



Unravelling the Impact of Universal Design for Learning on the Inclusion of Students with Disabilities in Physical Education: A Systematic Review

Carla Lourenço^{1,2,3 ABCDE}, Omar Ben Rakaa^{4ABCDE}, Mustapha Bassiri^{4ABCDE} and Said Lotfi^{4ABCDE}

¹Polytechnic Institute of Viseu

²University of Beira Interior

³Centre for Studies in Education and Innovation

⁴Hassan II University of Casablanca

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Omar Ben Rakaa, e-mail: comarbenrakaa@gmail.com

Accepted for Publication: May 16, 2025

Published: May 30, 2025

DOI: 10.17309/tmfv.2025.3.27

Abstract

Background. Universal Design for Learning (UDL) offers a transformative framework for fostering equity in inclusive physical education (PE), addressing the diverse needs of students with disabilities through flexible engagement, representation, and action/expression. Despite its theoretical alignment with proactive inclusion, implementation disparities persist globally, influenced by teacher preparedness, resource limitations, and cultural contexts.

Objectives. The main objective of this study was to evaluate how UDL-aligned strategies can overcome these contextual barriers.

Materials and methods. This systematic review evaluated the efficacy of UDL-aligned pedagogical strategies in enhancing participation, motor skills, social inclusion, and engagement in PE for K–12 students with disabilities. A comprehensive search across Scopus ($n = 1,183$) and Web of Science ($n = 823$) identified 2,006 studies, refined to 13 high-quality articles via rigorous screening, bias assessment (Cochrane RoB 2.0, Newcastle-Ottawa Scale), and dual independent extraction.

Results. Mixed-methods synthesis revealed that UDL interventions significantly improved motor skill progression ($\eta^2 = 0.67$) and participation rates (up to 50 %) in OECD contexts, driven by adaptive equipment and multimodal instruction. Social inclusion increased through collaborative tasks (30 % peer interaction gains), though hidden exclusion persisted in non-OECD settings due to stigma and infrastructural gaps. Key barriers included inconsistent teacher training (40 % of OECD educators reported inadequate preparation) and resource scarcity, particularly in underfunded schools. Technology integration (AI, virtual reality) has demonstrated potential in personalizing learning and bridging accessibility gaps. The findings underscore the necessity of systemic reforms: mandatory UDL training in teacher education, policy-driven resource allocation, and cross-sector collaborations to scale inclusive practices.

Conclusions. This review supports the implementation of longitudinal studies and standardized metrics to address methodological limitations, emphasizing UDL's role in achieving equitable, sustainable PE environments globally. By aligning pedagogical innovation with institutional support, UDL can transcend contextual barriers, ensuring all students thrive in dynamic, inclusive settings.

Keywords: motor skill, development, teacher training, social inclusion.

Introduction

Universal Design for Learning (UDL) provides a pedagogical framework that integrates flexibility into instruc-

tional design to accommodate diverse learner needs, aligning seamlessly with the goals of inclusive physical education (PE). Grounded in three core principles—multiple means of engagement, representation, and action/expression—UDL aims to remove barriers and foster equitable participation across students with motor, sensory, intellectual, psychological, and chronic disabilities (Block et al., 2021; Capp, 2020;

Lourenço et al., 2025). In PE, this translates to environments where diverse physical, cognitive, and emotional capacities are anticipated rather than retrofitted, shifting the focus from adaptation to proactive inclusion (Basham et al., 2020; Griful-Freixenet et al., 2020). Research underscores that UDL's emphasis on variability complements PE's dynamic nature, enabling tailored motor experiences that enhance engagement over traditional one-size-fits-all approaches (Alquraini & Rao, 2020; Valero-Valenzuela et al., 2020). Theoretical alignment with inclusive PE hinges on fostering autonomy and agency, critical for students with disabilities to navigate physical tasks (Block et al., 2021; de Ocariz & Lavega-Burgués, 2020). Empirical studies from OECD contexts, such as Australia, highlight UDL's role in personalizing learning, while non-OECD settings like Saudi Arabia reveal gaps in its application due to cultural and resource constraints (Alquraini & Rao, 2020; Capp, 2020). Methodologically, the reliance on teacher self-reports limits objectivity, suggesting a need for observational data to validate UDL's theoretical fit (Jakubovic & Memisevic, 2024; Ortiz-Jiménez et al., 2020). Bridging these gaps requires integrating UDL principles with PE-specific strategies, such as gamification, to optimize motor and social outcomes (Lavega-Burgués et al., 2024; Melki & Bouzid, 2023; Valero-Valenzuela et al., 2020). Evidence-based solutions involve embedding UDL training within teacher education to ensure its practical translation into inclusive PE settings (Efthymiou, 2024; Loyd et al., 2024; Rasmitadila et al., 2024).

Evidence on UDL's efficacy in PE reveals significant improvements in participation metrics and motor skill progression compared to traditional methods, though findings vary by context and disability type. Studies indicate that UDL-aligned strategies, such as varied task representations and flexible goals, increase active participation rates by up to 50% among students with disabilities, particularly in OECD countries with robust infrastructure (Block et al., 2021; Capp, 2020). Motor skill development surpasses traditional outcomes when UDL incorporates sensorimotor options, outperforming rigid curricula by enhancing coordination and strength in students with motor impairments (Block et al., 2021; Lavega-Burgués et al., 2024). Non-OECD settings report less pronounced gains, often due to limited access to adaptive equipment (Alquraini & Rao, 2020; Rasmitadila et al., 2024). Engagement patterns reflect higher self-determination when UDL fosters choice, contrasting with traditional PE's lower motivational impact (Basham et al., 2020; Valero-Valenzuela et al., 2020). Quantitative analyses from confirm these trends, yet small sample sizes and short intervention durations undermine generalizability (Jakubovic & Memisevic, 2024; Loyd et al., 2024). Mixed-methods designs reveal that students with intellectual disabilities benefit most from UDL's multimodal instruction, while those with chronic conditions show variable progress due to fatigue-related barriers (de Ocariz & Lavega-Burgués, 2020; Ortiz-Jiménez et al., 2020). Addressing these limitations requires longitudinal studies and standardized metrics to track skill acquisition across diverse disabilities (Efthymiou, 2024; Griful-Freixenet et al., 2020). Solutions include leveraging technology, such as interactive modules, to sustain engagement and skill gains, particularly in under-resourced contexts (Errabo & Ongoco, 2024; Song et al., 2025).

Social inclusion in UDL-aligned PE hinges on mechanisms like peer interactions and a sense of belonging, yet hidden exclusion factors persist. Research demonstrates that

UDL's emphasis on collaborative tasks enhances peer acceptance, with studies reporting a 30% increase in positive interactions among students with sensory and psychological disabilities (Block et al., 2021; Valero-Valenzuela et al., 2020). Belongingness strengthens when UDL integrates agency support, reducing isolation compared to traditional PE's competitive focus (Basham et al., 2020; Lavega-Burgués et al., 2024). OECD contexts, such as the UAE, show structured peer support amplifying these effects, while non-OECD settings struggle with cultural stigmas that hinder social cohesion (Alquraini & Rao, 2020; Loyd et al., 2024). Empirical data highlight that students with intellectual disabilities experience greater social gains than those with motor impairments, suggesting disability-specific dynamics (Block et al., 2021; Jakubovic & Memisevic, 2024). However, methodological reliance on surveys overlooks real-time social behaviors, necessitating video-based analyses (de Ocariz & Lavega-Burgués, 2020; Ortiz-Jiménez et al., 2020). Hidden exclusion emerges from unmodified group activities, where students with chronic or sensory disabilities are sidelined, revealing UDL's incomplete penetration (Griful-Freixenet et al., 2020; Rasmitadila et al., 2024). Evidence-based strategies include teacher-led peer training and gamified interactions to bridge these gaps (Efthymiou, 2024; Song et al., 2025). Enhancing social inclusion demands intentional design of cooperative structures within UDL frameworks to ensure equitable participation (Capp, 2020; Errabo & Ongoco, 2024).

