

# A Bibliometric Analysis of the Sports Education Model in Physical Education: Trends, Knowledge Structure, and Emerging Frontiers

Pangying<sup>1</sup>, Adjah Naqkiah Mazlan<sup>2</sup>

<sup>1</sup>Pangying, Faculty of Educational Sciences and Technology, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia, <sup>2</sup>Adjah Naqkiah Mazlan, Faculty of Educational Sciences and Technology, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

Email: adjahnaqkiah@utm.my

Corresponding Author Email: pangyingp@163.com

DOI Link: <http://dx.doi.org/10.6007/IJARPED/v15-i1/27394>

**Published Online:** 29 January 2026

## Abstract

**Purpose:** This study aims to track the research trends of Sport Education Model (SEM) from 1974 to 2025, and reveal the trends and frontiers. **Method:** Using a sample of 3315 documents from the WoS core collection, a four-layer quantitative framework of "statistics-co-occurrence-evolution-structure" was constructed using Bibliometrix, VOSviewer, CiteSpace, and Pajek. **Results:** There was a significant increase in output after 2005, with Europe, America, and China being the core contributors. Keywords and co-citations show a shift from curriculum structure to motivation, health, and digital integration, forming a "static core-dynamic periphery" knowledge pattern. **Discussion:** SEM has evolved from a teaching model to an interdisciplinary educational paradigm, but there is still a lack of multilingual evidence and longitudinal interventions. Future research should expand data sources and test its applicability in disadvantaged scenarios.

**Keywords:** Sport Education Model (SEM), Physical Education; Bibliometric Analysis, Research Trends, Knowledge Structure, Emerging Frontiers

## Introduction

Since Siedentop introduced the Sport Education Model (SEM) in the 1990s, it has emerged as a prominent paradigm for reforming school physical education (Chung et al., 2020). By simulating authentic sport competitions and assigning diverse roles to students, SEM not only improves physical fitness but also fosters social-emotional development, cooperation, and lifelong interest in physical activity (Hyun-Wook et al., 2018).

In the context of contemporary social science debates—particularly the global youth mental health crisis, declining physical activity levels, and increasing concerns about educational equity and digital transformation—SEM offers a promising student-centered approach to address these interconnected challenges (Shannon et al., 2021; Vassilis et al., 2022; Hiago et al., 2022). Recent empirical studies have demonstrated SEM's effectiveness in

enhancing autonomous motivation and basic psychological needs satisfaction (Casey & MacPhail, 2018; Kim et al., 2018), promoting health-related outcomes in diverse populations (Silva et al., 2022), and integrating digital tools to extend learning beyond the classroom (John et al., 2020). However, the long-term evolution of SEM research, its interdisciplinary knowledge structure, and its adaptability across linguistic and socioeconomic contexts remain under-explored.

The integration of psychology and sport science has expanded SEM research from pedagogical methods to broader topics, including learning motivation, basic psychological needs satisfaction, health promotion, and digital integration, gradually forming an interdisciplinary knowledge network (Vassilis et al., 2022; Silva et al., 2022). Systematic mapping of this development trajectory can clarify interdisciplinary co-creation in physical education theory and provide evidence-based support for teaching practices and public health policies (Hiago et al., 2022; Page et al., 2021).

However, existing reviews remain fragmented (Emma et al., 2020), lacking longitudinal quantitative analyses spanning multiple languages and the full period from 1974 to 2025. National and institutional differences, core author collaboration networks, and knowledge diffusion mechanisms have not been fully elucidated (Smith et al., 2021). Moreover, quantitative interpretations of knowledge structure and thematic evolution are limited, and the identification of emerging hotspots and frontiers requires more refined analysis.

The present study extends prior work by employing a comprehensive bibliometric approach to address these gaps, revealing how SEM has evolved into a multidimensional paradigm and identifying future directions in underrepresented contexts.

However, existing reviews still exhibit fragmented characteristics (Emma, van Sluijs, Donnelly, & Stamatakis, 2020); the lack of longitudinal quantitative studies spanning across languages and covering the years 1974–2025 makes it difficult to systematically present the evolution stages and features of SEM; national and institutional differences, core author collaboration networks, and knowledge diffusion mechanisms have not been fully revealed (Smith et al., 2021); furthermore, the quantitative interpretation of knowledge structure and thematic evolution remains weak, and the identification of hotspots and frontiers requires further refined analysis.

To address these limitations, this study utilizes the Web of Science Core Collection and employs Bibliometrix, VOSviewer, Pajek, and CiteSpace to construct a four-layer “statistics-co-occurrence-evolution-structure” quantitative framework for a systematic bibliometric review of SEM literature from 1974 to 2025.

The specific objectives are to:

- (1) depict publication trends and developmental stages over the past half-century;
- (2) analyze the aggregation and diffusion of global research contributions across countries and institutions;
- (3) reconstruct the knowledge structure and reveal its theoretical foundations;
- (4) identify emerging research frontiers and provide multidimensional evidence to deepen SEM theory, inform classroom practice, and promote adolescent health.

The scope encompasses 3315 peer-reviewed articles and reviews in multiple languages (English, Chinese, French, Spanish, German, Russian, and Portuguese), focusing exclusively on empirical and theoretical contributions related to the Sport Education Model in physical education contexts.

### **Methods**

This study utilized a systematic retrieval and bibliometric method to comprehensively present the research evolution, knowledge structure, and emerging frontiers of "sports education models" in the field of physical education (Rocio, Uceda, & De Pablo, 2020). Data were sourced from the Web of Science Core Collection, covering all document types fields, with a time range set from 1974 to 2025 to ensure capturing the complete historical context of the field's development. Data retrieval was conducted from April 15th to 30th, 2025, to ensure the analysis is based on the most recent available data.

During the identification phase, the study established the core theme of "Sports Education Model in Physical Education" and used Boolean logic to construct key word groups, including various expressions such as "Sport Education Model," "Sport Pedagogy," and "PE Curriculum," to ensure comprehensive coverage of the topic. A preliminary search yielded a total of 3578 relevant records. To enhance the scientific rigor of the screening process, gray literature, non-topic articles, editorials, and informal publications were first excluded.

Subsequently, during the screening phase, the study established three specific criteria; firstly, limiting the time frame to 1974-2025 to cover the entire process of the development and proposal of sports education model theories; secondly, filtering the literature types, retaining only journal articles and reviews, with languages limited to English, Chinese, French, Spanish, German, Russian, and Portuguese to ensure semantic accuracy and international representation; thirdly, manually screening based on titles and abstracts to exclude literature that does not match the research topic or lacks empirical design, ultimately selecting 3315 articles as the sample for quantitative analysis.

During the inclusion phase, the study clearly states that all final literature meets the preset inclusion criteria, which must have empirical research design, focus on the theme of "physical education models" in sports education, and be formally published in international journals; these literature are imported into visualization tools such as Bibliometrix, VOSviewer, and CiteSpace for analysis to support a systematic characterization of trends in literature quantity, collaboration networks, theme evolution, and knowledge structure.

In summary, this study strictly adhered to the PRISMA framework in methodology, ensuring the representativeness and scientificity of sample literature through multi-level screening. By combining various analytical tools, it achieved an in-depth interpretation from macro trends to micro structures, providing a solid empirical basis for the knowledge evolution in the field of sports education models (Page et al., 2021).

