

International School Sports Development Intelligence And Visual Analysis In The Last Decade ——Based On a Bibliometric Perspective

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Abstract. School physical education development in China has always played an important role in promoting students' physical and mental development, especially in recent years with the continuous improvement of China's physical education science system and more ambitious physical education and health development goals, school physical education development in China will continue to be studied in depth. This study is based on the current research status of international school sports development, by sorting out the developmental evolution of international high-quality research, research hotspots and frontiers; in order to contribute to the theoretical basis of domestic research and provide reference to the research of related scholars. The study shows that the research system of international school physical education is relatively fixed and perfect, and the research frontiers are highly relevant to the research hotspots, mainly including: (1) the optimization of the teaching system model of school physical education curriculum; (2) the functional utility of school physical education activities to promote the physical and mental development of children and adolescents; (3) the assessment content of school physical education teaching. Finally, suggestions are made for specific directions that domestic scholars can study in the future.

Keywords: School sport development;research frontiers;bibliometrics

1. Introduction

"The 14th Five-Year Plan calls for deepening the promotion of national fitness, allowing youth sports development to enter a new era, and bringing sports research and education to a new level [1]. School physical education is a basic project of national sports, which undertakes the mission of establishing moral education and is of great significance in promoting the construction of a strong sports country [2]. As an important part of school education, school physical education plays a key role in enhancing students' physical fitness and promoting their overall development. Students can not only acquire basic sports-related knowledge and motor skills in physical education courses and sports activities, but also develop a sense of solidarity and cooperation through sports, and promote the development of healthy exercise habits while cultivating excellent willpower character. The excellent development of school sports requires not only the practice of physical education and sports activities, but also the theoretical support of relevant research results.

Chinese academic research lacks a comprehensive discussion of the development of international school sports. Most studies are analyzed by simply listing parameters such as authors, institutions, and keywords, in addition to many problems of errors arising from improper use [3], resulting in the lack of reliability of most studies being relatively cursory. However, as scholars' application of Citespace software and scientometric methods for research and analysis continues to deepen and mature, many high-quality results are also produced. Inspired by the research of Wang Jinfeng and other scholars [4], this study analyzes the bibliometric research results on school sports development in recent years to explore the frontiers and hotspots of international school sports development from a more scientific and complete methodological perspective and to sort out the research knowledge base and hotspot frontiers of international school sports development in order to provide reference for subsequent scholars' research and to promote the development of school

sports in China. The purpose is to provide a reference for subsequent research and to promote the development of school sports in China.

2. Data sources

The research method based on bibliometric statistical combining is relatively comprehensive and objective in assessing and grasping the research situation compared with the traditional method; through information technology processing and visualization of data content, it can be more precisely and intuitively oriented to the research purpose and research questions without being disturbed by abstract concepts or subjective factors in the literature. Based on this, this study applies Citespace as a tool and Web of Science (WOS) as a database. The Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) were set as options for sorting out high-quality literature. Using the subject terms "school physical education" and "development" as the criteria, 2,967 documents related to the development of school physical education were selected as the research data samples, as shown in Table 1.

Tab.1 Literature retrieval identification

Item	Search Instructions
Search Type	TS= ("school physical education"AND "development")
Time Span	2012 to present
Literature Type	Article
Data source	WOS core database (SCI, SSCI indexed)

3. Overview

3.1 Number of articles issued year by year

The overall number of publications in a given field can reflect the level of development of research in that discipline to some extent. As shown in Figure 2, a statistical analysis of the annual distribution of 2085 sample articles in the target database sources from 2012 to the present reveals that the annual number of articles published in school sport development research literature fluctuates slightly but does not fluctuate much overall. 136 articles were published in 2012, and after a small recession in 2013, they were in an upward phase until 2015, then experienced two further recessions in 2016 and After two further pullbacks in 2016 and 2018, it reached a high of 322 articles in 2021. The overall number of articles published in school sports development in international core journals has remained above 131 over the decade, showing a gradual upward trend. The data was finally intercepted in January 2022, so the literature statistics in 2022 of this study cannot replace the research level in 2022. The exponential curve of the number of publications from 2012 to 2021 was fitted with $y=21.03x+92.533$, and the R^2 value was 0.8703. The good fit indicates that the academic community is paying more attention to the academic research on school sports development, and the related research is in a rapid development trend, and the high-level research results will be improved and deepened continuously.