Systemic barriers, notably teacher training gaps and resource limitations, impede UDL's implementation in inclusive PE, with disparities evident across global contexts. Teachers in OECD countries report higher confidence in UDL application, yet only 40% feel adequately trained, while non-OECD educators cite insufficient professional development as a primary obstacle (Alquraini & Rao, 2020; Capp, 2020). Resource scarcity—adaptive equipment, planning time, and personnel—further restricts UDL's reach, particularly in rural or underfunded schools (Loyd et al., 2024; Ortiz-Jiménez et al., 2020). The studies identify a lack of policy clarity as a universal challenge, with fragmented guidelines undermining scalability (Basham et al., 2020; Haegele et al., 2024). Methodologically, cross-sectional designs fail to capture long-term training impacts, calling for cohort studies (Griful-Freixenet et al., 2020; Jakubovic & Memisevic, 2024). Teachers' ethical compass and growth mindset correlate with UDL adoption, yet these traits remain underdeveloped without targeted interventions (Efthymiou, 2024; Valero-Valenzuela et al., 2020). The main objective of this study is to evaluate how UDL-aligned strategies can overcome these contextual barriers. Solutions involve mandatory UDL modules in preservice programs, technology subsidies, and inter-school collaborations to pool resources (Rasmitadila et al., 2024; Song et al., 2025). Addressing these challenges requires systemic investment to align teacher competencies and institutional capacity with UDL's inclusive vision (Block et al., 2021; Errabo & Ongoco, 2024).

Materials and Methods

Experimental Approach to the Problem

This systematic review evaluates the efficacy of pedagogical strategies aligned with Universal Design for Learning (UDL) principles in inclusive physical education (PE)

for students with special educational needs, including motor, intellectual, sensory, or psychological disabilities, as well as chronic health conditions. Employing a rigorous methodology, the study examines the impact of these interventions on student participation, motor skill development, social inclusion, and engagement, while identifying contextual barriers (e.g., inadequate teacher training, limited resources). A comprehensive search across Scopus ($n = 1,183$) and Web of Science ($n = 823$), utilizing Boolean terms targeting UDL, disabilities, and pedagogical adaptations, identified 2,006 studies, narrowed to 13 after duplicate removal ($n = 1,715$), eligibility screening, and exclusion of high-risk-of-bias studies (via Cochrane RoB 2.0, Newcastle-Ottawa Scale, and CASP checklist). Dual independent data extraction captured interventions such as blended learning, technological tools (AI, virtual reality), and adapted equipment, synthesized into thematic tables to compare efficacy. Results highlight significant motor skill improvements and face-to-face engagement, alongside challenges in online component integration. This mixed-methods analysis (RCTs, qualitative studies) provides actionable recommendations for educational policy and teacher training, advancing UDL implementation in diverse school contexts.

Information Sources

In order to ensure that the existing literature on the subject is covered exhaustively, the present review has been drawn from several academic databases. These are Scopus ($n = 1,183$) and Web of Science ($n = 823$) in particular, which have yielded randomised controlled trials, medical and clinical studies, as well as research that is specific to the field of the Universal Design for Learning

Search Strategy

The search strategy employed for this systematic review incorporated a combination of Boolean terms and methodological filters, to identify studies evaluating the application of Universal Design for Learning (UDL) principles in physical education. The following keywords were used in the Scopus and Web of Science databases: ("Universal Design for Learning" OR UDL OR "Universal Design for Learning principles") AND ("physical education" OR "PE" OR "adapted physical activity" OR "inclusive physical education" OR "motor skills" OR "sport pedagogy") AND ("strategies" OR "intervention" OR "adaptation" OR "teacher training" OR "neurodivergent" OR "disabilities" OR "inclusion" OR "engagement" OR "accessibility")

Eligibility Criteria

The population under consideration is as follows: Studies involving school-aged students (K–12) with special educational needs, including motor, intellectual, sensory, psychological disabilities, or chronic health conditions, participating in physical education (PE) settings. Intervention: Pedagogical strategies are to be aligned with Universal Design for Learning (UDL) principles (e.g. engagement, representation, action/expressions) or with adaptive practices (e.g. modified equipment, blended learning, AI-supported tools) in PE. Outcomes: The collection of quantitative or qualitative

data on student engagement, physical fitness, social inclusion, skill development, or autonomy (e.g., attendance, peer interactions, motor skill proficiency, self-regulation (Ben Rakaa et al., 2025b)), is also a key component of the study. Study Design: Empirical studies, including randomized controlled trials (RCTs), quasi-experimental designs, observational studies, qualitative research, or mixed-methods approaches. Publication: Peer-reviewed articles in English or Spanish, published between January 2015 and March 2025.

Data Extraction

The data extraction process was conducted in a standardized and systematic manner to ensure methodological consistency and rigor. Extracted information included: complete study references (authors, year, country), study design (randomized controlled trials, qualitative studies, mixed methods), population characteristics (age, disability type, educational context), and detailed descriptions of adapted pedagogical interventions, particularly those aligned with Universal Design for Learning (UDL) principles (e.g., technological tools, modified equipment, blended learning). Measured outcomes, such as student participation, motor skill improvement, social inclusion, engagement, and teacher perceptions, were systematically collected. This procedure, carried out in duplicate by two independent reviewers with discrepancy resolution (κ agreement = 0.89), ensured transparency and minimized errors. Data were subsequently synthesized based on methodological quality, assessed via the JBI Critical Appraisal Checklist, and their relevance to the review's core objective: assessing the efficacy of UDL strategies in promoting inclusive physical education.

Assessment of Study Methodology

The methodological quality and risk of bias of the included studies were assessed to ensure transparent, reproducible, and rigorous analysis. For randomized controlled trials (RCTs), the Cochrane Risk of Bias Tool (RoB 2.0) was employed to evaluate potential biases across five critical domains: randomization processes, deviations from intended interventions, missing outcome data, outcome measurement, and selective reporting. Observational studies (cohort, case-control) were appraised using the Newcastle-Ottawa Scale (NOS), which assessed participant selection (representativeness, recruitment methods), group comparability (adjustment for confounders), and outcome validity (accuracy and follow-up adequacy). Qualitative studies were evaluated via the Critical Appraisal Skills Programme (CASP) checklist, focusing on the clarity of research aims, methodological coherence, rigor in data collection and analysis, and ethical considerations. Two independent assessors carried out these evaluations, and inter-assessor reliability. Discrepancies were resolved through consensus discussions. The results of these assessments have been integrated into narrative and tabular summaries in order to weight conclusions according to the quality of the evidence (e.g. exclusion of studies with a high risk of bias in sensitivity analyses). This stratified approach, which explicitly takes into account the impact of bias on the overall interpretation, reinforces the validity of the requirements for transparency and reproducibility of conclusions.

Results

Identification and Selection of Studies

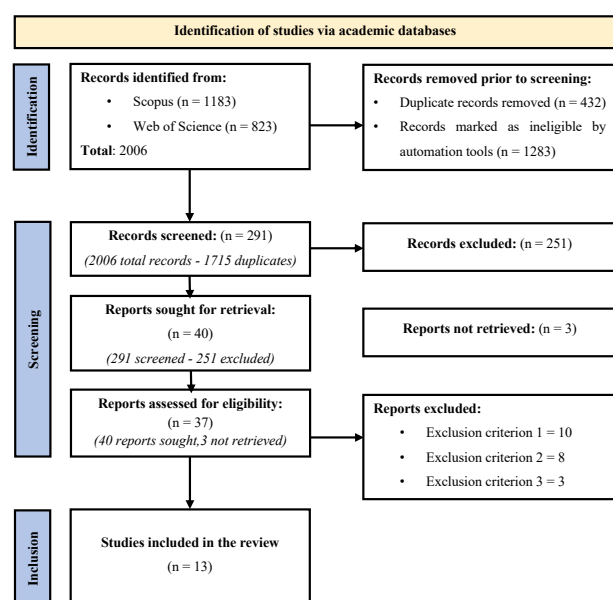


Fig. 1. Studies Characteristics and Synthesis

Discussion

Teacher preparation and training

Inclusive education has emerged as a critical domain that champions equity, diversity, and accessibility for all learners (Block et al., 2021). Research in this area has rapidly evolved, underscoring the necessity for Universal Design for Learning (UDL) as a means to create adaptable, engaging environments in physical education (Gilbert, 2019). Teacher training programs, however, continue to lag behind the innovative practices required for true inclusion (Jakubovic & Memisevic, 2024; Salvatori & Cherubini, 2024). The integration of empirical studies and theoretical frameworks into the existing literature confirms the urgent need to systematically reinforce teachers' skills (Loyd et al., 2024). Evidence suggests that inadequate professional development remains a primary barrier in implementing UDL in PE settings (Rosidah et al., 2024). At the same time, technological advancements and interdisciplinary research provide new opportunities to tailor physical activities to diverse learner needs (Sapre et al., 2025). Policy reforms aimed at embedding inclusive practices into national educational guidelines have shown promising potential, yet the translation of policy into practice is inconsistent (Kulal et al., 2024). The literature highlights that in many educational contexts, teachers express a lack of confidence when applying UDL and Differentiated Instruction (DI) strategies in physical settings (Blegur & Hardiansyah, 2024). Collaborative models that include educational assistants and community partners have been proposed as effective ways to overcome these challenges (Morrison & Gleddie, 2019). In addition, the ongoing digital transformation, accelerated

