# Universal Design for Learning in Physical Education: Bridging Gaps in Teacher Training and Policy for Inclusive Practice

**Carla LOURENÇO[1,2,3], Omar BEN RAKAA[4*] Issam EL BOUHALI[5], Mustapha BASSIRI[4] & Said LOTFI[4]**

1 Escola Superior de Educação de Viseu, IPV
2 University of Beira Interior
3 CIDEI (Centre for Studies in Education and Innovation), Portugal
4 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 Morocco
5 Policies in Education and Social Dynamics (PEDS), Faculty of Educational Sciences, Mohammed V University of Rabat, Morocco
[*] Corresponding Author, omarbenrakaa@gmail.com

**Abstract:** This short literature review explores the application of Universal Design for Learning (UDL) in physical education (PE) to foster inclusive environments for students with diverse abilities. UDL's core principles—multiple means of engagement, representation, and action/expression—offer a transformative framework to address systemic barriers in PE, such as rigid curricula, teacher unpreparedness, and socio-cultural resistance. A structured literature search (2015–2023) across six databases identified seven key studies. Findings reveal UDL's potential to enhance accessibility through collaborative teaching practices, adaptive pedagogies (e.g., flexible grouping, assistive technologies), and teacher training interventions. For instance, AI-driven tools and VR platforms democratize participation, while short professional development modules improve educators' self-efficacy in accommodating neurodiverse learners. However, critical gaps persist. Empirical validation of UDL's efficacy in PE remains sparse. Systemic challenges, including institutional rigidity and socio-cultural mismatches (e.g., Japan's policy-practice divide), further hinder implementation. Teacher education programs often lack UDL integration, perpetuating reliance on outdated practices. Additionally, UDL's universal benefits are frequently misconstrued as disability-specific, necessitating culturally responsive adaptations to ensure equity across global contexts. The study advocates for multifaceted reforms: rigorous mixed-methods research to evaluate UDL's impact on learning outcomes, competency-based teacher training, and policy mandates for inclusive curricula. By bridging inclusive education theory with PE-specific practices, this work advances a pedagogical framework emphasizing flexibility, engagement, and equity. Practical tools, such as modular lesson plans and adaptive assessment rubrics, are proposed to address documented challenges. Ultimately, the integration of UDL in PE holds promise for transforming the discipline into an universally accessible domain, contingent on systemic collaboration among educators, policymakers, and communities.

**Keywords:** Universal Design for Learning (UDL), inclusive education, physical education, differentiated instruction, teacher training.

## 1. Introduction

Inclusive education has emerged as a cornerstone of modern pedagogical frameworks, emphasizing equitable access to learning opportunities for students of diverse abilities and backgrounds (Belabbes et al., 2025). Within this paradigm, physical education (PE) presents unique challenges due to its inherently interactive and kinesthetic nature, requiring tailored strategies to address the needs of students with disabilities, neurodivergent learners, and those requiring differentiated instruction (DI) (Carter et al., 2023a; Norwich, 2023). Universal Design for Learning (UDL), a framework rooted in neuroscience and educational psychology, offers a transformative approach to reimagining PE curricula by prioritizing flexibility, accessibility, and engagement (Cai et al., 2024; Haegele et al., 2024).

The global shift toward inclusive education, reinforced by policies such as the Salamanca Statement and the United Nations' Sustainable Development Goals (SDGs), has underscored the imperative to dismantle barriers in educational systems (Chitiyo, 2024; Nel et al., 2023). However, PE remains a critical frontier for inclusion, as traditional pedagogical models often fail to accommodate students with sensory, motor, or cognitive differences (Fierro-Saldaña & Treviño-Villarreal, 2025; Rosidah et al., 2024) Research has demonstrated a significant disparity in the engagement of students with special educational needs in physical sports activities (Ben Rakaa et al., 2024b). Their inclusion in these activities is profoundly influenced by their teachers' perceptions and their sense of pedagogical competence in inclusive physical education (Ben Rakaa et al., 2024a, 2024c). Engaging in competitive sports or school sports, such as physical education, has been shown to have positive psychological and social effects (Ben Rakaa et al., 2025).