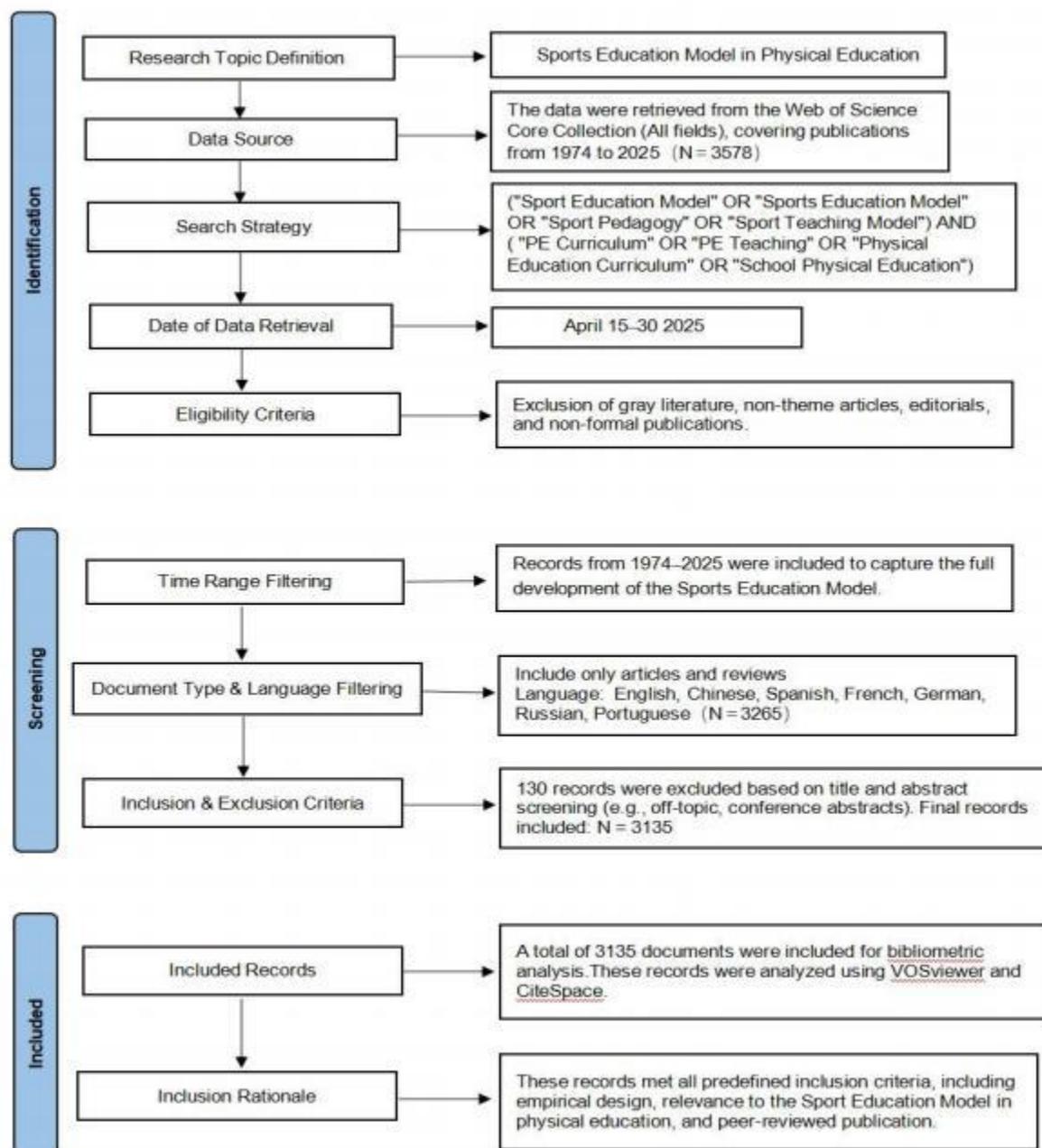


Figure 1. PRISMA Flow Diagram

To ensure the rigor of the research methods and the depth of the analysis results, this study constructed a four-layer analysis framework covering bibliometric statistics, network visualization, topic evolution, and knowledge structure analysis (Aria & Cuccurullo, 2017). As shown in Figure 2, this framework systematically matches different bibliometric software with specific analysis tasks to comprehensively depict the research landscape of the Sport Education Model (SEM) in physical education.

In the first level of analysis, this study utilized the powerful R software package Bibliometrix for descriptive statistical analysis, focusing on extracting annual publication trends, distribution of research output by country, and journal sources as basic

structural features. This step laid a solid data foundation for understanding the temporal evolution and geographical diffusion of SEM research from 1974 to 2025.

The second layer of analysis focuses on constructing science maps, using VOSviewer and Pajek to create and visualize keyword co-occurrence networks and author collaboration networks. VOSviewer is responsible for clustering and graphical representation, while Pajek is used for network layout optimization and modular analysis. This layer reveals the knowledge structure and research collaboration patterns in the field.

The third layer of analysis aims to explore the thematic evolution process of SEM research, utilizing both CiteSpace and Bibliometrix tools to leverage their complementary advantages in time evolution and strength validation. CiteSpace identifies key thematic turning points through burst detection and five-year slice analysis, while Bibliometrix assists in confirming evolutionary stage divisions and keyword popularity trends. This analysis clearly outlines the evolution path of SEM research topics from curriculum development to digital learning and psychological mechanisms.

Finally, in the fourth layer of analysis, a knowledge structure analysis was conducted using CiteSpace, utilizing co-citation analysis and timeline clustering to identify foundational literature in the field, emerging edge topics, and their semantic pathways. The analysis revealed the continuous stability of the theoretical core and the dynamic evolution of edge topics, providing a systematic explanation of how SEM research has evolved from instructional models to multidimensional educational paradigms.

Overall, this study employs a four-tier progressive analytical framework, balancing the breadth and depth of bibliometric research; the integration of statistical, semantic, structural, and temporal perspectives not only presents the macro development trajectory of SEM research, but also reveals the reconstruction logic of its knowledge system at the micro level; this methodological system enhances the empirical credibility of the research and provides a solid methodological foundation for future studies on sports education curriculum models (Abidin & Tarakcioglu, 2023).

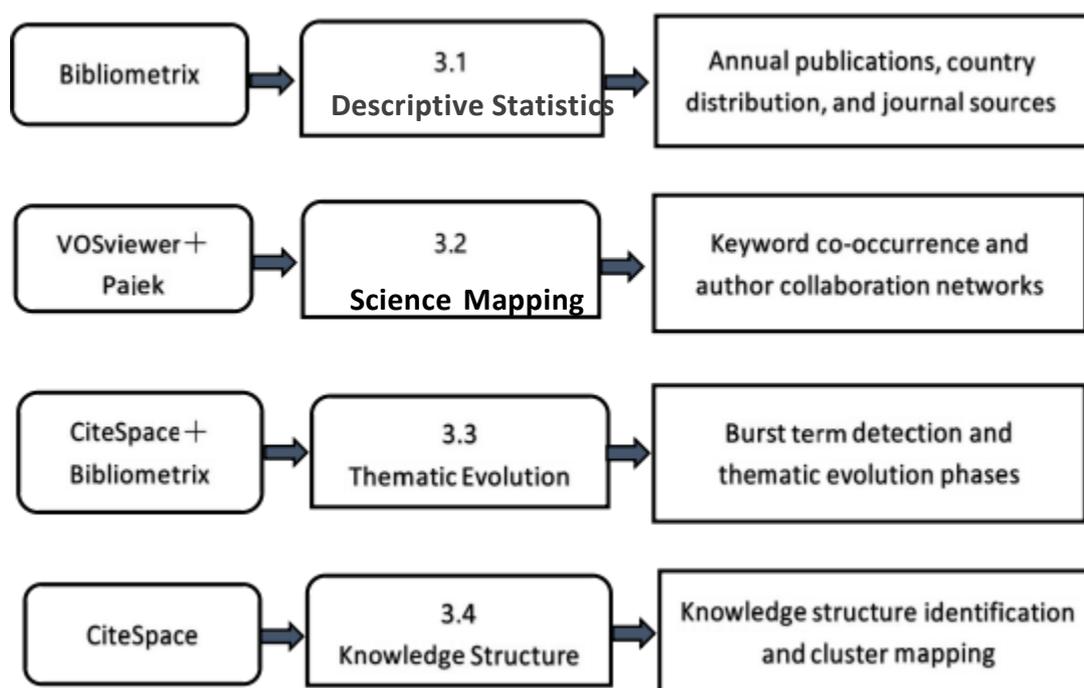


Figure 2 Analytical Tools and Applications Flowchart

## Results

### *Descriptive Statistics*

Between 1974 and 2025, research literature on the Sport Education Model (SEM) in physical education has shown a clear three-stage evolutionary trajectory. As shown in Figure 3, this research field has gone through a gradual development process from conceptual sprouting to thematic focus and then to academic mainstreaming.

In the first stage (1974 -2004), the annual number of publications related to SEM remained extremely low, with fewer than 10 papers published in most years, and some years even had zero publications; this period reflects that SEM was still in its infancy as an academic concept, and its theoretical framework and teaching practices had not yet gained widespread attention in the international academic community.

Since 2005, the annual number of publications has entered a steady growth period, indicating that research is gradually entering an expansion stage. With the advancement of sports curriculum reform and the diversification of teaching models, academic attention to SEM continues to increase. By 2015, the annual publication volume had approached one hundred, indicating that research topics focusing on teaching effectiveness, curriculum innovation, and student engagement were beginning to form a more concentrated and systematic theoretical system, laying a solid foundation for future development.