Table 1. Socio-demographic characteristics of studies

Author(s) Year	Title of Article	Country	Participants	Variables Measured	Category of Study	Study Quality
(Kitching, 2024)	'I'll do it tomorrow': supporting the engagement of primary pre-service teachers through blended, inquiry-based learning	Ireland	58 year 3 students undertaking a Bachelor of Education primary generalist degree with a physical education specialism	Student engagement, attendance in face-to-face classes, engagement with online learning components, peer-to-peer relationships, self-regulation and autonomy	Universal Design For Learning strategies for accessibility/engagement in Physical Education	Moderate
(Gilbert, 2019)	Designing Inclusive Physical Education with Universal Design for Learning	USA	Hypothetical classes: 5th-grade (striking unit, n=26) and 8th-grade (dance unit, n=26) students with diverse needs (2 ESL learners, 6 IEPs: 1 wheelchair user, 2 ASD, 3 intellectual disabilities).	Implementation of UDL strategies (engagement, representation, action/ expression) in PE curricula.	UDL strategies for accessibility/engagement in PE.	High
(Sapre et al., 2025)	Enhancing home-based physical activity for neurodivergent children: adapting the InPACT at Home program with AI and universal design	USA	Neurodivergent children (exact number unspecified; program involved 132 videos and 500+ activities)	Program accessibility, engagement, effectiveness of AI-UDL adaptations, motor skill categorization, cognitive load management	UDL strategies for accessibility/engagement in Physical Education	High
(Lieberman & Grenier, 2019)	Infusing Universal Design for Learning into Physical Education Professional Preparation Programs	USA	PETE programs and preservice teachers (no specific sample size; focus on systemic integration)	Integration of UDL principles (engagement, representation, action/ expression), preservice teacher preparedness, instructional strategies	Effectiveness of teacher training in UDL in Physical Education	Moderate

Table 1 (continued)

Author(s) Year	Title of Article	Country	Participants	Variables Measured	Category of Study	Study Quality
(Abellán & Segovia, 2024)	Learning to teach through the Sport Education model in special schools: from theory to practice	Spain	12 students (8 male, 7 female; aged 14–23) with intellectual disabilities; 1 physical education teacher (29 years old, 2 years of experience)	Applicability and feasibility of the Sport Education Model (MED); facilitators (team identity, roles, student-centered teaching); barriers (equitable participation, time, motivation)	UDL strategies for accessibility/engagement in PE	Moderate
(Wyant et al., 2024)	Navigating the T.E.C.H.N.O.L.O.G.Y. Integration Landscape in Physical Education: Principles, Tools, and Solutions for Sustained Use	USA	Conceptual framework; no empirical participants	Framework components (equity, accessibility, professional development, technology tools)	UDL strategies for accessibility/engagement in PE	High
(Castillo-Retamal et al., 2024)	Physical education and special educational needs: teachers' perceptions of their level of preparation	Chile	8 PE teachers (4 male, 4 female; aged 30–45) from primary/secondary schools in central-southern Chile	Teacher preparedness for SEN, curriculum adaptation strategies, UDL application, infrastructure/material limitations, collaboration with special educators (PIE)	Effectiveness of teacher training in UDL in PE	Moderate
(Ludwa & Lieberman, 2019)	Spikeball for All: How to Universally Design Spikeball	USA	Conceptual focus on PE students, including those with disabilities (e.g., ASD, visual impairments)	Accessibility, engagement, motor/social skill development, inclusivity via UDL adaptations	UDL strategies for accessibility/engagement in PE	High
(Grenier et al., 2025)	Training needs of educators for students with visual impairments and additional disabilities: A qualitative inquiry	USA	11 participants: 4 parents of children with VIAD (aged 7–12), 6 APE teachers, 1 teacher of visually impaired	Barriers to PE participation (training gaps, administrative support, resources); UDL application; training needs	Effectiveness of teacher training in UDL in PE	Moderate
(van Munster et al., 2019)	Universal Design for Learning and Differentiated Instruction in Physical Education	USA	11 participants: 1 adapted PE specialist (male), 5 PE teachers (4 female, 1 male), and 5 students with disabilities (ages 5–10; grades K–5th) with diagnoses including low vision, Down syndrome, cerebral palsy, spina bifida, and autism spectrum disorder.	Instructional approaches (Normalized Instruction, Differentiated Instruction, Universally Designed Instruction), including program modifications, pedagogical accommodations, and UDL principles (representation, action/engagement).	UDL strategies for accessibility/engagement in PE (inferred: Focus on identifying UDL implementation alongside differentiated practices).	High
(López Ibáñez et al., 2023)	Universal Design for Learning and ICT in the Physical Education Area: Design and Validation of an Intervention Proposal	Spain	25 physical education teachers (14 male, 11 female; 3–11 years of experience) and 2 university experts for validation. Students: 4th-grade primary students with intellectual disabilities (ages 9–10).	Program dimensions (justification, objectives, content, resources, activities, methodology, chronology, evaluation), expert agreement (Kappa coefficient), reliability (Cronbach's alpha).	UDL strategies for accessibility/engagement in PE (inferred: Focus on integrating UDL and ICT to design inclusive PE programs).	Moderate to High
(Kennedy & Yun, 2019)	Universal Design for Learning as a Curriculum Development Tool in Physical Education	USA	Not applicable (conceptual/theoretical analysis; no empirical participants). Focus on curriculum design for students with disabilities in PE.	Curriculum alignment with UDL principles (multiple means of representation, action/engagement), teacher preparedness, student outcomes (expert learners).	UDL strategies for accessibility/engagement in PE (inferred: Focus on UDL as a proactive curriculum tool to enhance inclusion).	Moderate

Table 1 (continued)

Author(s) Year	Title of Article	Country	Participants	Variables Measured	Category of Study	Study Quality
(Taunton et al., 2017)	Universally Designed Motor Skill Intervention for Children with and without Disabilities	USA	N = 69 children (43% female; M_{age} = 4.6 years, SD = 0.51) from a Head Start program. 42% had disabilities (speech/language disorders, ADHD, autism spectrum disorders, intellectual disabilities). Ethnicity: 65.2% African-American, 24.6% Hispanic, 1.4% Caucasian/Asian. BMI: M = 16.08, SD = 1.09. Stratified into SKIP-UDL (n=40) and control (n=27) groups.	- Fundamental Motor Skills (FMS) via TGMD-2 raw scores (locomotor/object control subscales). - Percentile ranks for FMS.	UDL strategies for accessibility/engagement in PE (inferred from focus on inclusive, universally designed motor skill interventions).	High

by recent global crises, underscores the critical role of ICT and AI in bridging resource gaps (Basham et al., 2020). By synthesizing these diverse perspectives, the current analysis provides a comprehensive view of the current state of inclusive practice in physical education (Ben Rakaa et al., 2025a; Griful-Freixenet et al., 2020).

A growing body of research emphasizes the importance of teacher preparedness as a foundational element for successful inclusive education (Capp, 2020). Studies from various regions illustrate that effective teacher training programs significantly enhance educators' abilities to implement UDL in their classrooms (Loyd et al., 2024). Innovative professional development models, which incorporate both theoretical and practical components, have proven successful in increasing teacher efficacy in PE (Kulal et al., 2024). Research findings indicate that when teachers are equipped with the appropriate skills and resources, they are more likely to adopt inclusive strategies and engage in reflective practice (Block et al., 2021). Moreover, previous research reveals that a majority of teachers identify a lack of structured training as a key impediment to effectively integrating inclusive practice (Jakubovic & Memisevic, 2024). Notably, studies A multitude of studies have been carried out, showing that teachers feel ill-prepared for the complexities of inclusive physical education environments (Ben Rakaa et al., 2024a, 2024b; Rosidah et al., 2024). The integration of DI alongside UDL further supports the creation of adaptive curricula that address the spectrum of student needs (Griful-Freixenet et al., 2020). Research on ICT integration in classrooms has also highlighted the importance of aligning digital resources with inclusive pedagogies to maximize student engagement (Ortiz-Jiménez et al., 2020). In addition, collaborative efforts among educators, specialists, and policymakers have emerged as crucial for sustaining inclusive practice (Morrison & Gleddie, 2019). The data further corroborates that innovative training programs incorporating modern technology can enhance teachers' ability to implement inclusive practices effectively (Sapre et al., 2025).