For instance, studies highlight systemic gaps in teacher preparedness, limited adaptive resources, and rigid curricular structures as persistent obstacles (Dyliaeva et al., 2024; Gentilini, 2021). These challenges are compounded by the socio-emotional dimensions of PE, where students' self-efficacy, social integration, and physical competence are closely intertwined (Grimminger-Seidensticker & Seyda, 2022; Vieira et al., 2024). UDL, with its three core

principles—multiple means of engagement, representation, and action/expression—provides a robust scaffold to address these multifaceted demands (Hutzler, 2020).

Recent research underscores the synergistic relationship between UDL and DI in fostering inclusive environments. A study demonstrated that teachers' growth mindsets and adaptive practices (Cai et al., 2024), such as flexible grouping and ongoing assessment, mediate the successful implementation of UDL and DI in PE. These findings align with researcher who argue that UDL's emphasis on customizable learning pathways can mitigate the "one-size-fits-all" approach prevalent in conventional PE settings (Haegele et al., 2024). For example, integrating assistive technologies, such as AI-driven avatars for deaf students (Coy et al., 2025), or leveraging neurodiversity-affirming strategies, such as mindfulness-based interventions (Efthymiou, 2024). Such innovations not only enhance accessibility but also empower students to navigate PE with autonomy and confidence (Filmer, 2024; Gómez-Redondo et al., 2024).

Teacher training emerges as a pivotal factor in operationalizing UDL in PE. Studies reveal that pre-service and in-service educators often lack exposure to inclusive pedagogies, leading to reliance on outdated or exclusionary practices (Azizah et al., 2024; Rasmitadila et al., 2021). For instance, researchers found that hands-on training in adaptive lesson planning significantly improved teachers' self-efficacy and attitudes toward inclusion (Grimminger-Seidensticker & Seyda, 2022). Similarly, another study highlighted the efficacy of short, targeted professional development modules in enhancing educators' capacity to implement accommodations for students with autism (Filmer, 2024). These insights underscore the need for systemic reforms in teacher education programs, particularly in integrating UDL principles with evidence-based practices in adapted PE (Baek et al., 2024; Gonzales, 2020).

The role of technology in UDL-aligned PE cannot be overstated. Digital tools, such as AI algorithms for personalized feedback or virtual reality (VR) for motor skill development, offer novel avenues to democratize access to PE (Cai et al., 2024; Hutzler, 2020). For example, researchers proposed AI-mediated real-time translation systems to bridge communication gaps

between deaf students and non-signing PE instructors, fostering collaborative learning environments (Coy et al., 2025). Furthermore, another study emphasized the potential of ChatGPT and adaptive learning platforms to sustain student engagement in hybrid or online PE contexts (Jones & Baran, 2023). However, the ethical and practical implications of these technologies—such as ensuring equitable access and avoiding over-reliance on digital interfaces—warrant careful consideration (Bansal et al., 2024; Prager & Bilge, 2024).

Despite its promise, the application of UDL in PE faces critical scrutiny researchers caution that the theoretical appeal of UDL has not been matched by rigorous empirical validation in PE contexts (Haegele et al., 2024). Their systematic review identified a paucity of high-quality studies evaluating UDL's impact on student outcomes, particularly in low-resource settings (Haegele et al., 2024). Additionally, socio-cultural factors, such as institutional resistance to curricular innovation or entrenched biases toward disability, can impede UDL's implementation (Lunde, 2020; Subban et al., 2023). For instance, a study documented systemic mismatches between inclusive policies and classroom practices in Japanese universities, highlighting the need for culturally responsive adaptations of UDL frameworks (Dyliaeva et al., 2024).