From 2016 to 2024, there was a rapid growth and deepening of themes in SEM research. The annual number of publications exceeded 200 for the first time, reaching a peak of 366 in 2024, setting a record high for the period. Research during this phase not only showed a rapid increase in quantity but also demonstrated a high level of focus and in-depth analysis, signaling that SEM has transitioned from a peripheral topic to a core

research theme in sports education. Although the number of publications dropped to 111 in 2025, this change is likely due to database inclusion lag and is not yet sufficient evidence of a decrease in research interest.

In summary, the annual trend of publications fully reveals the academic trajectory of the research topic transitioning from the periphery to the mainstream, reflecting the continuous attention of global sports education research to student-centered approaches, teaching innovation, and curriculum reform. This evolutionary process not only provides a clear empirical basis for understanding the development logic of SEM but also offers solid support for determining future research directions.

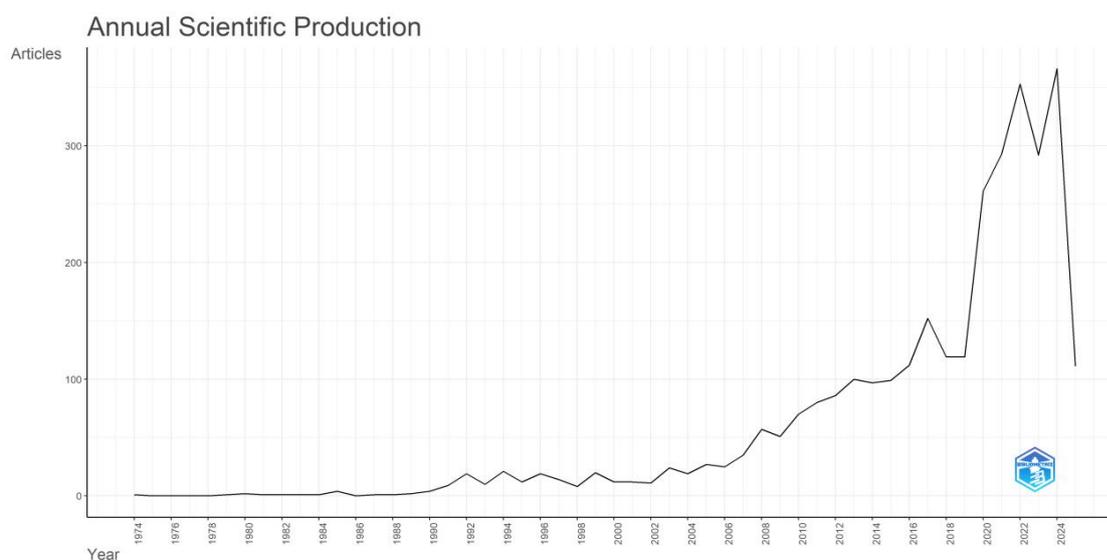


Figure 3 - Annual Scientific Production

Research on the Sports Education Model (SEM) in physical education shows a significant regional concentration trend globally, with only a few countries contributing the majority of research results. As shown in Figure 2, the United States has maintained a dominant position in this field, not only leading in the number of publications but also exerting a sustained and profound influence on theoretical construction and practical exploration. This advantage reflects its long-term academic accumulation and policy promotion in curriculum innovation, teaching model practice, and institutional implementation.

Following closely behind are the United Kingdom, Australia, and Spain, these high-productive countries mainly from English-speaking countries and Western Europe form the second tier; these countries generally have a strong academic tradition in sports education and invest sufficiently in teaching reform and policy research, with research focusing on evidence-based teaching and educational interventions, emphasizing the close integration of theory and practice.

Apart from Western countries, Asian countries such as China, South Korea, and Malaysia have shown a significant increase in research activity in recent years, especially in emerging topics such as digital technology integration, physical literacy education, and cross-cultural teaching; this trend is closely related to the modernization reform

of education in the region, reflecting the Asia-Pacific region's rise as an important force in physical education research.

In Latin America, Brazil, Chile, and Argentina also demonstrate a certain research output capacity; although the overall number of publications is not as high as in Europe, America, and Asia, their research often focuses on issues with strong local relevance such as youth development, community sports, and educational equity, reflecting the unique responses and practical concerns of Global South countries on sports education topics and providing valuable local perspectives for international academic discussions.

Overall, current SEM research is gradually showing a multipolar structure in geographical distribution. North America and Western Europe remain core research areas, but the participation of Asia and Latin America is steadily increasing, indicating the dynamic evolution of the global academic power structure. Despite uneven distribution of scientific research resources and output quantity among countries, the diversity of research topics and methodological paths in different regions inject theoretical diversity and research tension into the field. In the future, with the deepening of international academic cooperation and the acceleration of policy-driven educational reforms, non-Western countries are expected to further expand their academic contributions in this field, promoting a more balanced and diverse development pattern for global sports education research.

Country Scientific Production

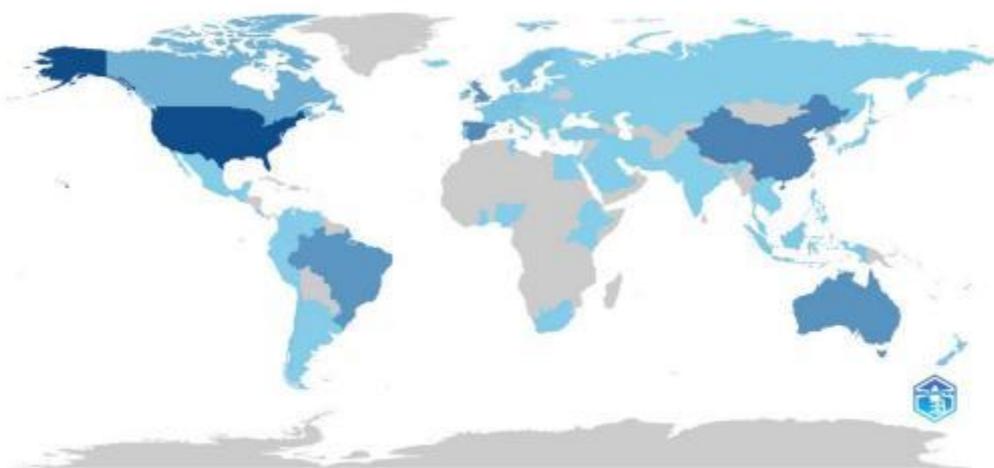


Figure 4 - Country Scientific Production

The research on the Sports Education Model (SEM) in the field of physical education shows a highly concentrated geographical distribution. As shown in Figure 5, the United States leads by a large margin with a total of 1428 literature, consistently ranking first globally. This dominant position reflects its continuous investment in physical education curriculum reform, teaching model innovation, and interdisciplinary integration, with its academic influence further consolidated through high citation frequency and international cooperation networks.

China ranks second with 783 articles, showing rapid growth in SEM research in recent years. This trend is closely related to China's deepening school sports reform and modernization of education, indicating its gradual establishment in the global discourse system of sports education. Spain (699 articles), Australia (624 articles), and the UK (616 articles) follow closely behind, forming a stable group of high-producing countries. Spain and Australia have made significant achievements in empirical research and curriculum implementation, while the UK continues to contribute theoretical research in curriculum structure, educational equity, and social-cultural dimensions.

Brazil (591 articles) as an important representative of the Global South, research focuses on youth development, health promotion, and social inclusion, reflecting a regional social responsibility orientation; Canada, Sweden, Ireland, and Portugal, although producing less, show a specialized research orientation in subfields such as teaching methods, multicultural education, and sports psychology, injecting diversity into the global SEM research ecosystem.

Overall, global SEM research shows a multi-center distribution pattern with North America, Western Europe, East Asia, and Oceania as the core, and Latin American countries gradually participating. This trend reveals the imbalance of research resources but also indicates an increasing research participation from developing regions, bringing more diverse perspectives and possibilities for knowledge innovation in sports education research.

