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Global research landscape on learning innovation in physical education: trends, collaboration networks, and future directions (2013–2022)

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ABSTRACT

Background: Innovation in physical education (PE) plays a key role in enhancing students' cognitive, affective, and psychomotor development. However, there is limited comprehensive mapping that captures global research trends, influential contributors, and thematic evolution related to learning innovation in PE over the past decade. **Objectives**: The objective of this study is to analyse publication trends, leading sources, influential authors and affiliations, collaboration networks, and thematic keyword patterns in global research on learning innovation in physical education from 2013–2022. **Methods**: A bibliometric analysis was conducted using Scopus-indexed journal articles (n = 867). Data were processed through VOSviewer (v1.6.19) and Publish or Perish to examine publication growth, prolific authors, affiliations, countries, journals, and keyword co-occurrence networks. **Finding/Results**: Publications showed a steady increase, peaking in 2022 (179 documents). Physical Education and Sport Pedagogy emerged as the most productive journal, while Universidad de Oviedo and China were the leading institutional and national contributors. Keyword clustering revealed five dominant themes: models-based practice, learning motivation, health-oriented PE, teacher professional development, and curriculum design. **Conclusion**: This study maps the global landscape of learning innovation in PE and highlights the growing shift toward learner-centred, theory-driven, and technology-enhanced pedagogical models. Future research should expand cross-regional collaboration, integrate multi-database analyses, and explore thematic evolution to capture dynamic shifts in PE innovation.

Keywords: Bibliometric; physical education; learning innovation; learning models; VOSviewer

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INTRODUCTION

Physical education (PE) plays an essential role in holistic student development, contributing not only to physical competence but also to emotional well-being, character formation, social skills, and critical thinking (García-Hermoso et al., 2020; Khairani et al., 2024; Khairani et al., 2024). As an academic discipline, PE must be positioned as a core component of education rather than secondary or supplementary (Pahliwandari, 2020; Sofyan et al., 2022). Innovation in PE is therefore crucial for ensuring that learning processes remain meaningful, sustainable, and responsive to emerging educational

challenges (Serdyukov, 2017). Recent pedagogical perspectives highlight the need for authentic, student-centered learning environments that promote responsible action, autonomous skill development, and ethical engagement in physical activity (Spittle et al., 2022; Yu & Yang, 2023).

In line with global shifts in education, the demand for innovative learning models—particularly those integrating technology—has grown significantly. Advances in learning strategies and digital tools are seen as critical for expanding accessible and flexible PE instruction, especially in contexts facing limitations of time, space, and instructional resources (Huang et al., 2025). Managing meaningful physical activity experiences has also emerged as a central challenge in contemporary PE pedagogy (Prat et al., 2019). As new instructional models and technologies continue to evolve, understanding how they shape PE learning becomes increasingly important for guiding effective practice and policy.

Despite the rapid growth of PE-related research, comprehensive bibliometric mapping of learning innovation in physical education remains limited. Studies often focus on specific pedagogical models (Fernandez-Rio & Iglesias, 2024; Wang et al., 2024) or isolated technological innovations (Almusawi et al., 2021), yet fail to present an integrated global overview of how research productivity, collaboration networks, themes, and knowledge structures have developed over time. This creates a gap in understanding the broader trajectory of innovation within PE. A systematic mapping of influential authors, institutions, countries, and thematic clusters is essential for situating the field within global academic developments and identifying underexplored areas requiring future inquiry.

Given the increasing importance of innovation—particularly following the acceleration of digitalisation and post-pandemic educational reforms—there is a pressing need to examine how learning models and innovative practices in PE have evolved globally. Bibliometric analysis provides a rigorous methodological approach to identify patterns of publication, conceptual structures, and collaborative relationships across large bodies of literature (Zupic & Čater, 2015). Unlike traditional narrative reviews, bibliometric methods offer objective, data-driven insights that help uncover research gaps, emerging themes, and influential scholarly contributions (Jiang et al., 2023; Byington et al., 2019; Markoulli et al., 2017).

This study therefore conducts a comprehensive bibliometric analysis of ten years (2013–2022) of global publications on learning innovation in physical education. Using VOSviewer and Publish or Perish, this research maps publication trends, identifies leading contributors, analyses collaboration patterns, and visualises thematic clusters within the field. Through this approach, the study offers a consolidated knowledge base and clearer direction for future pedagogical and research advancements. Based on these aims, the study addresses the following Research Questions (RQs):

RQ1. What are the global publication trends in research on learning innovation in physical education from 2013 to 2022?
RQ2. Which authors, institutions, countries, and journals are the most influential in advancing this research area?
RQ3. How are collaboration networks structured among researchers and institutions worldwide?
RQ4. What thematic clusters and keyword co-occurrence patterns characterise research on learning innovation in physical education?
RQ5. What research gaps and emerging themes can inform future studies in this field?

