



Learning and Development in Digitally Mediated Physical Education: A Bibliometric and Thematic Evolution Analysis of Online, Open Distance, and Technology-Enhanced Learning (2015–2025)

Joseph Lobo^{1,2ABCDE}

¹Bulacan State University

²INTI International University

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

Corresponding Author: Joseph Lobo, e-mail: joseph.lobob@bulsu.edu.ph

Accepted for Publication: May 28, 2026

Published: July 8, 2026

DOI: 10.17309/tmfv.2026.4.02

Abstract

Objectives. As physical education increasingly intersects with digital learning, artificial intelligence, and flexible modes of delivery, the field faces a critical question of how movement-based education can remain pedagogically meaningful in technologically mediated environments. This study mapped the global scholarship on digitally mediated physical education from 2015 to 2025, focusing on online, open-distance, and technology-enhanced learning.

Materials and Methods. Using a bibliometric design with thematic evolution analysis, 1,358 Scopus-indexed documents were examined using Bibliometrix/Biblioshiny and VOSviewer.

Results. The results revealed a rapidly expanding and interdisciplinary field shaped by the convergence of pedagogy, educational technology, artificial intelligence, public health, and computational learning systems. Conceptually, the literature was anchored in artificial intelligence, COVID-19, online learning, higher education, blended learning, distance learning, virtual reality, physical activity, digital technology, and educational technology. Bibliographic coupling and co-citation analyses showed that the field is sustained by both core pedagogical traditions and emerging technological knowledge bases. Thematic evolution indicated a progression from early ICT and blended learning applications toward pandemic-responsive online physical education and, more recently, AI-supported, immersive, teacher-oriented, and learner-centered digital pedagogies.

Conclusions. The study positions digitally mediated physical education as a developing learning-and-development field requiring stronger pedagogical, ethical, and theoretical grounding.

Keywords: digitally mediated physical education, online learning, open distance learning, artificial intelligence, bibliometric analysis, thematic evolution.

Introduction

Physical Education (PE) occupies a distinctive position in educational scholarship because it is not limited to the transmission of content knowledge or the performance of isolated movement skills. Rather, PE functions as an embodied learning environment where movement, cognition, affect, social interaction, health behavior, and personal development intersect. Bailey et al. (2009) emphasized

that PE and school sport may contribute to learners' physical, social, affective, and cognitive development when educational claims are supported by sound pedagogical practice. Lubans et al. (2010) further positioned fundamental movement skills as important foundations for children's and adolescents' physical, cognitive, and social development. In relation to instructional outcomes, Lonsdale et al. (2013) showed that PE-based interventions can increase students' moderate-to-vigorous physical activity when lessons are intentionally structured. Motivation is also central to PE's developmental function, as Haerens et al. (2010) linked students' motivational profiles in PE with the adoption of a

physically active lifestyle. These perspectives suggest that PE should be understood as a learning-and-development field in which movement experiences are connected to competence, motivation, participation, and long-term health-oriented behavior.

The increasing presence of digital technologies has complicated and expanded this traditional understanding of PE. Digital mediation does not simply transfer PE content from gymnasium to screen; it reconfigures how movement is demonstrated, practiced, monitored, assessed, and experienced. Gard (2014) anticipated that digitized health and PE would reshape how students encounter movement, health knowledge, and bodily learning. Enright and Gard (2016) similarly argued that media and digital technologies influence how sport and movement learning are socially and pedagogically organized. In broader educational settings, Boelens et al. (2017) identified flexibility, interaction, learning-process support, and affective climate as key design challenges in blended learning environments. Garrison and Kanuka (2004) further argued that blended learning has transformative potential when online and face-to-face learning are meaningfully integrated. Applied to PE, these arguments indicate that digital, blended, and open distance modes should not be viewed as neutral delivery systems, but as pedagogical environments that reshape participation, feedback, embodiment, and learner engagement.

The expansion of online learning, artificial intelligence, virtual reality, learning analytics, mobile learning, and teacher-facing digital tools has further widened the scope of digitally mediated PE. Rasheed et al. (2020) showed that the online component of blended learning introduces challenges related to learner self-regulation, technological readiness, teacher competence, and institutional support. In teacher education, Phelps et al. (2021) found that preservice PE teachers use technology for planning, instruction, and assessment, but also encounter barriers that point to the need for stronger technology-related preparation. Merchant et al. (2014) demonstrated that virtual reality-based instruction can influence learning outcomes across K-12 and higher education settings. Ifenthaler and Yau (2020) showed that learning analytics can support study success when data are used to provide meaningful feedback and learner support. Crompton and Burke (2023) documented the rapid expansion of artificial intelligence in higher education, suggesting that AI-supported learning has become increasingly important in contemporary digital pedagogy. These developments indicate that digitally mediated PE is no longer limited to online instruction or pandemic-era remote teaching, but now includes intelligent, immersive, data-informed, and technology-enhanced approaches to movement learning and learner development.

Despite this expansion, scholarship on digitally mediated PE remains marked by a methodological and pedagogical contradiction. On the one hand, digital learning, artificial intelligence, online instruction, open distance education, virtual reality, and educational technologies are increasingly being used to describe new possibilities for PE. On the other hand, much of this scholarship is dispersed across PE pedagogy, educational technology, public health, teacher education, sport science, and computationally oriented research, making it difficult to determine whether the field is developing around the embodied, relational, and

developmental purposes of PE or being absorbed into broader technology-driven educational discourse. This creates a scientific problem for PE scholarship because the expansion of digital tools does not automatically clarify how movement learning, motivation, feedback, participation, teacher preparation, and learner development are being conceptually organized in digitally mediated environments. Without a bibliometric and thematic synthesis, the field risks appearing as a collection of platform-based, pandemic-responsive, AI-oriented, or EdTech-adjacent studies rather than as a coherent PE-centered learning-and-development research area. Donthu et al. (2021) noted that bibliometric analysis is useful for examining large volumes of scientific data and identifying the evolutionary nuances and emerging areas of a field, while Aria and Cuccurullo (2017) emphasized that science mapping tools such as Bibliometrix support comprehensive workflows for identifying the structure and development of research fields. Therefore, this study conducts a bibliometric and thematic evolution analysis of digitally mediated PE scholarship from 2015 to 2025, focusing on online, open distance, and technology-enhanced learning. By doing so, it aims to clarify how digitally mediated PE has developed as a PE-centered learning-and-development field, identify the intellectual and conceptual structures shaping its growth, and explain how pedagogical, technological, and learner-development concerns have transformed over time.

Materials and Methods

Research design

This study employed a bibliometric research design complemented by thematic evolution analysis to map the development of digitally mediated physical education scholarship from 2015 to 2025. The analysis focused on literature related to online learning, open distance learning, blended and hybrid learning, e-learning, artificial intelligence, virtual learning, educational technology, and other technology-enhanced approaches in Physical Education. A bibliometric approach was appropriate because it enabled the systematic examination of publication trends, citation patterns, collaboration networks, conceptual structures, and intellectual foundations within the field (Hoang, 2025). Thematic evolution analysis further supported the identification of how major topics shifted over time, particularly from early digital and blended learning applications toward online instruction, AI-supported learning, immersive technologies, and learner-centered digital pedagogy.

Data Source and Search Strategy

Table 1 summarizes the search strategy and inclusion parameters of the study, including the Scopus retrieval date. The bibliographic data were retrieved from Scopus using the TITLE-ABS-KEY field, which enabled the capture of records whose titles, abstracts, or keywords reflected the focus of the study. Scopus was selected because it provides structured bibliographic metadata suitable for bibliometric analysis, including source titles, author information, affiliations, citations, abstracts, and keywords. The search strategy combined Physical Education-related terms with digital learning and technology-related terms to ensure that

the corpus remained anchored in PE while capturing its interdisciplinary links with online learning, open distance education, blended learning, artificial intelligence, virtual learning, and educational technology.

The search was intentionally broad because digitally mediated PE is indexed across several overlapping terminologies. However, records were retrieved only when PE-related terms such as “physical education,” “movement education,” “sport pedagogy,” “physical education teacher education,” or “PETE” intersected with digital or technology-related terms within the same TITLE-ABS-KEY search field. This PE-centered search architecture was used to minimize the retrieval of general educational technology, artificial intelligence, or online learning studies that were not connected to PE, movement learning, sport pedagogy, or PETE. The search was restricted to English-language articles, reviews, and conference papers published from 2015 to 2025.

