

PEDAGOGY IN MOTION: INTERSECTIONS OF EDUCATIONAL SCIENCE AND EXERCISE  
EPISTEMOLOGY IN SOCIETY 5.0

EDUCARE IL CORPO, FORMARE LA MENTE: DIALOGO TRA PEDAGOGIA E MOVIMENTO  
NELL'ERA 5.0

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**ABSTRACT**

This review examines physical education's epistemological foundations in Society 5.0, addressing methodological and philosophical challenges in movement-based learning. It advocates for an integrated framework reconciling quantitative/qualitative approaches, emphasizing physical literacy and inclusive pedagogy. The analysis explores digital transformation's impact and proposes a transdisciplinary research agenda.

Questo studio esamina i fondamenti epistemologici dell'educazione fisica nella Società 5.0, analizzando sfide metodologiche e filosofiche nell'apprendimento basato sul movimento. Propone un approccio integrato che supera dicotomie quantitative/qualitative, valorizzando la physical literacy e strategie inclusive. Si discute l'impatto della trasformazione digitale e si propone un'agenda di ricerca transdisciplinare.

**KEYWORDS**

Physical education; pedagogical methodology; movement sciences; embodied learning; Society 5.0; physical literacy. Educazione fisica; metodologia pedagogica; scienze del movimento; embodied learning; Società 5.0; alfabetizzazione motoria.

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## **Introduction: the educational fact in movement sciences**

The conceptualization of pedagogy as a science concerned with the "educational fact" presents unique challenges when applied to the domain of physical education and movement sciences. As education transitions into what has been termed Society 5.0—characterized by the integration of physical and cyber spaces to create human-centered sustainable development (Fukuyama, 2018)—the epistemological foundations of physical education pedagogy require critical reexamination. This narrative review investigates the theoretical, methodological, and ethical dimensions of pedagogical science within movement education, exploring the continuous tension between empirical measurement and axiological considerations that define this field.

The educational fact in physical education represents a complex phenomenon that transcends traditional disciplinary boundaries. As Whitehead (2010) articulates in her seminal work on physical literacy, movement education encompasses not merely the acquisition of motor skills but the development of embodied knowledge, motivational attributes, and confidence to value and participate in physical activities across the lifespan. This comprehensive conceptualization demands a pedagogical approach that acknowledges both the objective, measurable aspects of physical development and the subjective, experiential dimensions of embodied learning (Quennerstedt, 2019).

Recent research further underscores physical literacy's role in reframing physical inactivity among children and youth, positioning it as a holistic framework that integrates physical, cognitive, and affective domains (Durden-Myers, 2024; Grauduszus et al., 2024). These studies highlight its potential to address pressing developmental needs in an increasingly sedentary society, aligning with Society 5.0's human-centered vision.

The purpose of this review is to synthesize contemporary research on the epistemological foundations of physical education pedagogy, with particular emphasis on the methodological pluralism necessary to address the multidimensional nature of the educational fact in movement sciences. Through critical analysis of current literature, this review aims to articulate an integrated framework that reconciles the apparent dichotomies of quantitative and qualitative approaches, synchronic and diachronic dimensions, and theoretical and practical methodologies that characterize pedagogical research in this domain.

## **1. Methods and design**

This narrative review employs a qualitative synthesis of contemporary literature to explore the intersections of pedagogical science and exercise epistemology within the context of Society 5.0. Drawing on an interdisciplinary approach, the study integrates perspectives from educational philosophy, exercise physiology, sociology of sport, and cognitive neuroscience. The methodology involves a critical analysis of peer-reviewed articles, books, and theoretical frameworks, selected purposively to address the multidimensional nature of physical education pedagogy. By reconciling quantitative and qualitative insights, synchronic and diachronic perspectives, and descriptive and prescriptive approaches, the review constructs an integrated epistemological framework that reflects both empirical rigor and axiological sensitivity. This design enables a comprehensive examination of the educational fact in movement sciences, emphasizing methodological pluralism and transdisciplinary collaboration.

