidmore et al., 2024). Although there is not much research on direct trials to evaluate standard health literacy scales, formative studies or qualitative reports show that there is increased understanding and determination to adopt preventive behaviours, following the immersive experiences (Skidmore et al., 2024).

iv. Student Perceptions, Usabilities and Implementation Studies

The user-centred studies lay a lot of emphasis on usability, perceived realism, and satisfaction as prime mediators of learning outcomes. Fontenot et al. (2024) demonstrated fairly positive usability ratings of healthcare students in VR simulation modules, whereas implementation reviews (Lie et al., 2023) indicate the authors found barriers, such as cost, faculty preparedness, and curriculum integration, that need to be overcome to achieve long-term adoption.

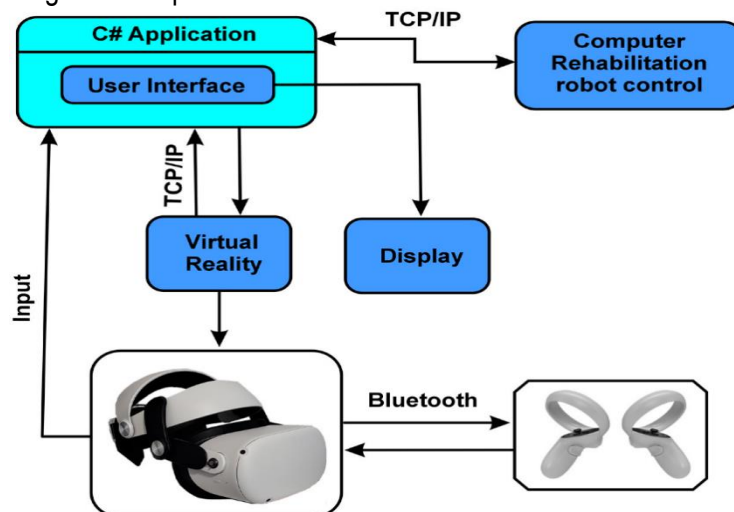


Figure 2: Illustration of a VR-based interactive learning setup for Human Kinetics training, showing feedback loops between user, system, and environment.

Source: Covaciu et al., 2024

Virtual Reality Design Principles in Human Kinetics and Health Education

Implementing the idea of the virtual reality in Human Kinetics and Health Education involves an effective design of the instruction based on the theory of pedagogy and the needs of the discipline. VR experiences are not possible to be confined to the realistic movement and physiological reactions only, but they should lead to the conceptual knowledge, skill acquisition, and behavioural change, which are applicable to exercise performance and health promotion.

One of the principles is content validity and physiological accuracy. VR modules would be created with cooperation of exercise physiologists, sport scientists, and health educators in order to guarantee proper dimension of biomechanics, physiological reactions, and behaviour health situations. This involves simulating heart rate reactions, perceived exertion signals, and appropriate movement patterns in tested physiological models and simulations based on data (Makransky & Petersen, 2021). In case the exercise tasks or clinical situations are mis-modelled, the misconceptions might be strengthened; therefore, expert co-creation, the repetitive testing, and consistency with the scientific standards are paramount.

It is also vital that there is learning outcome-oriented instructional scaffolding. VR scenarios need to directly be aligned with cognitive, psychomotor and behavioural competencies- such as concepts of exercise physiology concepts, through motor skill execution, and health literacy competencies. The principles of effective VR pedagogy encompass preparation of the pre-briefing that prepares learning, instructions and cues provided during the simulation, and post-processing of the experience through debriefing to convert reflection and transfer learning into actual performance (Sohrwardi, 2025; Grantcharov & Andersen, 2023). In the absence of scaffolding, immersion can bring about superficial practise but not conceptual change.

There are also meaningful feedback and assessment processes. VR enables multimodal feedback, i.e. visual overlay, auditory, and when present, haptic feedback, in order to increase motor learning and skill development. Embedded formative assessment and analytics-driven feedback can be supported by the data of learner's performance (e.g., motion tracking, decision pathways, task accuracy, etc.). The combination of the telemetry and performance dashboards facilitates the authentic competency assessment and longitudinal levels of skills (Sung et al., 2024; Schaerz et al., 2023). These methods point to evidence that feedback-based immersive environments improve movement control, self-efficacy and persistence.