Table 1. Search strategy and inclusion parameters

Parameter	Description
Database & indexes	Scopus
Search field	TITLE-ABS-KEY
Search string	TITLE-ABS-KEY ((“physical education” OR “physical educat*” OR “movement education” OR “sport pedagogy” OR “physical education teacher education” OR “PETE”) AND (“online learning” OR “online teaching” OR “online instruction” OR “online education” OR “distance learning” OR “distance education” OR “open distance learning” OR “open and distance learning” OR “ODL” OR “remote learning” OR “remote teaching” OR “remote instruction” OR “e-learning” OR “elearning” OR “mobile learning” OR “m-learning” OR “virtual learning” OR “virtual teaching” OR “virtual instruction” OR “digital learning” OR “digital teaching” OR “digital instruction” OR “technology-enhanced learning” OR “technology enhanced learning” OR “blended learning” OR “hybrid learning” OR “flexible learning” OR “modular distance learning” OR “emergency remote teaching” OR “learning management system” OR “LMS” OR “digital platform” OR “online platform” OR “ICT” OR “educational technology” OR “digital technology” OR “artificial intelligence” OR AI)) AND (LIMIT-TO (DOCTYPE, “ar”) OR LIMIT-TO (DOCTYPE, “cp”) OR LIMIT-TO (DOCTYPE, “re”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “j”) OR LIMIT-TO (SRCTYPE, “p”))
Language	English
Document types	Article, Review and Conference Papers
Retrieval date	April 24, 2026
Final timespan of corpus	2015-2025

Eligibility Criteria and Corpus Delimitation

Records were included if they were indexed in Scopus as English-language articles, reviews, or conference papers published between 2015 and 2025 and were substantively connected to digitally mediated PE. The initial search yielded 1,605 records, which were screened and manually refined to ensure PE-centered relevance. Records were retained when they focused on online or open distance PE, blended or hybrid PE, technology-enhanced PE pedagogy, AI-supported PE, virtual or digital movement learning, PE teacher education, sport pedagogy, physical activity instruction, or PE-related learner development. Records were excluded when they primarily belonged to general educational technology, AI in education, online learning, open distance education, computer science, public health, or generic higher education without an explicit PE, movement education, sport pedagogy, or physical activity instruction focus.

Screening was conducted through an iterative eligibility-verification process. Titles, abstracts, author keywords, index keywords, source titles, and subject-area information were examined to determine whether each record was aligned with digitally mediated PE. Borderline records were rechecked after data cleaning, particularly those positioned between PE, general EdTech, AI-supported education, public health, and computational learning systems. Following corpus delimitation, the final dataset comprised 1,358 documents published across 525 sources and authored by 3,399 scholars. The corpus consisted of journal articles (n = 1,005), conference papers (n = 307), and reviews (n = 46).

Data Cleaning and Preprocessing

The retrieved records were screened and cleaned before analysis to improve consistency, relevance, and reliability. The process involved checking bibliographic fields for formatting inconsistencies, removing records outside the retained document categories, and manually excluding documents that did not align with the study’s focus on digitally mediated PE. Titles, abstracts, author keywords, index keywords, source titles, and subject-area information were examined to determine whether each record demonstrated an explicit connection to PE, movement learning, sport pedagogy, physical activity instruction, PETE, or PE-related learner development. Furthermore, a verification pass was conducted after the initial cleaning to recheck borderline records, particularly those positioned between PE, general educational technology, AI-supported education, public health, online learning, and computational learning systems. Records with uncertain relevance were reassessed against the eligibility criteria and were retained only when their PE-centered or movement-learning connection was explicit in the bibliographic information. Author’s Keywords were also reviewed and standardized to reduce fragmentation caused by spelling variation, capitalization, hyphenation, singular and plural forms, and closely related terms. A thesaurus file was used in VOSviewer to merge equivalent terms and improve the clarity of keyword co-occurrence, bibliographic coupling, and co-citation visualizations.

Bibliometric Analysis

The cleaned dataset was analyzed using Bibliometrix/Biblioshiny for descriptive bibliometric outputs and thematic

evolution (Aria & Cuccurullo, 2017, 2026), while VOSviewer was used for science mapping and network visualization (Bukar et al., 2023). Descriptive analysis summarized the field's publication growth, source productivity, author contributions, citation characteristics, document types, and collaboration indicators. Co-authorship and country collaboration analyses were used to examine collaborative patterns, while keyword co-occurrence analysis mapped the conceptual structure of the field. Bibliographic coupling at the source level identified contemporary research-front relationships among publication outlets, whereas co-citation analysis examined the shared intellectual foundations of the field. Trend-topic and thematic evolution analyses were also conducted to identify how major themes in digitally mediated Physical Education changed across the study period.

Network Thresholds and Visualization Parameters

Thresholds were selected to balance inclusiveness, readability, and interpretive clarity. Rather than maximizing the number of displayed items, the analysis retained settings that produced coherent and analytically meaningful network structures. The final thresholds were set at a minimum of 5 documents for country co-authorship, 9 occurrences for Author's Keyword co-occurrence, 10 documents for source-level bibliographic coupling, and 20 citations for source co-citation analysis. Author-level co-authorship was initially examined, but the resulting map was not sufficiently clear for interpretation; therefore, the country-level network was emphasized to capture international collaboration patterns more effectively. In the visualizations, nodes represented countries, keywords, sources, or cited sources depending on the analysis conducted, while links indicated the strength of association between items. Node size reflected relative prominence, and colors represented clusters of closely related items.

Source Composition and Interpretive Approach

The final corpus reflected the interdisciplinary character of digitally mediated PE, with sources drawn from PE pedagogy, sport education, educational technology, public health, computer science, and conference-based publication venues. This composition was considered appropriate because digitally mediated PE is not developed exclusively within traditional PE journals, but also through technological, computational, and health-oriented research spaces. Source interpretation distinguished between core PE and sport pedagogy outlets, educational technology and public health journals, and technology-oriented conference proceedings. Core PE and sport pedagogy sources were interpreted as more directly connected to movement learning, pedagogy, teacher education, and learner development, while technology-oriented and conference-based sources were interpreted as evidence of the field's broader digital and computational expansion.

Ethical Statement

This study relied exclusively on bibliographic records indexed in Scopus and did not involve human participants,

personal data, or direct intervention. This study has been exempted for ethical review by the Bulacan State University-Research Ethics Committee (BulSU-ERC) BulSUERC-2026-0145-EX.

Results

Descriptive Profile and Publication Growth

The final dataset comprised 1,358 documents published between 2015 and 2025 across 525 sources, indicating that digitally mediated Physical Education has become a substantial and visible research area. The corpus recorded an annual growth rate of 24.00%, an average document age of 3.90 years, and 9.61 citations per document, with 42,641 references supporting the dataset. The presence of 4,286 Keywords Plus and 3,141 Author Keywords further suggests a thematically diverse field shaped by online learning, distance education, artificial intelligence, digital technologies, blended learning, physical activity, and educational innovation. The authorship and document profile indicate a collaborative and article-driven field. A total of 3,399 authors contributed to the corpus, with 279 single-authored documents and an average of 3.31 co-authors per document. International co-authorship accounted for 15.39%, suggesting moderate cross-national collaboration. Journal articles dominated the corpus ($n = 1,005$), followed by conference papers ($n = 307$) and reviews ($n = 46$), reflecting the field's grounding in peer-reviewed research while also showing the influence of technology- and innovation-oriented conference outputs. Annual production, shown in Figure 1, demonstrates strong growth across the period. Output increased from 32 publications in 2015 to 56 in 2019, then rose sharply during the pandemic period, reaching 91 in 2020 and 218 in 2021. Although production declined in 2022 and 2023, it accelerated again in the most recent years, reaching 223 publications in 2024 and peaking at 275 in 2025. This pattern suggests that digitally mediated PE has moved beyond a temporary COVID-19 response and has become a sustained research area concerned with digital pedagogy, AI-supported learning, flexible delivery, and learner development.