## **2. Epistemological foundations of physical education pedagogy**

### **2.1 Historical evolution of pedagogical approaches in physical education**

The epistemological foundations of physical education pedagogy have evolved significantly over the past century, reflecting broader shifts in educational philosophy and scientific understanding. As Kirk (2010) documents in his historical analysis of physical education, the field has progressed through distinct paradigmatic phases, from the military-inspired gymnastics systems of the early 20th century to the scientific movement education of the mid-century period, and eventually to the current health-oriented and inclusive approaches. Each paradigmatic shift has been accompanied by corresponding changes in epistemological assumptions regarding the nature of knowledge, learning, and the purpose of physical education.

This historical trajectory reflects what Tinning (2008) identifies as the "epistemological turn" in physical education research—a movement away from positivistic approaches focused exclusively on measurable outcomes toward interpretive and critical methodologies that acknowledge the socially constructed nature of movement experiences. This turn continues to resonate in contemporary analyses of movement sciences' scientific identity, where tensions between biomedical and pedagogical domains challenge epistemological coherence (D'Isanto et al., 2024). Such debates underscore the need for frameworks that embrace interpretive complexity over reductive positivism.

This evolution mirrors broader developments in educational research, where the limitations of purely empirical-experimental approaches have become increasingly apparent when addressing complex educational phenomena (Biesta, 2015).

## **2.2 Contemporary epistemological frameworks**

Contemporary physical education research operates within multiple epistemological frameworks, each offering distinct perspectives on the educational fact. As Ennis (2017) articulates, these frameworks can be broadly categorized into three interdependent dimensions.

1. Empirical-analytical frameworks that prioritize objective measurement, causal relationships, and generalizable findings. This approach is exemplified by research on motor learning, exercise physiology, and biomechanical efficiency (Schmidt & Lee, 2019).
2. Interpretive-hermeneutic frameworks that emphasize meaning-making, lived experiences, and contextual understanding. This perspective is evident in phenomenological studies of embodiment, qualitative investigations of student experiences, and sociocultural analyses of physical activity (Standal & Engelsrud, 2011). Recent phenomenological analyses extend this perspective, illustrating how bodily movements in digital contexts, such as video gaming, project a situated yet abstract virtuality that shapes embodied learning (Wang, 2025; Ravn, 2022). These findings reinforce the relevance of lived experience in diverse movement contexts.
3. Critical-emancipatory frameworks that focus on power dynamics, social justice, and transformative possibilities. This approach informs research on inclusive physical education, gender equity in sport, and decolonizing movement practices (Fitzpatrick, 2013).

The integration of these epistemological perspectives represents what Armour and Chambers (2014) describe as the "new agenda" for physical education research—an approach that acknowledges the multidimensional nature of movement education and the inadequacy of any single methodological tradition when addressing the complexity of the educational fact.

### **3. Methodological pluralism in physical education research**

#### **3.1 Quantitative approaches and their limitations**

Quantitative methodologies have historically dominated physical education research, reflecting origins in exercise physiology and motor learning (Bailey et al., 2009). These approaches generate valuable insights regarding physiological adaptations, biomechanical efficiency, and skill acquisition (Metzler, 2017).

However, exclusively quantitative approaches encounter significant limitations when addressing the complex nature of educational movement contexts (Enright & O'Sullivan, 2011). Recent reviews of assessment tools demonstrate how traditional quantitative tests fail to capture perceptual-cognitive dimensions critical in game scenarios (Zhang et al., 2025).

Key limitations include: Reduction of complex movement experiences to measurable variables, obscuring subjective dimensions (Standal, 2015); decontextualization from sociocultural environments (Azzarito & Kirk, 2013); and privileging normative standards that may reinforce exclusionary practices (Fitzgerald, 2011). These highlight the "complexity gap" between reductionist methodologies and the inherent complexity of movement education as embodied experience (Ovens et al., 2013).

#### **3.2 Qualitative methodologies and phenomenological approaches**

Physical education research has increasingly embraced qualitative methodologies that privilege subjective experiences and contextual understanding (Smith & Sparkes, 2016). These approaches provide critical insights into the lived reality of educational phenomena.

