The Effect of the Sport Education Model on Sports Ability: A Critical Systematic Review

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Abstract

The comparative efficacy of the Sport Education Model (SEM) and Traditional Teaching (TT) approaches on students' athletic proficiency within Physical Education (PE) instruction, encompassing game performance, technical prowess, and physical fitness, constitutes a significant area of investigation. Yet, a comprehensive assessment discerning the differential impacts of these pedagogical methods on students' athletic capabilities remains wanting. This study endeavours to discern disparities between the Sport Education Model and conventional teaching methodologies in augmenting students' athletic proficiencies. A thorough exploration of scholarly literature was conducted utilizing databases such as Web of Science, PubMed, Scopus, and EBSCOhost (CENTRAL and SPORTDicus). Criteria for study inclusion were formulated utilizing the PICOS framework, stipulating: (i) Population - comprising healthy students; (ii) Intervention - encompassing any SEM intervention program aimed at enhancing students' athletic abilities; (iii) Contrast - spanning any manifestation of traditional teaching methods; (iv) Outcomes - gauged through athletic proficiency metrics, encompassing game performance, technical aptitude, and physical fitness; and (v) Study design - inclusive of randomized controlled trials and non-randomized controlled trials. A total of 12 studies were scrutinized, with five of them being published within the last five years. Methodological rigor was evaluated leveraging the Downs and Black checklist, culminating in an assessment of moderate quality across all studies. The potential for bias within the literature was scrutinized utilizing the ROBINS-I tool, revealing three articles to possess a moderate risk of bias, while the remainder were deemed to exhibit a high risk. Findings derived from predominantly quasi-experimental designs involving college and junior high school students as participants suggest both the Sport Education Model and Traditional Teaching methods to be efficacious in augmenting students' athletic proficiencies, albeit with SEM demonstrating a superior efficacy compared to TT in most instances. Notably, a considerable proportion of studies failed to meet the minimum unit requirement as per Siedentop's guidelines, and model fidelity across many studies remained uncertain. Current evidence underscores the heightened effectiveness of SEM over TT in enhancing students' athletic proficiencies. Nevertheless, the generalizability of findings to wider student demographics remains limited, necessitating further investigation into the efficacy of SEM particularly among primary and high school students. To ensure the reliability and validity of ensuing research endeavours, meticulous attention to intervention planning and design, including considerations of intervention frequency and dosage, is imperative. Moreover, the adherence to model fidelity must be upheld as an indispensable procedural imperative.

Keywords: Sport Education Model, Sports Ability, Game Performance, Technical Performance, Physical Fitness

Introduction

The Importance of the Traditional Teaching and Sport Education Model

Physical Education (PE) holds significant importance within school settings for nurturing students' athletic prowess (Bessa et al., 2019). Traditional Teaching (TT) methodologies, which have persisted from the 20th century to the present day (Gubacs-Collins, 2015), typically centre around the instructor as the primary authority figure. In such pedagogical paradigms, teachers bear the sole responsibility for curriculum design, delivery, and assessment, with limited student involvement (Mosston & Ashworth, 1986; Pritchard et al., 2008). Notably, instructional priorities often prioritize classroom management and behavioural norms to optimize teaching efficacy and maximize instructional time. This instructional approach facilitates the acquisition of foundational sports skills and

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knowledge among students (Bessa et al., 2021). The emphasis on repetitive drills, scaffolding, and incremental difficulty inherent in traditional instruction has proven particularly effective in cultivating novice-level competencies (Hastie et al., 2011; Pritchard et al., 2008; Sweeting & Rink, 1999). However, critiques of this approach highlight its restrictive nature concerning students' sporting experiences, as most knowledge is transmitted directly by teachers (McMorris, 1998). In recent decades, educational scholars have explored alternative pedagogical models to enhance the quality of PE instruction and foster improved learning environments for students (Bessa et al., 2019). The Sport Education Model (SEM) endeavours to furnish students with authentic and educative sporting experiences within the school context, aiming to cultivate competent, literate, and enthusiastic individuals. SEM serves as an efficacious approach for educators to enrich students' sporting experiences within the school environment. This model affords students a more holistic comprehension of sports and practical engagement in PE activities. Within SEM, the instructional unit is structured akin to a competitive season, typically spanning a minimum of 20 sessions along with requisite adaptations (Kastrena & Setiawan, 2017; Layne, 2015; Layne & Hastie, 2015a; Pereira et al., 2015; Pritchard et al., 2008). Students are organized into teams and assigned diverse roles such as coach, team leader, athlete, referee, recorder, reporter, and support staff. In addition to the competitive season and its associated roles, SEM encapsulates four distinctive features: formalized participation in official matches, documentation of memorable moments, cultivation of celebratory ambiance, and culminating events. Furthermore, SEM offers considerable flexibility in instructional content and strategies (Garcia Lopez & Kirk, 2022), accommodating variations across different stages of the season through direct instruction, cooperative learning, and peer-based instruction. Consequently, SEM heralds a departure from the traditional teacher-centric approach toward a more student-centred instructional methodology (Hastie & Wallhead, 2016; Manninen & Campbell, 2022; Wallhead & O'sullivan, 2005).

Objective and Research Gap

This systematic review endeavours to analyse the principal outcomes of a comparative inquiry concerning the effects of the SEM and TT on students' athletic competencies within the domain of physical education. The conventional pedagogical approach in physical education instruction predominantly accentuates a teacher-centric framework, prompting apprehensions regarding its efficacy in providing students with a comprehensive athletic experience and skillset. SEM is lauded for its aspiration to cultivate adept, literate, and enthusiastic individuals among student cohorts. Moreover, a multitude of scholars have embarked on empirical investigations and methodical evaluations delineating the advantages of SEM across various facets of student development (Bessa et al., 2019; Bessa et al., 2021; Manninen et al., 2022; Tendinha et al., 2021). However, a discernible void exists in reviews that specifically probe the relationship between SEM and TT methodologies and students' motor proficiencies. Consequently, the interrogation of whether SEM might assume a pivotal role in nurturing students' athletic prowess precipitated the inception of this review.