And lastly, there should be equitable and culturally responsive design. Being available and culturally relevant will make sure that VR reinforces, rather than exacerbates, the participation and learning differences. Low-end VR solutions (mobile-based VR and 360deg video) can be expanded to access in resource-limited university settings, especially in African settings where the high-end headsets are still prohibitively expensive (Omoriegie and Adeyemi, 2023). The modules must have local language, health realities, exercise norms, and cultural values of physical activity and health practises. The accessibility features needed, such as customizable interfaces, subtitles, locomotion

options, and universal avatars, should address various needs and requirements of learners so that it can be universal and inclusive.

Collectively, they render VR as a technology that can be utilised to reflect physiological realities in a manner that is authentic, scaffold meaningful interaction, provide feedback-intensive learning, and support equity. With such considerations in place VR can develop competency-based learning, increase student engagement and instill health promoting behaviours in the Human Kinetics and Health Education programmes.

Table 1: Sample Virtual Reality (VR) Modules in Human Kinetics

Module Title	Learning Focus	VR Activities	Expected Learning Outcomes	Assessment Methods
Human Anatomy and Functional Movement	Musculoskeletal anatomy, biomechanics, movement analysis	Interactive 3D exploration of body systems; virtual dissection; movement simulation	Improved anatomical knowledge; enhanced spatial understanding of movement structures	VR quizzes; anatomy identification tests; reflective reports
Exercise Technique and Motor Skill Acquisition	Exercise performance, motor learning, movement correction	Real-time motion tracking; guided exercise coaching; instant feedback on posture and technique	Improved psychomotor competence; reduced movement errors; enhanced exercise proficiency	Performance rubrics; VR skill demonstrations; instructor evaluation
Sports Coaching and Tactical Decision-Making	Coaching strategies, game analysis, tactical awareness	Virtual game simulations; decision-making scenarios; athlete-coach role-play exercises	Improved tactical thinking; enhanced coaching communication skills; better decision-making under pressure	Scenario-based assessments; coaching simulation scores; tactical analysis reports
Injury Prevention and Rehabilitation	Injury mechanisms, rehabilitation protocols, corrective exercise	Simulated injury cases; virtual rehabilitation exercises; movement screening activities	Enhanced understanding of injury prevention; improved rehabilitation planning skills	Case-study analysis; rehabilitation program design; VR practical assessment

Fitness Assessment and Exercise Prescription	Fitness testing, program planning, exercise prescription	Virtual client assessment; simulated fitness testing; personalised exercise design	Increased competence in fitness evaluation and prescription development	Exercise prescription project; client assessment reports; practical examinations
Adapted Physical Activity and Inclusive Sports	Physical activity for special populations and disability inclusion	Simulations involving individuals with disabilities; inclusive sport environments	Greater awareness of adaptive physical activity; improved inclusive coaching skills	Reflective journals; inclusion-focused project work; practical simulations

Source: Researchers Designed

Table 2: Sample Virtual Reality (VR) Modules in Health Education

Module Title	Learning Focus	VR Activities	Expected Learning Outcomes	Assessment Methods
Health Promotion and Lifestyle Education	Nutrition, physical activity, disease prevention	Community health simulations; virtual counselling sessions; lifestyle coaching scenarios	Improved health literacy; enhanced health-promotion competencies	Health-promotion campaign design; VR scenario evaluation; reflective reports
Community Health Education	Community engagement, public health communication	Virtual community visits; stakeholder interaction simulations; health-needs assessment exercises	Improved community assessment skills; enhanced communication competence	Community health project; simulation performance assessment
Behaviour Change Communication	Health behaviour theories, motivational strategies	Virtual counselling sessions; motivational interviewing practice; behaviour-change scenarios	Improved communication skills; increased confidence in facilitating behaviour change	Counselling simulation ratings; communication skills checklist

Disease Prevention and Health Literacy	Communicable and non-communicable disease prevention	Outbreak-response simulations; risk communication exercises; disease prevention campaigns	Enhanced disease-prevention knowledge; improved health-literacy competencies	Knowledge tests; health-literacy assessments; scenario-based evaluations
School Health Education	Health education in school settings	Virtual classroom teaching; student-health scenarios; school-health program planning	Improved instructional skills; enhanced school-health program management abilities	Lesson-plan evaluation; teaching demonstrations; peer assessment
Environmental and Occupational Health Education	Environmental hazards, workplace health and safety	Virtual workplace inspections; environmental risk simulations; hazard identification exercises	Increased competence in risk assessment and safety education	Hazard assessment reports; workplace safety simulation evaluations