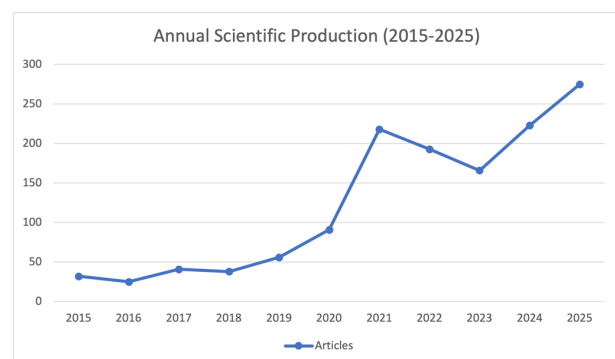


Fig. 1. Annual scientific production in digitally mediated physical education scholarship

Citation impact varied across annual cohorts, largely reflecting differences in citation maturity. Earlier and mid-period publications recorded higher mean total citations

per article, with 2017 showing the highest value (21.34), followed by 2020 (19.87), 2018 (19.05), and 2019 (17.46). When normalized by citable years, 2020 recorded the strongest mean citation performance (2.84 citations per year), suggesting that pandemic-era scholarship became an important point of consolidation for research on online, remote, and digitally mediated physical education. More recent publications, particularly those from 2024 and 2025, should be interpreted cautiously because they have had less time to accumulate citations. The citation profile indicates meaningful scholarly visibility while also reflecting the expected temporal effects of citation accrual.

Leading Sources, Authors, Affiliations and Influential Documents

As shown in Table 2, scholarship on digitally mediated PE is distributed across a distinctly interdisciplinary publication base, shaped by conference proceedings, Physical Education journals, sport pedagogy outlets, educational technology sources, and broader health and public health journals. The Journal of Physics: Conference Series emerged as the most productive source with 44 articles, followed by the ACM International Conference Proceeding Series with 39 articles. This pattern indicates the strong presence of computational, technological, and conference-based scholarship within the field, particularly in relation to artificial intelligence, digital systems, learning technologies, and technology-enhanced educational applications. At the same time, the presence of Journal of Physical Education and Sport with 36 articles, Sport, Education and Society with 27 articles, Journal of Teaching in Physical Education with 26 articles, Retos with 25 articles, European Physical Education Review with 19 articles, and Journal of Physical Education, Recreation and Dance with 19 articles confirms that the field remains firmly anchored in PE pedagogy, sport education, teacher education, and movement-based learning. Additional contributions from Applied Mathematics and Nonlinear Sciences and the International Journal of Environmental Research and Public Health further suggest that digitally mediated PE has developed at the intersection of computational methods, pedagogical innovation, health promotion, and educational development.

Table 2. Most relevant sources within the corpus (2015–2025)

Sources	Number of articles
Journal of Physics: Conference Series	44
ACM International Conference Proceeding Series	39
Journal of Physical Education and Sport	36
Applied Mathematics and Nonlinear Sciences	33
International Journal of Environmental Research and Public Health	27
Sport, Education and Society	27
Journal of Teaching in Physical Education	26
Retos	25
European Physical Education Review	19
Journal of Physical Education, Recreation and Dance	19

The author citation profile presented in Table 3 likewise points to a recognizable group of influential contributors whose work has shaped the scholarly conversation around technology, pedagogy, online learning, and Physical Education. Goodyear, V. A. emerged as the most cited author within the corpus with 114 citations, followed by Wang, Y. with 108 citations, Casey, A. with 84 citations, and Calderón, A. with 83 citations. Other highly cited authors included Killian, C. M. with 81 citations, Sargent, J. with 68 citations, Armour, K. M. with 59 citations, González-Calvo, G. with 57 citations, Marttinen, R. with 56 citations, and Macphail, A. with 48 citations. This pattern suggests that the field is shaped by scholars working across Physical Education pedagogy, digital technology, online and blended instruction, teacher education, and pandemic-related pedagogical adaptation. Rather than reflecting a purely technical or platform-driven body of research, the author citation profile indicates that digitally mediated PE is strongly informed by pedagogical, sociocultural, and teacher-centered perspectives.

Table 3. Most cited authors within the corpus (2015–2025)

Author	Citations
Goodyear, V. A.	114
Wang, Y.	108
Casey, A.	84
Calderón, A.	83
Killian, C. M.	81
Sargent, J.	68
Armour, K. M.	59
González-Calvo, G.	57
Marttinen, R.	56
Macphail, A.	48

Table 4 presents the most locally cited documents, which indicate the key intellectual anchors of the corpus. Casey et al. (2017) ranked first with 53 local citations and 190 global citations, highlighting the field's concern with the relationship between pedagogy, technology, and learning in health and Physical Education. This is followed by Jeong and So (2020) and three were recommended teachers making efforts to improve the online classes offered by the Korea Ministry of Education. A qualitative case study method employing phenomenological procedures to collect and analyze the data was used. The difficulties of operating middle and high school online physical education classes for the first time included (1, whose work on online PE during the pandemic received 47 local citations and 125 global citations, reflecting the strong influence of COVID-19-related remote instruction research. The remaining highly cited documents further show that the field is shaped by four major concerns: digital pedagogy, pandemic-driven instructional change, artificial intelligence, and online or blended PE. Studies by Varea et al. (2022) where close proximity and physical contact is common, particularly in Spain which has a high proximity culture. Significantly, the delivery of PE has changed because of the Covid-19 pandemic, and this brings significant consequences for preservice PE teachers. Purpose: The aim of the paper is to explore the changes of PE during Covid-19 and the effects on

pre-service teachers. Methods: Semi-structured interviews were used to produce data with a group of 12 preservice PE teachers from Spain (four women and eight men, Lee and Lee (2021) including education. AI can also provide special support to learners through academic sustainability or discontinuation predictions. While AI research remains in its early stages, we must examine how it evolves and exerts its potential over time. By utilizing AI in physical education (PE, Mercier et al. (2021)362, Bodsworth and Goodyear (2017), Killian et al. (2019), O'Brien et al. (2020), Howley (2022) and Chan et al. (2021) collectively point to a literature centered on technology integration, teacher adaptation, remote learning, AI-supported PE, and digital instructional models.

At the institutional level, Table 5 indicates an internationally distributed but selective network of affiliations contributing to digitally mediated PE scholarship. Deakin University emerged as the most productive affiliation with 21 articles, followed by the University of Limerick (15) and the University of Granada (11). A second group of productive institutions included Australian Catholic University, Universiti Sains Malaysia, and the University of New Hampshire (10). Additional contributions came from

Universiti Putra Malaysia (9), and Dublin City University, Loughborough University, and Lviv Polytechnic National University (8). This affiliation profile suggests that the field is not concentrated in a single geographic or institutional center. Instead, it is sustained by a distributed international network of universities with strengths in PE, sport pedagogy, teacher education, educational technology, and health-related research.

Table 5. Most relevant affiliations within the corpus (2015–2025)

Affiliation	Articles
Deakin University	21
University of Limerick	15
University of Granada	11
Australian Catholic University	10
Universiti Sains Malaysia	10
University of New Hampshire	10
Universiti Putra Malaysia	9
Dublin City University	8
Loughborough University	8
Lviv Polytechnic National University	8

Table 4. Most cited documents within the corpus (2015–2025)