The investigation posits four primary research inquiries:

(Q1) Within which contextual domains do studies predominantly concentrate when contrasting the efficacy of the SEM and TT methodologies in fostering students' athletic capabilities?

(Q2) What are the prevailing variables subjected to analysis in these comparative experiments, and what outcomes emerge from such analyses?

(Q3) What methodological approaches are employed to scrutinize the development of sports abilities within the SEM instructional framework?

(Q4) How many studies have undertaken assessments of model fidelity in implementation?

Through addressing these inquiries, the study endeavours to furnish a comprehensive comprehension of the influence exerted by SEM and TT on students' athletic proficiencies, thereby augmenting ongoing endeavours aimed at elevating the standard of physical education and enhancing students' sporting learning experiences.

Literature Review

Sports Ability

The construct of sports ability, as highlighted by Houston et al. (2002), represents a subjective measure, subject to the individual respondent's interpretation. Drawing upon prior research endeavours on sports ability (Xu et al., 2021;Houston et al., 2002; Huang et al., 2021; Li et al., 2022; Sun, 2015; Yadav & Bhainaik, 2022), this review operationalizes sports ability as encompassing the elements of talent (fundamental physical aptitude), skill (proficiency in executing specific tasks or sequences), and game performance (Ackerman, 1990; Famose & Duranl, 1988). This conceptualization incorporates dimensions such as coordination, muscular strength, agility, swiftness, and overall athleticism. It is acknowledged that sports ability exhibits considerable variability among individuals and can be cultivated and refined through systematic training, dedicated practice, and accumulated experience (Wilmore & Costill, 1999).

Previous Studies of the SEM on Students' Sports Ability

Quiñonero-Martínez et al. (2023) investigated the physical fitness levels of children and adolescents utilizing Eurofit and Alpha Fitness assessments. Findings revealed enhanced performance in the standing long jump and speed-agility tests

among the control group, whereas the experimental group exhibited negligible progress. Parker and Curtner-Smith (2005) underscored the significance of both the SEM and traditional MA units in influencing students' health-related fitness. Despite the absence of statistical significance, discernible trends in the data provided avenues for future research and insights to refine prevailing practices in physical education. Ko et al. (2006) employed FITNESSGRAM® assessments to gauge fitness levels, demonstrating that the integration of fundamental SEM principles into fitness units effectively bolstered students' proficiencies. Quiñonero-Martínez et al. (2023) explored innovations in physical education by implementing SEM to evaluate the physical fitness of middle school students. Their investigation suggested that SEM characteristics could proficiently instruct and cultivate essential competencies. Wahl-Alexander and Chomentowski (2018) delved into the impact of foundational physical education courses at the university level on college students' aerobic fitness. Through comparing SEM with direct instructional approaches, they observed notable enhancements among students participating in the SEM-based physical conditioning course, underscoring the affirmative influence of SEM adoption in university physical education settings.

Tendinha et al., 2021 scrutinized the influence of the SEM on the motor skill advancement of students throughout a volleyball season. Implemented by in-service educators with ongoing professional development support, the study evaluated motor skills within the context of the "Keep It Alive" volleyball game. Substantial enhancements were evident in various facets including volleyball technique, communication, movement proficiency, and overall performance scores, indicating the constructive impact of SEM on motor skill development. Hastie and Casey (2014) juxtaposed two variants of SEM in track and field events, evaluating their effects on students' skill acquisition, technical proficiency, and knowledge acquisition. Both cohorts exhibited noteworthy progress, with SEM classes demonstrating superior proficiency in technical execution and skill mastery. Notably, solely the SEM group displayed significant enhancements in knowledge acquisition, underscoring the structured framework of SEM as a contributing factor. Hastie et al. (2009) delved into students' skill enhancement and strategic acumen during a badminton season utilizing SEM. Notable advancements were observed in students' capacity to control and execute badminton manoeuvres assertively. Furthermore, improvements were evident in the selection of tactical solutions and rationale behind strategic decisions. Guijarro and MacPhail (2021) contrasted SEM with a combined SEM and Teaching Games for Understanding (TGfU) amalgamation, with findings indicating the superiority of the combined model in fostering decision-making abilities, supportive interactions, overall game performance, and student engagement. This underscores the advocacy for integrating these models in physical education to bolster students' game performance and participation. Araujo et al. (2019) examined enhancements in game performance across three hybrid Sport Education-Step-Game-Approach volleyball seasons involving 18 Portuguese high school students, emphasizing the efficacy of multiple seasons within SEM to mitigate skill level disparities. Layne and Yli-Piipari (2015b) investigated the impact of SEM on college students' basketball performance and content comprehension. Through a comparative analysis with traditional teaching methods involving 25 participants, significant advancements were noted in offensive game proficiency and content understanding among the SEM group, indicating the model's efficacy in augmenting game skills and knowledge acquisition.

The analysed studies depict nuanced findings regarding sports ability, delineating disparate responses to fitness assessments and the progression of motor skills. While Quiñonero-Martínez et al. (2023) revealed divergent outcomes in physical fitness, Parker et al. (2005) suggested potential trends warranting consideration for refining pedagogical practices in physical education. SEM consistently exhibited favourable impacts on fitness levels and motor skill advancement, as evidenced by the studies conducted by Ko et al. (2006), and Hastie et al. (2009). Notably, Guijarro and MacPhail (2021) underscored the superiority of a combined SEM and TGfU approach, highlighting the influence of instructional methodologies on game performance. These variations underscore the necessity for tailored instructional strategies, signifying that the efficacy of SEM is contingent upon contextual factors, with instructional nuances playing a pivotal role in shaping outcomes across diverse educational environments.