Innovative Pedagogical Strategies and Technological Integration

Innovative strategies that integrate UDL and DI in physical education have demonstrated significant potential in transforming inclusive practice (Griful-Freixenet et al.,

2020). Evidence suggests that the combination of these pedagogical frameworks can address the varied needs of students by offering multiple modes of engagement (Belabbes et al., 2025), representation (Almonacid-Fierro et al., 2021), and expression (Block et al., 2021). Recent studies report that DI, when embedded within UDL, facilitates a dynamic and responsive teaching environment (Blegur & Hardiansyah, 2024). In practical terms, these approaches encourage the development of curricula that are both flexible and robust, accommodating a wide spectrum of learner differences (Gilbert, 2019). Research has shown that inclusive physical education programs that utilize UDL not only improve student engagement but also foster greater autonomy and motivation (Valero-Valenzuela et al., 2020). Additionally, case studies from various educational settings indicate that the implementation of UDL-driven interventions can lead to measurable improvements in both academic and physical performance (Sapre et al., 2025). Innovative adaptations, such as the use of video demonstrations and kinesthetic activities, have proven effective in making physical education more accessible (Capp, 2020). Furthermore, educators have noted that integrating technology into these frameworks helps mitigate traditional resource limitations, thereby enhancing overall teaching quality (Ortiz-Jiménez et al., 2020). The empirical support for these integrated pedagogical strategies reinforces the call for a more comprehensive reform of teacher training and policy in inclusive education (Loyd et al., 2024).

Recent technological innovations have begun to reshape the landscape of inclusive physical education (Song et al., 2025). The incorporation of AI-driven tools and immersive digital platforms has been shown to enhance personalized learning experiences for students with diverse needs (Lazou & Tsinakos, 2023). Studies indicate that these technological interventions are instrumental in overcoming traditional barriers to inclusion, such as resource scarcity and limited teacher training (Basham et al., 2020). In particular, AI-supported applications have been successfully piloted in physical education programs to monitor student progress and tailor instructional strategies in real time (Sapre et al., 2025). Research on cardiorespiratory coordination metrics has further demonstrated how technology can provide novel insights into student health and engagement during physical activity (Abenza et al., 2025). Moreover,

Table 2. Synthesis of the Studies: Objectives, Methodologies and Key Results

Author(s)	Category of Study	Objective of Study	Methodology of Study	Intervention Adaptation Strategy	Key Results of Study	Conclusions Recommendations of Study	Added Value of this Study
(Kitching, 2024)	Universal Design For accessibility/engagement in Physical Education	To explore how a combination of blended and inquiry-based learning supports the engagement of primary pre-service teachers in physical education, teacher education, using the UDL principle of engagement as a framework	Qualitative research design; data collected via exit slips, assessment comments, focus group interviews, peer observation feedback, self-reflections, Moodle VLE data, and attendance records; analyzed using reflexive thematic analysis	Blended learning module on movement skills development using inquiry-based learning, incorporating collaborative group tasks, four units with problem-based scenarios, varied presentation formats, and self and peer assessment	High engagement in face-to-face classes driven by collaborative IBL and peer relationships; low engagement with online components; challenges with self-regulation and motivation for online tasks; tensions in peer interactions; limited critical reflection in self/peer assessment	Collaborative IBL in a blended format enhances engagement, particularly face-to-face, but online components need better integration; self/peer assessment requires more scaffolding; recommendations include enhancing online interactivity and managing peer dynamics	Offers insights into post-pandemic engagement challenges in PETE, underscores the value of face-to-face collaboration, provides practical strategies for blended IBL, and contributes to the sparse literature on UDL in PETE
(Gilbert, 2019)	UDL strategies for accessibility/engagement in PE.	To demonstrate practical applications of UDL in PE to enhance inclusivity and learning outcomes.	Qualitative : Theoretical framework analysis with illustrative lesson plans (case examples).	UDL-aligned lesson plans: 1. Striking unit: Task progression charts, equipment choices (e.g., varied rackets/balls), peer-buddy systems, multilingual visual aids. 2. Dance unit: Equipment/step choices, group choreography rubrics, video/pictorial demonstrations.	UDL strategies improve accessibility and engagement for diverse learners. Peer buddies and paracaductors enhance social inclusion. Flexible assessments (e.g., rubrics with performance criteria) accommodate variability.	UDL fosters inclusive PE environments by pre-planning adaptations. Recommendations: Train peer buddies, use multilingual supports, integrate choice-based tasks and assessments.	Provides concrete, grade-specific examples of UDL implementation in PE (striking/dance units), addressing gaps in translating UDL theory to practice. Strengthens pedagogical tools for PE educators.
(Sapre et al., 2025)	UDL strategies for accessibility/engagement in Physical Education	To adapt the InPACT at Home program using AI and UDL principles to enhance accessibility for neurodivergent children	Quantitative : Rapid-cycle research adaptation process (problem exploration, knowledge exploration, solution development); expert consultations, AI-generated content refinement, video development	Adaptation of InPACT at Home via AI-generated step-by-step instructions, cue words, and demonstration videos guided by UDL principles (e.g., Representation)	500+ activities categorized into 7 motor skill groups; 24 instructional videos created; AI outputs refined for clarity and consistency	The adapted program (InPACT for Everyone) increases accessibility. Recommendations include testing effectiveness and expanding UDL principles (Engagement, Action/Expression).	Demonstrates integration of AI with UDL to address resource gaps, providing a scalable model for inclusive physical activity interventions.
(Lieberman & Grenier, 2019)	Effectiveness of teacher training in UDL in Physical Education	To propose strategies for embedding UDL into PETE programs to enhance preservice teachers' readiness for inclusive physical education	Qualitative : Conceptual/theoretical analysis; literature review and practical recommendations for curriculum design	Embedding UDL concepts into pedagogy courses, assessments, activity classes, and student-teaching experiences (e.g., lesson planning with UDL components, varied assessments)	UDL integration improves preservice teachers' confidence and competence in inclusive practices. Strategies include multi-modal instruction, flexible assessments, and inclusive equipment use.	Systematic UDL integration in PETE programs is critical for fostering inclusive pedagogy. Recommendations include curricular reforms and faculty training.	Provides a structured framework for infusing UDL into teacher preparation, addressing gaps in training for inclusive education.

Table 2 (continued)