METHOD

Research Design

This study employed a bibliometric research design to analyse publication trends, collaboration networks, and thematic developments related to learning innovation in physical education over a 10-year period (2013–2022). A bibliometric approach was used because it enables systematic evaluation of scientific outputs through descriptive indicators and network visualisation.

Procedures

Metadata search in the Scopus database is carried out using a series of words: TITLE-ABS-KEY (“physical education” OR “sport* education” AND “learning” AND “innovation” OR “learning” AND "model*") AND PUBYEAR > 2012 AND PUBYEAR < 2023 AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (PUBSTAGE, “final”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “j”)), and downloading in the form of a file comma-separated value (CSV). In addition, several criteria are determined in the collection of this Scopus metadata, including: (i) years taken from 2013 to 2022. The timeframe of 2013-2022 was selected to reflect the most recent decade of scientific advancements in learning models and innovations within physical education. Starting in 2013, research in this area began a significant shift towards technology-driven, student-centered, and competency-based methodologies, aligning with international educational trends. The endpoint of 2022 was chosen to include the latest complete publication cycle available in Scopus, thereby ensuring data stability and relevance. As a result, this period provides a comprehensive and representative overview of contemporary research trends and thematic developments spanning a full decade, (ii) the publication stage of the final article, (iii) only articles of document type are retrieved, (iv) only English articles were taken, 5) types of scientific sources are only in journals. Found 871 documents from 2013-2022. The CSV file is converted into an Excel file for manual checking. After manually checking the Excel file format by duplicating values based on the article title, author, and DOI, four metadata or duplicate documents were found. On that basis, we deleted these documents, and only the final 867 documents were analysed using VOSviewer and Publish or Perish (PoP) software.

Analysis

To analyse the data, VOSviewer software is used to analyse keywords, abstracts, authors and affiliations. VOSviewer software can help researchers perform bibliometric analysis and visualise the results of bibliometric analysis (Akbari et al., 2020; Ezugwu et al., 2021; Hudha et al., 2020; Martínez-López et al., 2020; Shukla et al., 2020). It works comprehensively with a wide index of information and can provide a variety of engaging visuals, inspections, and investigations (van Eck & Waltman, 2010). Therefore, VOSviewer is the right choice in carrying out the analysis process in this study.

RESULTS AND DISCUSSION

Trends in the publication of learning models and innovations in physical education

The findings in Table 1 of the source co-citation analysis indicate that the journals most commonly co-occurring and constituting the primary theoretical foundation are: (i) *Physical Education and Sport Pedagogy*, (ii) *Journal of Teaching in Physical Education*, (iii) *European Physical Education Review*, (iv) *Sport, Education, and Society*, and (v) *Journal of Physical Education and Sport*. These five constitute the conceptual foundation of learning models and innovation in physical education, serving as the primary platform for disseminating research focused on pedagogy, learning innovation, and motivation theory.

Table 1. Profile of Publication Progress

Year	N	Scientific sources	N	Affiliate	N	Country	N
2022	179	Physical Education and Sport Pedagogy	73	Universidad de Oviedo	24	China	191
2021	157	Journal of Teaching in Physical Education	41	University of Limerick	22	United States	173
2020	109	European Physical Education Review	37	The University of North Carolina at Greensboro	18	Spain	123
2019	98	Journal of Physical Education and Sport	37	Loughborough University	17	United Kingdom	84
2018	57	Sport Education and Society	30	Universidad de Castilla-La Mancha	15	Australia	65
2017	82	International Journal of Environmental Research and Public Health	28	Auburn University	15	Indonesia	52
2016	54	Computational Intelligence and Neuroscience	24	Universidad de Extremadura	15	Canada	32
2015	49	International Journal of Human Movement and Sports Sciences	22	The Ohio State University	14	Portugal	29
2014	40	Journal of Physical Education Recreation and Dance	22	Universidade do Porto	14	Ireland	28
2013	42	Frontiers in Psychology	17	The University of Alabama	14	Italy	23