Previous Systematic Review Research

Prior reviews centred around the SEM undoubtedly serve as invaluable resources for synthesizing available evidence concerning the primary objectives of physical education. These objectives primarily encompass students' personal and social skills (Bessa et al., 2019; Bessa et al., 2021), as well as motor and cognitive development (Bessa et al., 2021), motivation (Manninen et al., 2022; Tendinha et al., 2021), fulfillment of basic needs (Manninen et al., 2022), cultivation of prosocial attitudes (Manninen et al., 2022), and attainment of learning outcomes. Conclusions drawn from these reviews indicate that the integration of SEM yields positive effects in enhancing student performance across these dimensions. However, despite their informative contributions, these reviews are not without limitations. While numerous systematic reviews have summarized key findings regarding the influence of various teaching methodologies, no

quantitative or qualitative reviews have been identified to date that specifically juxtapose, analyse, and discuss the effects of SEM and TT on students' sports ability. This underscores the innovative nature of the present review. Aligned with the aforementioned rationale, this study endeavours to scrutinize the principal findings of pertinent surveys dedicated to comparing the impacts of SEM and TT on students' sports ability.

Methods

Protocol and Registration

In adhering to the guidelines stipulated by the PRISMA statement (Page et al., 2021), this systematic review and meta-analysis adhered to rigorous reporting standards. Furthermore, the review protocol has been formally registered on Inplasy.com (INPLASY022100040), ensuring transparency and methodological rigor in the research process.

Search Strategy

The exploration for articles pertinent to the subject matter encompassed a comprehensive search across four electronic databases: SCOPUS, PubMed, EBSCOhost (SPORT Discus and CINAHL Plus), and Web of Science. The search spanned from 2008 to 2023, with the final search deadline set for mid-June 2023. Search terms encompassed citations and keywords as reviewed by Llurda-Almuzara et al. (2020) in their systematic literature review, alongside indicators associated with sports ability, including terms such as "sports ability," "physical skills," "techniques," "performance," "coordination," "strength," "agility," "speed," and "athleticism." These terms were combined utilizing English Boolean operators "AND" and "OR," employing phrases like "sports education," "direct instruction," "traditional teaching," "traditional instruction," "traditional style," "teacher-centred teaching model," and "skill-drill-game." Additionally, collaboration with subject-specific librarians ensured the optimization of search outcomes. Furthermore, a meticulous examination of the reference lists of included studies within this review was conducted to corroborate the initial search's impact and identify any potentially overlooked relevant literature. This manual procedure entailed a thorough scrutiny of titles, author attributions, and publication years to gather supplementary scholarly resources.

Eligibility Criteria

Simonsohn et al. (2014) advocate for the establishment of eligibility criteria preceding electronic retrieval. In accordance with this recommendation, inclusion and exclusion criteria were delineated for this review, guided by the PICOS framework (Population, Intervention, Comparison, Outcomes, and Study Design), prior to initiating the electronic literature search (see Table 1 for details).

Inclusion Criteria

The chosen literature had to adhere to the following criteria: (i) articles had to be full-text and in English, sourced from peer-reviewed journals, excluding books, incomplete articles, conference abstracts, and dissertations; (ii) participants in the studies were required to be students with a health status enabling regular physical activity; (iii) the research had to entail interventions conducted within the realm of physical education, with comprehensive delineations of the intervention process and content; (iv) the study needed to contrast the effects of SEM (Simulated Environment) and TT methods on at least one indicator of student sports ability; and (v) the study design had to be quantitative, with evaluation outcomes grounded in objective experiments or measurements.

Exclusion Criteria

(i) Research that fails to satisfy the aforementioned inclusion criteria; (ii) Literature situated beyond the educational domain; (iii) Investigations incorporating a blend of SEM and alternate teaching frameworks, such as TGfU, as referenced in Bessa et al. (2021); (iv) Studies that do not employ a quantitative research design and lack evaluation outcomes derived from objective experiments or measurements; (v) Instances where either no control group is present or the control group does not receive traditional instruction.

Table 1

Inclusion Criteria According to the PICOS Conditions

Items	Detailed Inclusion Criteria
Population	Students (male/female)
Intervention	Sports Education Model
Comparison	Traditional teaching (direct instruction, traditional instruction, traditional style, teacher-centred teaching model)
Outcome	Sport ability
Study Designs	RCT

Study Selection

The initial search strategy was guided by the expertise of a librarian to ensure the elimination of duplicate literature. The retrieved articles were subsequently imported into Mendeley reference management software. Following this, we independently evaluated the titles and abstracts to determine their relevance for inclusion or exclusion. Articles considered highly pertinent were then meticulously reviewed in their entirety. The Notes feature in the Mendeley software facilitated the annotation and

revision of SEM and TT intervention outcomes concerning their impact on students' sports abilities. Lastly, two reviewers assessed the full text of the selected articles and extracted significant information. In instances of disagreement, a third reviewer participated in the evaluation process until consensus was achieved among all three reviewers regarding the screening outcomes.

Data Extraction and Quality Assessment

Key data extracted from the chosen literature encompassed details such as authorship, publication timeframe, research aims, participant demographics, participants' nationality, specifics of the exercise regimen, intervention methodologies applied in the experimental group, instructional approaches utilized in the comparison group, fidelity assessments for the intervention model, variables related to sports proficiency, and primary comparative outcomes.