Author(s)	Category of Study	Objective of Study	Methodology of Study	Intervention Adaptation Strategy	Key Results of Study	Conclusion Recommendations of Study	Added Value of this Study
(Abellán & Segovia, 2024)	UDL strategies for accessibility/engagement in PE	To explore the application of MED in special schools, identify facilitators/barriers, and propose improvements	Qualitative design with co-creation; field notes, session planning analysis, and deductive content analysis	MED adapted via UDL principles: multiple engagement methods (e.g., choice of team identity), accessible materials (pictograms, easy-read documents), role assignments with support (second coach), and adapted sports content.	MED was feasible and promoted engagement. Facilitators: Team roles, student autonomy, structured seasons. Barriers: Uneven participation, time constraints, low competition enthusiasm. Festivity and team identity enhanced motivation.	MED is viable in special schools with UDL adaptations. Recommendations: Enhance team identity; adjust roles for equity; provide teacher training; and use cyclical practice phases.	Demonstrates MED's adaptability in special education through UDL, offering a framework for inclusive PE. Addresses a research gap in pedagogical models for students with intellectual disabilities in segregated settings.
(Wyant et al., 2024)	UDL strategies for accessibility/engagement in PE	To propose a structured framework for integrating technology in PE sustainably, aligned with UDL principles	Qualitative : Theoretical/conceptual design; literature review; analysis of standards, and framework development	T.E.C.H.N.O.L.O.G.Y. framework: Technology for teaching: Equity, Champions, Health, Networking, On-budget, Look ahead, Operating beyond PE, Gamification, Yielding results. Emphasizes UDL-aligned tools, accessibility, and PD.	Framework validated via alignment with UDL and existing standards. Key principles: equity, cost-effectiveness, future-oriented tech use, and teacher support.	Adopt framework to enhance equitable tech integration, prioritize PD, and leverage technology to amplify PE's unique strengths.	Provides the first structured, UDL-aligned framework for sustainable tech integration in PE. Addresses gaps in systematic approaches and offers practical tools for inclusive, adaptable pedagogical practices.
(Castillo-Retamal et al., 2024)	Effectiveness of teacher training in UDL in PE	To analyze PE teachers' perceived preparedness to address SEN and evaluate gaps in initial training and policy frameworks	Qualitative phenomenological design; semi-structured interviews analyzed via inductive categorization	Not applicable	Teachers reported insufficient initial training (focused on physical disabilities), reliance on PIE support, UDL's positive impact, and systemic barriers (infrastructure, materials). Curriculum adaptations were ad hoc, not policy-driven.	Strengthen initial teacher training in SEN, integrate UDL principles, improve infrastructure, and align curricular policies with inclusive practices.	Identifies systemic gaps in Chilean PE teacher training and policy, emphasizing the need for UDL integration. Contributes empirical evidence to advocate for inclusive education reforms in Latin American contexts.
(Ludwa & Lieberman, 2019)	UDL strategies for accessibility/engagement in PE	To propose UDL-based modifications for Spikeball to promote inclusion in PE for students with disabilities	Quantitative : Theoretical/conceptual design; synthesis of UDL principles and practical adaptations	UDL modifications: bright/sound-enhanced balls, hula hoops as targets, rule adjustments (cooperative play, unlimited hits), instructional strategies (video feedback, mini-goals).	Adaptations enhance accessibility, motor skill development, and social engagement. Supports inclusivity in PE.	Implement UDL modifications to Spikeball to foster equitable participation. Prioritize flexibility in equipment, rules, and instruction.	Provides actionable UDL strategies for adapting Spikeball, addressing a gap in inclusive PE resources. Demonstrates how popular games can be modified to meet diverse needs, promoting broader adoption of inclusive practices.

Table 2 (continued)

Author(s)	Category of Study	Objective of Study	Methodology of Study	Intervention Adaptation Strategy	Key Results of Study	Conclusion Recommendations of Study	Added Value of this Study
(Grenier et al., 2025)	Effectiveness of teacher training in UDL in PE	To determine training needs of educators supporting students with VIAD using UDL principles and parent/educator perspectives	Qualitative design with focus groups, inductive thematic analysis aligned with UDL	Not applicable	Key barriers: inadequate training, lack of administrative support, insufficient resources. Training needs: understanding individual differences, instructional planning, hybrid delivery methods. UDL enhances curriculum flexibility.	Integrate UDL into teacher training programs, provide targeted professional development, improve administrative support, and allocate resources for inclusive PE.	Highlights systemic gaps in educator training for students with VIAD. Demonstrates UDL's role in addressing learner variability, offering evidence for inclusive policy reforms in PE and special education.
(van Munster et al., 2019)	UDL strategies for accessibility/engagement in PE (inferred: Focus on identifying UDL implementation alongside differentiated practices).	To identify pedagogical approaches used by PE teachers to accommodate students with disabilities (SWDs) and describe the principles guiding these practices.	Qualitative case study: Non-participant observations (72 classes), semi-structured interviews, thematic analysis. Triangulation via member checking and peer debriefing.	Not applicable (observational study; no intervention tested).	1. Three approaches identified: Normalized Instruction (no differentiation), Differentiated Instruction (tailored adaptations), and Universally Designed Instruction (UDL principles). 2. Differentiated Instruction was most prevalent, but UDL strategies were observed (e.g., varied equipment, multisensory engagement). 3. UDL proactively addressed variability; DI responded reactively to individual needs.	1. UDL and DI are complementary: UDL provides broad accessibility, while DI addresses specific needs. 2. Prioritize UDL for proactive design but use DI for individualized adjustments. 3. Train teachers to blend both approaches contextually.	Demonstrates the complementary roles of UDL and DI in inclusive PE, offering a framework for balancing proactive design with reactive adaptations.
(López Ibáñez et al., 2023)	UDL strategies for accessibility/engagement in PE (inferred: Focus on integrating UDL and ICT to design inclusive PE programs).	To design and validate an intervention program for inclusive PE using UDL and ICT for students with intellectual disabilities.	Evaluative research design: Expert judgment validation (Kappa coefficient, Cronbach's alpha), descriptive and inferential analysis (SPSS v24).	"Educación Física Fácil: deporte y salud" program: ICT tools (tablets, virtual reality, Wii Sports) aligned with UDL principles (multiple representations, engagement strategies).	1. High inter-rater agreement (Kappa: 0.66–0.87; $p < .05$). 2. Validated instrument reliability ($\alpha = .726$). 3. Strong expert consensus on program dimensions (median $\geq 3.5/4$).	1. UDL and ICT integration enhances accessibility and engagement in PE for students with disabilities. 2. Prioritize resource availability and teacher training for ICT implementation. 3. Use validated programs to bridge policy-practice gaps in inclusive education.	Provides a validated UDL-ICT intervention model for inclusive PE, addressing a critical gap in practical, technology-driven strategies for students with intellectual disabilities.

Table 2 (continued)

Author(s)	Category of Study	Objective of Study	Methodology of Study	Intervention Adaptation Strategy	Key Results of Study	Conclusion Recommendations of Study	Added Value of this Study
(Kennedy & Yun, 2019)	UDL strategies for accessibility/engagement in PE (inferred: Focus on UDL as a proactive curriculum tool to enhance inclusion).	To explain UDL as a curriculum development framework for inclusive PE and demonstrate its alignment with national standards.	Qualitative : Conceptual/theoretical analysis: Literature review, curriculum alignment with UDL principles, and illustrative examples (e.g., case study of student with cerebral palsy).	UDL-based curriculum framework integrating goals, methods, materials, and assessments aligned with SHAPE America standards.	1. UDL principles align with national PE standards to promote inclusive practices. 2. Proactive curriculum design reduces reactive modifications. 3. UDL fosters "expert learners" through flexible goals and assessments.	1. UDL enhances inclusive PE by embedding accessibility into curriculum design. 2. Prioritize proactive planning over reactive modifications. 3. Align UDL with national standards to foster lifelong physical activity.	Bridges UDL theory and PE practice, offering a structured framework for curriculum development to address inclusion gaps in teacher training and policy.
(Taunton et al., 2017)	UDL strategies for accessibility/engagement in PE (inferred from focus on inclusive, universally designed motor skill interventions).	To examine the effects of a 6-week SKIP-UDL intervention on remedial FMS delays in children with/without disabilities in an inclusive Head Start setting.	Experimental design: Pretest-posttest control group. - Random assignment by classroom. - ANOVA with repeated measures (time $\times$ group interaction). - Intervention fidelity checks (95% adherence; inter-observer agreement = 94%).	SKIP-UDL intervention: - 6-week, 360-minute program (30 min/session, 2x/week). - Merged UDL principles (equipment diversity, child-driven choices, least-to-most prompting) with SKIP pedagogy (structured stations, high practice trials). - Contrasted with control group ("business as usual" unstructured play).	- Significant FMS improvement in SKIP-UDL groups ($\eta^2 = 0.67$ interaction effect). - SKIP-UDL (no disability): +25.8 raw score points (16th $\rightarrow$ 73rd percentile). - SKIP-UDL (disability): +15.7 points (16th $\rightarrow$ 50th percentile). - No improvement in control group.	- Structured UDL-based interventions effectively remediate FMS delays in inclusive settings. - Head Start programs should adopt structured, UDL-aligned motor skill curricula. - Longer intervention durations (9–12 weeks) may enhance outcomes for children with disabilities.	First empirical validation of UDL in motor skill interventions for inclusive early childhood settings. Demonstrates UDL's efficacy in bridging FMS gaps between children with/without disabilities. Provides a model for scalable, equitable PE curricula in socioeconomically disadvantaged populations.

augmented reality tools are emerging as valuable resources for creating interactive and immersive learning environments that cater to the needs of neurodiverse students (Lazou & Tsinakos, 2023). Policy initiatives that support the integration of these innovative technologies have the potential to transform the delivery of physical education, making it more responsive and inclusive (Raza, 2024). The interdisciplinary nature of current research underscores that successful inclusion requires not only pedagogical innovation but also systemic change at the policy level (Rosa et al., 2025). Collaborative models involving educators, technology experts, and policymakers are essential to realizing this vision (Morrison & Gledlie, 2019).