Author

Co-citation analysis in **Table 2** reveals that the most commonly co-cited papers originate from research focusing on model-based practice (MBP) methodologies, motivation theory, and cooperative learning within physical education. Several essential documents that provide theoretical grounds include: (i) Kuo et al. (2014) discuss the interplay between interaction, Internet self-efficacy, and self-regulated learning, emphasising the relevance of self-efficacy and self-regulated learning in online education as a basis for technological innovation, (ii) Kirk (2013) and Hastie and Casey (2014) serve as pivotal references in model-based practice (MBP), underscoring pedagogical frameworks aimed at authentic learning experiences, (iii) Vasconcellos et al. (2020) advanced self-determination theory (SDT). These co-citations demonstrate that research in this domain is grounded in social constructivist learning theory, self-determination theory (SDT), and model-based pedagogical strategies that prioritise student autonomy and innovative learning.

Table 2. Top 10 Authors with The Highest Number of Citations

Cites	Authors	Title	Year	Source
390	Y.-C. Kuo, A.E. Walker, K.E.E. Schroder, B.R. Hland	teraction, Internet self-efficacy, and lf-regulated learning as predictors of student satisfaction in online education courses	2014	Internet and Higher Education
218	D. Kirk	Educational Value and Models-Based Practice in Physical Education	2013	Educational Philosophy and Theory
177	D. Vasconcellos, P.D. Parker, T. Hilland, R. Cinelli, K.B. Owen, N. Kapsal, J. Lee, D. Antczak, N.	Self-Determination theory applied to physical education: A systematic review and meta-analysis	2020	Journal of Educational Psychology

Cites	Authors	Title	Year	Source
	Ntoumanis, R.M. Ryan, C. Lonsdale			
158	P.A. Hastie, A. Casey	Fidelity in models-based practice research in sport pedagogy: A guide for future investigation	2014	Journal of Teaching in Physical Education
131	L.M. Muratori, E.M. Lamberg, L. Quinn, S.V. Duff	Applying principles of motor learning and control to upper extremity rehabilitation	2013	Journal of Hand Therapy
131	A. Casey	Models-based practice: Great white hope or white elephant?	2014	Physical Education and Sport Pedagogy
126	A. Casey, V.A. Goodyear	Can Cooperative Learning Achieve the Four Learning Outcomes of Physical Education? A Review of Literature	2015	Quest
126	G. Raiola	Motor learning and teaching method	2017	Journal of Physical Education and Sport
107	V.A. Goodyear, A. Casey	Innovation with change: developing a community of practice to help teachers move beyond the â€˜honeymoonâ€™ of pedagogical rendition	2015	Physical Education and Sport Pedagogy
104	T.L. McKenzie, M.A.F. Lounsbery	Physical education teacher effectiveness in a public health context	2013	Research Quarterly for Exercise and Sport

Keyword

Of the 2,018 keywords with criteria that have been determined for at least 10 occurrences of these keywords, 24 keywords were found that met the threshold, after being entered in the thesaurus file. This file serves as a managed file to combine words with synonyms or singular/plural words. The distribution of occurrences and total link strength of the 31 keywords can be seen in **Table 3**. The keyword "physical education" is very dominant as a keyword that is always used related to the theme of learning models and innovations in physical education with a total of 268 appearances. This shows that these keywords are indeed the main choice used by writers as scientific identities.

Table 3. The Distribution of Occurrences and Total Link Strength of Keywords

Keyword	Occurrences	Total link strength	Keyword	Occurrences	Total link strength
Physical education	268	172	Curriculum	13	14
Physical activity	39	38	Primary school	13	15
Pedagogical model	37	40	Teaching	13	22
Models-based practice	31	44	Adolescents	12	14
Motivation	31	42	Education	12	8
Learning	25	31	Motor learning	12	6
Sport education	24	26	Sport	12	13
Pedagogy	23	31	Children	11	12
Self-determination theory	22	25	Health	11	17
Cooperative learning	20	19	Instructional models	11	13
Professional development	16	22	Professional learning	11	14
Teacher education	16	23	Students	10	7