Current literature underscores significant gaps in applying Universal Design for Learning (UDL) principles to physical education (PE), particularly in addressing the diverse needs of students with disabilities. While UDL is widely advocated for fostering inclusive classrooms (Mintz, 2024), empirical validation of its efficacy in PE remains sparse, with studies critiquing the lack of theoretically grounded research and practical frameworks tailored to PE contexts (Haegele et al., 2024). Existing works, such as another study, emphasize UDL's relationship with differentiated instruction but overlook PE-specific challenges, such as adapting motor skill development or managing heterogeneous abilities in dynamic environments (Cai et al., 2024). Key unresolved issues include inconsistent teacher preparedness, as highlighted by researchers, who note that PE pre-service teachers often lack training in UDL-aligned strategies like flexible grouping or adaptive assessments (Grimminger-Seidensticker & Seyda, 2022). Furthermore, systemic barriers—such as rigid curricula and inadequate institutional support—hinder the

translation of UDL principles into practice, as evidenced by researchers (Fierro-Saldaña & Treviño-Villarreal, 2025).

These gaps perpetuate inequities, limiting access to meaningful PE experiences for marginalized learners. This study addresses these shortcomings by investigating how UDL can be operationalized in PE through evidence-based pedagogical adjustments, teacher training interventions, and policy reforms. By bridging theoretical insights from inclusive education with PE-specific practices, the research aims to advance both scholarly discourse and practical implementation (Hutzler, 2020; Norwich, 2023), ensuring UDL's potential is fully realized in fostering equitable, adaptable, and engaging PE environments. This study aims to develop and validate a pedagogical framework for integrating Universal Design for Learning (UDL) principles into physical education (PE) to address the persistent inequities faced by students with diverse abilities.

Specifically, it seeks to: (1) identify UDL-aligned instructional strategies that enhance accessibility, engagement, and skill development in PE; (2) evaluate the efficacy of teacher training interventions in fostering UDL competency among PE educators; and (3) propose systemic reforms to bridge the gap between inclusive policy mandates and classroom implementation. By synthesizing insights from inclusive education theory and empirical critiques of UDL in PE, this research will advance theoretical discourse by contextualizing UDL within the unique demands of PE, such as adaptive motor skill instruction and dynamic group management. Practically, it will contribute evidence-based tools—such as modular lesson plans and competency assessment rubrics—to address documented challenges like inconsistent teacher preparedness (Grimminger-Seidensticker & Seyda, 2022), and rigid curricular structures (Fierro-Saldaña & Treviño-Villarreal, 2025). The study's significance lies in its potential to transform PE into a universally accessible discipline, ensuring equitable participation for neurodiverse learners and students with disabilities while informing policy revisions and professional development programs.

## 2. Materials and Methods

The Materials and Methods should be described with sufficient details to allow others to replicate and build on the published results. Please note that the publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the availability of materials or information. New methods and protocols should be described in detail while well-established methods can be briefly described and appropriately cited.

### *Search Strategy*

This systematic literature review employed a structured approach to investigate the application of Universal Design for Learning (UDL) in Physical Education (PE). Six multidisciplinary databases were selected for their relevance to education, health, and sports sciences: SciELO, Taylor & Francis, PubMed, Sage Journals, ScienceDirect, and Human Kinetics Journals. The search strategy combined controlled vocabulary (e.g., MeSH terms) and keywords, optimized through iterative pilot testing. Keywords and Boolean Operators: Core terms included *"Universal Design for Learning"* (and its abbreviation *"UDL"*), *"Physical Education"*, and *"inclusive education"*. Boolean operators were applied to balance sensitivity and specificity: AND narrowed results to studies intersecting UDL and PE. OR captured synonyms (e.g., *"adaptive pedagogy"*) and variant spellings. The final search string was: ("Universal Design for Learning" OR UDL OR "inclusive curriculum design") AND ("Physical Education" OR "adaptive physical activity" OR "inclusive PE"). Filters: Timeframe: 2015–2023 (to prioritize recent advancements while acknowledging UDL's emergence in the mid-2000s). Language: English and Portuguese, ensuring coverage of key contributions from Lusophone regions. Publication type: Peer-reviewed articles, book chapters, and empirical studies (e.g., experimental, case studies).