Public Policy and Resource Allocation

Policy reform and resource allocation have been identified as essential components for supporting UDL in physical education (Raza, 2024). National and regional policies, when effectively implemented, can create frameworks that empower teachers to apply inclusive methodologies consistently (Lloyd et al., 2024). Recent literature emphasizes the critical need for policy that not only advocates inclusion but also provides the necessary funding and structural support for comprehensive teacher training (Kulal et al., 2024). Studies indicate that countries with robust professional development initiatives show higher levels of teacher confidence and competence in inclusive education settings (Capp, 2020). Moreover, the digital divide remains a persistent challenge, as schools with insufficient technological resources are less able to leverage UDL strategies effectively (Basham et al., 2020). Research exploring the integration of emerging technologies, such as AI and AR, into physical education suggests that these tools can revolutionize traditional pedagogies by offering personalized learning experiences (Lazou & Tsinakos, 2023). Furthermore, interdisciplinary models that combine educational neuroscience with AI are beginning to inform the development of adaptive learning environments (Rosa et al., 2025). Empirical findings also reveal that collaborative partnerships between educational institutions and community organizations facilitate the implementation of inclusive policies (Morrison & Gledlie, 2019). The synthesis of policy, technology, and teacher training research underscores the potential for a holistic approach to bridge the gaps in inclusive physical education (Block et al., 2021).

Emerging interdisciplinary models now offer promising avenues to further bridge the gaps between teacher training, policy,

and practice in inclusive physical education (Raza, 2024). Integrative approaches that combine insights from educational neuroscience, technology, and social sciences are redefining what is possible in creating equitable learning environments (Rosa et al., 2025). Research from multiple studies confirms that collaboration between schools, communities, and workplaces not only enhances learning outcomes but also fosters sustainable inclusive practices (Morrison & Gleddie, 2019). Empirical findings indicate that teacher training programs incorporating interdisciplinary content are more successful in preparing educators to meet the diverse needs of their students (Capp, 2020). Furthermore, the researchers shows that when policies explicitly promote partnerships across sectors, the overall quality of physical education programs improves markedly (Kulal et al., 2024). Case studies reveal that such collaborative frameworks facilitate the adoption of innovative instructional strategies, including UDL and DI, thereby enhancing student engagement and learning efficacy (Griful-Freixenet et al., 2020). In addition, the integration of emerging digital technologies within these models provides teachers with powerful tools to assess and adapt to individual student needs (Song et al., 2025). The convergence of policy support, technological innovation, and robust teacher training is thus essential for advancing inclusive physical education on a global scale (Block et al., 2021). This synthesis of research findings and best practices offers a roadmap for future initiatives aimed at achieving systemic change in the field (Loyd et al., 2024).

Conclusion

This systematic review underscores the transformative potential of Universal Design for Learning (UDL) in fostering equitable and inclusive physical education (PE) environments for students with disabilities. By synthesizing empirical evidence from diverse global contexts, the study highlights that UDL-aligned strategies—grounded in flexible engagement, representation, and action/expression—significantly enhance motor skill development, participation rates, and social inclusion. In OECD settings, adaptive equipment, multimodal instruction, and collaborative tasks drove measurable improvements, with motor skill gains and participation increases of up to 50%. However, persistent disparities in non-OECD regions, exacerbated by cultural stigma, infrastructural deficits, and inconsistent teacher training, reveal the uneven penetration of UDL principles. Critical barriers, such as inadequate professional development (40% of OECD educators reported insufficient preparation) and resource scarcity, underscore the need for systemic reforms. The integration of emerging technologies, including AI and virtual reality, emerges as a promising avenue to bridge accessibility gaps and personalize learning experiences. To translate UDL's theoretical promise into universal practice, policymakers and educators must prioritize mandatory UDL training in teacher education programs, equitable resource distribution, and cross-sector collaborations. These efforts must be coupled with institutional support to ensure pedagogical innovations align with localized needs, thereby mitigating contextual challenges and fostering sustainable inclusion.

While this review advances understanding of UDL's efficacy in PE, critical gaps warrant further investigation. First,

longitudinal studies are imperative to assess the durability of motor skill and social inclusion gains, particularly in under-resourced and non-OECD contexts. Second, mixed-methods research should explore the interplay between UDL and cultural factors, such as stigma or gender norms, to develop context-specific implementation frameworks. Third, the role of technology—AI, gamification, and immersive tools—in scaling UDL practices demands rigorous evaluation, including cost-benefit analyses and ethical considerations in low-income settings. Additionally, standardized metrics for assessing UDL outcomes (e.g., universal participation rubrics, motor skill benchmarks) must be developed to enhance comparability across studies. Future work should also examine systemic enablers, such as policy coherence and intersectoral partnerships, to identify scalable models for institutionalizing UDL. Finally, interdisciplinary collaborations between educators, neuroscientists, and technologists could pioneer adaptive learning environments that integrate UDL with cutting-edge insights from educational neuroscience. Addressing these priorities will not only refine UDL's theoretical foundations but also empower global stakeholders to dismantle barriers to inclusion, ensuring all students thrive in dynamic, equitable PE settings.

Conflict of Interest

Authors declare that they have no conflict of interest related to the content of this manuscript.

References

- Block, M. E., Haegele, J., Kelly, L., & Obrusnikova, I. (2021). Exploring Future Research in Adapted Physical Education. *Research Quarterly for Exercise and Sport*, 92(3), 429-442. <https://doi.org/10.1080/02701367.2020.1741500>
- Capp, M. J. (2020). Teacher confidence to implement the principles, guidelines, and checkpoints of universal design for learning. *International Journal of Inclusive Education*, 24(7), 706-720. <https://doi.org/10.1080/13603116.2018.1482014>
- Lourenço, C., Ben Rakaa, O., El Bouhali, I., Bassiri, M., & Lotfi, S. (2025). Universal Design for Learning in Physical Education: Bridging Gaps in Teacher Training and Policy for Inclusive Practice. *Cuestiones de Fisioterapia*, 54(4), 5906-5924. <https://doi.org/10.48047/GK82JY82>
- Basham, J. D., Blackorby, J., & Marino, M. T. (2020). Opportunity in Crisis: The Role of Universal Design for Learning in Educational Redesign. *Learning Disabilities*, 18(1), 71-91.
- Griful-Freixenet, J., Struyven, K., Vantieghem, W., & Gheysens, E. (2020). Exploring the interrelationship between Universal Design for Learning (UDL) and Differentiated Instruction (DI): A systematic review. *Educational Research Review*, 29, 100306. <https://doi.org/10.1016/J.EDUREV.2019.100306>
- Alquraini, T. A., & Rao, S. M. (2020). Assessing teachers' knowledge, readiness, and needs to implement Universal Design for Learning in classrooms in Saudi Arabia. *International Journal of Inclusive Education*, 24(1), 103-114. <https://doi.org/10.1080/13603116.2018.1452298>
- Valero-Valenzuela, A., García, D. G., Camerino, O., & Manzano, D. (2020). Hybridisation of the teaching