Source: Researchers Designed

Ethical Considerations and Data Privacy in Virtual Reality Learning Environments

The immersive and data-intensive nature of Virtual Reality (VR) creates unique ethical responsibilities that extend beyond those encountered in conventional educational settings. Because VR environments simulate realistic experiences and continuously collect user interaction data, ethical safeguards are essential to protect learners while maximizing educational benefits (Radianti et al., 2020; Kavanagh et al., 2022).

i. Informed Consent and Disclosure of Risks

In VR-based learning, learners are exposed to highly immersive environments that can elicit strong cognitive, emotional, and physiological responses. Although immersion enhances engagement, motivation, and experiential learning, it may also result in cybersickness, motion sickness, dizziness, visual fatigue, or temporary disorientation (Mousavi et al., 2024). Therefore, learners should receive clear information regarding the objectives, procedures, potential risks, and expected benefits of VR activities before participation. Informed consent promotes learner autonomy and ensures that participation remains voluntary. Educational institutions should also provide opportunities for learners to withdraw from VR sessions without academic penalties and establish protocols for monitoring and managing adverse reactions during learning activities (Parong & Mayer, 2021).

ii. *Privacy and Data Security*

One of the distinguishing features of VR is its ability to capture detailed behavioural, physiological, and performance-related information. Data generated during VR learning may include movement patterns, gaze tracking, reaction times, heart rate measurements, decision logs, and other biometric indicators. Such information can reveal sensitive personal characteristics and learning behaviours, making data protection a critical ethical obligation (Slater et al., 2022). To safeguard learners' rights, institutions should ensure data anonymization, secure storage systems, restricted access, and compliance with national and institutional data protection regulations. Transparent data governance policies are essential to maintaining trust and encouraging learner participation in VR-enhanced educational programs (European Commission, 2024).

iii. *Equity and Inclusion*

The educational benefits of VR should be accessible to all learners regardless of socioeconomic status, age, disability, or technological access. High costs of head-mounted displays, limited internet connectivity, and physical accessibility barriers can create inequities in participation and learning outcomes (Makransky & Petersen, 2021). Consequently, educators should adopt inclusive implementation strategies, including alternative learning pathways, accessible interfaces, adjustable settings, and low-cost VR options where appropriate. The principles of Universal Design for Learning (UDL) advocate providing multiple means of engagement, representation, and expression to accommodate diverse learner needs (Rose & Meyer, 2002). Applying UDL principles in VR design enhances educational equity and supports broader participation in immersive learning environments.

iv. *Cultural Sensitivity and Ethical Representation*

VR simulations frequently involve health scenarios, lifestyle behaviours, disease prevention situations, and community interactions. These experiences can significantly influence learners' perceptions, attitudes, and behaviours. Consequently, content developers and educators must ensure that VR experiences are culturally appropriate, evidence-based, and free from stereotypes or stigmatizing representations (Southgate et al., 2023). In Health Education particularly, simulations addressing obesity, substance use, sexual health, disability, or chronic diseases should promote empathy, respect, and inclusiveness rather than reinforce social biases. Ethical content design strengthens learner engagement while supporting culturally responsive teaching and meaningful learning outcomes.

5. *Accessibility and Learner Well-being*

Effective VR learning requires continuous attention to learner comfort and safety. Although immersion can enhance knowledge retention, psychomotor skill acquisition, and behavioural change, prolonged exposure may contribute to physical discomfort, cognitive overload, or fatigue (Makransky & Petersen, 2021). Educators should therefore establish exposure limits, schedule regular breaks, provide alternative instructional formats, and

monitor learners for signs of discomfort. Accessibility features such as adjustable visual settings, customizable interfaces, seated participation options, and assistive technologies can further improve learner experiences and support sustained engagement in VR environments (Southgate et al., 2023).

Implications for VR-Based Learning

Ethical considerations are not merely administrative requirements but fundamental determinants of effective VR learning. Learners who feel safe, respected, and supported are more likely to engage deeply with immersive experiences, resulting in improved cognitive processing, psychomotor development, and behavioural outcomes. Conversely, inadequate attention to privacy, accessibility, inclusivity, or learner well-being may undermine educational effectiveness and reduce acceptance of VR technologies. Therefore, ethical design and implementation should be regarded as integral components of VR pedagogy, ensuring that immersive learning environments remain safe, equitable, and educationally meaningful (Radianti et al., 2020; Kavanagh et al., 2022).