The five keyword clusters in **Table 4** thematically delineate the conceptual framework and trajectory of research advancement in learning models and innovation within physical education. The red cluster functions as the principal axis that underscores the essence of physical education by implementing many creative learning methods, including model-based practice and cooperative learning, designed to enhance student

interaction, collaboration, and real learning experiences. The green cluster highlights the psychological aspects of learning through the themes of motivation and self-determination theory, which prioritise enhancing intrinsic motivation and student autonomy as essential for effective pedagogical innovation. The blue cluster illustrates a focus on health and physical education from an early age, highlighting the significance of including health, physical activity, and education in establishing active lifestyle patterns and sustaining fitness consciousness. The yellow cluster emphasises teacher professional development through pedagogy, teacher education, and professional learning, demonstrating that innovation's sustainability relies on teachers' ability to adopt new pedagogical methods. The purple cluster underscores the significance of curriculum and foundational skills acquisition through educational frameworks, motor learning, and primary education, accentuating the necessity of adaptive and developmentally appropriate curriculum design. This thematic framework illustrates that innovation in physical education is influenced not just by learning models but also by the synergistic interplay of motivation theories, health considerations, teacher professional development, and curriculum design tailored to learners' needs.

Table 4. 5 Keyword Clusters

Red	Green	Blue	Yellow	Purple
Cooperative Learning	Adolescents	Children	Pedagogy	Curriculum
Instructional Models	Motivation	Education	Professional Development	Motor Learning
Models-Based Practice	Self-Determination Theory	Health	Professional Learning	Primary School
Pedagogical Model	Sport	Learning	Teacher Education	Teaching
Physical Education	Students	Physical Activity		
Sport Education				

Figure 1 illustrates a density visualisation of the keyword analysis pertaining to learning innovation in physical education research. The hue and intensity of the illumination signify the density of occurrences and the strength of associations among keywords. Vivid red signifies regions with elevated frequency and robust total link strength, whereas pale green denotes places with diminished occurrence and weaker connections. This visualisation illustrates that the keyword "physical education" predominates in regions with maximum density (in red), signifying that the theme is the primary focus of the research. The yellow portions denote supporting topics such as "motivation," "physical activity," "pedagogical mo[35]," and "model-based practice," which, while less prominent, significantly contribute to the expansion of the pedagogical and theoretical framework within the domain of physical education. This density visualisation offers a thorough depiction of the concentration and emphasis of research within the literature, indicating that collaborative and practice-based learning models continue to be the focal points in the advancement of contemporary physical education research.

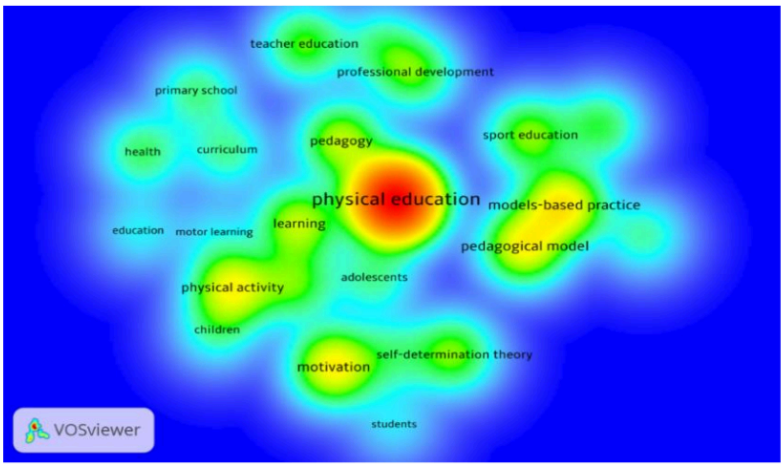

Figure 1. Author Keyword of Density Visualization

By year, there has been a trend of fluctuations over the past ten years. From 2013 to 2017 there was an increase in the number of publications every year which showed an increasing trend, although not too significant. Only from 2016 to 2017 has there been a significant increase with 32 publications added. However, in 2018, the publication trend has decreased significantly, namely 25 publications, so that in 2018 there were only 57 publications. 2019-2022 the trend has again increased significantly to three digits, and the peak of publication will occur in 2022 with 179 publications. Thus, the trend of publications related to learning models and innovations in physical education over the last 10 years (2013-2022) tends to experience a positive trend or increase overall.

Based on scientific sources, it is still dominated by journals from major publishers in the world. There is only one university-based journal (under university management), namely "*Journal of Physical Education and Sport*" under Editura Universitatea din Pitesti, Romania. As for the affiliation of the authors, it is still dominated by writers from universities/universities spread from countries in Europe and the United States. However, one thing that is interesting is that by country there are several countries from the Asian continent as the largest contributors in terms of documents that have been published, including China with a total of 191 documents and Indonesia with 52 documents..