Document	Local citations	Global citations
Casey, A., Goodyear, V. A., & Armour, K. M. (2017). Rethinking the relationship between pedagogy, technology and learning in health and physical education. <i>Sport, Education and Society</i> , 22(2), 288–304. https://doi.org/10.1080/13573322.2016.1226792	53	190
Jeong, H.-C., & So, W.-Y. (2020). Difficulties of Online Physical Education Classes in Middle and High School and an Efficient Operation Plan to Address Them. <i>International Journal of Environmental Research and Public Health</i> , 17(19), 7279–7279. https://doi.org/10.3390/ijerph17197279	47	125
Varea, V., González-Calvo, G., & García-Monge, A. (2022). Exploring the changes of physical education in the age of Covid-19. <i>Physical Education and Sport Pedagogy</i> , 27(1), 32–42. https://doi.org/10.1080/17408989.2020.1861233	40	127
Lee, H. S., & Lee, J. (2021). Applying Artificial Intelligence in Physical Education and Future Perspectives. <i>Sustainability</i> , 13(1), 351. https://doi.org/10.3390/su13010351	39	149
Mercier, K., Centeio, E., Garn, A., Erwin, H., Marttinen, R., & Foley, J. (2021). Physical Education Teachers' Experiences With Remote Instruction During the Initial Phase of the COVID-19 Pandemic. <i>Journal of Teaching in Physical Education</i> , 40(2), 337–342. https://doi.org/10.1123/jtpe.2020-0272	39	84
Bodsworth, H., & Goodyear, V. A. (2017). Barriers and facilitators to using digital technologies in the Cooperative Learning model in physical education. <i>Physical Education and Sport Pedagogy</i> , 22(6), 563–579. https://doi.org/10.1080/17408989.2017.1294672	36	129
Killian, C. M., Kinder, C. J., & Woods, A. M. (2019). Online and Blended Instruction in K–12 Physical Education: A Scoping Review. <i>Kinesiology Review</i> , 8(2), 110–129. https://doi.org/10.1123/kr.2019-0003	29	56
O'Brien, W., Adamakis, M., O'Brien, N., Onofre, M., Martins, J., Dania, A., Makopoulou, K., Herold, F., Ng, K., & Costa, J. (2020). Implications for European Physical Education Teacher Education during the COVID-19 pandemic: A cross-institutional SWOT analysis. <i>European Journal of Teacher Education</i> , 43(4), 503–522. https://doi.org/10.1080/02619768.2020.1823963	29	101
Howley, D. (2022). Experiences of teaching and learning in K-12 physical education during COVID-19: An international comparative case study. <i>Physical Education and Sport Pedagogy</i> , 27(6), 608–625. https://doi.org/10.1080/17408989.2021.1922658	25	41
Chan, W. K., Leung, K. I., Hoc, C., Wuc, W., Lam, K. Y., Wong, N. L., Chan, C. Y. R., Leung, K. M., & Tse, A. C. Y. (2021). Effectiveness of online teaching in physical education during covid-19 school closures: A survey study of frontline physical education teachers in Hong Kong. <i>Journal of Physical Education and Sport</i> , 21(4), 1622–1628. https://doi.org/10.7752/jpes.2021.04205	24	41

Collaborative Structure of the Field

Author-level co-authorship was initially examined, but the network was not sufficiently clear for interpretation. Collaboration was therefore analyzed at the country level. As shown in Figure 2, 52 countries were connected in the final network, indicating that digitally mediated PE scholarship has developed a broad international collaboration base. The network shows that collaboration is global but unevenly distributed. China appears as the most central hub, with the largest node and multiple cross-national links. Other countries contribute to the connected structure, but with comparatively smaller and less central positions. Overall, the map suggests that the field is internationally networked, yet collaboration remains concentrated around a limited number of highly active countries.

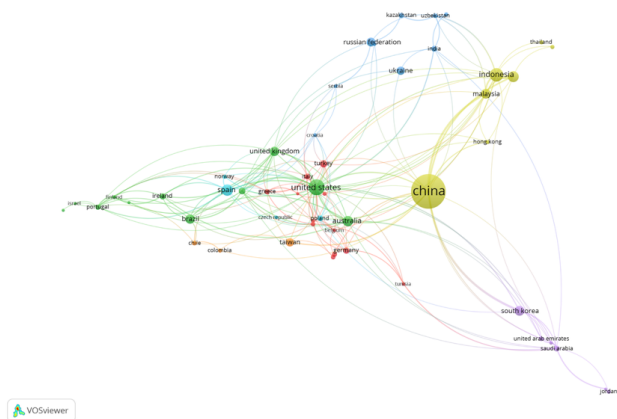


Fig. 2. Country co-authorship network map in digitally mediated physical education scholarship

The countries' collaboration world map in Figure 3 reinforces the international but uneven structure of digitally mediated Physical Education scholarship. Cross-national collaboration is most visible around China, which appears as the most prominent hub, alongside strong linkages involving the United States, Australia, India, Canada, and parts of Europe and Southeast Asia. Although the map shows broad geographic reach, the collaboration pattern remains concentrated among a limited number of highly active countries rather than being evenly distributed across all regions. This suggests that the field has become globally connected, but its international knowledge production is still shaped by selective and dominant research hubs.

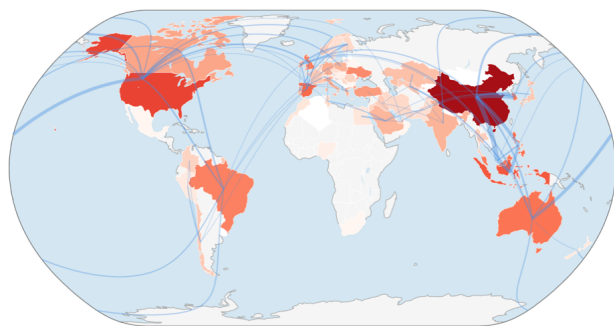


Fig. 3. Countries' collaboration world map in digitally mediated physical education scholarship

Conceptual Structure of the Field

The conceptual structure of digitally mediated PE scholarship was examined through a co-occurrence analysis of Author Keywords using a minimum threshold of 9 occurrences. At this level, 57 connected items formed 5 clusters (Figure 4), indicating that the field is conceptually organized around digital pedagogy, online delivery, teacher development, emerging technologies, and pandemic-related teaching and learning. The red cluster represents digital and blended learning applications in PE, including terms such as “blended learning,” “e-learning,” “flipped classroom,” “gamification,” “mobile learning,” “motivation,” “learning outcomes,” “physical activity” and “teacher training.” The green cluster reflects AI-driven and advanced technological systems, organized around “artificial intelligence,” “machine learning,” “deep learning,” “big data,” “internet of things (IoT),” “virtual reality,” “wearable technology” and “online physical education.” The blue cluster highlights online learning and teacher education, linking adapted “physical education,” “digital learning,” “distance learning,” “online learning,” “physical education teacher education,” “professional development” and “teacher education.” The yellow cluster captures pedagogical integration and instructional support, with terms such as “assessment,” “information and communications technology,” “pedagogy,” “teachers,” “technology integration” and “TPACK.” Finally, the purple cluster reflects pandemic-related and learner-centered concerns, centered on “COVID-19,” “online teaching,” “self-efficacy” and “student engagement.” The network shows that the field is structured by the convergence of pedagogy, digital delivery, intelligent technologies, and learner development.



Fig. 4. Co-occurrences network map in digitally mediated physical education scholarship

Table 6 further clarifies the conceptual profile of the field by identifying the most frequent Author Keywords in the corpus. “Artificial intelligence” emerged as the most frequent keyword with 150 occurrences and a total link strength of 116, indicating the growing prominence of intelligent systems and AI-supported applications in digitally mediated PE. “Covid-19” ranked second with 109 occurrences and the highest total link strength (132), confirming the pandemic’s strong role in accelerating research on online, remote,

and technology-supported PE. Other frequent keywords included “online learning” (85), “higher education” (81), “blended learning” (66), “distance learning” (64), “virtual reality” (61), “physical activity” (55), “digital technology” (54) and “educational technology” (48). These patterns suggest that the field is conceptually organized around AI, pandemic-responsive teaching, online and distance learning, higher education contexts, immersive technologies, physical activity, and broader educational technology integration.

Table 6. Most frequent Author’s Keywords

Rank	Author’s Keyword	Occurrences	Total link strength
1	Artificial intelligence	150	116
2	Covid-19	109	132
3	Online learning	85	97
4	Higher education	81	92
5	Blended learning	66	78
6	Distance learning	64	61
7	Virtual reality	61	52
8	Physical activity	55	78
9	Digital technology	54	55
10	Educational technology	48	50

Furthermore, the trend-topics analysis shows a clear temporal shift in digitally mediated Physical Education scholarship. Earlier topics were associated with “multimedia technology,” “health and physical education,” “adapted physical education,” “mobile learning,” “flipped classroom” and “digital learning,” suggesting an initial emphasis on technology-supported instruction and early digital applications in PE. Around the pandemic period, terms such as “college physical education,” “teaching,” “COVID-19,” “blended learning” and “physical activity” became more visible, reflecting the field’s response to remote instruction, flexible delivery, and activity-based learning during educational disruption. In the most recent period, the literature increasingly centered on “online learning,” “digital technology,” “artificial intelligence,” “educational technology,” “virtual reality,” “gamification” and “student engagement.” This pattern suggests that the field has moved from general digital and blended delivery toward more specialized concerns involving AI-supported learning, immersive technologies, learner engagement, and future-oriented digital pedagogy.