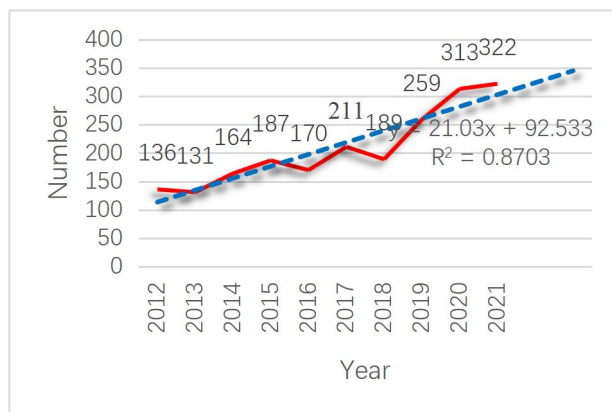


Fig.2 Annual quantity of published articles

3.2 Country co-occurrence analysis

Centrality is a concept commonly used in knowledge networks; in general, the larger the value of centrality of a node, the stronger its linking role in the network and the greater and more important its influence [5]. In order to explore the academic impact and competitiveness of school sport development research in various countries around the world, the knowledge mapping of the source countries was carried out along the data sample and statistical analysis of the number of publications and neutrality was performed. As shown in Figure 3 with Table 2. The absolute leader in terms of volume is the United States, which occupies 30.21% of the total volume and has a centrality of 0.27 in the network. in descending order of volume, followed by Australia, the United Kingdom, Spain, China, Canada, Germany, Brazil, Portugal, and Ireland. Although there is a gap with the leading echelon, it is clear that Chinese scholars have a certain level of international academic investment in school sport development research. In the future, it is necessary to maintain the research investment, but also to continue to explore the depth of research and strengthen the academic exchange links with the international in order to improve the quality and influence of research.



Fig.3 National Co-occurrence Map

3.3 Analysis of authors

The analysis of authors with high academic productivity and influence in a specific field allows to explore the core direction of the field. The authors of the literature related to international school sports development were analyzed econometrically, mapped out, and the core authors were

identified by combining Price's law[6].The highest number of articles issued by a single author in this study is 11. Based on the law, it can be concluded that the authors who have issued 3 articles in the data of this study can be considered as core authors. As shown in the figure and table, the core authors of international school sport development are Ann Macphail, K. Andrew R. Richards, Collin A. Webster, Daniel Mayorgavega, and Mark S. Tremblay, as shown in Figure 4.



Fig.4 Co-occurrence Map of Core Authors

4. Research evolution

4.1 Co-citation analysis based on literature

Based on the original sample data, the time slice was set to one year and run with the default TopN=50 to generate the co-citation knowledge graph and clustering information summarization. The module values $Q=0.7368$, $S=0.8955$ in the knowledge map indicated that the clustering was good and could be analyzed in the next step.

The six largest clusters generated by the International School Sport Development Study were #2 fundamental motor skills, #1 motor activity, #0 sport education, #4 teaching model and impact, #6 cognitive function, #3 obesity prevention Together, these six clusters reflect the basic topical directions of national school sport development. Cluster #2 fundamental motor skills is the largest and occupies the center of the research. By year, themore cutting-edge clustering themes can be deduced as #2 fundamental motor skills, #4 teaching model and impact, and #6 cognitive function.Details of the clusters for international school sport development are shown in Table 5.