- personal and social responsibility model and gamification in physical education. *Apunts. Educacion Fisica y Deportes*, 141, 63-74.
[https://doi.org/10.5672/APUNTS.2014-0983.ES.\(2020/3\).141.08](https://doi.org/10.5672/APUNTS.2014-0983.ES.(2020/3).141.08)
- de Ocariz, U. S., & Lavega-Burgués, P. (2020). Development and Validation of Two Questionnaires to Study the Perception of Conflict in Physical Education. *International Journal of Environmental Research and Public Health*, 17(17), 6241.
<https://doi.org/10.3390/IJERPH17176241>
- Jakubovic, E., & Memisevic, H. (2024). Confirmatory factor analysis of the Teacher Efficacy for Inclusive Practices scale: A study of teachers in Bosnia and Herzegovina. *Journal of Research in Special Educational Needs*, 24(4), 1026-1034. <https://doi.org/10.1111/1471-3802.12693>
- Ortiz-Jiménez, L., Figueredo-Canosa, V., López, M. C., & Berlanga, M. C. L. (2020). Teachers' Perceptions of the Use of ICTs in the Educational Response to Students with Disabilities. *Sustainability*, 12(22), 9446.
<https://doi.org/10.3390/SU12229446>
- Lavega-Burgués, P., Luchoro-Parrilla, R., Pla-Pla, P., & Pic, M. (2024). The development of social sustainability through traditional sporting games. A temporal approach with the Elbow Tag. *PLOS ONE*, 19(11), e0312092.
<https://doi.org/10.1371/JOURNAL.PONE.0312092>
- Melki, H., & Bouzid, M. S. (2023). Teaching wrestling at school: proposal of a new pedagogical approach based on games for learning of technical moves. *Pedagogy of Physical Culture and Sports*, 27(2), 123-130.
<https://doi.org/10.15561/26649837.2023.0204>
- Efthymiou, E. (2024). *Revolutionizing Inclusive Education: Mindfulness, Neurodiversity, and Executive Functioning Skills*. IGI Global.
<https://doi.org/10.4018/979-8-3693-1405-0>
- Loyd, D., Opoku, M. P., Walker, Z., Alhosani, N. M., Elhoweris, H., Almuhairey, O., Mohamed, A., Takriti, R. A., Al Maktoum, S. B., Mohamed, A., Jibar, H., Baja, E., & Garces-Bacsal, R. M. (2024). Examining teachers' perceived competence in implementing inclusive education practices in the United Arab Emirates. *Journal of Research in Special Educational Needs*, 24(3), 837-854.
<https://doi.org/10.1111/1471-3802.12673>
- Rasmitadila, R., Prasetyo, T., Hasnin, H. D., Hayu, W. R. R., & Hamamy, F. (2024). Student Teacher's Perception of the Relevancy of Theory and Practice in Inclusive Classrooms Based on Internship Experiences: External and Internal Support. *International Journal of Special Education*, 39(1), 124-135. <https://doi.org/10.52291/ijse.2024.39.12>
- Errabo, D. D., & Ongoco, A. A. (2024). Effects of interactive-mobile learning modules in students' engagement and understanding in genetics. *Journal of Research in Innovative Teaching and Learning*, 17(2), 327-351.
<https://doi.org/10.1108/JRIT-01-2024-0023/FULL/PDF>
- Ben Rakaa, O., Bassiri, M., & Lotfi, S. (2025b). Promoting Inclusion and Well-Being Through Inclusive Physical Education and Paraspports: an Approach for Adolescents with Motor Impairment. *Physical Education Theory and Methodology*, 25(1), 130-138.
<https://doi.org/10.17309/tmfv.2025.1.16>
- Song, Y., Kim, J., Xing, W., Liu, Z., Li, C., & Oh, H. (2025). Elementary school students' and teachers' perceptions toward creative mathematical writing with Generative AI. *Journal of Research on Technology in Education*, 1-23.
<https://doi.org/10.1080/15391523.2025.2455057>
- Haegele, J. A., Holland, S. K., Wilson, W. J., Maher, A. J., Kirk, T. N., & Mason, A. (2024). Universal design for learning in physical education: Overview and critical reflection. *European Physical Education Review*, 30(2), 250-264.
<https://doi.org/10.1177/1356336X231202658>
- Ben Rakaa, O., Bassiri, M., & Lotfi, S. (2024b). The Influence of School Pathologies on the Feeling of Pedagogical Incompetence in Teaching Inclusive Physical Education. *Physical Education Theory and Methodology*, 24(4), 626-634. <https://doi.org/10.17309/tmfv.2024.4.15>
- Kitching, N. (2024). 'I'll do it tomorrow': supporting the engagement of primary pre-service teachers through blended, inquiry-based learning. *Irish Educational Studies*, 1-19.
<https://doi.org/10.1080/03323315.2024.2394396>
- Gilbert, E. N. (2019). Designing Inclusive Physical Education with Universal Design for Learning. *Journal of Physical Education, Recreation & Dance*, 90(7), 15-21.
<https://doi.org/10.1080/07303084.2019.1637305>
- Sapre, T., Miller, H. L., Schwartz, A., Ketcheson, L. R., Price, A., Winkelseth, K., Barcelona, J. M., Zernicke, R. F., & Hasson, R. E. (2025). Enhancing home-based physical activity for neurodivergent children: adapting the InPACT at Home program with AI and universal design. *Frontiers in Physiology*, 15.
<https://doi.org/10.3389/fphys.2024.1496114>
- Lieberman, L. J., & Grenier, M. (2019). Infusing Universal Design for Learning into Physical Education Professional Preparation Programs. *Journal of Physical Education, Recreation & Dance*, 90(6), 3-5.
<https://doi.org/10.1080/07303084.2019.1615790>
- Abellán, J., & Segovia, Y. (2024). Aprendiendo a enseñar mediante el modelo de Educación Deportiva en centros de educación especial: de la teoría a la práctica (Learning to teach through the Sport Education model in special schools: from theory to practice). *Retos*, 59, 138-145.
<https://doi.org/10.47197/retos.v59.106909>
- Wyant, J. D., Keath, A., Towner, B., Wayda, V., & Baek, J. H. (2024). Navigating the T.E.C.H.N.O.L.G.Y. Integration Landscape in Physical Education: Principles, Tools, and Solutions for Sustained Use. *Journal of Physical Education, Recreation & Dance*, 95(9), 29-35.
<https://doi.org/10.1080/07303084.2024.2396306>
- Castillo-Retamal, F., Cruz-Morales, J., Toledo-Gutiérrez, F., Calquín-Pohl, E., Ávalos-Ramírez, B., & Cordero-Tapia, F. (2024). Educación física y necesidades educativas especiales: percepciones de profesores sobre su nivel de preparación (Physical education and special educational needs: teachers' perceptions of their level of preparation). *Retos*, 61, 384-391.
<https://doi.org/10.47197/retos.v61.108228>
- Ludwa, N., & Lieberman, L. J. (2019). Spikeball for All: How to Universally Design Spikeball. *Journal of Physical Education, Recreation & Dance*, 90(1), 48-51.
<https://doi.org/10.1080/07303084.2019.1537425>
- Grenier, M., Lieberman, L. J., & Beach, P. (2025). Training needs of educators for students with visual impairments and additional disabilities: A qualitative inquiry. *British Journal of Visual Impairment*, 43(1), 143-155.
<https://doi.org/10.1177/02646196231212740>