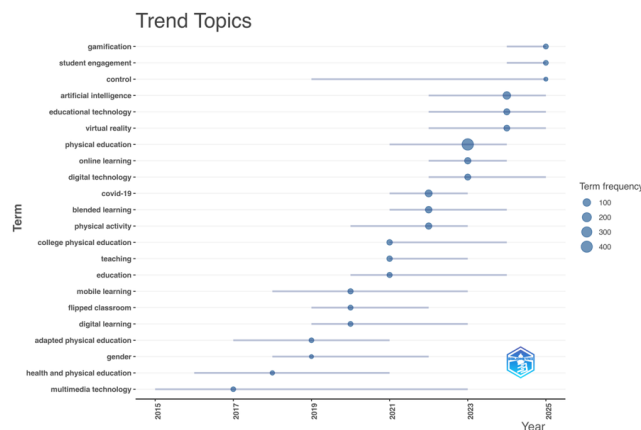


Fig. 5. Trend topics based on Author’s Keywords in digitally mediated physical education scholarship

Figure 6 presents the thematic evolution of digitally mediated PE scholarship across four periods. During 2015-2018, the field was mainly shaped by early digital and instructional themes such as “physical education,” “ICT,” “digital technologies,” “blended learning model,” “motor activity,” “cooperative learning” and “autonomous motivation.” In 2019-2021, the themes shifted toward “digital technologies,” “blended learning,” “COVID-19,” “students,” “college physical education,” “online adapted physical education” and adapted “physical education,” reflecting the strong influence of pandemic-related instructional changes. By 2022-2023, the field became more technologically diversified, with themes such as “artificial intelligence,” “internet of things,” “health promotion,” “action recognition,” “online education,” “teacher education” and “fully online teaching” becoming more visible. In the most recent period, 2024-2025, the literature moved further toward “online learning,” “artificial intelligence,” “ICT,” “pre-service teacher training,” “academic self-efficacy,” “autonomous motivation,” “virtual reality technology” and “digital technologies.” The thematic evolution suggests that the field has progressed from early ICT-based and blended learning applications toward a broader digital learning-and-development ecosystem shaped by AI, online delivery, teacher preparation, learner motivation, and immersive technologies.

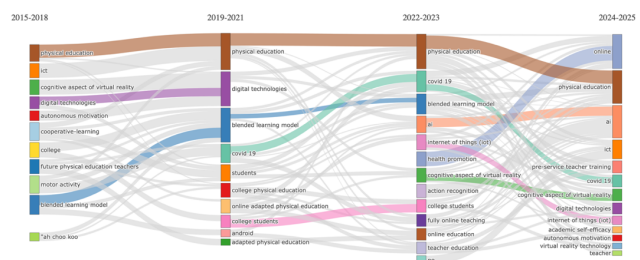


Fig. 6. Thematic Evolution of scholarship in mediated physical education

Intellectual Structure of the Field

The bibliographic coupling map in Figure 7 shows that the contemporary research front of digitally mediated Physical Education is organized into four source clusters. The red cluster represents technology- and computation-oriented outlets, including Journal of Physics: Conference Series, ACM International Conference Proceeding Series, Applied Mathematics and Nonlinear Sciences, and related sources. The green cluster reflects educational technology and public-health-oriented research, with sources such as Education and Information Technologies, Education Sciences, Frontiers in Public Health, and Interactive Learning Environments. The blue cluster represents the core Physical Education and sport pedagogy literature, including Journal of Teaching in Physical Education, Physical Education and Sport Pedagogy, Sport, Education and Society, and European Physical Education Review. The yellow cluster appears as a smaller peripheral conference-based stream. The map suggests that the field is shaped by the convergence of computational innovation, educational technology, public health, and PE pedagogy.

Table 7. Bibliographic coupling clusters of sources

Cluster	Theme	Sources (n)	Representative sources
1	Computational, AI, and Technology-Driven Learning Systems in Physical Education	15	ACM International Conference Proceeding Series; Applied Mathematics and Nonlinear Sciences; Computer-aided Design and Applications; Frontiers in Psychology
2	Digital Pedagogy, Online Learning, and Health-Oriented Educational Development	6	Education and Information Technologies; Education Sciences; Frontiers in Public Health; Interactive Learning Environment
3	Physical Education Pedagogy, Sport Education, and Movement-Based Learning	5	E3S Web of Conferences; European Physical Education Review; Journal of Teaching in Physical Education; Physical Education and Sport Pedagogy

Note: A small peripheral cluster composed of two sources, Journal of Physical Education, Recreation and Dance and Proceedings – 2021 International Conference on Information Technology and Contemporary Sports, TCS 2021, was retained in the visualization but not interpreted as a major cluster due to its limited size. This cluster may indicate a smaller practice-oriented stream linking applied Physical Education, sport technology, and professional innovation.

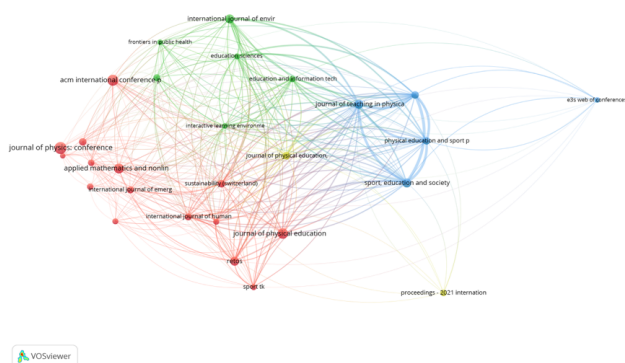


Fig. 7. Bibliographic coupling network in digitally mediated physical education scholarship

Table 7 further clarifies the intellectual structure of the field by showing that the publication front is organized into three major thematic clusters and one small peripheral cluster. Cluster 1 centers on computational, AI, and technology-driven learning systems in PE, bringing together sources linked to artificial intelligence, digital systems, and applied technological innovation. Cluster 2 reflects digital pedagogy, online learning, and health-oriented educational development, highlighting journals focused on educational technology, online instruction, and broader health-related learning contexts. Cluster 3 captures physical education pedagogy, sport education, and movement-based learning, indicating the continued importance of core PE and sport pedagogy outlets in shaping the field. A small peripheral cluster was also observed, suggesting a minor practice-oriented stream related to applied PE, sport technology, and professional innovation. These groupings show that the field is intellectually sustained by the convergence of technological innovation, digital pedagogy, and core Physical Education scholarship.

The co-citation analysis presented in Figure 8 further clarifies the foundational knowledge base of digitally mediated PE scholarship. Using a minimum threshold of 5 citations, the network formed 5 clusters, indicating that the field draws from several related but distinct citation traditions. The red cluster reflects PE pedagogy, assessment, and online education foundations, represented by sources such as Adapted Physical Activity Quarterly, American Journal of Distance Education, Assessment and Evaluation in Higher Education, and Australasian Journal of Educational

Technology. The green cluster represents medical, public health, and sports science foundations, including BMC Medical Education, BMC Public Health, BMJ, and British Journal of Sports Medicine. The blue cluster captures computational and analytics-oriented foundations, with sources such as Applied Sciences, CEUR Workshop Proceedings, Complexity, and Computational Intelligence and Neuroscience. The yellow cluster highlights psychology, public health, and behavioral-health perspectives, represented by Frontiers in Psychology, Frontiers in Sports and Active Living, International Journal of Behavioral Nutrition and Physical Activity, and International Journal of Environmental Research and Public Health. Finally, the purple cluster reflects core PE and sport pedagogy foundations, including Acta Gymnica, Asia-Pacific Journal of Health, Sport and Physical Education, Curriculum Studies in Health and Physical Education, and the books Digital Technologies and Learning in Physical Education and Digital Technology in Physical Education. The co-citation structure suggests that the field is grounded in PE pedagogy, public health, educational technology, and computational innovation.