Tab.5 Core clustering (based on LLR algorithm)

N u m b e r	Cluste ring	Size valu e	Conto ur value	Averag e publica tion year	Representative Views
2	funda menta l motor skills	38	0.876	2015	O'Brien [7] et al. assessed the convergent validity between basic motor skills and functional motor assessment in adolescents by integrating motor skills and patterns in the school physical education curriculum. By increasing physical education teachers' awareness of the complementary nature of motor skills and movement patterns in adolescent physical education learning, the perspective of assessment of motor competence in physical education was expanded.
1	motor activit y	37	0.862	2012	Lonsdale [8] and others appropriately modified interventions previously proven effective in improving children's physical activity, basic motor skills, and cardiorespiratory fitness, and scaled up to implement reassessment of their effectiveness. Online learning was introduced to improve teachers' translational skills and to provide the government with evidence and a framework to guide physical activity promotion.
0	sport educat ion	35	0.897	2011	O'Leary [9] took a case study approach to explore teachers' adoption of the Teaching Games for Understanding (TGfU) model. An informal game teaching approach to overcome traditional teaching was found to be one of the effective ways to overcome traditional teaching under suitable environmental and time conditions.
4	teachi ng model and impac t	30	0.861	2016	González-Víllora [10] et al. evaluated a mixed model of physical education for adolescents aged 6-18 years and showed that the combination of a model physical education and practice and sports initiation model facilitated game understanding and tactical-technical skill improvement; the mixed model of teaching personal and social responsibility facilitated psychological, social and personal development. The hybrid model was superior compared to single program implementation.
6	cognit ive functi on	27	0.877	2016	Aadland [11] et al. evaluated the impact of professional development of preschool staff on children's physical activity and developmental outcomes and concluded that the promotion of staff professional development and the integration of physical activity with cognitive engagement in play and learning activities may provide viable options for enhancing the physical and cognitive development of young children.
3	obesit y preve nion	24	0.923	2009	Lubans [12] et al. refined the study design and conducted a multi-group intervention trial with comprehensive objective measures of physical activity, motor skills, and cardiorespiratory fitness to explore SCORES, an innovative school intervention specifically targeting elementary school students in low-income communities to safeguard students' physical health. It can be used to guide elementary teachers' pre-service education, professional learning, and school policies.

4.2 Analysis of Burst Literature

The literature review by Bailey et al [13] on the educational effectiveness of physical education and physical activity in schools began to emerge in 2012 and ended in 2014, being the first to do so. The study took a critical perspective, arguing that the educational benefits of physical education activities are mostly dependent on factors such as content and teaching methods, and suggested that some studies had insufficient evidence to infer educational benefits and the specific generative mechanisms were not clear, thus questioning the simple "contribution of educational effects of physical education activities" studies. The Ogden et al. [14] study of body mass index in US adolescents began to emerge in 2012 and ended in 2013, which corresponds to the #3 obesity prevention clustering above. The study showed that high body mass index was prevalent among US adolescents in 2007-2008 and predisposed to a range of public health and health problems; and suggested that there were differences in body mass index trends between populations of different ethnic groups. Janssen et al [15] conducted a systematic review of the health benefits of physical fitness activities for children and adolescents in The study affirmed physical activity for health, advocated moderate exercise intensity, appropriate weight-bearing exercise and aerobic exercise, and made recommendations for appropriate physical activity for children and adolescents. Hallal et al [16] described physical activity levels globally in detail through a survey study, the literature emerged in 2014 and lasted for four years, the study showed that lack of physical The proportion of physically inactive adults varies across regions, with higher proportions in the Americas and Mediterranean regions. Children and adolescents also have suboptimal levels of physical activity, and people generally become less physically active as they age, with some variation by gender and region. Studies have proposed to enhance the optimization of physical activity monitoring in order to facilitate the development and implementation of appropriate policy programs to improve physical activity levels and promote healthy development. The literature by Lubans et al [17], also emerging in 2014, examines the relationship between functional movement test (FMS) ability and health benefits in children and adolescents, concluding that the relationship remains uncertain and requires more relevant Morgan et al [18] also conducted a systematic

Evaluation and Meta-analysis based on the FMS theme, which emerged in 2015 with a synoptic strength of 6.83, concluding that physical education interventions introduced in schools and communities and highly professional qualified teachers can significantly improve functional movement test levels in adolescents. In the same year, a study by Lonsdale et al [19] emerged with a systematic review and Meta-analysis of interventions to increase moderate to high physical activity in school physical education classes, which showed that interventions can increase the proportion of time students spend on moderate to high intensity activities during physical education classes, but also due to the small number of studies in this area, the findings need to be taken with a grain of salt. The following studies have begun to emerge or are still in the emergence phase in recent years and can be considered at the forefront of research impact in the field.