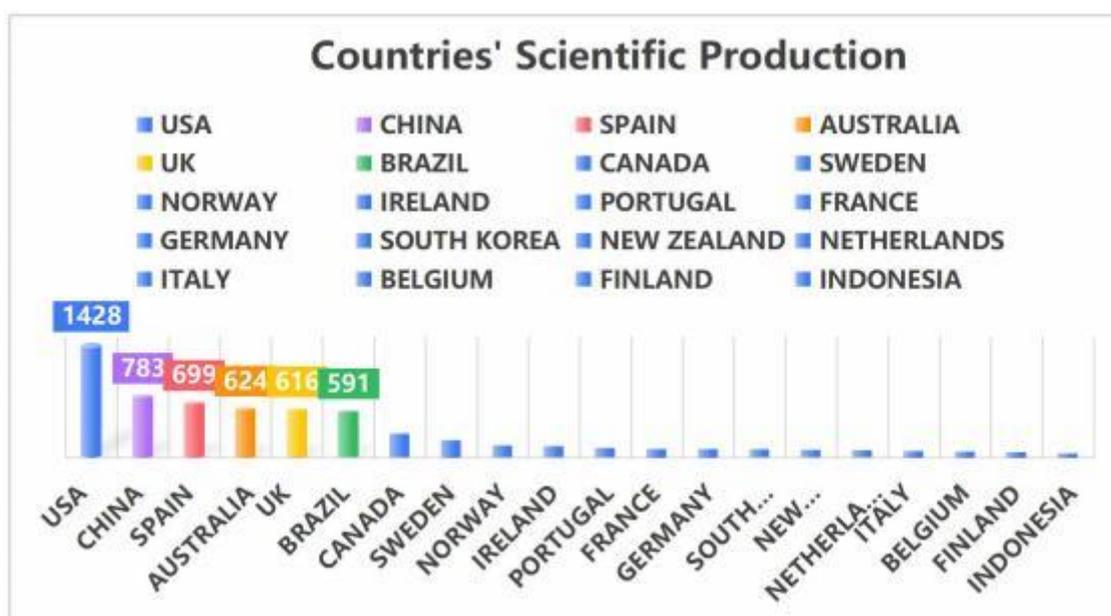


Figure 5 - Country Scientific Production

As shown in Figure 6, research on the "Sports Education Model" in the field of physical education shows a significant concentration of publications in a few high-impact journals. The core literature is mainly published in a handful of influential journals; "Physical Education and Sport Pedagogy" ranks first with 724 articles, demonstrating its academic authority and theoretical leadership in this research topic.

Following closely behind is the "Journal of Teaching in Physical Education" (197 articles) and "Sport, Education and Society" (167 articles), both of which are important academic platforms in the field, focusing on educational research from teaching practices and social-cultural perspectives; these journals collectively establish the mainstream dissemination pathway and knowledge diffusion platform for research on physical education models.

Furthermore, regional journals like "European Physical Education Review," "Retos," and "Movimiento" have been actively promoting localized research in physical education, bringing diverse perspectives and methodological pathways to the field. The involvement of interdisciplinary journals such as "International Journal of Environmental Research and Public Health" and "Frontiers in Psychology" indicates that this topic is gradually expanding into intersecting areas such as health science and psychology.

As a whole, research related to SEM has clear academic affiliations and journal preferences, providing a solid foundation for subsequent research to track literature, evaluate impact, and construct knowledge structures.

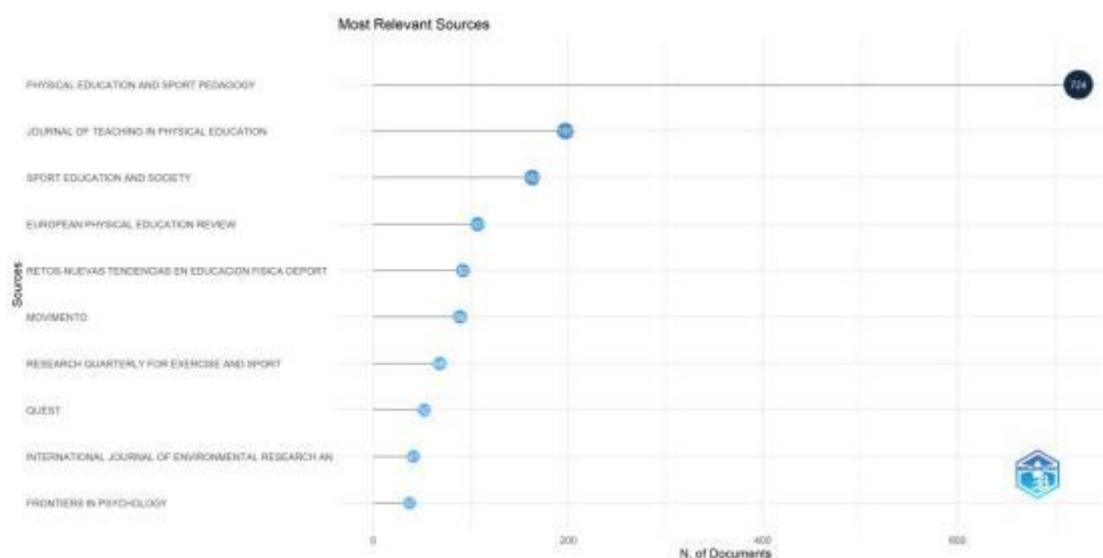


Figure 6 - Most Relevant Sources

### Science Mapping

The author collaboration network map reveals the academic community structure formed around the "Sports Education Model" in the field of sports education; as shown in Figure 7, the network exhibits highly clustered characteristics, with multiple author groups forming clear boundaries in research topics and collaboration relationships.

The central orange cluster in the graph, led by Kirk D, demonstrates his dominant position in the field. The authors within this cluster collaborate continuously on course structure reform and student-centered concepts, with highly consistent research topics, establishing a research paradigm that combines theoretical advancement with practical innovation.

The blue cluster adjacent to it is led by Casey A and Hastie P, representing a significant force in the international dissemination and local adaptation of the Sport Education Model; the team promotes the application of SEM in different countries and teaching fields, demonstrating notable characteristics of international collaboration.

The green cluster is centered around Davids K and focuses on the systematic integration of educational technology, particularly with distinct characteristics in perceptual motor behavior and nonlinear teaching theory. The cluster has a compact collaborative structure, reflecting a strong tendency towards theoretical method integration.

Another independent cluster led by Larsson H and Quennerstedt M emphasizes the issues of physical education and identity construction from a sociocultural perspective; this group has made significant contributions to critical education research and provided diverse theoretical support for SEM studies.

The brown cluster on the edge of the map is represented by MacPhail A, with research focusing on teacher education, gender equality, and educational equity issues. Despite being on the periphery, it shows clear research potential in terms of structure and themes.

Overall, the author has formed multiple stable and interactive research groups around curriculum theory, teaching practices, social culture, and technology integration; the high degree of aggregation of core nodes in the network indicates that the field has developed a mature academic ecosystem, while also suggesting that future research could further enhance interdisciplinary and cross-border cooperation to enhance the depth and breadth of knowledge integration.

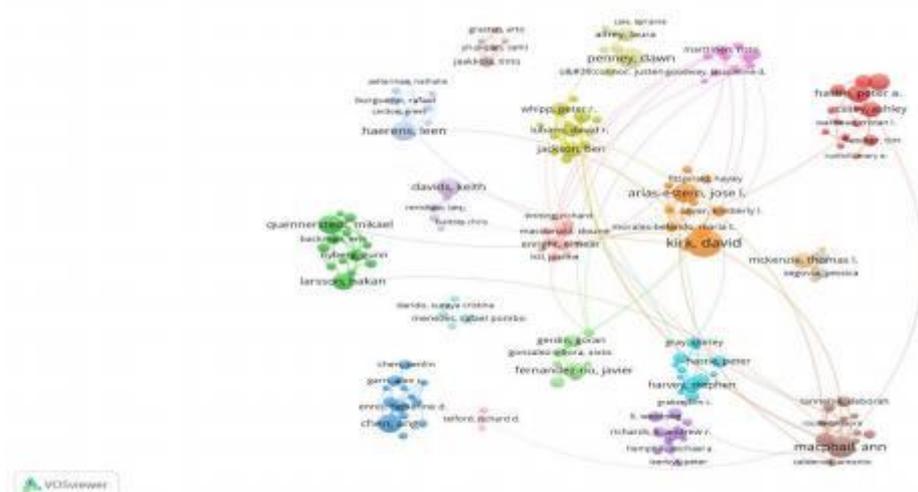


Figure 7 Co-authorship Network Map

The co-occurrence network of keywords effectively reveals the structural relationships and aggregation trends of research topics related to the "Sports Education Model" in the field of sports education; as shown in Figure 8, based on 3315 sample documents,

high-frequency keywords appearing no less than 10 times were extracted to form six main clusters, presenting a multidimensional knowledge map with "physical education" at its core.