Phenomenological approaches have emerged as productive for investigating experiential dimensions of movement education. Standal and Engelsrud's (2011) study of adapted physical activity explores how individuals experience their moving bodies and construct meaning through movement—acknowledging Merleau-Ponty's (1962/2011) identification of the body's role in knowledge construction.

Narrative inquiry has provided insights into physical identity construction through educational experiences. Dowling's (2012) study illustrates the interplay between personal experiences and pedagogical practices. Similarly, composite narratives from individuals with disabilities reveal physical literacy as an avenue for personal growth, emphasizing autonomy in embodied learning (Pushkarenko et al., 2023).

### **3.3 Mixed-methods designs and integrative approaches**

Recognition of complementary strengths across methodological traditions has led to mixed-methods designs in physical education research (Casey et al., 2020). These approaches reconcile the apparent dichotomy between quantitative and qualitative methodologies.

Mixed-methods research represents a distinct paradigm acknowledging the multifaceted nature of movement education (Armour & Chen, 2012). Quennerstedt et al.'s (2014) study combined quantitative measures with qualitative analyses to understand how health is constructed in educational settings. Action research in Brazil exemplifies this integration of cultural, bodily, and environmental dimensions in physical education (Oliveira de Souza et al., 2025).

This methodological pluralism reflects the "epistemological sophistication" necessary for addressing complexity in movement contexts (Tinning, 2008)—embracing "methodological assemblages" capable of engaging with the multiplicity of educational phenomena (Law, 2004).

## **4. The axiological dimension: values, ethics, and educational facts**

### **4.1 Physical literacy as an axiological framework**

Physical literacy has emerged as a powerful axiological framework within physical education pedagogy, articulating both movement education's intrinsic value and its broader educational significance (Whitehead, 2010). The International Physical Literacy Association defines it as encompassing motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for lifelong physical activity engagement (Liu & Chen, 2020). This definition explicitly acknowledges physical education's normative, value-laden nature, positioning it beyond mere motor skill acquisition toward developing capabilities essential for human flourishing.

Physical literacy's axiological dimension challenges instrumental approaches that position movement solely as a means to extrinsic ends like health promotion (Tinning, 2010). Instead, it establishes movement education as inherently valuable—aligning with Biesta's (2010) "normative core" of educational practice. Empirical studies confirm that interventions addressing all PL domains enhance physical competence and enjoyment, reinforcing its axiological significance (Grauduszus et al., 2024; Grecic et al., 2024).

This orientation necessitates methodological approaches engaging with questions of value, meaning, and purpose beyond empirical measurement. Standal and Aggerholm's (2016) philosophical analysis demonstrates these considerations require "phronetic knowledge"—practical wisdom integrating empirical understanding with ethical judgment in specific contexts.

#### **4.2 Ethical considerations in physical education research**

Recognition of physical education as axiologically laden raises critical ethical considerations beyond procedural concerns to fundamental questions about values embodied in research methodologies themselves (Fitzgerald, 2011).

Particularly significant are the ethical implications of approaches positioning learners as objects rather than subjects with agency. Evans et al. (2008) demonstrate how methodologies objectifying bodies through normative measurement risk reinforcing surveillance, classification, and exclusion practices that contradict education's inclusive aims. Multiple case studies illustrate how inclusive PL practices, informed by stakeholder voices, counter normative biases and foster ethical research environments (Pushkarenko et al., 2024).

These concerns echo Biesta's (2010) "violence of measurement"—the potential for empirical approaches to reduce educational experiences to quantifiable indicators neglecting subjective, ethical dimensions.

In response, researchers have increasingly embraced participatory methodologies positioning learners as co-researchers. Enright and O'Sullivan's (2011) participatory action research exemplifies how collaborative inquiry can generate knowledge respecting participants' agency, expertise, and lived experiences while maintaining methodological rigor.

#### **4.3 Reconciling methodological rigor and axiological respect**

The tension between methodological rigor and axiological respect represents a central challenge for physical education research, particularly with vulnerable populations or sensitive aspects of embodied experience. Addressing this tension requires reconceptualizing what constitutes "rigor" in educational fact research (Casey et al., 2020).