The literature by Robinson et al [20] emerged in 2017 and lasted for four years. Based on the background of increased investment in research related to exercise capacity and health promotion, the overall analysis and evaluation concluded that various data on exercise capacity and health showed a positive correlation, but because the physical and mental development of the human body is a complex process, various aspects of research still need to be improved. It was noted that the study is helpful to help address low physical activity levels and increased obesity rates in children and adolescents, and future research needs to synergize the time dimension to understand the long-term process of these effects. The study by Regina et al [21] assessed temporal trends in physical activity levels of school-going adolescents in 146 countries and regions based on a large data sample. The study showed that physical activity levels were inadequate in most national regions, and that under-activity among male adolescents had diminished, but physical activity among females remained largely unchanged, leading to increased gender variability in physical activity. Government functionaries are called upon to provide targeted interventions to provide for the physical health of children and adolescents. The study by Watson et al [22] was a systematic

review and Meta-analysis of the effects of classroom physical activity interventions on academic performance and physical effectiveness. The study concluded that classroom forms of physical activity may have a positive impact on academic performance, but the generation of results was not clear. Future research needs to be more objective and precise in the measurement of physical activity and academic effects and continue to refine the methodological system of multidimensional measurement.

Tab.6 Core Burstiness Literature

Author	Year	Strength	Start	End	2012—2022
Bailey[13]	2009	5.72	2012	2014	
Ogden[14]	2010	5.03	2012	2013	
Janssen[15]	2010	7.25	2014	2015	
Hallal[16]	2012	5.18	2014	2017	
Lubans[17]	2010	5.16	2014	2015	
Morgan[18]	2013	6.83	2015	2018	
Lonsdale[19]	2013	4.87	2015	2017	
Robinson[20]	2015	4.8	2017	2020	
Regina[21]	2020	6.12	2020	2022	
Watson[22]	2017	4.88	2020	2022	

4.3 Analysis based on landmark literature

To explore the more cutting-edge research hotspots, the literature data from 2017 to 2021 were intercepted (only 3 literature in 2022, which were not considered in the study), the co-citation network of Pajek of school sports development literature was generated with the help of CiteSpace, and the generated map file was imported into the alluvial flow generation program (alluvial generator) in MapEquation, in which the iconic literature was distinguished by color highlighting, and the hotspots and preamble could be tracked accordingly, as shown in Figure 5.

Barnett et al [23] developed a systematic review of factors related to motor ability for interventions targeting the refined motor ability of children and adolescents, with a PageRank of 25.5%, a sustained landmark of 5 years, and a broader impact on subsequent studies. The study explained the correlation between specific factors and specific motor ability. among the correlated factors affecting motor ability, biological and demographic factors are widely validated, but cognitive, emotional and other psychological factors, cultural and social factors are less studied. the landmark study by Chen et al [24] also lasted 5 years with a PageRank value of 16%. This study examined the relationship between physical fitness changes and academic performance of Taiwanese students and showed that cardiorespiratory fitness improvement was more significantly associated with academic performance than other physical fitness indicators, and that the relationship between BMI and academic performance existed but was weak. a study by Casey [25] with a PageRank of 7.14% assessed the feasibility of adopting a model-based approach to teaching and learning in physical education subjects. Model-based practices have begun to help teacher-practitioners change and develop their pedagogy and curriculum, but there are difficulties in shifting instructional model approaches in practice and a general perceived gap in the impact of instructional approaches. Burns [26] et al. studied predictors and trends in motor skills of children from low-income families with a PageRank of 7.11%, and a multilevel model The analysis concluded that (Gross Motor Development-2nd Edition, TGMD-2) scores were effective in predicting aerobic capacity. Castelli [27] et al. made recommendations for teacher workers to promote school physical activity to guarantee the operation of school physical activity, making it possible to guarantee students' exercise health. Among them, Barnett and Chen's study has a broader and cutting-edge impact on school physical education development, which can be

corresponded to the clustering of #2 fundamental motor skills and #4 teaching model and impact above, respectively.