Table 3. Selected recent studies on VR in health education and Human Kinetics (2019–2025)

Study (Year)	Design	Population / Sample	Intervention / Focus	Key Findings
Kyaw et al. (2019)	Systematic review	Health professions education studies	VR simulations across clinical skills	VR improved postintervention knowledge and skills versus traditional methods.
Sung et al. (2024)	Systematic review & meta-analysis	RCTs in healthcare education	VR-based healthcare education	Moderate positive effects on knowledge/skills; heterogeneity by discipline.
Fontenot et al. (2024)	Mixed methods	Undergraduate healthcare students	VR simulation usability	Positive usability and student perceptions; recommendations for integration.
Lie et al. (2023)	Scoping review	Health professions	Implementation studies on VR	Identified barriers/facilitators; faculty readiness crucial.
Schaerz et al. (2023)	Review	XRE in youth exercise	Extended reality exercise	XR can increase enjoyment and adherence in youth.
Skidmore et	Scoping	Health literacy	VR for health	Promising but

al. (2024)	review	VR studies	knowledge & self-management	limited direct health literacy measures; calls for rigorous evaluation.
Witte et al. (2025)	Review	Sports domains	VR perceptual training	VR training can transfer perceptual skills to real-world sports tasks.

Notes: Table summarises evidence across sectors. Systematic reviews provide the strongest load-bearing evidence for VR's educational benefits; discipline-specific trials vary in rigour.

Fontenot, J., Hebert, M., Lin, H. C., & Kulshreshth, A. K. (2024). Examining the perceptions among undergraduate nursing students using virtual reality in a community course: a mixed-methods explanatory study. *Journal of community health nursing*, 41(3), 145-155.

Conceptual Models



Figure 3: A three-layer conceptual model illustrating how virtual reality (VR) technologies influence cognitive, psychomotor, and affective learning pathways, leading to improvements in exercise knowledge, skill acquisition, and health literacy.

Source: Adapted from Efendi et al., 2023

Layer 1: VR Affordances

The affordances of VR encompassed at the foundation include immersion, multimodal feedback, repeatability, and safe failure settings. Immersion provokes a feeling of presence that makes the focus and realism more advanced (Makransky& Petersen, 2023). Multimodal feedback is visual, auditory, and haptic and activates more than one channel of sensory stimulation leading to deeper processing (Zhan & Cheng, 2025).). Repeatability enables practise which is essential in psychomotor learning in the Human Kinetics (Zhang et al., 2023). Safe failure also allows the learner to experiment but not physically, which is beneficial in high-risk situations such as exercise testing or injury prevention training.

Layer 2: Mechanisms of Action

Such affordances occur and trigger embodied learning, situated cognition, and motivational engagement processes.

- i. Embodied learning suggests that the cognition has a strong connection to sensorimotor experiences (Sullivan, 2018).
- ii. Situated cognition makes the learning process more context-ubiquitous, thereby boosting the move toward real-world application (Eshun et al., 2025).
- iii. Gamified or interactive VR scenarios are a source of motivation that will help to establish persistence and engagement (Christopoulos &Mystakidis, 2023)
- iv. Domination in VR- repetitions of achievements in safe environments- enhance the self-efficacy of learners, which is the major construct of the Social Cognitive Theory and the key to adherence to exercises and health-promoting behaviour (Bandura, 2013).

Layer 3: Outcomes

The combination of these mechanisms leads to the results pertaining to Human Kinetics and Health Education:

- i. Knowledge (exercise physiology knowledge).
- ii. Psychomotor skills (many, accuracy of movement, coordination).
- iii. Health literacy (knowledge of health risks, interpretation of physiological feedback).
- iv. Behavioural change (higher adherence to exercise, better preventive behaviours).