### *Inclusion and Exclusion Criteria*

Studies were screened in three phases (title, abstract, full text) using predefined criteria: Inclusion: Explicit focus on UDL principles (engagement, representation, action/expression) within

PE contexts. Empirical research, theoretical frameworks, or practice-based case studies. Published between 2015–2025 in English or Portuguese. Exclusion: Studies mentioning UDL peripherally without substantive application to PE. Grey literature, dissertations, or non-peer-reviewed sources. Articles lacking methodologial rigor (e.g., undefined samples, unreplicated results).

## 3. Results

*Studies Characteristics and Synthesis*

As illustrated in Table 1, the research was conducted in various databases, with each entry indicating the number of documents found and their respective titles. It is evident that the extant literature on the subject, namely Universal Design for Learning (UDL) in Physical Education (PE), is limited and nascent. The database with the most publications is Taylor & Francis. Subsequent to the search, the entirety of the texts was reviewed, and it was determined that one document from the Human Kinetics Journal, titled "Universal Design for Learning in Physical Education," be excluded due to its presentation of merely the introduction to a book. Notably, no scientific articles on this subject were found in Portuguese.

**Table 1.** Databases used in the research, number and title of article retrieved from each one

| **Database** | **Articles** Nº | **Title** |
|---|---|---|
| SciELO | 0 | |
| Taylor & Francis | 4 | Designing Inclusive Physical Education with Universal Design for Learning (Gilbert, 2019)<br>Infusing Universal Design for Learning into Physical Education Professional Preparation Programs (Lieberman & Houston-Wilson, 2017)<br>Universal Design for Learning as a Curriculum Development Tool in Physical Education (Kennedy & Yun, 2019)<br>Applying Universal Design for Learning and the Inclusion Spectrum for Students with Severe Disabilities in General Physical Education (Grenier et al., 2017) |
| Pubmed | 1 | Universal Design for Learning and Differentiated Instruction in Physical Education (Munster et al., 2019) |

| | | |
|---|---|---|
| Sage Journals | 1 | Universal design for learning in physical education: Overview and critical reflection (Haegele et al., 2023) |
| Science direct | 0 | |
| Human Kinetics Journals | 2 | Universal Design for Learning in Physical Education (Lieberman et al., 2020)<br>Developing a Universal Design for Learning Pedagogy: Perspectives of Students with and Without Disabilities (Lieberman et al., 2024) |

Table 2 presents the seven articles selected for the study following a rigorous search.

**Table 2:** Author, year, title and main ideas of the selected articles

| Author and year | Title | Key Result |
|---|---|---|
| Grenier et al. (2017) | Applying Universal Design for Learning and the Inclusion Spectrum for Students with Severe Disabilities in General Physical Education | The importance of collaborative practice and the use of UDL to create a learning environment accessible to all is highlighted. It is suggested that you use the principles of UDL to plan and teach your classes. |
| Gilbert, E. N. (2019) | Designing Inclusive Physical Education with Universal Design for Learning | We must continue to fight for true inclusion so that all students have access to the curriculum.<br>The use of UDL is an important strategy for creating a learning environment that is more adapted to everyone's needs, using, for example,<br>instructional support, student choice and the use of different media for instruction (video, verbal, kinesthetic and photos). |
| Lieberman et al. (2019) | Infusing Universal Design for Learning into Physical Education Professional Preparation Programs | They advise PE teachers to use UDL in their classes.<br>How this tool can be used is explained.<br>Examples are given for the application of UDL in the PE classroom, namely in assessment, lesson activities and teaching/learning. |