Risk Assessment of Bias in Non-Randomized Controlled Trial Studies

Sterne et al. (2016) introduced the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I), a comprehensive bias assessment tool tailored for non-randomized studies assessing the effects of interventions (NRSI). This tool, published in the British Medical Journal (BMJ), represents a significant advancement in quality assessment within the NRSI domain. ROBINS-I is versatile, designed to be applicable across various non-randomized study designs including cohort studies, case-control studies, and quasi-experiments. Distinguished by its domain-based evaluation approach, ROBINS-I categorizes assessment domains into three distinct phases: pre-intervention (encompassing confounding bias and bias in participant selection), intervention (addressing bias in intervention assignment), and post-intervention (encompassing bias from incomplete intervention data, bias from missing outcome data, bias from outcome measurement, and bias from selective outcome reporting). Within each assessment domain, multiple Signalling questions are posed, totalling 34 in all. This delineation mirrors the parallel structure of RCTs embodied in the RoB2.0 tool, offering a comprehensive framework for assessing bias in NRSI.

Methodical Quality

The methodological rigor of the studies was appraised utilizing the Downs and Black (1998) checklist, renowned for its comprehensive assessment of study strengths and weaknesses across three domains: reporting (items 1-10), validity (items 11-26), and statistical precision (item 27), encompassing a total of 27 items. Each item is evaluated on a scale of 1, with the checklist furnishing explicit criteria for scoring. Evaluation outcomes were classified according to Grgic et al.'s (2018) criteria, where scores falling within the range of 20 to 27 were deemed indicative of "good quality," scores between 11 to 19 signified "medium quality," and scores below 11 were categorized as "poor quality." The assessment process was conducted independently by two researchers, with discrepancies resolved through consultation with a third author until consensus was reached. The articles received ratings ranging between 12 and 13 points, indicating a moderate level of methodological quality (refer to Table 2 for details).

Table 2

Study Quality Checklist with Quality Scores Assigned

Author(s)/Date	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	QS
Kastrena & Setiawan (2018)	1	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Layne & Piipari (2015)	0	1	1	0	1	1	0	1	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	0	0	0	UTD	0	13
Layne (2015)	0	1	1	0	1	1	0	1	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	0	0	0	UTD	0	13
Li et al (2022)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Nikravan et al (2019)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	0	0	0	UTD	0	12
Pereira et al., (2015)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Hastie et al. (2009)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Pritchard et al. (2008)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Rocamora et al. (2019)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Wahl-Alexander et al. (2018)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	1	0	0	UTD	0	13
Xu et al (2021)	1	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	0	0	0	UTD	0	13
Zhang (2020)	0	1	1	0	1	1	0	0	1	UTD	UTD	UTD	0	0	0	1	1	1	1	1	1	0	0	0	UTD	0	12

QS: Quality Score

Results

Figure 1 delineates the processes involved in study selection, while Table 3 furnishes a comprehensive overview of the 12 studies encompassed within this review. Additionally, Table 4 presents the outcomes of the assessment of literature bias risk, detailing author(s)/date, research domain, study typology, risk appraisal tool, and overall evaluation rating. The detailed assessment reports for each study can be accessed in the supplementary materials. Notably, confounding variables emerged as the primary contributor to overall bias risk, with assessment findings revealing moderate bias in 25% of experimental studies and severe bias in 75% of them. However, all included literature exhibited low risk pertaining to participant selection, recommended intervention classifications, and deviations from established interventions. Moreover, a subset of the literature (Layne, 2015; Layne et al., 2015b; Pritchard et al., 2008) demonstrated low-risk missing data, while others lacked pertinent information in this regard. Regarding outcome measures, the majority of projects evinced a moderate risk of bias, with only one study (Pritchard et al., 2008) displaying a low risk of bias in outcome measurement. Finally, a moderate risk of bias was noted in the assessment of selective reporting bias across all project outcomes.