This reconceptualization aligns with Tracy's (2010) "big tent" criteria for qualitative research quality—extending beyond traditional validity and reliability to

encompass ethical considerations like sincerity, credibility, resonance, and meaningful coherence. Applied to physical education research, these criteria suggest methodological rigor must be evaluated by alignment with the axiological dimensions being investigated.

This reconciliation reflects Biesta's (2015) "beautiful risk" of education—recognizing that pedagogical practice involves uncertainty, unpredictability, and ethical judgment that cannot be reduced to technical procedures. Physical education research must maintain epistemological humility, acknowledging the limitations of any single methodological approach when addressing the complex, value-laden nature of the educational fact.

## **5. Physical education in society 5.0: emerging challenges and opportunities**

### **5.1 Technological integration and digital pedagogies**

Society 5.0, characterized by the integration of physical and digital spaces in human-centered systems, presents significant implications for physical education pedagogy (Fukuyama, 2018). Digital technologies—including wearable devices, virtual reality, and data analytics—are increasingly incorporated into movement education, enabling novel assessment methods and personalized learning experiences (Casey et al., 2017). Emerging applications such as AI tutors and virtual fitness platforms like the Retroverse enhance enjoyment and spatial learning through embodied interaction (Ackermann et al., 2025; Liu et al., 2024).

These technological developments necessitate corresponding methodological evolutions. Lupton's (2015) analysis of digital health technologies highlights how movement quantification introduces new dimensions requiring critical investigation—including data ownership, algorithmic bias, embodied surveillance, and the potential reductionism of translating complex movement experiences into numerical representations.

Digital technologies simultaneously offer innovative methodological possibilities for investigating educational phenomena in movement contexts. Østerlie et al. (2025) demonstrate how video analysis enables micro-level examination of movement mechanics and social interactions that traditional observations cannot capture. Similarly, Goodyear et al. (2018) illustrate how social media platforms function both as research sites and pedagogical spaces where physical identities are constructed and negotiated.

This integration necessitates what Williamson (2020) terms "methodological innovation"—approaches capable of investigating learning across physical-virtual environments, how technologies mediate embodied experiences, and how digital data shapes pedagogical practices.

## **5.2 Inclusive pedagogies and diverse movement capabilities**

Society 5.0's emphasis on human-centered sustainable development aligns with increasing recognition of inclusive approaches accommodating diverse movement capabilities, cultural backgrounds, and learning preferences (Fitzgerald & Stride, 2012). This orientation requires methodologies capable of engaging with the heterogeneity of educational phenomena across different populations.

Barton's (2013) research demonstrates this challenge involves fundamental reconsideration of how movement capabilities are conceptualized and investigated. Traditional approaches presupposing normative developmental trajectories risk marginalizing learners whose movement experiences deviate from established norms (Fitzgerald, 2011).

Researchers have developed methodologies specifically designed to investigate inclusive practices. Haegele and Sutherland (2015) illustrate how disability-focused approaches, including narrative inquiry and phenomenological analysis, illuminate the experiences of learners with disabilities. Recent studies further emphasize tailoring physical literacy to diverse contexts, ensuring inclusivity across cultural and ability spectrums (Durden-Myers, 2024). Flintoff and Scraton (2013) demonstrate how intersectional methodologies reveal how gender, race, class, and ability interact to shape movement experiences.

These developments reflect Siedentop's (2002) "inclusive imperative" in physical education research—the ethical necessity of investigating educational phenomena across diverse populations rather than generalizing from normative samples. This aligns with Biesta's (2010) "subjectification function" of education—cultivating uniqueness and agency rather than standardization.

## **5.3 Sustainable approaches to movement education**

The sustainability emphasis within Society 5.0 extends beyond environmental concerns to what Lawson (2018) identifies as "sustainable physical education"—

pedagogical approaches promoting lifelong engagement, equitable access to movement resources, and positive relationships with embodied practice.