The green cluster located at the center of the network revolves around "physical education," "curriculum," and "school physical education," extending to key words such as "assessment," "teacher education," and "social justice," representing the foundational position of curriculum research in this field. This cluster embodies the systematic integration of teaching content, implementation framework, and societal value, laying the traditional mainline of physical education research.

The red cluster centers around "sport pedagogy" and emphasizes the integration of innovative teaching models and classroom practice. Key terms such as "cooperative learning" and "models-based practice" point to the implementation of structured teaching strategies, reflecting a systematic shift in research paradigm from theoretical exploration to teaching application.

The blue cluster focuses on "motivation" and "self-determination theory", forming a theoretical group supported by educational psychology. This type of research emphasizes students' autonomy and intrinsic motivation mechanisms, revealing the interaction between psychological factors in sports learning and the learning environment, demonstrating interdisciplinary integration features.

The yellow cluster located in the bottom right of the map focuses on "physical activity" and "mental health", highlighting the practical role of school sports in adolescent health interventions. It emphasizes the connection between physical education and public health issues, demonstrating a shift towards policy-oriented research.

The purple cluster is centered around the themes of "inclusion" and "diversity", reflecting a concern for social equity and inclusive education. This section focuses on the curriculum participation of marginalized groups and the social responsibility of teacher education, showcasing the expansion of sports education in the dimension of social justice.

The orange cluster is characterized by "children," "motor competence," and "systematic review," reflecting an empirical orientation towards child development and evidence-based research. This cluster highlights the systematic and scientific nature of research methods, indicating a trend towards methodological standardization in the field.

Overall, the co-occurrence network reveals a structural transformation of sports education research from curriculum core to psychological mechanisms, health interventions, and social value expansion. While the "curriculum-teaching" static core remains stable, "motivation-health-fairness" forms the dynamic periphery, providing a new direction for building a more integrated and practically relevant knowledge system.

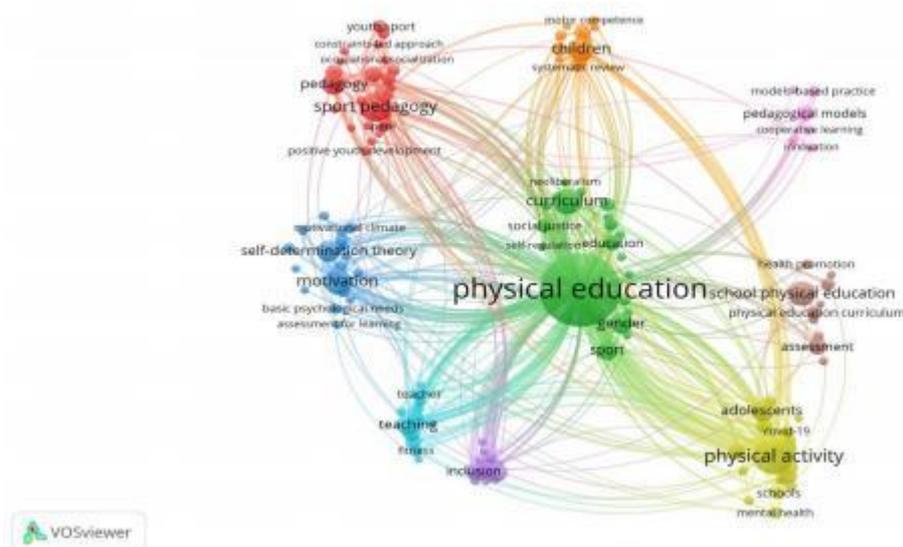


Figure 8 - Keyword Co-occurrence Network

### *Thematic Evolution*

The evolution of keywords presents the structural changes and focus paths of research topics on the Sports Education Model (SEM) in sports education at different stages, as shown in Figure 9. From 1974 to 2025, research in this field has gone through an evolutionary process from theoretical construction to practical expansion and then to diverse integration, forming three relatively clear development stages.

The first stage (1974–2005) focused on theoretical construction, with an emphasis on establishing the SEM framework and defining course objectives. Key terms such as "intrinsic motivation," "value orientations," and "motor performance" highlighted the early research on learning motivation, curriculum values, and physical performance. Literature in this stage emphasized clarifying basic concepts and establishing logical teaching models, forming the theoretical foundation for subsequent studies.

The second phase (2006–2015) witnessed the expansion of methodological systems and the diversification of research topics; keywords "physical education," "sport," and "children" remained active during this stage, but their semantic connections shifted towards new topics such as "engagement" and "performance," indicating a deeper exploration of student behaviors and learning outcomes. Concurrently, research methods transitioned from being predominantly quantitative to a blend of methods, reflecting adaptability in addressing complex teaching scenarios.

In the third stage (2016–2025), there is a significant feature of interdisciplinary integration and technology-driven characteristics; the keywords "self-determination theory," "students," and "performance" become the research core, indicating that educational psychology and individual development are beginning to be deeply embedded in physical education research; at the same time, "physical education" still maintains its central position, connecting with keywords such as "VR," "digital tools," and "health promotion," showing the direction of curriculum integration with technology and a focus on physical and mental health.

In general, the research topics of SEM have evolved from early foundational studies focusing on course structure and motivation theory to a new stage that integrates educational psychology, health science, and digital education. This evolutionary trajectory not only reflects the continuous deepening of the theoretical system in this field, but also reveals the dynamic adjustments in response to real educational challenges and strategic innovations.

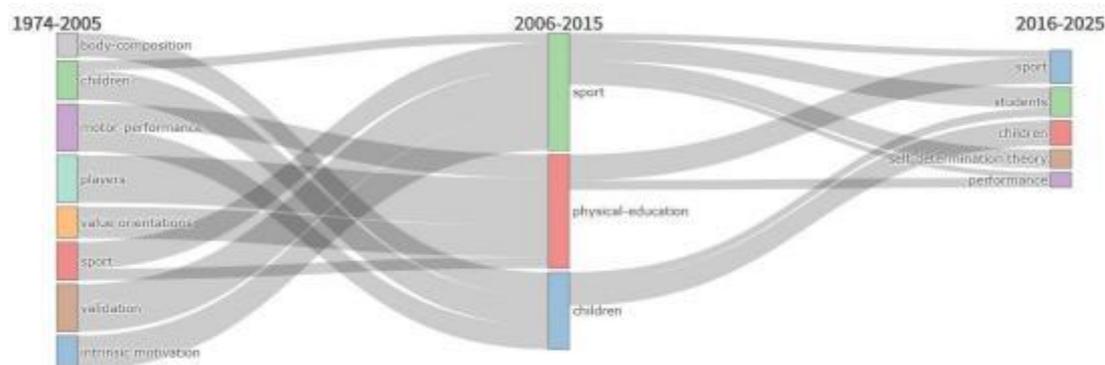


Figure 9 - Thematic Evolution Structure

The keyword burst analysis reveals the shift of focus in sports education research topics over time, providing key clues to understanding the development process of "sports education models"; as shown in Figure 10, early studies centered around motivation theory, with the emergence of "motivational climate" and "intrinsic motivation" in 1994 marking the starting point of research, signifying that learning motivation has become a fundamental dimension in the construction of sports education theory.

Since 2006, research has shifted from basic theory to psychological mechanisms and teaching strategies, with keywords such as "achievement goals," "self-determination theory," and "constraints-led approach" emerging successively, reflecting the widespread application of teaching models in empirical research. During this stage, structural teaching methods such as SEM and TGFU have become the focus of validation, driving the development of physical education towards the integration of behavioral control and cognitive adjustment.

After 2016, research focus has further shifted towards teaching modeling and core competency building, with keywords such as "models-based practice," "pedagogical models," and "physical literacy" prominently appearing, indicating that research has entered a new stage of paradigm reconstruction and curriculum deepening. This trend emphasizes the intervention effect of systematic teaching design on learning outcomes, highlighting the overall evolution of physical education curriculum structure.

The high intensity emergence of the "sport education model" in 2021-2022 (5.71) indicates its increasing dominance in current research, as well as its active process of localization and transformation in different educational settings. Additionally, the concentrated appearance of "elementary school," "college students," and "occupational socialization" demonstrates the expansion of research subjects across age groups and the social extension of research dimensions.