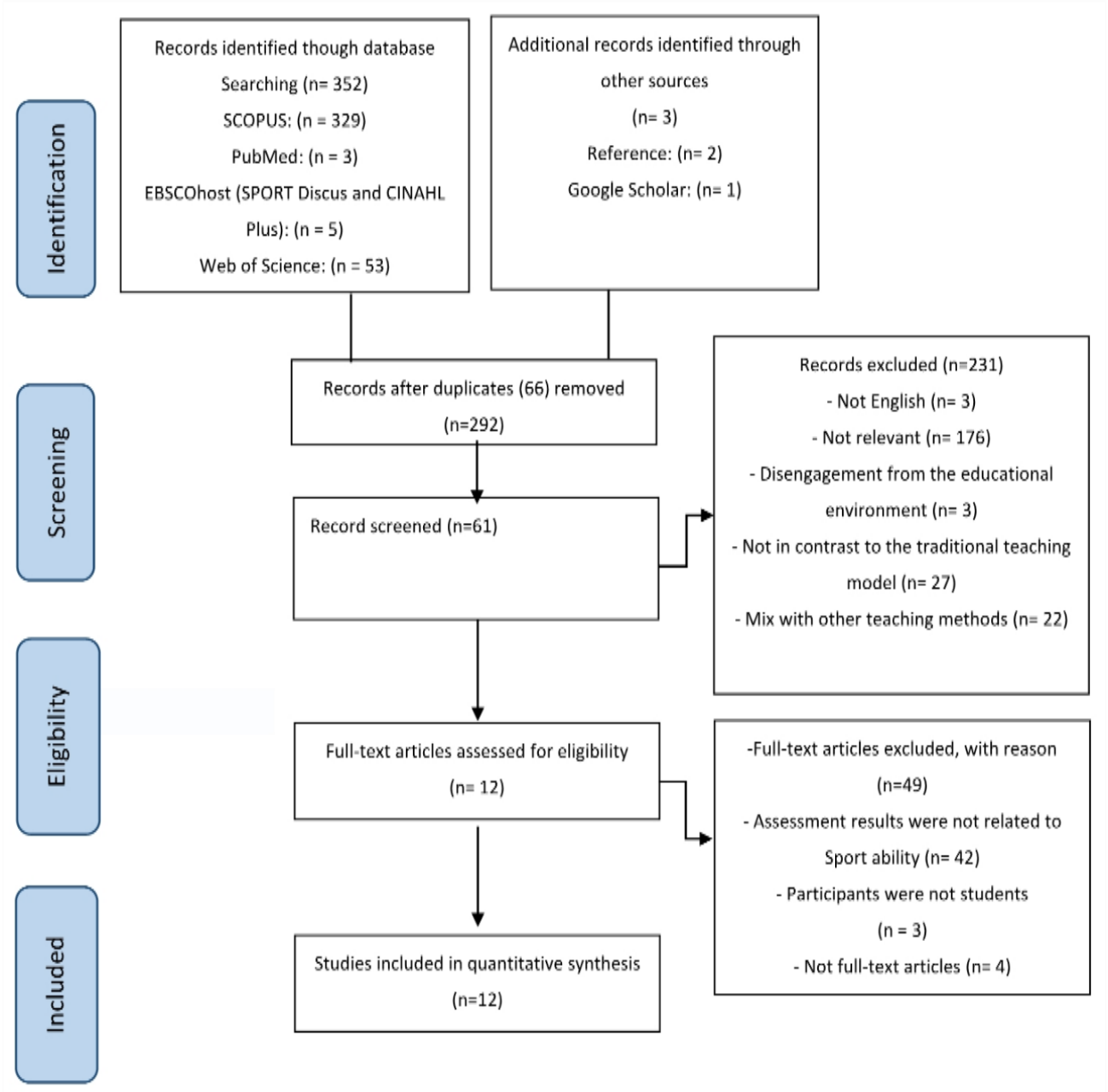

Figure 1: PRISMA Summary of the Study Selection Process.

Table 3

Characteristics of Included Studies.

Author(s)/Date	Purpose	N (sex) / Age	Country	Sport	Intervention	Comparison	Fidelity	Variables	Main Findings
Kastrena et al. (2017)	To explore the influence of SEM and TT on improving students' volleyball playing skills	Middle school N=30 Male 22, Female 3	Indonesia	Volleyball	SEM 19 lessons Three times a week	TT	Unit plan and curriculum elements	volleyball playing skills	-SEM is significantly better than TT in improving students' volleyball skills
Layne et al. (2015a)	To investigate the effect of the SEM model on basketball performance and knowledge of physical activity curriculum content among students	College N=25, Male 22, Female 3 EG=12 male and 1 female CG=10 male and 2 female	US	basketball	SEM 28 lessons Two to three times a week One hour and 25 minutes	TT	No	Offensive game performance Game efficiency	- Students in the sports education group showed significant improvements in offensive game performance compared to the TT model. - There was a slight increase in game efficiency in the SEM group, whereas students in the traditional group experienced a decrease.

Layne (2015)	To compare the effects of SEM and DI on students' running performance	College 26 students (15 males, 11 females) SEM=15 CG=11	US	Running	SEM 42 lessons Three times a week 50min	DI	Experienced & Checklist	Running performance	- Both two teaching methods can significantly improve the jogging performance of college students. - There was no significant difference between the two teaching methods.
Li et al (2022)	To compare the effects of SEM and TT teaching modes on the ability and knowledge of volleyball in Chinese sports professionals.	College EG=55 (41 boys, 14 girls) CG=55 (39 boys, 16 girls)	China	Volleyball	SEM 16 lessons Once a week 90min	TT	Unit plan and curriculum elements and experienced	Game-like Skills (forearm pass, overhead setting) Game Performance (Adjustment, decision making, skill technique, and skill outcome)	- In the SEM group, the Performance of forearm pass, overhead setting skill, and Game Performance were significantly improved. - In the TI group, only the Performance of overhead setting skill and Game Performance produced a significant improvement effect. - SEM was significantly better than TI.
Nikravan et al (2019)	To compare the effects of traditional methods and sports education on Physical Fitness and Competency.	Junior EG=18 CG=18 grade two of junior school	Iran	volleyball	SEM 12 sessions 90 min	TT	No	Physical Fitness (Agility, Jump Sport, Sit-up, Speed, Endurance, Flexibility, Horizontal bar) Competency	- Comparison between groups: Exercise education was given priority over traditional methods in improving physical fitness (except jumping). - Intra-group comparison: the competency was significantly improved.

(Pereira et al., 2015)	To compare the influence of SEM and DI on students' track and field performance	Junior N=47 10-13 years old EG=19 (9 boys and 10 girls) CG=28 (16 boys and 12 girls)	Portugal	Track and Field	SEM 20 lessons Twice a week 45 min	DI	Unit plan and curriculum elements & Experienced & Checklist	Shot-put Triple-jump Hurdles	- The SEM group showed significant improvements in all items, but evidence of significant improvements in DI was limited to boys and taller students
Hastie et al. (2009)	To explore the effects of obstacle course education season on the aerobic fitness level of college students	Primary school N=48 (Mage=10.6), M/F=23/ 25 EG = 23 (M\F=12/11) CG = 25 (M\F=12/11)	US	Disc Lacrosse	SEM 20 classes Five times a week 40min	DI	Experienced	Aerobic fitness (PACER)	The Aerobic fitness of students in the SEM group was significantly better than that in the DI group.
Pritchard et al. (2008)	To investigate how SEM and TS would affect skill development, knowledge, and game performance for volleyball at the	Junior EG=26 CG=21 Age=14–15	US	Volleyball	SEM 20 lessons Five times a week 50 min	TS	Unit plan and curriculum elements & Checklist	Skill (Set and Pass) Game Performance (Decision made Skill execution Adjust)	- There was no statistically significant difference between the skills, but there was a statistically significant difference between the game performance, SEM better than TS