Longitudinal methodologies have emerged as particularly valuable for investigating sustainability across the lifespan. Green's (2012) decade-long study of physical activity trajectories reveals patterns of engagement and disengagement that shorter-term studies cannot capture. This aligns with reflections on physical education's horizontal knowledge structure, where slow progress necessitates practical tools like game-based assessments to sustain engagement (Barker et al., 2025; Zhang et al., 2025).

Equally significant are methodological approaches investigating environmental dimensions of sustainable physical education. These include Yemini et al.'s (2023) "place-based methodologies" examining how educational practices interact with specific geographical, ecological, and sociocultural contexts—reflecting Harvey et al.'s (2017) "contextual turn" in physical education research.

The integration of these perspectives reflects Tinning's (2012) "ethical imperative" for research in the 21st century—approaches acknowledging the interconnected nature of individual well-being, social equity, and environmental sustainability in movement education. This orientation aligns with Biesta's (2015) "teleological dimension" of educational research—recognizing that methodological choices implicitly reflect normative commitments regarding education's purpose and value.

## **6. Toward an integrated epistemological framework**

### **6.1 Reconciling theoretical dichotomies**

The preceding analysis reveals multiple apparent dichotomies that characterize physical education research: quantitative/qualitative methodologies, synchronic/diachronic perspectives, empirical/interpretive approaches, and descriptive/prescriptive orientations. As Armour and Chambers (2014) argue, these dichotomies often function as artificial boundaries that fragment understanding of the educational fact rather than as productive distinctions that illuminate its complexity.

An integrated epistemological framework for physical education pedagogy would reconceptualize these apparent oppositions as complementary dimensions of a unified approach to investigating the educational fact. This integration reflects what Quennerstedt (2019) describes as the "both/and logic" necessary for

addressing complex educational phenomena—an approach that acknowledges both the objective, measurable aspects of physical development and the subjective, experiential dimensions of embodied learning. Frameworks like the Epistemic Judgement Framework exemplify this, offering reflexive tools to navigate epistemological tensions in teacher development (Grecic et al., 2024).

This integrative perspective aligns with what Ennis (2017) identifies as the "boundary-crossing competence" required for physical education research in contemporary contexts—the capacity to move fluidly between different methodological traditions, theoretical perspectives, and disciplinary frameworks in response to the multidimensional nature of the educational fact. This competence reflects what Klein (2010) terms "interdisciplinary thinking"—the cognitive capacity to integrate diverse knowledge systems in addressing complex problems that exceed disciplinary boundaries.

## **6.2 Transdisciplinary research agendas**

The reconceptualization of physical education pedagogy as a transdisciplinary field represents a significant epistemological shift from earlier approaches that positioned it primarily within kinesiology or physical education departments. As Lawson (2018) argues, addressing the complex challenges facing movement education in Society 5.0 requires research agendas that transcend traditional disciplinary boundaries to integrate perspectives from education, sociology, psychology, physiology, philosophy, and other fields relevant to understanding the educational fact.

This transdisciplinary orientation is exemplified by emerging research centers that explicitly position movement education at the intersection of multiple knowledge domains. The Physical Literacy Research Group at Liverpool John Moores University, for instance, brings together researchers from sport science, education, psychology, and public health to investigate physical literacy from complementary perspectives (Liverpool John Moores University, n.d.). Similarly, the Physical Culture Research in Education (PCRE) at the University of Edinburgh integrates sociological, historical, and pedagogical approaches to examine the evolving nature of movement education in contemporary contexts (University of Edinburgh, n.d.).

These transdisciplinary initiatives reflect what Enright and O'Sullivan (2011) identify as the "collaborative imperative" in physical education research—the recognition that addressing the multifaceted nature of the educational fact requires collective expertise that exceeds the capabilities of any single researcher or disciplinary

perspective. This collaborative orientation aligns with what Gibbons et al. (2012) term "Mode 2 knowledge production"—research that occurs within contexts of application, involves heterogeneous practitioners, and is oriented toward addressing complex social problems rather than discipline-specific questions.