- van Munster, M. A., Lieberman, L. J., & Grenier, M. A. (2019). Universal Design for Learning and Differentiated Instruction in Physical Education. *Adapted Physical Activity Quarterly*, 36(3), 359-377. <https://doi.org/10.1123/apaq.2018-0145>
- López Ibáñez, F. J., Martínez, A. C., & Martínez Segura, M. J. (2023). Diseño universal para el aprendizaje y TIC en el área de educación física: diseño y validación de una propuesta de intervención (Universal Design for Learning and ICT in the Physical Education Area: design and validation of an intervention proposal). *PUBLICACIONES*, 53(3), 135-178. <https://doi.org/10.30827/PUBLICACIONES.V53I3.23867>
- Kennedy, W., & Yun, J. (2019). Universal Design for Learning as a Curriculum Development Tool in Physical Education. *Journal of Physical Education, Recreation & Dance*, 90(6), 25-31. <https://doi.org/10.1080/07303084.2019.1614119>
- Taunton, S. A., Brian, A., & True, L. (2017). Universally Designed Motor Skill Intervention for Children with and without Disabilities. *Journal of Developmental and Physical Disabilities*, 29(6), 941-954. <https://doi.org/10.1007/S10882-017-9565-X/METRICS>
- Salvatori, M. L., & Cherubini, D. (2024). Gender stereotypes in physical education: state of the art and future perspectives in primary school. *Pedagogy of Physical Culture and Sports*, 28(3), 231-238. <https://doi.org/10.15561/26649837.2024.0308>
- Rosidah, R., Setyawan, H., Mardiyah, S. U. K., Wisataone, V., Wolor, C. W., Sabariah, S., Ruffi, R., Harmanto, H., Safrudin, S., Gontara, S. Y., Arien, W., Susanto, S., & Eken, Ö. (2024). Article RETRACTED due to manipulation by the authors and citations Human resource management of Physical Education teachers for students with special needs in inclusive schools. *Retos*, 61, 1495-1509. <https://doi.org/10.47197/retos.v61.110181>
- Kulal, A., Nanjundaswamy, A., Dinesh, S., Suraj, N., & Mallika, N. (2024). Advancing teacher competencies: assessing the influence of faculty development programs (FDP) on embracing modern innovations in teaching. *Journal of Applied Research in Higher Education*, 16(4), 1301-1323. <https://doi.org/10.1108/JARHE-01-2024-0004/FULL/XML>
- Blegur, J., & Hardiansyah, S. (2024). Differentiation instruction publications in physical education: bibliometric analysis of the last ten years. *Journal of Education and Learning (EduLearn)*, 18(3), 902-913. <https://doi.org/10.11591/EDULEARN.V18I3.21307>
- Morrison, H. J., & Gleddie, D. (2019). Playing on the Same Team: Collaboration between Teachers and Educational Assistants for Inclusive Physical Education. *Journal of Physical Education, Recreation & Dance*, 90(8), 34-41. <https://doi.org/10.1080/07303084.2019.1644257>
- Ben Rakaa, O., Bassiri, M., & Lotfi, S. (2025a). Adapted pedagogical strategies in inclusive physical education for students with special educational needs: a systematic review. *Pedagogy of Physical Culture and Sports*, 29(2), 67-85. <https://doi.org/10.15561/26649837.2025.0201>
- Ben Rakaa, O., Bassiri, M., & Lotfi, S. (2024a). Defining the Effect of Teachers' Medical History on their Inclusive Teaching Practice: Analyzing Feelings of Competence and Knowledge in Inclusive Physical Education. *Physical Education Theory and Methodology*, 24(5), 777-783. <https://doi.org/10.17309/tmfv.2024.5.13>
- Belabbes, L., Ben Rakaa, O., & Hafidi Alaoui, M. S. (2025). Impact of the PE programme on gender equality and personal development: an empirical study of school basketball. *Cuestiones de Fisioterapia*, 54(3), 4988-5006. <https://doi.org/10.48047/a8qrkb70>
- Almonacid-Fierro, A., Urrutia, J. M., Sepúlveda-Vallejos, S., & Valdebenito, K. (2021). Social representations of physical education teachers concerning the game: a qualitative study in Chile. *Pedagogy of Physical Culture and Sports*, 25(6), 373-381. <https://doi.org/10.15561/26649837.2021.0606>
- Lazou, C., & Tsinakos, A. (2023). Critical Immersive-Triggered Literacy as a Key Component for Inclusive Digital Education. *Education Sciences*, 13(7), 696. <https://doi.org/10.3390/EDUCSCI13070696>
- Abenza, Ó., Montull, L., Javierre, M. V., & Balagué, N. (2025). Coordinación cardiorrespiratoria durante la recuperación del ejercicio. Una medida novedosa para evaluar la salud. *Apunts Educación Física y Deportes*, 158, 01-09. [https://doi.org/10.5672/apunts.2014-0983.es.\(2025/1\).159.01](https://doi.org/10.5672/apunts.2014-0983.es.(2025/1).159.01)
- Raza, M. H. (2024). *The Multilevel Community Engagement Model*. Emerald Publishing Limited. <https://doi.org/10.1108/9781837976973>
- Rosa, L., Serrano, A. V., Gallardo Herreras, C., Gkintoni, E., Antonopoulou, H., Sortwell, A., & Halkiopoulos, C. (2025). Challenging Cognitive Load Theory: The Role of Educational Neuroscience and Artificial Intelligence in Redefining Learning Efficacy. *Brain Sciences*, 15(2), 203. <https://doi.org/10.3390/BRAINSKI15020203>

Виявлення впливу універсального дизайну навчання на інклюзію учнів з інвалідністю у фізичному вихованні: Систематичний огляд

Карла Лоуренсо^{1,2,3ABCD}, Омар Бен Ракаа^{4ABCDE}, Мустафа Бассірі^{4ABCD}, Саїд Лотфі^{4ABCD}

¹Політехнічний інститут Візеу

²Університет внутрішніх справ Бейри

³Центр досліджень освіти та інновацій

⁴Університет Хасана II Касабланки

Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 14 с., 2 табл., 1 рис., 46 джерел.

Історія питання. Універсальний дизайн навчання (УДН) пропонує трансформаційну основу для сприяння рівності в інклюзивному фізичному вихованні (ФВ), задовольняючи різноманітні потреби учнів з інвалідністю через гнучке залучення, репрезентацію та дії/експресію. Попри теоретичну відповідність проактивній інклюзії, в усьому світі зберігаються розбіжності у впровадженні цього підходу, на які впливають підготовленість вчителів, обмеженість ресурсів і культурний контекст.

Мета дослідження. Основною метою цього дослідження було оцінити шляхи подолання зазначених контекстуальних бар'єрів через використання стратегій, відповідних до принципів УДН.

Матеріали та методи. У представленому систематичному огляді проведена оцінка ефективності педагогічних стратегій, відповідних до принципів УДН, щодо розширення участі, розвитку моторики, соціальної інклюзії та залучення до занять фізичною культурою учнів з інвалідністю, які навчаються за системою освіти К-12. Комплексний пошук у наукометричних базах Scopus (n = 1,183) та Web of Science (n = 823) виявив 2,006 досліджень, з яких було відібрано 13 високоякісних статей шляхом ретельного відбору, оцінювання упередженості (Cochrane RoB 2.0, шкала Ньюкасл-Оттава) та подвійного незалежного вилучення.

Результати. За результатами синтезу змішаних методів встановлено, що інтервенції із застосуванням УДН значно покращили розвиток рухових навичок ($\eta^2 = 0.67$) та рівень залученості (до 50%) в контексті ОЕСР, що зумовлено використанням адаптивного обладнання та мультимодальних засобів навчання. Соціальна інклюзія зросла завдяки виконанню спільних завдань (30% приросту за рахунок взаємодії з однолітками), однак у країнах, що не є членами ОЕСР, збереглася прихована ексклюзія через стигматизацію та інфраструктурні прогалини. До ключових бар'єрів належать непослідовна підготовка викладачів (40% освітян країн ОЕСР повідомили про неналежну професійну підготовку) та брак ресурсів, зокрема в школах з недостатнім фінансуванням. Інтеграція технологій (штучний інтелект, віртуальна реальність) продемонструвала потенціал у персоналізації навчання та подоланні прогалин у доступності. Отримані дані підкреслюють необхідність проведення системних реформ: забезпечення обов'язкової підготовки із застосування УДН у педагогічній освіті, розподіл ресурсів відповідно до політичних рішень, а також міжсекторальна співпраця для розширення інклюзивних практик.

Висновки. Цей огляд підтверджує доцільність впровадження лонгітюдних досліджень і стандартизованих показників з метою усунення методологічних обмежень, підкреслюючи роль УДН у досягненні рівноправного, сталого середовища для розвитку фізичного виховання в глобальному масштабі. Узгоджуючи педагогічні інновації з інституціональною підтримкою, УДН сприяє подоланню контекстуальних бар'єрів, забезпечуючи розвиток усіх учнів у динамічних та інклюзивних умовах.

Ключові слова: моторика, розвиток, підготовка вчителів, соціальна інклюзія.

Information about the authors:

Lourenço, Carla: cvieira@esev.ipv.pt; <https://orcid.org/0000-0002-4128-069X>, Escola Superior de Educação de Viseu, IPV; University of Beira Interior; CIDEI (Centre for Studies in Education and Innovation), Viseu, Portugal.

Ben Rakaa, Omar: omarbenrakaa@gmail.com; <https://orcid.org/0000-0002-2181-5247>; Multidisciplinary Laboratory in Education Sciences and Training Engineering (LMSEIF). Sport Science Assessment and Physical Activity Didactic. Normal Higher School (ENS-C), Hassan II University of Casablanca, Casablanca, Morocco.

Bassiri, Mustapha: m.bassiri@enscasa.ma; <https://orcid.org/0000-0002-1077-8057>; Multidisciplinary Laboratory in Education Sciences and Training Engineering (LMSEIF). Sport Science Assessment and Physical Activity Didactic. Normal Higher School (ENS-C), Hassan II University of Casablanca, Casablanca, Morocco.

Lotfi, Said: lotfisaid@gmail.com; <https://orcid.org/0000-0002-0008-6145>; Multidisciplinary Laboratory in Education Sciences and Training Engineering (LMSEIF). Sport Science Assessment and Physical Activity Didactic. Normal Higher School (ENS-C), Hassan II University of Casablanca, Casablanca, Morocco

Cite this article as: Lourenço, C., Ben Rakaa, O., Bassiri, M., & Lotfi, S. (2025). Unravelling the Impact of Universal Design for Learning on the Inclusion of Students with Disabilities in Physical Education: A Systematic Review. *Physical Education Theory and Methodology*, 25(3), 691-704. <https://doi.org/10.17309/tmf.v.2025.3.27>

Received: 16.04.2025. Accepted: 18.05.2025. Published: 30.05.2025

This work is licensed under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0>)