Rocamora et al. (2019)	To assess SEM and DI in Primary Education students' physical activity intensity levels, game performance, and friendship goals.	Primary school N=88 EG=47 CG=41 Mage=11.16±0.63	SEM 15 lessons Three times a week 45min	DI
Wahl-Alexander et al. (2018)	To compare the effects of SEM and TI on aerobic fitness levels of college students.	College M=23, F=24 EG= 12 boys and 11 girls Mage=22 CG=11	SEM 26 lessons Bi-weekly for 75 min	TI
Xu et al (2021)	To compare the effects of SEM and TSM on table tennis skills and attitudes of high school students in China.	High school N=64 Age: 16–17 years old	SEM 16 lessons Once a week 40min	TSM
Zhang (2020)	The enlightenment of the physical education model to college physical education	College N=60 (20 boys, 40 girls) Mage= 20.52±0.8	SEM 16 lessons Once a week 90 min	TT

Game performance (Progress to goal Get open Defend opponent Prevent score)	Trained& Experienced & Checklist	Cardiovascular fitness levels	Table tennis skills (Backhand drive Forehand drive Topspin serve)	Physical quality
The SEM could be considered more effective than DI to improve Primary Education students' game performance.	The Progressive Aerobic Cardiovascular Endurance Run (PACER) and the one-mile run were significantly improved in the SEM group, and the PACER laps were significantly improved compared with the TT group		- The technical level of the students in both classes has improved significantly, and the progress of SEM students in forehand drive and serve is obviously higher than that of TSM students.	The SEM model was significantly better than the control group in improving the physical quality of college students.

DI: Direct Instruction, TI: Traditional Instruction, TS: Traditional Style, TSM: Traditional Sports Model

Table 4

Study Risk of Bias.

Author(s)/Date	Study Design	Risk Assessment Tool	Overall Evaluation Rating
Kastrena et al. (2017)	CT	ROBINS-I	Serious
Layne et al. (2015a)	CT	ROBINS-I	Serious
Layne et al. (2015b)	CT	ROBINS-I	Serious
Li et al. (2022)	CT	ROBINS-I	Serious
Nikravan and Zarei (2019)	CT	ROBINS-I	Serious
Pereira et al., (2015)	CT	ROBINS-I	Serious
Hastie et al. (2009)	CT	ROBINS-I	Serious
Pritchard et al. (2008)	CT	ROBINS-I	Serious
Rocamora et al. (2019)	CT	ROBINS-I	Serious
Wahl-Alexander et al. (2018)	CT	ROBINS-I	Moderate
Xu et al (2021)	CT	ROBINS-I	Serious
Zhang (2020)	CT	ROBINS-I	Serious

CT = Non-Randomized Controlled Trial / Quasi-Experimental Studies

The Findings of this Review can be Summarized as Follows

(Q1) In which contexts do studies on the development of students' sports abilities predominantly focus when comparing the two teaching methods, SEM and TT?

The majority of the 12 studies included in this review emanated from developed nations, accounting for 7 studies (58%). Specifically, the United States contributed 5 studies (42%), while Spain and Portugal each provided 1 study (8%) respectively. Developing countries constituted 5 studies (42%), encompassing China with 3 studies (25%), Iran with 1 study (8%), and Indonesia with 1 study (8%). Regarding participant classification, the studies categorized participants as university students (5 studies, 42%), senior high school students (1 study, 8%), junior high school students (4 studies, 33%), and primary school students (2 studies, 17%). Team sports predominated, with volleyball being featured in 4 studies (33%), followed by basketball (1 study, 8%), handball (1 study, 8%), and disc lacrosse (1 study, 8%). Individual sports included running (1 study, 8%), track and field (1 study, 8%), table tennis (1 study, 8%), physical fitness (1 study, 8%), and multi-activity physical fitness (1 study, 8%).

(Q2) What are the variables most commonly analysed in these comparative experiments?

The 12 studies scrutinized three variables associated with athletic ability: game performance, technical performance, and physical fitness. Game performance was the focus of four studies (Layne et al., 2015b; Li et al., 2022; Pritchard et al., 2008; Rocamora et al., 2019), while technical performance was investigated in six studies (Kastrena et al., 2017; Layne, 2015; Li et al., 2022; Pereira et al., 2015; Pritchard et al., 2008). Physical health was explored in four studies (Hastie et al., 2009; Nikravan et al., 2019; Wahl-Alexander et al., 2018; Zhang, 2020).

(Q3) What methodologies are employed to investigate the development of sports abilities within the SEM curriculum?

The majority of studies included in this review adopted quasi-experimental designs with quantitative analysis. Among these designs, 11 studies utilized before-and-after tests, constituting 92%, while only one study employed a 2 × 3 (group × time) research design (Pritchard et al., 2008). Major confounders' distribution was unmentioned in all studies, and only two studies provided characterization of patients lost to follow-up (Layne, 2015; Layne et al., 2015b). None of the studies attempted to blind subjects to the intervention they received or those assessing the primary outcome of the intervention. Five studies randomized pairs (Hastie et al., 2009; Li et al., 2022; Pereira et al., 2015; Rocamora et al., 2019), constituting 33% of the total. While nine studies described the source of the test or assessment criteria when measuring variables, only three studies demonstrated the reliability of the test instrument, test method, and ratter (Li et al., 2022; Pereira et al., 2015; Pritchard et al., 2008). Regarding intervention duration and frequency: out of the 12 studies, only 6 studies (50%) had SEM seasons longer than 20 class hours, while the remaining 6 studies (50%) had durations below 20 class hours. The frequency of course interventions ranged from once every two weeks to five times per week, with each session lasting between 40 and 90 minutes. Only one study (8%) did not provide information on the timing of each implementation (Kastrena et al., 2017).