### **6.3 Methodological innovation and hybrid approaches**

The development of an integrated epistemological framework requires not merely the combination of existing methodologies but the creation of new, hybrid approaches specifically designed to investigate the multidimensional nature of the educational fact in movement contexts. As Markula and Silk (2011) argue, these methodological innovations must be capable of simultaneously engaging with the material, discursive, and experiential dimensions of physical education in ways that traditional approaches cannot.

Promising developments in this direction include what Pink (2015) terms "sensory ethnography"—an approach that combines traditional ethnographic methods with specific attention to embodied, sensory experiences in physical education contexts. Similarly, what Lupton (2017) identifies as "digital methods" offer possibilities for investigating how movement experiences are increasingly mediated through technological interfaces, data visualizations, and virtual environments.

Perhaps most significant is the emergence of what Kermarrec et al. (2021) describe as "participatory mixed-methods designs" that integrate quantitative and qualitative approaches within collaborative research frameworks that position learners as co-investigators rather than research subjects. These hybrid methodologies reflect what Biesta (2010) identifies as the "pragmatic paradigm" in educational research—an approach that selects and combines methods based on their appropriateness for specific dimensions of the educational fact rather than allegiance to particular philosophical traditions.

These methodological innovations align with what Lawson (2018) describes as the "complexity turn" in physical education research—recognition that investigating the educational fact in contemporary contexts requires approaches capable of engaging with the interconnected, dynamic, and multi-level nature of movement education. This complexity orientation reflects what Byrne and Callaghan (2022) identify as the "methodological implications of complexity theory"—the need for research approaches that acknowledge emergence, non-linearity, and contextual specificity rather than seeking universal laws or generalizable principles.

## Conclusion

This narrative review has examined the epistemological foundations of physical education pedagogy, emphasizing the necessity of methodological pluralism to address the multidimensional nature of education in movement sciences. The analysis underscores that no single methodological approach—whether theoretical, historical-comparative, or empirical-experimental—can fully capture the complexity of education in the context of Society 5.0. Instead, an integrated epistemological framework is essential—one that navigates the interplay between descriptive and normative dimensions, empirical investigation and axiological reflection, and scientific rigor and humanistic inquiry.

The inherent tension between "being" and "ought to be" in physical education pedagogy is not a problem to be resolved but a productive dynamic that defines the field. As Standal (2015) highlights, this dialectic reflects the dual nature of education as both a social science and a normative enterprise. Biesta's (2015) concept of the "wisdom of the practitioner" becomes particularly relevant in this regard, as educators and researchers must navigate diverse forms of knowledge, methodological approaches, and ethical considerations within specific educational contexts.

This perspective has broader implications for pedagogical science, reinforcing the necessity of recognizing education's dual empirical and axiological dimensions. Greene's (2000) notion of the "dialectical imagination" provides a valuable lens, advocating for an approach that integrates multiple perspectives to understand complex educational phenomena. In this regard, recent advancements—including AI-enhanced learning environments and inclusive physical literacy interventions—offer both theoretical and practical tools to deepen our understanding of the educational fact (Ackermann et al., 2025; Durden-Myers, 2024). AI-driven analytics, for instance, provide novel insights into student learning patterns, while inclusive interventions highlight the ethical and social imperatives of equitable education.

Despite its comprehensive synthesis, this review is not without limitations. The reliance on qualitative synthesis and purposive literature selection introduces potential subjectivity, which may have led to the omission of divergent perspectives or underrepresented empirical studies. Furthermore, while the interdisciplinary approach strengthens theoretical integration, it limits the depth of analysis within specific empirical domains, such as quantitative evaluations of intervention efficacy. Future research should complement this work by employing mixed-

methods approaches, longitudinal studies, and systematic reviews that provide a more nuanced empirical validation of the proposed epistemological framework.

As physical education pedagogy evolves within the emerging paradigm of Society 5.0, maintaining epistemological sophistication will be critical for addressing the complexities of movement education. By embracing methodological pluralism, fostering transdisciplinary collaboration, and maintaining axiological sensitivity, researchers can develop approaches that uphold both the scientific rigor of pedagogical inquiry and the fundamental dignity of the learners at its core.

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