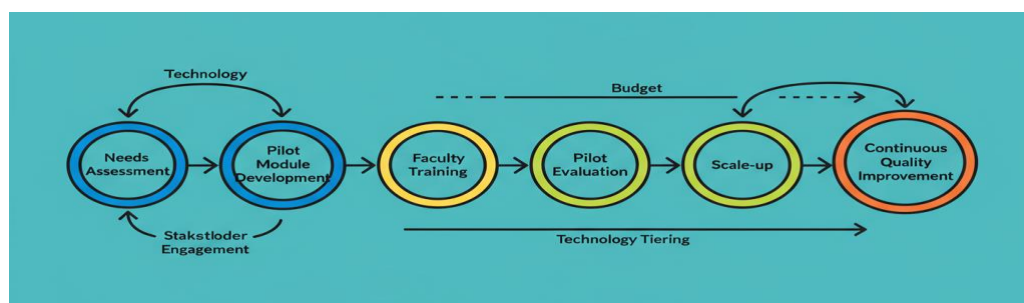


Figure 2: Implementation Roadmap for Integrating VR into Human Kinetics and Health Education

Source: Adapted from Nettlefold et al. (2023)

Description

The implementation road map of introducing VR modules into the Human Kinetics and Health Education curriculums is shown in Figure 2 (a five-phase implementation plan). The roadmap is a cycle and focuses on the continuous improvement, cost planning and stakeholder engagement.

Phase 1 - Needs Assessment

Assessment of the needs and readiness starts by the institutions that determine the gaps in the curriculum and the technological capacity (Lie et al., 2023). Faculty readiness and the demand of learners can be determined through surveys and focus groups (Alisoy et al., 2025).

Phase 2 - Development of Pilot Module.

Design interdisciplinary pilot modules with the aim of achieving the main learning outcomes, e.g., exercises physiology simulator, learning motor skills, or health literacy (Birt et al., 2018). Evidence-based design principles (content validity, scaffolding, feedback loops, cultural relevance) should be put into practice.

Phase 3 - Faculty Training

Hold faculty workshops to develop competence in VR pedagogy, technical troubleshooting and ethical use. Research indicates that successful VR integration is strongly predicted by educator confidence and digital literacy (Nugraha et al., 2025).

Phase 4 - Pilot Evaluation

Compare pilot results based on a mixed-method approach, i.e., quantitative (knowledge tests, skill rubrics) and qualitative (student reflections, usability surveys) results. The feedback loops provide a chance to improve the content and delivery.

Phase 5 - Scale-Up and Quality Improvement.

Scale successful modules, which must be in line with the institutional strategy, accreditation standards, and sustainability of resources. Enhance constant surveillance systems in order to deliver accessibility, data confidentiality, and equity to learners (Skidmore et al., 2024).

Overlays:

It consists of a roadmap with the budget planning, tiers of technology (low, medium, high fidelity), and stakeholder engagement loops, i.e., connecting the administrators, IT professionals, and academic personnel into a sustainable VR ecosystem.

Discussion: Strengths, Weaknesses and Critical Gaps.

1. Strengths and Opportunities

Pedagogical Alignment

VR is in line with the experiential philosophy of learning that supports Human Kinetics and Health Education. In immersive environments, the learners take part in active experimentation and thoughtful observation-the two primary principles of the *Experiential Learning Cycle proposed by Kolb* (Kolb & Kolb, 2018). As per the empirical studies, the VR can be used to get better cognitive and motor learning results (Makransky& Petersen, 2023).

Motivational and Psychological Advantages

The research about sports psychology emphasises the potential of VR in enhancing motivation and enjoyment, as well as self-efficacy, essential to sustain health-related behaviour over a long period of time (Stretton et al., 2025). VR activities, such as gamified ones, have been found to enhance the low engagement in anxiety reduction and exercise maintenance (Zhan & Cheng, 2025).

Safety and Repeatability

VR enables the students to train complex or risky tasks in a safe environment, say, an emergency response drill or a biomechanical experiment, without the risk of getting injured. It is also capable of facilitating inclusive participation, allowing learners that are physically or psychologically disabled to participate in otherwise inaccessible learning processes (Hine et al., 2024).

Evidence of Effectiveness

Recent meta-analyses reveal that immersive VR results in moderate-to-large effects on the knowledge level and procedural precision in health education settings (Hongthong et al., 2025; Zhang et al., 2023). Moreover, positive results of published indicate beneficial outcomes on the exercise understanding and psychomotor coordination, which means that they can be applied across domains (Bös& Mechling, 2026; Iorga et al., 2023; Tomporowski & Pendleton, 2018).