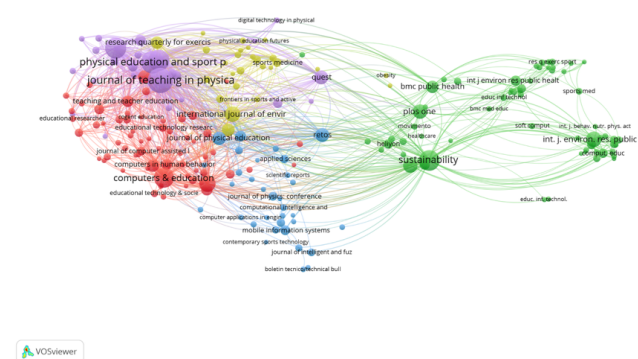


Fig. 8. Co-citation network in digitally mediated physical education scholarship

Discussion

Digitally Mediated Physical Education Has Moved Beyond Emergency Remote Teaching

The findings suggest that digitally mediated PE should no longer be interpreted merely as an emergency response

to educational disruption. Although the pandemic clearly accelerated online and remote PE scholarship, the field now appears to be moving toward a more durable digital learning ecosystem. This shift can be explained by the changing pedagogical function of technology in PE. In earlier applications, digital tools often served as instructional supplements for demonstration, communication, content delivery, or activity monitoring. Overtime, digital mediation became more central to how PE teachers organized participation, feedback, assessment, motivation, and learner interaction, especially when conventional face-to-face movement instruction was disrupted or reconfigured. This transformation reflects a movement from technology as delivery infrastructure to technology as pedagogical mediation. Casey et al. (2017) argued that digital technology in health and PE should be understood through its relationship with pedagogy and learning rather than as a neutral instructional add-on. This interpretation is reinforced by Casey and Jones (2011), who showed that digital technology can enhance student engagement in PE when embedded within meaningful pedagogical design. Similarly, Bodsworth and Goodyear (2017) demonstrated that technology integration becomes educationally valuable when it supports cooperative learning rather than merely digitizing existing practices. Goodyear et al. (2023) further emphasized that online physical activity interventions have potential when designed around engagement, participation, and pedagogical relevance rather than platform use alone. Therefore, the present findings indicate that digitally mediated PE has expanded because the field increasingly recognizes that technology does not simply transmit PE content; it reorganizes the conditions through which movement learning, engagement, feedback, and participation become possible.

Covid-19 Functioned as A Catalyst, Not the Final Identity of the Field

The prominence of COVID-19-related terms should be interpreted as a turning point in the field rather than as evidence that digitally mediated PE is limited to pandemic scholarship. The pandemic accelerated the field because it exposed a central pedagogical tension in PE. Movement learning has historically depended on physical co-presence, direct observation, embodied demonstration, immediate feedback, and social interaction, yet these conditions were suddenly displaced into remote and digitally mediated environments. This disruption forced PE scholars and teachers to examine what could still be preserved, adapted, or redesigned when the gymnasium, playing area, and shared physical space were no longer the default conditions for instruction. Jeong and So (2020) and three were recommended teachers making efforts to improve the online classes offered by the Korea Ministry of Education. A qualitative case study method employing phenomenological procedures to collect and analyze the data was used. The difficulties of operating middle and high school online physical education classes for the first time included (1) showed that online PE during school closures exposed difficulties in participation, feasibility, and instructional operation, making visible the pedagogical vulnerabilities of remote movement-based learning. Varea et al. (2022) where

close proximity and physical contact is common, particularly in Spain which has a high proximity culture. Significantly, the delivery of PE has changed because of the Covid-19 pandemic, and this brings significant consequences for preservice PE teachers. Purpose: The aim of the paper is to explore the changes of PE during Covid-19 and the effects on pre-service teachers. Methods: Semi-structured interviews were used to produce data with a group of 12 preservice PE teachers from Spain (four women and eight men similarly argued that the pandemic changed how PE was experienced and delivered, particularly because PE is traditionally embodied, social, and practice-based. Mercier et al. (2021)362 further showed that PE teachers' early experiences with remote instruction revealed substantial challenges in adaptation, communication, and instructional redesign. O'Brien et al. (2020) extended this concern to PETE, showing that the pandemic disrupted not only school PE delivery but also the preparation of future PE teachers. In this sense, COVID-19 became an epistemic catalyst because it made the field confront what counts as meaningful PE when embodiment, feedback, interaction, and participation are mediated through digital systems. The pandemic did not define the final identity of digitally mediated PE; rather, it revealed the pedagogical problems that later research on online learning, AI, virtual environments, and technology-enhanced instruction attempted to address.

The Emerging Field Requires Stronger Alignment Between Technology and Pedagogy

A major implication of the findings is that digitally mediated PE must be guided by pedagogy rather than by technological novelty. The thematic movement toward online learning, AI-supported instruction, teacher education, and digital platforms suggests that the field is evolving because PE teachers and scholars are increasingly required to translate movement-based learning into environments where demonstration, feedback, assessment, and interaction are no longer fully dependent on shared physical space. This creates a pedagogical design problem rather than a purely technical problem. Digital PE becomes meaningful only when technology helps teachers sustain the educational purposes of PE, including movement competence, motivation, inclusion, reflective learning, and lifelong physical activity orientation. Howley (2022) showed that teaching and learning in K-12 PE during COVID-19 varied across contexts, suggesting that digital delivery is shaped by institutional conditions, teacher capacity, and pedagogical interpretation. O'Brien et al. (2022) further demonstrated that pandemic-era PETE affected student teachers' practice and well-being, reinforcing the need to treat digital PE as a professional preparation issue rather than only a delivery issue. Lee and Lee (2021) including education. AI can also provide special support to learners through academic sustainability or discontinuation predictions. While AI research remains in its early stages, we must examine how it evolves and exerts its potential over time. By utilizing AI in physical education (PE positioned artificial intelligence as a future-facing resource for PE, particularly in areas such as learner evaluation, customized instruction, and feedback. However, Zawacki-Richter et al. (2019)2019 cautioned in the broader AI-in-education literature that AI applications often

advance faster than educators' pedagogical understanding of how these systems should shape teaching and learning. These works suggest that the epistemic direction of digitally mediated PE should not be determined by the availability of platforms, AI systems, or digital tools, but by their capacity to support learning quality, feedback, motivation, inclusion, and meaningful movement participation.

Immersive And Intelligent Technologies Are Expanding the Boundaries of PE Learning

The increasing visibility of artificial intelligence, virtual reality, mobile learning, and educational technology suggests that digitally mediated PE is entering a more technologically complex phase. This evolution can be explained by the search for tools that can extend or partially compensate for what PE traditionally provides through direct bodily presence. Terms/themes such as demonstration, movement feedback, spatial awareness, performance observation, peer interaction, and adaptive instruction. AI, VR, wearable technologies, and learning analytics become visible in the field because they promise new ways of monitoring movement, personalizing feedback, simulating activity environments, and supporting learner engagement beyond conventional classroom or gymnasium settings. Radianti et al. (2020) showed that immersive virtual reality in higher education requires careful attention to design elements, learning content, and theory, which is highly relevant for PE because movement learning depends on embodied, spatial, and experiential forms of participation. Bacca et al. (2014) similarly highlighted the educational potential of augmented reality, particularly when immersive technologies are aligned with learning tasks rather than treated as novelty tools. Bond et al. (2020) showed that educational technology research is increasingly tied to behavioral, affective, and cognitive engagement, which provides a useful lens for interpreting digital PE as a learner-development space. However, Goodyear et al. (2019) warned that wearable technologies in health and PE can produce surveillance, self-surveillance, and resistance, suggesting that digitally mediated PE must also be ethically examined. This concern becomes more urgent as AI, wearable devices, learning analytics, and platform-based PE increasingly involve bodily data, performance records, health indicators, movement traces, and learner behavior. Thus, the future of the field depends not only on whether AI, VR, and wearable tools can enhance instruction, but also on whether they can protect student safety, ensure data privacy, prevent harmful surveillance, support autonomy and inclusion, and promote healthy relationships with physical activity.

Future Research Should Foreground Learning and Development Rather Than Technology Alone

The strongest contribution of this field lies in repositioning digitally mediated PE as a learning-and-development environment rather than as a technology-adoption space. The thematic evolution observed in the corpus suggests that the field is gradually shifting from questions of access, delivery, and platform use toward deeper concerns about motivation, engagement, feedback, self-efficacy, teacher preparation, embodied learning, and learner development. PE cannot be evaluated only by whether technology enables

instruction to continue; it must also be examined according to whether digitally mediated experiences support meaningful movement participation, competence development, social connection, and long-term physical activity orientation. Lupton (2015) showed that digitized health and PE raise important questions about how bodies, data, and schooling are assembled through technology. Rich and Lupton (2022) similarly argued that digital biopedagogies require attention to how health, bodies, and learning are reorganized through sociomaterial relations. Ryan and Deci (2020) emphasized that motivation and well-being depend on conditions that support autonomy, competence, and relatedness, which is especially important when PE shifts into online, AI-supported, or technology-enhanced environments. Ennis (2017) argued that PE should educate students for lifelong physical activity by strengthening motivation, meaning, and mindful engagement. These perspectives suggest that future research should move beyond measuring access, platform use, or technological adoption and instead examine whether digitally mediated PE supports movement competence, self-efficacy, student engagement, physical activity behavior, psychosocial development, data safety, and lifelong participation. This learning-and-development agenda is where digitally mediated PE can become more than a technical adaptation; it can become a reimagined pedagogical space for developing physically active, motivated, safe, and self-regulating learners.