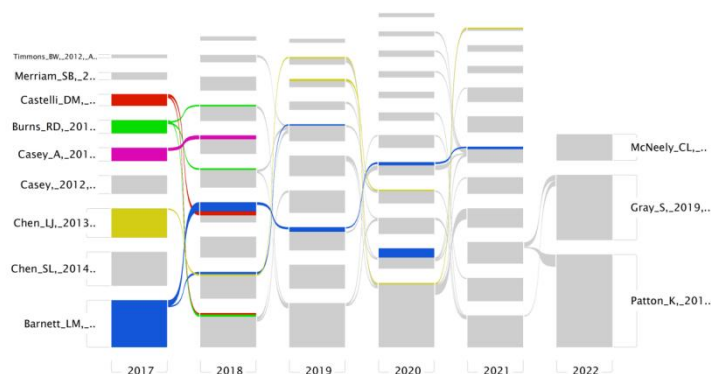


Fig.5 Impact flow diagram of symbolic literature

5. Research conclusions and insights

5.1 Overview of International School Sports Development Research

Research on school sport development has received extensive attention from international scholars, which can be derived from the statistical analysis of the number of articles published in the screened literature and national institutions. Although the trend of publications has a small range of fluctuation changes, but from the overall data of the exponential fit analysis, the research of scholars in this field will continue to increase the input of which. From the analysis of the frequency of citations, centrality and volume of publications of the main countries and scientific institutions where the results are published, it is concluded that the academic influence of the United States, Australia and the United Kingdom in the development of school sports is more significant. The core authors derived from the statistical analysis of the volume of publications only differ from the authors of the core literature, and the inference that the volume of publications corresponds to the core authors is not precise enough in the field of school sport development research, but it does have some correlation. Although Chinese scholars have research outputs in international journals, there is still a large gap in academic impact compared to their countries. The international experience does still have great relevance and inspiration for Chinese scholars in the research of school sport development [28,29].

5.2 Key research in the development of international school sport

Through the keyword statistical analysis of literature data samples and the combing of important literature above, the research contents of international school sports development can be divided into six major categories, namely, research subjects, implementation paths, countries or regions, program contents, functional utility, and behavioral intentions. Among them, according to the research subjects, they mainly include children and youth, physical education teachers, physical education-related practitioners and government departments; with reference to the implementation pathways, they mainly include school interventions, curriculum system optimization and improvement of teaching models; the program contents mainly include basic motor skills, body mass index, functional movement tests and physical activity levels; according to the functional utility, they can be divided into the effects on cognitive function, The program content includes basic motor skills, body mass index, functional motor tests and physical activity level, etc. These together constitute the research framework of international school sport development research.

5.3 International School Sports Development Research Direction

School sports carry an important role in improving the physical fitness of children and adolescents and promoting all-round physical and mental development [30], so relevant research

will also continue to be improved. The following are some future directions that can be further explored through the analysis of research literature: (1) At present, according to the combining, it can be found that physical activities have a facilitating effect on various aspects of children and adolescents' physical and mental development, but the specific mechanism of the occurrence of the effect is still not clear enough and can continue to be improved. (2) There are some differences in physical fitness in different regions, ethnic groups, and genders, so there is a need to cover a wider research group, especially the local physical health research in China. (3) There are still many difficulties in the intervention of physical activities for children and youth in schools and the transformation of teaching activities. It needs to be combined with more in-depth research combining theory and practice. (4) There are fewer studies on sports performance, cognitive, emotional and other psychological factors of sports ability, as well as cultural and social factors, which can continue to be improved.

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