(Q4) How many studies have assessed the fidelity of model implementation?

Nine out of 12 studies (75%) confirmed fidelity to SEM implementation, albeit employing different methods. The assessment of SEM and TT courses primarily involved detailed descriptions of the SEM unit plan and curriculum elements, the involvement of experienced teachers, or the use of instructional checklists. In 5 out of the 9 studies (56%), authors solely provided thorough descriptions of curriculum elements or sought the expertise of experienced instructors, which may not guarantee adherence to accepted SEM standards. However, in four studies, instructional checklists were utilized alongside detailed descriptions of curriculum elements or the involvement of experienced instructors.

Discussion

Findings About Studies Background

The majority of studies investigating the SEM model have traditionally been conducted in developed nations, notably the United States (Wallhead et al., 2005). However, there is a burgeoning interest in implementing the SEM model in developing countries, particularly evident in China (Sun, 2018) This transition likely reflects the alignment between the SEM model's objectives and the trajectory of educational reform in China. The study participants primarily consist of coeducational students, reflecting the SEM's primary implementation environment within educational institutions (Bessa et al., 2021). The majority of participants are sourced from junior high school and college settings, consistent with prior research findings (Bessa et al., 2019; Bessa et al., 2021; Manninen et al., 2022; Tendinha et al., 2021). The distinctive contribution of SEM lies in its holistic approach to promoting students' physical and psychological well-being. It not only prioritizes skill acquisition but also fosters a sense of community, teamwork, and sportsmanship among students. This aspect gains particular significance within the educational reform context in China, characterized by an increasing emphasis on comprehensive education (Sun, 2018).

Regarding sports, the research indicates a prevalence of team sports in SEM studies (Bessa et al., 2019; Bessa et al., 2021). This underscores the necessity for future investigations to encompass individual sports, thereby enhancing the breadth of understanding and mitigating the risk of biased outcomes. The literature underscores the significance of reporting on participants lost to follow-up, as it impacts various facets of research quality, encompassing bias assessment and data integrity. However, this review reveals that only two studies provide such information, underscoring a gap in the present research landscape. Given SEM's distinct role in fostering holistic development and its increasing relevance across diverse educational contexts, forthcoming research endeavours should prioritize diversifying the range of sports studied and the geographical locations investigated. Moreover, enhanced transparency and rigor in reporting are imperative to augment the quality of research in this domain.

Findings About the Game Performance

The examination of teaching methodologies' influence on students' athletic competencies, particularly concerning game performance development, has garnered significant scholarly attention (Layne et al., 2015b; Li et al., 2022; Pritchard et al., 2015; Pritchard et al., 2008) (Layne et al., 2015b; Li et al., 2022; Pritchard et al., 2008; Rocamora et al., 2019). Scholars have identified various criteria for assessing game performance, encompassing offensive and defensive proficiencies, alongside decision-making and adaptability skills (Li et al., 2022; Pritchard et al., 2008). In direct comparison between the SEM and TT approaches, the SEM cohort exhibited notable enhancements in offensive capabilities (Rocamora et al., 2019). Particularly noteworthy, in metrics such as 'Defend Opponent' and 'Prevent Score,' the SEM's effect size surpassed that of TT by a factor of 4.8 (Rocamora et al., 2019). These findings align with Pritchard et al.'s (2008) observations, demonstrating SEM's superiority in skill execution. Intriguingly, while SEM showcased significant advancements in decision-making and adaptability (Li et al., 2022; Pritchard et al., 2008), Pritchard et al. (2008) concluded that TT had negligible influence on students' decision-making capacities. This consistency is mirrored in Layne et al. (2015b) assessment of game efficiency indicators. Despite SEM's apparent superiority across multiple domains, further research is imperative to substantiate these findings, especially across diverse sports and age demographics. Coaches and educators may find merit in embracing the SEM, particularly in contexts necessitating the augmentation of students' offensive and defensive proficiencies.

Findings About Technical Performance

An essential focus of this review pertains to the progression of students' technical aptitude, an area of significant scholarly inquiry (Kastrena et al., 2017; Layne, 2015; Li et al., 2022; Pereira et al., 2015; Pritchard et al., 2008). Researchers have utilized diverse metrics to evaluate technical proficiency, encompassing volleyball techniques, running capabilities, and various athletic skills (Li et al., 2022; Pereira et al., 2015; Pritchard et al., 2008). Studies have yielded varied outcomes regarding the efficacy of SEM and TT methodologies. Kastrena et al. (2017) observed SEM's significant superiority over TT in refining volleyball skills. Conversely, Layne (2015) reported no significant disparity between the two methods in improving running performance among college students. However, Li et al. (2022) and others noted SEM's notable supremacy in specific skills like forearm passing and overhead setting. Pereira et al. (2015) and Pritchard et al. (2008) extended these observations to distinct demographic cohorts, such as boys and taller individuals, highlighting that under TT, only certain proficiencies like forearm passing exhibited significant enhancement. Xu et al. (2021) similarly indicated the effectiveness of both SEM and TT, with SEM demonstrating greater augmentation in skills like forehand spike and serve. Synthesizing the

insights from five distinct investigations, it can be deduced that SEM generally surpasses TT in bolstering students' technical competence (Kastrena et al., 2017; Li et al., 2022; Pereira et al., 2015; Pritchard et al., 2008).