2. Limitations and Challenges

Heterogeneity of Evidence

The systematic reviews point out that the quality of VR studies, sample size, and fidelity are extremely diverse, which prevents generalisation (Lanier et al., 2019).

Implementation Barriers

Among the challenges are a high cost of equipment, insufficient institutional backing, and faculty training (Lie et al., 2023; Nugraha et al., 2025). Strategic planning, budgeting, and interdisciplinary effort are needs in the integration.

Equity and Access Issues

VR systems that are of high fidelity can exclude learners in low resource conditions. As a way to fill this gap, the scalable solutions of 360° video and mobile VR are suggested (Skidmore et al., 2024). The inclusiveness can also be facilitated by shared-resource models and cloud-based simulation repositories.

Ethics and Data privacy issues

The telemetry data obtained during VR interactions is ethically dangerous unless it is received in anonymised and safe form. The institutions are obligated to follow data protection policies as well as make informed consent procedures, which should tackle the motion sickness and psychological impacts (Hine et al., 2024).

3. Research Gaps and Future Directions

Health Literacy Measurement

Very little of the research applies validated health literacy scales to determine the effect of VR interventions, which leaves a gap in the research methodology (Skidmore et al., 2024). In future studies, measurements of multidimensional outcomes should be included using such tools as *Health Literacy Questionnaire (HLQ)* or *eHEALS*.

Longitudinal Behaviour Change

Although the beneficial effects of most interventions on short-term knowledge and motivation are well-documented, there is little support on how the behaviour change will be maintained in the long run (Matthews et al., 2024). There is a need to have longitudinal RCT and mixed-method evaluation.

Context-Specific Evaluation

The literature on the topic is limited in a variety of cultural and low-resource institutions of higher learning, particularly in Africa and Asia, where the infrastructural and pedagogical setting differs considerably (Birt et al., 2018). Interventions adapted locally should be given priority in order to attain external validity and cultural sensitivity.

Intelligent AI and Adaptive Learning

The VR systems of the future may also include adaptive learning that incorporates AI that reacts to physiological and performance data of learners; and adjust difficulty or feedback (Zhan & Cheng, 2025). These innovations would have the ability to personalise learning and maximise the results in teaching exercise physiology.

Conclusion

Virtual reality is an innovative pedagogical prospect of Human Kinetics and Health Education. The ability of the technology to generate embodied, contextualised, and safe learning environments closely works with the overall objectives of the exercise physiology education and health literacy development. Implementation studies, systematic reviews show positive impacts on knowledge and skills, whereas discipline-specific research

shows potential in motivation and engagement in physical activity. However, there could be better evidence and research by large, methodologically sound trials, standardised outcome measures (especially of health literacy), and equity and sustainable adoption implementation research. Through careful design, faculty and infrastructure investments and more focused evaluation, VR can be used to enhance knowledge of exercises and health literacy of learners- ultimately leading to healthier populations and more competent graduates. It was therefore recommended that;

- i. Stakeholders should adopt strategic, evidence-based approaches to implementation, evaluation, and sustainability.
- ii. Educators and curriculum designers should introduce VR through small-scale pilot projects aligned with specific learning outcomes, supported by structured prebriefing, debriefing, assessment, and reflective activities. A tiered technology approach is recommended, utilizing cost-effective mobile or 360° VR solutions for broad access while reserving advanced head-mounted display (HMD) systems for complex skill-based training.
- iii. Institutional leaders should prioritise faculty training, technical support, and capacity building alongside investments in VR hardware. Establishing shared VR facilities and resource management systems can improve accessibility and cost-effectiveness. Institutions should also monitor both educational outcomes and operational performance indicators, such as system reliability and user satisfaction.
- iv. Researchers are encouraged to conduct robust, adequately powered studies that compare VR with other active learning approaches. The adoption of standardised measures for health literacy and psychomotor competence will strengthen evidence synthesis across studies. Further research should investigate the pedagogical, technological, and learner-related factors that influence VR effectiveness.
- v. Policymakers and funding agencies should promote interdisciplinary collaborations among health educators, human kinetics specialists, educational technologists, and software developers. Increased funding for implementation research, particularly in resource-constrained institutions, is essential. Supporting open educational resources and shared VR content repositories can further enhance accessibility, reduce costs, and promote equitable adoption of VR-enhanced learning.

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