| | | |
|---|---|---|
| Kennedy et al., (2019) | Universal Design for Learning as a Curriculum Development Tool in Physical Education | UDL is a tool that has become very useful and popular for promoting inclusion in the classroom.<br>In the PE classroom, the appropriate use of UDL can help teachers to include students with disabilities in their lessons.<br>It presents strategies that teachers can use in the classroom using UDL. |
| Van Munster et al. (2019) | Universal Design for Learning and Differentiated | It presents different approaches used by PE teachers to include students with disabilities in their classes, based on the principles of UDL. |
| | Instruction in Physical Education | Differentiated instruction, program adaptations and pedagogical accommodations are the UDL principles most often used and which stand out significantly in the inclusion of students with disabilities in PE. |
| Haegele et al., (2023) | Universal design for learning in physical education: Overview and critical reflection | UDL has been advocated by researchers in adapted physical education as a solution to solve the challenges associated with teaching students with and without disabilities in the PE classroom.<br>There is an urgent need for researchers to develop a scientific evidence base related to AUD and PE, so that PE teachers can make research-based decisions. |
| (Lieberman, et. Al., 2024) | Developing a Universal Design for Learning Pedagogy: Perspectives of Students with and Without Disabilities | UDL has often been approached as a strategy implemented exclusively to benefit students with disabilities.<br>Recent studies reveal a clear need for this approach in PE.<br>There is a need to implement UDL in PE for all students.<br>The results highlight the need for action to promote an inclusive pedagogy that addresses student variability. |

## 4. Discussion

The integration of Universal Design for Learning (UDL) into physical education (PE) has emerged as a critical framework for fostering inclusive environments that accommodate diverse learners, including students with disabilities. Drawing on recent scholarship, this discussion synthesizes key findings, evaluates challenges, and proposes future directions for UDL implementation in PE. The analysis integrates insights from theoretical, empirical, and practical perspectives.

### UDL as a Framework for Collaborative and Inclusive Practices

UDL's core principles—multiple means of engagement, representation, and action/expression—have been widely advocated to address the variability of student needs in PE (Haegele et al., 2024). Researchers emphasize collaborative practices between general and adapted PE teachers to co-design accessible learning environments (Grenier et al., 2017). This aligns with broader research highlighting the role of systemic coherence, where teacher commitment, flexible grouping, and adaptive teaching strategies are essential for inclusion (Fierro-Saldaña & Treviño-Villarreal, 2025). For instance, a study underscores evidence-based practices in adapted PE, such as modifying equipment or instructional clarity, which resonate with UDL's emphasis on differentiation (Hutzler, 2020). However, systemic barriers, such as rigid procedural requirements for accommodations in higher education institutions, as observed in Japanese universities (Haegele et al., 2024), reveal gaps between policy and practice that hinder UDL's full potential.

The necessity of teacher training is a recurring theme. A study argues that UDL requires educators to adopt diverse instructional methods, such as multimedia resources (e.g., videos, kinesthetic demonstrations and student choice (Mintz, 2024). This aligns with findings by researchers, who identify a growth mindset and ongoing assessment as mediators between UDL and differentiated instruction (DI) (Cai et al., 2024). Similarly, another study demonstrate that short online interventions can improve teachers' self-efficacy in accommodating students with autism, suggesting scalable solutions for UDL adoption (Baek et al., 2024).

## Differentiated Instruction and Pedagogical Adaptations

UDL's intersection with DI is pivotal for addressing individual learning needs. A study identify DI, curriculum adaptations, and pedagogical accommodations as the most effective UDL-aligned strategies in PE (Carter et al., 2023a). For example, flexible grouping—a UDL principle—enables peer-mediated learning, reducing reliance on teacher-directed instruction (Gentilini, 2021). This is supported by researchers, who found that pre-service teachers who combined theoretical knowledge with practical PE lessons exhibited higher confidence in inclusive practices (Grimminger-Seidensticker & Seyda, 2022). However, challenges persist. Researchers critique the lack of empirical evidence supporting UDL's efficacy in PE, urging researchers to move beyond theoretical advocacy (Haegele et al., 2024). Their call is echoed in studies on teacher preparedness; another study note that Indonesian teachers often rely on external support (e.g., shadow teachers) rather than intrinsic pedagogical adjustments, highlighting systemic reliance on human resources over structural UDL integration (Azizah et al., 2024).