In conclusion, the sudden analysis portrays the phased evolution process of sports education research from motivation driving, theoretical construction to teaching modeling and integrated innovation, validating the judgment of this study on the development path of "sports education model" and providing temporal evidence for understanding its knowledge evolution logic.

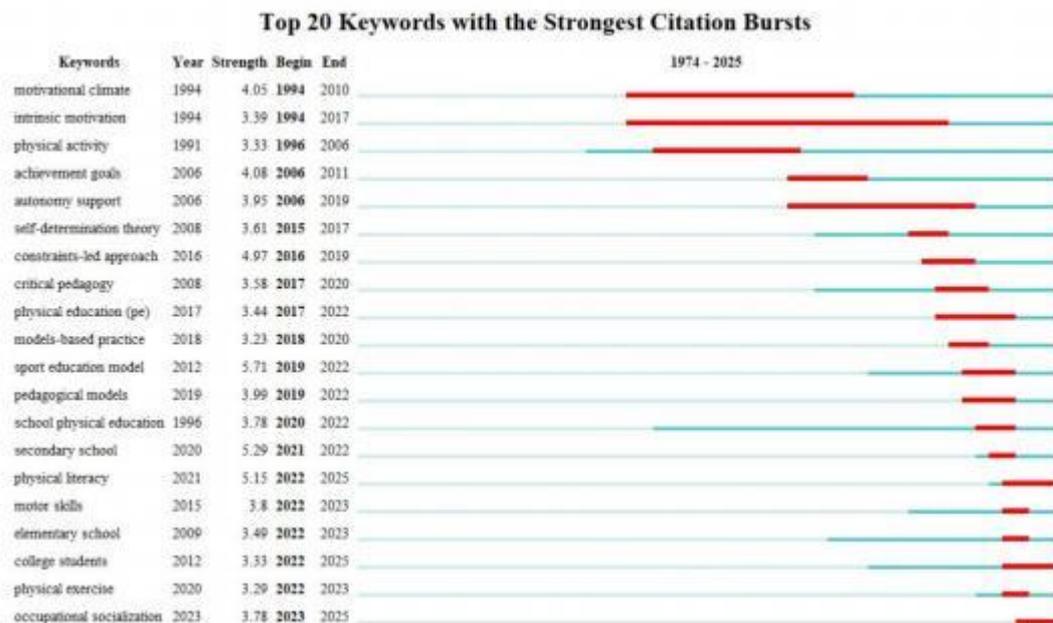


Figure 10 - Top 20 Keywords with the Strongest Citation Bursts

### Knowledge Structure

Based on CiteSpace, a timeline graph of co-cited literature was generated, identifying 20 knowledge clusters in the field of sports education, specifically focusing on the Sports Education Model (SEM) research evolution. The graph illustrates the continuity of core topics and semantic connections across clusters, showcasing a multi-level research trajectory from theoretical origins to practical applications and interdisciplinary integration.

Among the numerous clusters, Cluster #0 (physical education), Cluster #1 (basic psychological needs), Cluster #2 (attitudes), and Cluster #3 (physical education curriculum) form the core components closely related to curriculum studies. These four clusters collectively point to key issues in SEM research, covering theoretical foundations, psychological mechanisms, behavioral pathways, and curriculum implementation, forming structural pillars in the current research ecosystem.

Cluster #0 focuses on the foundational theoretical construction of sports education, with its sustained presence on the timeline indicating the central role of curriculum theory throughout the research period; Cluster #1, on the other hand, revolves around the "motivation mechanism," emphasizing the regulatory effect of satisfying basic psychological needs on learning behavior; The high-frequency connection paths between this cluster and Cluster #0 reveal the mediating role of motivation in the implementation of teaching goals and student engagement.

Cluster #2 extends further into the issue of attitude construction and the conversion of behavioral intentions, reflecting the deep coupling relationship between educational psychology and curriculum design; Cluster #3 embodies new trends in curriculum practice, with keywords like "digital transformation" and "teaching innovation" highlighting the trend of technology integration and instructional restructuring, providing a methodological perspective for understanding the reform of physical education curriculum.

Overall, the knowledge map not only reveals the thematic evolution path of SEM-related research, but also clearly presents a structural picture of the integration of the four elements of "theory-motivation-attitude-practice", providing systematic support for understanding the stability and dynamics of the knowledge structure in this field.

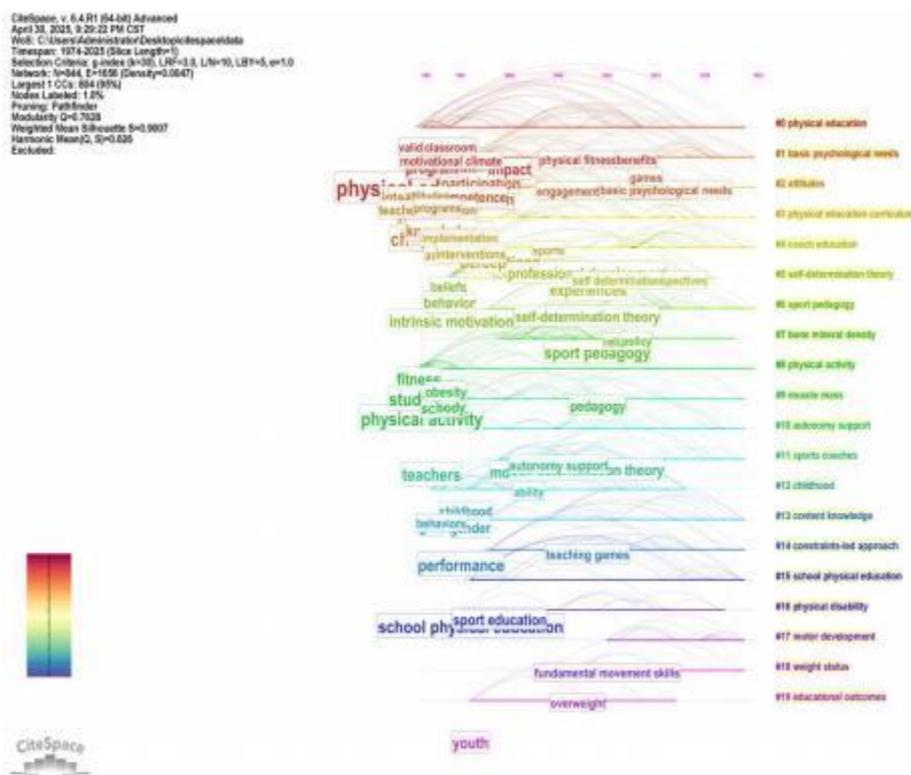


Figure 11 - Timeline View of Keyword Clusters

The knowledge structure map presented in Figure 12 reveals the theoretical clusters and structural logic in the field of physical education, with the "physical education model" as the core topic. Cluster #0 (physical education) and Cluster #1 (basic psychological needs) form a clear structural axis, with key words such as "motivation," "competence," and "participation" intensively interacting between them, demonstrating the highly coupled research characteristics of teaching strategies and psychological mechanisms.

This clustering axis indicates that motivational mechanisms represented by self-determination theory have a core explanatory power in sports curriculum design and classroom practices, guiding students' active participation through teacher support strategies; the extension of Cluster #1's theme not only reflects the deepening of

psychological foundation theories but also reinforces the learner-centered teaching reform orientation.

Cluster#2(attitudes) is positioned in the middle layer of the structure, presenting a semantic connection path between the main axis clustering, reinforcing the cognitive-emotional-behavioral chain of "motivation-attitude-behavior"; this logical framework plays a crucial role in explaining the mechanism of student sports behavior transformation, providing theoretical support for sports intervention and curriculum feedback.

Cluster#3(physical education curriculum) focuses on curriculum implementation and intervention effectiveness, with keywords such as "implementation," "interventions," "programs" showing its practice-driven characteristics. Despite being located at the bottom of the map, it is related to the upper clusters in terms of path structure, indicating that new topics such as digital technology and curriculum reform are gradually being integrated into the core research system, becoming the edge innovation area of the knowledge structure.

In conclusion, the graph presents a multidimensional intersectional structure with "motivation" as the core connecting node, focusing on the multiple intersections of teaching strategies, psychological mechanisms, behavioral attitudes, and course practices. This structural feature not only outlines the internal logic of physical education research but also provides a theoretical basis and strategic insights for optimizing curriculum model reconstruction and empirical intervention pathways.