According to the most cited paper, Kuo et al. (2014), student happiness with the learning experience is essential, particularly in distance education programs, since it is linked to both student success and the calibre of online programs. The literature provides strong evidence that student contact has a significant impact on student satisfaction. Additionally, Erragcha et al. (2022) highlighted that improved knowledge creation leads to higher student satisfaction in a collaborative learning environment that is rich in social interactions. Some literature portrays a dichotomy, despite concerns that participation may lead to dissatisfaction. However, research by Howson and Matos (2021) demonstrated that engagement and satisfaction were directly related, particularly when peer and academic staff contacts were taken into account. This implies that the nature of involvement in online learning settings must be taken into account for a thorough

understanding of pleasure.

Related to this research, "pedagogical models" and "models-based practice" are the keywords most often used by writers to thoroughly explore the problem of models and innovations in physical education learning. The pedagogical model is closely related to a plan that needs to be conceptualized and planned by an educator to respond and seek formulas for the success of the learning process. When creating a high-quality online education framework, Stukalo and Simakhova emphasise the importance of fundamental pedagogical concepts, including student engagement, creative approaches, and efficient evaluation techniques (Stukalo & Simakhova, 2020). According to Joshi (2022) research, a key component of online learning success is the incorporation of pedagogical practices at every stage of program design. A substantial investment in teacher preparation can help bridge the gap between traditional teaching methods and the requirements of distance learning (Tanucan, 2023). According to Almekhlafi et al. (2024), teachers often lack the pedagogical design skills necessary for effective online instruction, which has a detrimental impact on students' interest and motivation. Some of the problems that must be resolved include: (i) What content to teach, (ii) How this information can be grouped into controllable units, (iii) What's the most logical? order to present these units?, (iv) What content delivery method was most effective for the unit?

Meanwhile, model-based practice is an effort to better meet the requirements of students in all learning domains. By making learning relevant, Rahmah et al. (2024) emphasised the value of contextual learning frameworks in raising student satisfaction and engagement. According to Mahande et al. (2021), students can enhance their metacognitive abilities by actively participating in assignments that require introspection and critical thinking. Students benefit from environments that promote self-directed learning while also facilitating social interaction, according to Miao and Ma (2022) research, which found that self-regulation strategies incorporated into structured teaching practices significantly increased student engagement. As an up-to-date, innovative and new approach in physical education learning and other physical activity contexts that are intended to accommodate all physical education learning domains namely affective, cognitive and psychomotor. Compared to students learning using traditional techniques, PBL participants were more likely to take ownership of their education (Thamrin et al., 2018). Additionally, the Moving-Goal Football model was examined as an illustration of how targeted physical exercise might be designed to maximise learning benefits (Zulkarnaini et al., 2019). Khusna et al. (2022) emphasised how technology, such as the inaRISK program, facilitates project-based learning, which enhances students' cognitive and psychomotor abilities, as well as their comprehension of physical education concepts. Physical literacy enables students to actively engage in their education by practising not only their physical skills but also their cognitive and affective dispositions towards fitness and health, according to Bulqini et al. (2021). Additionally, Sotto (2021) study showed that these kinds of settings had a favourable effect on students' cognitive, affective, and psychomotor development, emphasising the advantages of cooperation in achieving a common objective, which improves social skills and emotional health.

CONCLUSION

This bibliometric analysis highlights a clear upward trend in publications on learning models and innovation in physical education during 2013-2022, with the peak occurring in 2022. Physical Education and Sport Pedagogy emerged as the most productive source, while Universidad de Oviedo and China were the leading contributors in institutional and

national output, respectively. Keyword clustering revealed five major thematic areas: (i) models-based practice, (ii) cooperative learning and motivation, (iii) pedagogical models, (iv) teacher education and professional development, and (v) technology-enhanced learning. These findings demonstrate a global shift toward learner-centered and innovation-driven approaches in physical education pedagogy. Future bibliometric studies should incorporate multiple databases, citation bursts, and thematic evolution analysis to capture more dynamic changes in this rapidly developing field.

This study was limited to Scopus-indexed journal articles, which may omit relevant papers indexed in WoS or other databases. Moreover, the analysis did not include citation bursts or thematic evolution, which could provide insights into temporal shifts in research focus. Therefore, it is highly recommended for future researchers to conduct in-depth studies regarding the various parameters that appear in this study, such as experimental research, meta-analysis, systematic literature review, or other research. This research is the basis and reference for conducting the research.

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