Findings About Physical Fitness

This review examines four studies focusing on physical fitness dimensions (Hastie et al., 2009; Nikravan et al., 2019; Wahl-Alexander et al., 2018; Zhang, 2020). Various indicators like agility, jump, sit-up, speed, endurance, flexibility, balance, aerobic and cardiovascular fitness, and physical quality were utilized (Hastie et al., 2009; Nikravan et al., 2019; Wahl-Alexander et al., 2018; Zhang, 2020). Nikravan et al. (2019) highlighted SEM's superiority in most aspects over the TT method, except for the high jump. Hastie et al. (2009) found SEM students had notably better aerobic fitness compared to the Direct Instruction (DI) group, corroborating Wahl-Alexander et al. (2018). Zhang (2020) showed SEM's significant enhancements in college students' physical quality compared to a control group. These consistent findings indicate SEM's superior effectiveness over TT in improving students' physical fitness.

Findings About the Methodology of the Studies

Quasi-experimental designs, often featuring pre-post testing, are frequently utilized to enhance experimental control in research exploring the impact of teaching methods on students' physical and mental development (Stratton, 2019). This trend is affirmed by the literature, where studies commonly employ quasi-experimental designs like non-randomized controlled designs with pre-test and post-test measurements (Burgueño Menjibar & Medina Casaubón, 2020; Puente-Maxera et al., 2018; Wallhead & Ntoumanis, 2004). Due to the close relationship between teaching methods and educational settings, research predominantly occurs within school environments, posing challenges for achieving full participant randomization. Consequently, true experimental designs, considered the gold standard, are less prevalent. Among the 12 studies in this review, 11 adopted a pre-test and post-test design, while only one study incorporated a pre-test, mid-test, and post-test approach to capture dynamic changes in students' sports ability. Understanding these pedagogical dynamics is crucial for comprehensively grasping the teaching process and guiding future pedagogical models (Bessa et al., 2021), aligning with Hastie et al. (2016) emphasis on the teaching process. While research is starting to heed the recommendation of conducting experimental SEM studies (Hastie et al., 2011), greater participant involvement, especially among younger students, is warranted. Moreover, adhering to the recommended SEM season length of at least 20 lessons, as outlined by Siedentop et al., is crucial for students to acquire a systematic understanding of sports knowledge and skills. However, the majority of reviewed studies did not meet this duration standard, prompting suggestions to enhance season length or intervention frequency to improve SEM group performance (Layne et al., 2015b; Tendinha et al., 2021). To ensure success and reliability, future research should prioritize meticulous planning and design regarding the number and frequency of interventions.

Findings About the Model Fidelity

Ensuring fidelity to the SEM curriculum in research is essential for validating and ensuring the integrity of study outcomes. This serves two primary purposes: (i) establishing a transparent connection between the intervention and its results, and (ii) mitigating the risk of erroneous conclusions by evaluating fidelity (Bessa et al., 2021). Studies in this domain should offer a comprehensive depiction of the unit plan, curriculum elements, and instructors' SEM experience during implementation (Hastie et al., 2014). Model fidelity has emerged as a central concern in academia, often assessed through tools based on the Instructional Checklist developed by Pritchard et al. in 2008. Despite the recognized significance of fidelity (Ko et al., 2006), this review identified that only one out of 12 studies examined both the curriculum unit plan and elements, along with instructors' SEM experience. A majority of studies (67%) did not assess the SEM curriculum at all, while half provided descriptions without addressing the critical aspect of model fidelity. These omissions can lead to inconsistencies in research findings (Bessa et al., 2019). Given these gaps, this systematic review strongly advocates for renewed attention to evaluating model fidelity as a pivotal research focus in future studies.

In assessing the literature quality, we found an average score of 12.67 out of 27 on the Downs and Black checklist, indicating medium quality, albeit nearing the lower threshold. Several studies lacked detail on blinding, randomization, power, sample representation, and confounder adjustment. Moreover, many studies offered thorough descriptions of SEM but provided limited insight into the TT model, often portraying it unfavourably. Future studies should strive for objectivity and comprehensiveness in describing all teaching methods compared, aiding teachers in leveraging the strengths of each model effectively.

Conclusion

This study offers a comparative analysis of the effects of TT and SEM on students' sports abilities. Despite the prevalent use of TT in physical education, its efficacy in enhancing

students' sports abilities lacks substantial evidence compared to SEM. SEM consistently demonstrates superior outcomes in areas like game and technical performance, and physical fitness. However, research on SEM's impact at elementary and high school levels remains limited, highlighting the need for more comprehensive investigations across different age groups. While TT has its merits as a commonly employed method, teaching approaches should remain unbiased, adaptable, and responsive to diverse teaching challenges. Acknowledging the potential of TT and its correct implementation is essential. Future research should prioritize standardized teaching practices, including unit plans, curriculum elements, experienced instructors, and instructional checklists. Furthermore, experimental designs should incorporate rigorous measures such as blinding, randomization, efficacy testing, sample representation, and confounder adjustment to ensure robust findings.

Limitations

This review presents compelling evidence supporting SEM's superiority over TT models in enhancing students' sports abilities. Nonetheless, several limitations are noted. Firstly, the studies overlook the impact of class sizes on teaching outcomes, neglecting to explore optimal group sizes or numbers. Future research should investigate how class size influences teaching effectiveness in SEM and TT contexts. Secondly, most studies fail to document the experimental environment or consider participants' extracurricular exercise engagement, potentially affecting students' attitudes toward physical education. Additionally, factors like climate and time are not adequately addressed in assessing students' attitudes during experimental teaching. Lastly, there is a notable absence of short- or long-term follow-up assessments post-trial, hindering the determination of SEM curriculum's lasting effects on students' sports abilities.

Declarations

Funding

This research received no external funding.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Systematic Review Registration

[https://inplasy.com/] [INPLASY202360034].

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