Conclusions

This study positions digitally mediated physical education as an evolving pedagogical field rather than a temporary instructional adjustment or a purely technology-driven extension of traditional PE. Its value lies not simply in documenting the expansion of online learning, open distance learning, artificial intelligence, virtual reality, blended instruction, and educational technologies, but in showing that these developments collectively signal a deeper reconfiguration of how movement, learning, engagement, assessment, teacher preparation, and learner development are being imagined in digital environments. The central challenge moving forward is not whether technology will continue to enter physical education, but whether it will be used in ways that preserve the embodied, relational, inclusive, and developmental purposes of the discipline. Future scholarship must therefore move beyond describing digital tools and begin asking stronger pedagogical questions about how digitally mediated PE can cultivate motivation, competence, self-efficacy, physical activity participation, and lifelong movement orientation. In this sense, the future of the field depends on maintaining a careful balance between technological innovation and the human-centered educational mission of PE.

Limitations

This study has several limitations that should be considered when interpreting its findings. First, the analysis was limited to Scopus-indexed documents; therefore, relevant publications indexed exclusively in Web of Science, ERIC, PubMed, Google Scholar, regional databases, or non-indexed professional outlets may not have been captured.

Second, although the search strategy was designed to delimit a PE-centered corpus, the interdisciplinary nature of digitally mediated PE means that some adjacent studies from educational technology, sport science, public health, computer science, or computational learning fields may have entered the dataset. Third, the inclusion of conference papers and non-core PE sources may have shaped some bibliometric patterns, particularly in relation to source productivity, keyword prominence, bibliographic coupling, and co-citation structures. Although these sources were retained because digitally mediated PE is partly shaped by technological, computational, and health-oriented scholarship, they may have increased the visibility of artificial intelligence, digital systems, educational technology, and applied computational themes relative to more traditional PE pedagogy themes. Fourth, bibliometric indicators such as citation counts, keyword frequency, co-occurrence, bibliographic coupling, and co-citation provide structural evidence of scholarly patterns, but they do not replace full-text critical appraisal of methodological quality, theoretical depth, pedagogical effectiveness, or learner-development outcomes. Finally, recent publications, particularly those from 2024 and 2025, may be underrepresented in citation-based influence because they have had limited time to accumulate citations.

Future Research Directions

Future research should move beyond documenting the presence of digital technologies in Physical Education and examine how these technologies actually shape learning quality, movement competence, motivation, self-efficacy, engagement, assessment, and long-term physical activity participation. Greater attention is needed to the pedagogical and ethical use of artificial intelligence, virtual reality, wearable technologies, learning analytics, and personalized feedback systems, particularly in relation to inclusion, data privacy, student autonomy, and embodied learning. Future studies may also compare digitally mediated PE across educational levels, cultural contexts, and resource conditions to determine how digital access, teacher readiness, institutional support, and curriculum design influence learner development. More empirical and theory-driven research is also needed to clarify whether online, blended, hybrid, and AI-supported PE can support not only instructional continuity, but also meaningful, inclusive, and developmentally responsive movement education.

Ethics Approval

This study relied exclusively on bibliographic records indexed in Scopus and did not involve human participants, personal data, or direct intervention. This study has been exempted for ethical review by the Bulacan State University-Research Ethics Committee (BulSU-ERC) BulSUERC-2026-0145-EX.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The bibliographic dataset was derived from records indexed in Scopus and analyzed using bibliometric software.

AI Transparency Statement

The author used ChatGPT 5.4+ by OpenAI during the preparation of this manuscript to assist with language refinement, organization, and drafting support. All intellectual decisions, interpretation of the literature, synthesis of ideas, and final approval of the manuscript remained the responsibility of the author.

Funding

The publication of this article is supported by the Bulacan State University through the Office of the Vice President for Research, Extension, and Innovation.

Acknowledgements

Not applicable

Conflicts of Interest

The author declares no conflict of interest.

References

- Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., & Sandford, R. (2009). The educational benefits claimed for physical education and school sport: An academic review. *Research Papers in Education*, 24(1), 1–27. <https://doi.org/10.1080/02671520701809817>
- Lubans, D.R., Morgan, P.J., Cliff, D.P., Barnett, L.M., & Okely, A.D. (2010). Fundamental Movement Skills in Children and Adolescents: Review of Associated Health Benefits. *Sports Medicine*, 40(12), 1019–1035. <https://doi.org/10.2165/11536850-000000000-00000>
- Lonsdale, C., Rosenkranz, R.R., Peralta, L.R., Bennie, A., Fahey, P., & Lubans, D.R. (2013). A systematic review and meta-analysis of interventions designed to increase moderate-to-vigorous physical activity in school physical education lessons. *Preventive Medicine*, 56(2), 152–161. <https://doi.org/10.1016/j.ypmed.2012.12.004>
- Haerens, L., Kirk, D., Cardon, G., De Bourdeaudhuij, I., & Vansteenkiste, M. (2010). Motivational profiles for secondary school physical education and its relationship to the adoption of a physically active lifestyle among university students. *European Physical Education Review*, 16(2), 117–139. <https://doi.org/10.1177/1356336X10381304>
- Gard, M. (2014). eHPE: A history of the future. *Sport, Education and Society*, 19(6), 827–845. <https://doi.org/10.1080/13573322.2014.938036>
- Enright, E., & Gard, M. (2016). Media, digital technology and learning in sport: A critical response to Hodkinson, Biesta and James. *Physical Education and Sport Pedagogy*, 21(1), 40–54. <https://doi.org/10.1080/17408989.2015.1043258>
- Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to the design of blended learning: A systematic literature review. *Educational Research Review*, 22, 1–18. <https://doi.org/10.1016/j.edurev.2017.06.001>
- Garrison, D.R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, 7(2), 95–105. <https://doi.org/10.1016/j.iheduc.2004.02.001>
- Rasheed, R.A., Kamsin, A., & Abdullah, N.A. (2020). Challenges in the online component of blended learning:

- A systematic review. *Computers & Education*, 144, 103701. <https://doi.org/10.1016/j.compedu.2019.103701>
- Phelps, A., Colburn, J., Hodges, M., Knipe, R., Doherty, B., & Keating, X.D. (2021). A qualitative exploration of technology use among preservice physical education teachers in a secondary methods course. *Teaching and Teacher Education*, 105, 103400. <https://doi.org/10.1016/j.tate.2021.103400>
- Merchant, Z., Goetz, E.T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T.J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, 70, 29–40. <https://doi.org/10.1016/j.compedu.2013.07.033>
- Ifenthaler, D., & Yau, J.Y.-K. (2020). Utilising learning analytics to support study success in higher education: A systematic review. *Educational Technology Research and Development*, 68(4), 1961–1990. <https://doi.org/10.1007/s11423-020-09788-z>
- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, 20(1), 22. <https://doi.org/10.1186/s41239-023-00392-8>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W.M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Hoang, A.-D. (2025). Evaluating Bibliometrics Reviews: A Practical Guide for Peer Review and Critical Reading. *Evaluation Review*, 49(6), 1074–1102. <https://doi.org/10.1177/0193841X251336839>
- Aria, M., & Cuccurullo, C. (2026). *Science Mapping Analysis—A primer with Biblioshiny*. McGraw-Hill.
- Bukar, U.A., Sayeed, M.S., Razak, S.F. A., Yogarayan, S., Amodu, O.A., & Mahmood, R.A. R. (2023). A method for analyzing text using VOSviewer. *MethodsX*, 11, 102339. <https://doi.org/10.1016/j.mex.2023.102339>
- Casey, A., Goodyear, V.A., & Armour, K.M. (2017). Rethinking the relationship between pedagogy, technology and learning in health and physical education. *Sport, Education and Society*, 22(2), 288–304. <https://doi.org/10.1080/13573322.2016.1226792>
- Jeong, H.-C., & So, W.-Y. (2020). Difficulties of Online Physical Education Classes in Middle and High School and an Efficient Operation Plan to Address Them. *International Journal of Environmental Research and Public Health*, 17(19), 7279–7279. <https://doi.org/10.3390/ijerph17197279>
- Varea, V., González-Calvo, G., & García-Monge, A. (2022). Exploring the changes of physical education in the age of Covid-19. *Physical Education and Sport Pedagogy*, 27(1), 32–42. <https://doi.org/10.1080/17408989.2020.1861233>
- Lee, H.S., & Lee, J. (2021). Applying Artificial Intelligence in Physical Education and Future Perspectives. *Sustainability*, 13(1), 351. <https://doi.org/10.3390/su13010351>
- Mercier, K., Centeio, E., Garn, A., Erwin, H., Marttinen, R., & Foley, J. (2021). Physical Education Teachers' Experiences With Remote Instruction During the Initial Phase of the COVID-19 Pandemic. *Journal of Teaching in Physical Education*, 40(2), 337–342. <https://doi.org/10.1123/jtpe.2020-0272>
- Bodsworth, H., & Goodyear, V.A. (2017). Barriers and facilitators to using digital technologies in the Cooperative Learning model in physical education. *Physical Education and Sport Pedagogy*, 22(6), 563–579. <https://doi.org/10.1080/17408989.2017.1294672>
- Killian, C.M., Kinder, C.J., & Woods, A.M. (2019). Online and Blended Instruction in K–12 Physical Education: A Scoping Review. *Kinesiology Review*, 8(2), 110–129. <https://doi.org/10.1123/kr.2019-0003>
- O'Brien, W., Adamakis, M., O'Brien, N., Onofre, M., Martins, J., Dania, A., Makopoulou, K., Herold, F., Ng, K., & Costa, J. (2020). Implications for European Physical Education Teacher Education during the COVID-19 pandemic: A cross-institutional SWOT analysis. *European Journal of Teacher Education*, 43(4), 503–522. <https://doi.org/10.1080/02619768.2020.1823963>
- Howley, D. (2022). Experiences of teaching and learning in K-12 physical education during COVID-19: An international comparative case study. *Physical Education and Sport Pedagogy*, 27(6), 608–625. <https://doi.org/10.1080/17408989.2021.1922658>
- Chan, W.K., Leung, K.I., Hoc, C., Wuc, W., Lam, K.Y., Wong, N.L., Chan, C.Y. R., Leung, K.M., & Tse, A.C. Y. (2021). Effectiveness of online teaching in physical education during covid-19 school closures: A survey study of frontline physical education teachers in Hong Kong. *Journal of Physical Education and Sport*, 21(4), 1622–1628. <https://doi.org/10.7752/jpes.2021.04205>
- Casey, A., & Jones, B. (2011). Using digital technology to enhance student engagement in physical education. *Asia-Pacific Journal of Health, Sport and Physical Education*, 2(2), 51–66. <https://doi.org/10.1080/18377122.2011.9730351>
- Goodyear, V.A., Skinner, B., McKeever, J., & Griffiths, M. (2023). The influence of online physical activity interventions on children and young people's engagement with physical activity: A systematic review. *Physical Education and Sport Pedagogy*, 28(1), 94–108. <https://doi.org/10.1080/17408989.2021.1953459>
- O'Brien, N., O'Brien, W., Costa, J., & Adamakis, M. (2022). Physical education student teachers' wellbeing during Covid-19: Resilience resources and challenges from school placement. *European Physical Education Review*, 28(4), 873–889. <https://doi.org/10.1177/1356336X221088399>
- Zawacki-Richter, O., Marín, V.I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 39–39. <https://doi.org/10.1186/s41239-019-0171-0>
- Radianti, J., Majchrzak, T.A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778. <https://doi.org/10.1016/j.compedu.2019.103778>
- Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk, K. (2014). Augmented Reality Trends in Education: A Systematic Review of Research and Applications. *Educational Technology and Society*, 17(4), 133–149. <https://www.jstor.org/stable/jeductechsoci.17.4.133>
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: A systematic evidence map. *International Journal of Educational Technology in Higher Education*, 17(1), 2. <https://doi.org/10.1186/s41239-019-0176-8>

- Goodyear, V.A., Kerner, C., & Quennerstedt, M. (2019). Young people's uses of wearable healthy lifestyle technologies; surveillance, self-surveillance and resistance. *Sport, Education and Society*, 24(3), 212–225. <https://doi.org/10.1080/13573322.2017.1375907>
- Lupton, D. (2015). Data assemblages, sentient schools and digitised health and physical education (response to Gard). *Sport, Education and Society*, 20(1), 122–132. <https://doi.org/10.1080/13573322.2014.962496>
- Rich, E., & Lupton, D. (2022). Rethinking digital biopedagogies: How sociomaterial relations shape English secondary students' digital health practices. *Social Science & Medicine*, 311, 115348. <https://doi.org/10.1016/j.socscimed.2022.115348>
- Ryan, R.M., & Deci, E.L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Ennis, C.D. (2017). Educating Students for a Lifetime of Physical Activity: Enhancing Mindfulness, Motivation, and Meaning. *Research Quarterly for Exercise and Sport*, 88(3), 241–250. <https://doi.org/10.1080/02701367.2017.1342495>

Еволюція навчання у цифрово-опосередкованому фізичному вихованні: бібліометричний та тематичний аналіз онлайн-, відкритого дистанційного та технологічно підтримуваного навчання (2015–2025)

Джозеф Лобо^{1,2,ABCDE}

¹Державний університет Булакан

²Міжнародний університет ІНТІ

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

Реферат. Стаття: 14 с., 7 табл., 8 рис., 26 джерел.

Мета. Інтеграція фізичного виховання з цифровим навчанням, штучним інтелектом і гнучкими форматами організації освітнього процесу актуалізує питання збереження педагогічної цінності рухового навчання в технологічно опосередкованому освітньому середовищі. Метою дослідження було картографування світового наукового доробку з проблематики цифрово-опосередкованого фізичного виховання за 2015–2025 роки з акцентом на онлайн-, відкритому дистанційному та технологічно підтримуваному навчанні.

Матеріали та методи. Дослідження виконано з використанням бібліометричного дизайну та аналізу тематичної еволюції. Проаналізовано 1358 документів, індексованих у Scopus, із застосуванням програмних пакетів Bibliometrix/Biblioshiny та VOSviewer.

Результати. Результати засвідчили стрімкий розвиток міждисциплінарного напрямку досліджень, що формується на перетині педагогіки, освітніх технологій, штучного інтелекту, громадського здоров'я та комп'ютерних систем навчання. На концептуальному рівні науковий доробок був зосереджений навколо таких тем, як штучний інтелект, COVID-19, онлайн-навчання, вища освіта, змішане навчання, дистанційне навчання, віртуальна реальність, фізична активність, цифрові технології та освітні технології. Аналіз бібліографічного зв'язку та співцитовання показав, що цей науковий напрям спирається як на усталені педагогічні традиції, так і на нові технологічні бази знань. Аналіз тематичної еволюції виявив перехід від раннього використання інформаційно-комунікаційних технологій і змішаного навчання до онлайн-фізичного виховання, зумовленого пандемією COVID-19, а в подальшому — до цифрових педагогічних підходів, заснованих на використанні штучного інтелекту, імерсивних технологій, орієнтації на діяльність учителя та студентоцентрованому навчанні.

Висновки. Цифрово-опосередковане фізичне виховання визначено як напрям розвитку теорії та практики навчання, що перебуває на етапі становлення й потребує подальшого педагогічного, етичного та теоретичного обґрунтування.

Ключові слова: цифрово-опосередковане фізичне виховання, онлайн-навчання, відкрите дистанційне навчання, штучний інтелект, бібліометричний аналіз, тематична еволюція.

Information about the Authors:

Lobo, Joseph: joseph.lobo@bulsu.edu.ph; 0000-0002-2553-467X; College of Sports Exercise and Recreation, Bulacan State University, Guinhawa, City of Malolos, 3000, Bulacan, Philippines; Graduate School, Bulacan State University, Guinhawa, City of Malolos, 3000, Bulacan, Philippines; INTI International University, Nilai, Malaysia.

Cite this article as: Lobo, J. (2026). Learning and Development in Digitally Mediated Physical Education: A Bibliometric and Thematic Evolution Analysis of Online, Open Distance, and Technology-Enhanced Learning (2015–2025). *Physical Education Theory and Methodology*, 26(4), 655–668. <https://doi.org/10.17309/tmfv.2026.4.02>

Received: 10.05.2026. Accepted: 28.05.2026. Published: 08.07.2026

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