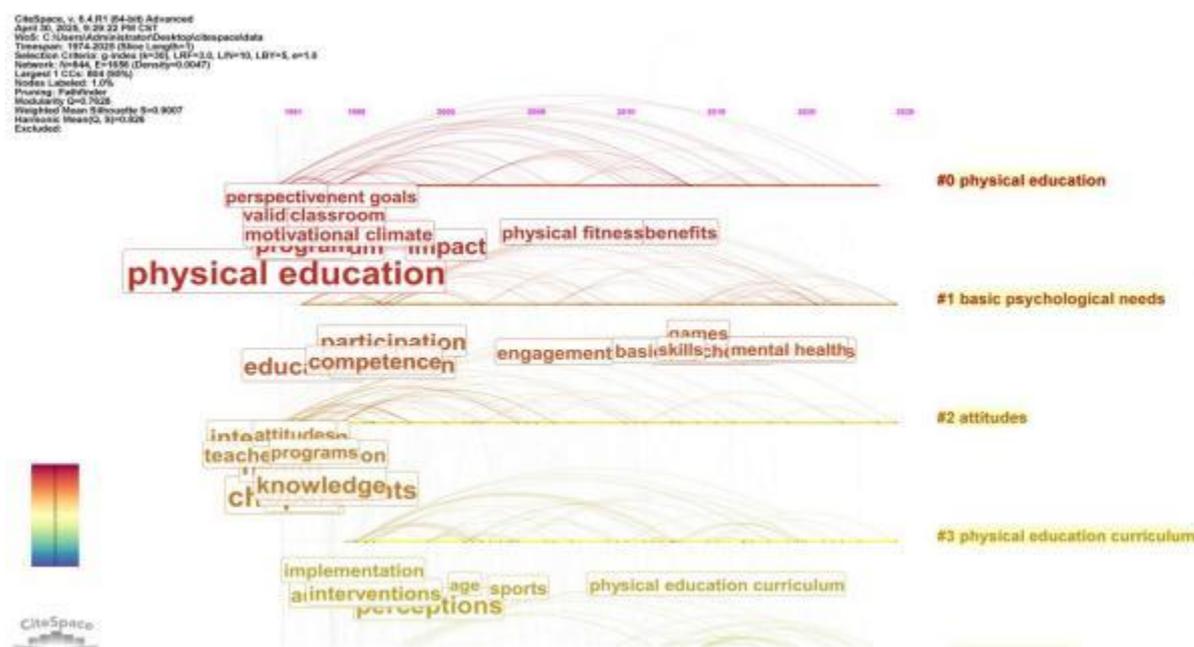


Figure12 - Timeline View of Co-cited Keywords Highlighting Major Clusters (#0–#3) in the Sports Education Model Research

The Timeline graph in Figure 13 reveals a knowledge structure in sports education research that exhibits an evolution pattern of coexisting "static core" and "dynamic periphery". The overall structure demonstrates a hierarchical relationship from central clustering to expanding peripheral themes, reflecting a dual development of stable theoretical frameworks and updated research topics.

The static core focuses on Cluster #5 (self-determination theory) and Cluster #8 (physical activity), both of which show a long-term active trajectory in literature citations. Keywords such as "intrinsic motivation," "fitness," and "self-determination theory" are concentrated between 1995 and 2020, forming the theoretical backbone of physical education research. The teaching motivation theories, physical literacy promotion, and health behavior interventions indicated by these keywords have established a systematic and continuous research foundation in physical education curriculum, providing stable academic support and practical guidance in the field.

In contrast, dynamic edge clustering reflects the recent technological shift and psychological expansion trend in knowledge structure; on the right side of the map, emerging keywords such as "mental health" and "digital learning" are gradually connecting with the core clusters, signaling the integration of mental health education and educational technology as a new research growth point; although these topics are currently on the periphery, their continuous expansion on the timeline foreshadows their potential for deep involvement in the future sports education model.

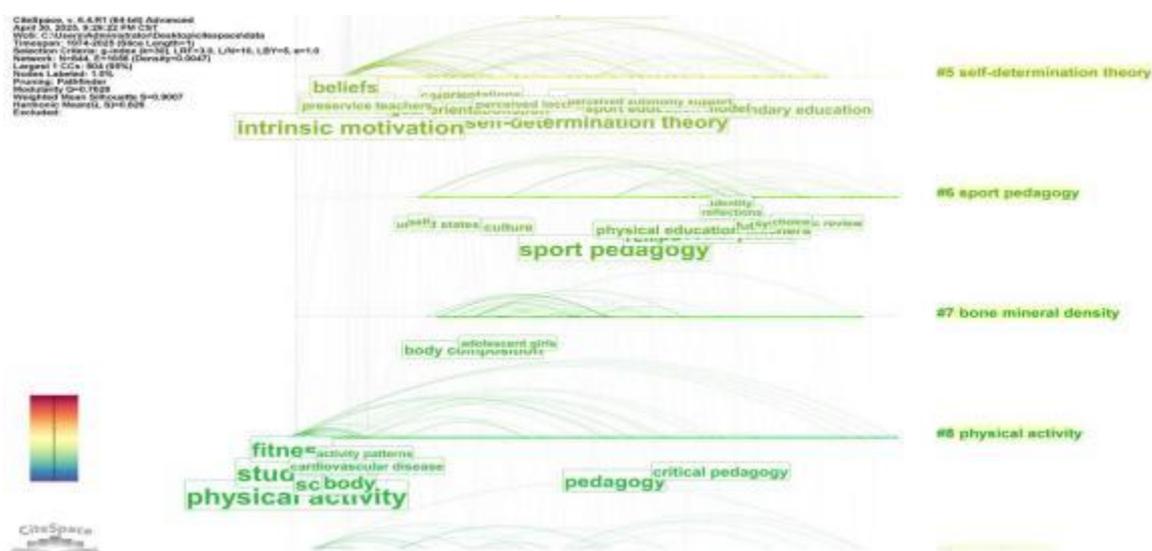


Figure 13 - Timeline View of Co-cited Keywords in Clusters #5–#8 in the Research on the Sports Education Model

In summary, the Timeline clearly demonstrates a static structure with "teaching strategies - healthy behaviors" as the backbone and a dynamic path with "psychological mechanisms - digital transformation" as the trend. The parallel development of this binary structure not only highlights the theoretical foundation of physical education research but also indicates its vast potential in interdisciplinary integration and educational innovation.

## Discussion

This study tracked the evolution trajectory of SEM research from 1974 to 2025 using a sample of 3315 documents from the Web of Science core collection, revealing a shift in focus from curriculum structure to motivation mechanisms, health promotion, and technology integration, leading to reflections on theoretical and practical aspects.

In theory, SEM has evolved from a single teaching framework to a multidimensional educational paradigm; while curriculum design remains the structural cornerstone of the model, the continued embedding of self-determination theory makes motivation satisfaction a key mechanism for explaining students' sustained engagement, with the intervention of health science and educational technology further expanding the model's disciplinary boundaries (Kim, Park, & Wallace, 2018). Thus, SEM presents a composite theoretical landscape of "curriculum-motivation-health-technology," providing a new explanatory framework for understanding the comprehensive value of physical education.

This theory expansion places higher demands on classroom practice; the policy experience of high-productivity countries shows that only by incorporating SEM into national curriculum standards and supporting teacher professional development can its advantages in stimulating autonomy and sense of belonging through structured teaching, role rotation, and festive rituals be fully realized; at the same time, a hybrid curriculum trend emerges, coupling SEM with models such as TGfU, TPSR, to simultaneously reach skill development, emotional attitudes, and health literacy goals within the same teaching unit, enhancing the completeness and inclusiveness of the curriculum (Casey & MacPhail, 2018).

Technology empowerment is reshaping the implementation scenarios of SEM; Wearable devices, video analysis, and online collaboration platforms provide teachers with real-time monitoring and personalized feedback tools, enabling classroom learning to extend across time and space, and providing students with data-based self-regulation paths (Silva et al., 2022); The effectiveness of technological integration also confirms the theoretical "motivation-behavior-health" chain, creating a positive cycle of curriculum innovation and student experience (Chung, Lei, Yeung, & Hagger, 2020).

The research still has dual limitations in terms of scope and methods; relying on a single English database may underestimate the contributions of non-English academic communities. The decline in publications in 2025 is also affected by the lag in database updates, and should not be seen as direct evidence of declining interest. Additionally, existing quantitative methods are difficult to assess the intensity of interventions and actual learning outcomes, and urgently need to be combined with systematic reviews and meta-analyses.