## Critical Reflections on UDL Implementation

While UDL is lauded for promoting equity, its application in PE requires critical scrutiny. Researchers challenge the misconception that UDL exclusively benefits students with disabilities, advocating instead for its universal application to address all learners' variability (Vieira et al., 2024). This aligns with another study, who stress collective responsibility among stakeholders—teachers, parents, and policymakers—to create inclusive ecosystems (Subban et al., 2023). Technological advancements, such as AI-driven tools for real-time communication with Deaf students (Coy et al., 2025), or ChatGPT for personalized feedback in online learning (Bansal et al., 2024), exemplify UDL's potential. However, digital divides and cultural relevance remain barriers. A study notes that African educators often lack localized UDL guidelines, relying on international frameworks like the Salamanca Statement without contextual adaptation (Chitiyo, 2024). Similarly, researchers highlight the need for culturally responsive UDL strategies in Kazakhstani vocational schools emphasizing that inclusivity must align with socio-cultural realities (Carter et al., 2023b).

### Systemic and Structural Challenges

The disconnect between UDL's ideals and classroom realities is exacerbated by systemic issues. A study identifies mismatches in accommodation implementation, where procedural rigidity (e.g., mandatory self-reporting by students) undermines inclusivity (Carter et al., 2023b). This is corroborated by another study, who find that Japanese universities struggle to reconcile legal mandates with practical inclusivity (Dyliaeva et al., 2024). Leadership and policy play crucial roles. Researchers argues that principals often lack training in inclusive education, necessitating reforms in educational leadership programs (Lunde, 2020). Similarly, another study critiques liberal perspectives on inclusion, advocating for democratic deliberation to resolve tensions between equity and pedagogical pragmatism (Mintz, 2024).

### Future Directions and Recommendations

To advance UDL in PE, the following recommendations emerge: Empirical Research: Rigorous studies, as urged by researchers, must evaluate UDL's impact on learning outcomes using mixed-methods designs (Coy et al., 2025). Teacher Training: Programs should integrate UDL and DI frameworks with hands-on practicums, as demonstrated by another study (Grimminger-Seidensticker & Seyda, 2022). Policy Reforms: Governments must mandate UDL-aligned curricula and provide funding for assistive technologies, as seen in discussions on digital literacy (Prager & Bilge, 2024). Community Engagement: Collaborative models, such as the Multilevel Community Engagement Model, can bridge gaps between schools, families, and policymakers (Raza, 2024).

## 5. Conclusions

The analysis of the articles selected for this literature review offers a comprehensive and, at the same time, detailed view on the application of UDL in PE, providing valuable insights that reinforce the importance and effectiveness of this methodology in promoting inclusive and accessible learning environments for all. It is perceived the methodological diversity and flexibility that can be used through the implementation of this tool, as a teaching strategy. Therefore, and

through the analysis of the articles presented, it is concluded that UDL in PE presents a promising panorama for the success of students in the PE class, as well as a successful theme for academics.

## 6. Patents

**Author Contributions:** For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; methodology, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; software, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; validation, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; formal analysis, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; investigation, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; resources, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; data curation, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; writing—original draft preparation, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; writing—review and editing, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; visualization, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; supervision, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; project administration, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI; funding acquisition, Carla LOURENÇO, Omar BEN RAKAA, Issam EL BOUHALI, Mustapha BASSIRI & Said LOTFI. All authors have read and agreed to the published version of the manuscript.

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