Future research should focus on integrating data across databases and multiple languages to capture local innovations in developing regions and underrepresented language contexts. Longitudinal tracking designs and evaluation tools based on motivation-health dual indicators can help assess the real impact of SEM on students' lifelong physical activity behaviors. Strategies for special education settings, rural schools, and underdeveloped areas should also be prioritized to enhance the fairness and

universality of the model. Lastly, exploring the "intelligent sports education model" driven by virtual reality and artificial intelligence can inject data-driven decision-making mechanisms into SEM, advancing physical education towards a new stage of precision and personalization.

### **Conclusion**

Based on a sample of 3315 articles from the Web of Science Core Collection, this study utilized bibliometrix, VOSviewer, CiteSpace, and Pajek to systematically analyze and visualize the global landscape of research on physical education models from 1974 to 2025. The findings indicate that SEM has undergone a paradigm shift from a marginal concept to a mainstream topic, with increasing publication output, geographical distribution, and collaboration networks, reflecting the global demand for physical education curriculum reform.

Trend analysis indicates that 2005 was a critical point for accelerating research, with a shift to high-density output period after 2016. This rapid rise coincided with international policy advocacy and modernization agendas in education; the United States, United Kingdom, Australia, Spain, and China have become strategic hubs for knowledge dissemination, while emerging forces in Asia and South America are advancing thematic depth through technology integration and equity issues, leading to a multipolar research landscape.

Knowledge structure presents a coexistence of "static core" and "dynamic edge"; with curriculum modeling and basic psychological needs as the theoretical axis, ensuring the continuity of SEM as a structured teaching model; motivation mechanisms, health promotion, and digital empowerment continue to permeate, driving the model's expansion and deepening of applications. This dual-layer structure illustrates that the theoretical flexibility of SEM stems from the continuous absorption of emerging issues, while its stability is rooted in the internal consistency of curriculum logic.

Comprehensive evidence shows that SEM has evolved from a single teaching framework to an educational paradigm that integrates motivation, health orientation, and technology; core elements such as role rotation, team competition, and festival ceremonies, after being redesigned with digital tools and hybrid models, demonstrate significant potential to optimize classroom ecology, enhance student agency, and promote lifelong physical activity.

Research has also exposed the gap between corpus limitations and methodological issues; biases in English databases may obscure multilingual achievements, and the lack of longitudinal verification hinders intervention intensity and learning effectiveness. Adaptation strategies for non-mainstream scenarios still appear weak; future work needs to integrate cross-lingual data sources, establish a dual index assessment system for motivation and health, and conduct long-term experiments in vulnerable groups and intelligent sports fields to test the global adaptability and local vitality of SEM.

Overall, SEM has the inherent drive to continuously lead and innovate in the education ecosystem where "student-centeredness, health-driven, and technology-enabled" intersect. The multidimensional evidence in this study provides a solid foundation for understanding its evolutionary mechanism and future direction, as well as offering a reference framework for policymakers, teachers, and researchers facing complex educational contexts.

## References

- Abidin, K., & Tarakcioglu, A. A. (2023). Sustainable energy research trend: A bibliometric analysis using VOSviewer, RStudio Bibliometrix, and CiteSpace software tools. *Sustainability, 15*(4).
- Allison, N. S., Mederic, M. H., & Ryan, C. K. (2020). Sports ultrasound training during a pandemic: Developing a "hands-on" skill through distance learning. *American Journal of Physical Medicine & Rehabilitation, 99*(9), 860–862.
- Anna, H., & Michalis, S. (2018). School-based sports development and the role of NSOs as "boundary spanners": Benefits, disbenefits and unintended consequences of the sporting schools policy initiative. *Sport, Education and Society, 23*(4), 367–380.
- Ashley, C., & Ann, M. (2018). Adopting a models-based approach to teaching physical education. *Physical Education and Sport Pedagogy, 23*(3), 294–310.
- Baofu, W., & Senlin, C. (2022). Physical education curriculum interventions: A review of research patterns and intervention efficacy. *Quest, 74*(2), 205–220.
- Barbara, E. B., James, A. D., Joshua, L. H., Peter, R. W., & Ben, J. (2018). Student motivation in high school physical education: A latent profile analysis approach. *Journal of Sport & Exercise Psychology, 40*(4), 206–216.
- Chloe, P. A., Rohan, M. T., Richard, D. T., & Lisa, S. O. (2019). Sport, physical activity and physical education experiences: Associations with functional body image in children. *Psychology of Sport and Exercise, 45*, 101572.
- Derwin King Chung, C., Lei, Z., Alfred Sing Yeung, L., & Martin, S. H. (2020). Reciprocal relations between autonomous motivation and social cognition constructs in sport injury prevention. *Psychology of Sport and Exercise, 48*, 101660.
- Dillon, L., Katie, F., & Hayley, M. (2016). Models-based practices in physical education: A sociocritical reflection. *Journal of Teaching in Physical Education, 35*(4), 400–411.
- Eliane, M. B., Nicole, R. H., Haley, E. W., Sarah Elizabeth, S., Junielly, V., Jared, M., Acacia, C. P., & Ran, Z. (2021). Artificially intelligent chatbots in digital mental health interventions: A review. *Expert Review of Medical Devices, 18*, 37–49.
- Emma, N., van Sluijs, T., Dyrstad, A., & Standage, E. (2020). Physically active lessons in schools: A systematic review and meta-analysis. *British Journal of Sports Medicine, 54*(14), 826–838.
- Enid, K. S., Cheryl, M., Sandra, M., Peter, R., & Wenonah, C. (2021). Inclusive physical education: A critical discourse analysis. *Journal of Teaching in Physical Education*, Advance online publication.
- Gerald, W., Katherine, D., Schon, A., Jeffrey, G., Gregory, Z., Howard, M. F., & Satish, M. (2020). AI-powered digital health platforms improve outcomes for older adults. *JMIR Aging, 3*(2), e19554.
- Hiago, L. R. S., Bernardo, P. B., Eduardo, O. P., Rhai, A. A., Anderson, M., Gustavo, B. C., Gustavo, R. M., & Moacir, M. (2022). Remote data collection in sport sciences. *Journal of Applied Physiology, 133*(6), 1430–1432.

- Humberto, A., Edison Renato, S., Marcus, L., Domício, P., & Roberto, B. (2022). VOSviewer and Bibliometrix. *Journal of the Medical Library Association*, 110(3), 392–395.
- Kim, H.-W., Park, M., & Wallace, J. P. (2018). Perceived social support, loneliness, and physical activity in older adults. *Journal of Sport and Health Science*, 7(2), 237–244.
- John, K., Sam, E., & Stefania, V. (2020). Educational video resources and parental involvement in youth soccer. *Psychology of Sport and Exercise*, 50, 101730.
- John, T., Sandra, B., Imogen, H. B., Lars, K., Maria, F., Pauline, W., Andre, F. C., Matcheri, K., Jake, L., & Joseph, F. (2021). Digital psychiatry: Current evidence and future directions. *World Psychiatry*, 20(3), 318–335.
- John, W., & Shane, P. (2024). Applying the concept of PE-for-sport-literacy. *Sport, Education and Society*. Advance online publication.
- Julia, L., Allan, R. P., & Toni, B. (2025). Asian minds and bodies: Student engagement in physical education. *Sport, Education and Society*. Advance online publication.
- Lyndsey, M. F., Anthony, P. K., Shawn, R. E., Michael, W. C., Anne, M., James, R. C., & Nicholas, L. P. (2021). Predictive accuracy of concussion assessment tools. *The American Journal of Sports Medicine*, 49(4), 1040–1048.
- Massimo, A., & Corrado, C. (2017). Bibliometrix: An R-tool for science mapping. *Journal of Informetrics*, 11(4), 959–975.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Moher, D. (2021). The PRISMA 2020 statement. *BMJ*, 372, n71.
- Tony, P., Andrew, H., Robert, W., & Jonathan, M. (2008). Effects of two instructional approaches on skill development. *Measurement in Physical Education and Exercise Science*, 12(4), 219–236.
- Wei, W., Yongyong, Z., Yenchun Jim, W., & Mark, G. (2023). Factors of dropout from MOOCs: A bibliometric review. *Library Hi Tech*, 41(2), 432–453.
- Yuan, L., Yanan, D., Mengsheng, Y., Jiaqi, L., Huanxia, B., Rui, L., & Andrew, L. (2023). Digital preservation of architectural heritage. *Heritage Science*, 11(1).