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Comparing Sport Education and Direct Instruction to Enhance Physical Literacy in Elementary Physical Education

Hairui Liu
University of North Dakota
Grand Forks, North Dakota
UNITED STATES

Melanie Gregg
University of Winnipeg
Winnipeg, Manitoba
CANADA

Peter Hastie
Auburn University
Auburn, Alabama
UNITED STATES

Author Biographies

Hairui Liu, is an Assistant Professor, Department of Education, Health & Behavior Studies, at the University of North Dakota. His research focuses on models-based practice in physical education and motor development.

Melanie J. Gregg, is a Full Professor in sport and exercise psychology, Department of Kinesiology and Applied Health, at the University of Winnipeg. Her research interests include psychosocial aspects of physical literacy development, mental imagery use in sport, and psychological skill use by athletes with intellectual impairment.

Peter Hastie, is a Wayne T. Smith Distinguished Professor, School of Kinesiology, College of Education, at Auburn University. His research in Sport Education focuses on implementing Sport Education in youth sport settings, student-designed games research, and the ecology of a mastery climate in physical education programs.

Abstract

This study compared the effectiveness of two pedagogical models in physical education for enhancing physical literacy. Grades 3-5 students participated in a 10-session team handball module. Classes were randomly allocated to one of two instructional conditions: a direct instruction model (n = 22) focused on skill acquisition through introductory activities, skill/drill practices, and subsequent gameplay, and the Sport Education Model (n = 40), which incorporated skill-focused practice, strategy and rules learning, team practice sessions, and formal and informal inter-team games. Using a quasi-experimental design with pre- and post-measures, the Sport Education group gained more motivation and confidence compared to the Direct Instruction group post-intervention. Compared to the Direct Instruction group, the Sport Education group demonstrated enhanced skill improvement, superior team handball literacy, and increased enjoyment. These findings underscore the added value of the Sport Education Model in fostering positive physical literacy outcomes in physical education.

Keywords: handball, direct instruction, Sport Education, Canadian Assessment of Physical Literacy

Résumé

Cette étude a comparé l'efficacité de deux modèles pédagogiques en éducation physique visant à améliorer la littératie physique. Des élèves de la 3e à la 5e année ont participé à un module de handball en équipe de 10 séances. Les classes ont été réparties aléatoirement dans l'une des deux conditions d'enseignement suivantes : un modèle d'instruction directe (n = 22) axé sur l'acquisition de compétences par le biais d'activités d'introduction, d'exercices et de jeux, et le modèle Sport Education (n = 40), qui intégrait des exercices axés sur les compétences, l'apprentissage de stratégies et de règles, des séances d'entraînement en équipe, ainsi que des matchs interéquipes formels et informels. Grâce à un devis quasi expérimental avec des mesures avant et après l'intervention, le groupe Sport Education a gagné en motivation et en confiance par rapport au groupe d'instruction directe. Comparativement au groupe d'instruction directe, le groupe Sport Education a démontré une amélioration plus marquée des compétences, une meilleure littératie en handball en équipe et un plaisir accru. Ces résultats soulignent la valeur ajoutée du modèle Sport Education pour favoriser des retombées positives en matière de littératie physique en éducation physique.

Mots-clés: handball; instruction directe; le modèle Sport Education; évaluation canadienne de la littératie physique

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Introduction

Physical literacy (PL) is widely recognized as an individual's capacity to lead a physically active lifestyle (Morison, 1969; Whitehead, 2015). The concept was first proposed by Morison (1969), who noted that physically literate individuals move efficiently, creatively, competently, and with enthusiasm. Whitehead's (2015) interpretation of PL is currently the most frequently cited in scholarly discourse, in which she describes PL as the motivation, confidence, physical competence, understanding and knowledge that individuals develop in order to maintain physical activity at an appropriate level throughout their life.

PL is a determinant of physical activity and finds its origins in Physical Education (PE) (Cairney et al., 2019). It is now prevalent across public health, recreation, sport, and education sectors (Dudley et al., 2017). Recent years have seen an increase in PL promotion as an international initiative, particularly in Great Britain, Canada, Australia, New Zealand, and the United States (Allan et al., 2017; Dudley et al., 2017; Jurbala, 2015). The consensus is that PE, alongside other platforms such as youth sports and public health, offers an environment conducive to the development of PL (Allan et al., 2017).

In Canada, PL is recognized as a multifaceted concept that includes the development of movement skills, confidence, and motivation to engage in various physical activities. Physical and Health Education Canada (PHE Canada) adopts the International PL Association's definition, stating that PL is "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (Whitehead, 2016). This holistic perspective underscores the importance of fostering not only physical skills but also the psychological and cognitive attributes necessary for lifelong participation in physical activity.

Lounsbery and McKenzie (2015) voiced concerns that the adoption of general education trends in PE, such as character education and efforts to increase academic subject matter integration, has led to the marginalization of the subject. They argue that this could, in turn, decrease the time and resources allocated to it within the overall curriculum. However, others have suggested that several objectives of general education, such as promoting student morals, values, responsibilities, and respect for self and others, can be subtly integrated within the PE context, resulting in a definition of PL that ensures that PE contributes significantly to these broader educational goals (Dudley, 2015). In essence, as students develop PL, they also cultivate social development, knowledge, understanding of morals, and values for engaging in physical activities.

PL can be operationalized in PE through games-based pedagogical models (Flemons et al., 2018; Pot et al., 2018) such as Teaching Games for Understanding (Thorpe et al., 1986) and Sport Education (SE; Siedentop, 1994). SE is a curriculum and instructional model designed to offer educationally rich sports experiences for students in school PE (Siedentop et al., 2020). This curriculum design highlights and replicates positive aspects of sports experiences that traditionally take place outside of school. Within SE, students participate in prolonged seasons, during which they become part of a stable team. These consistent team affiliations enable students to practice together, compete, and experience social development opportunities inherent in group membership. The implementation of these features suggests that SE could be instrumental in promoting PL across various team-based physical activities (Hastie & Wallhead, 2015).

Contrary to traditional *reproductive* teaching styles, which focus on the direct transmission of knowledge and skills from teacher to student through teacher-led instruction, demonstration, and imitation, SE adopts a student-centered structure that emphasizes the affective learning domain, encompassing elements like motivation and goal setting (Pot et al., 2018). Activities in SE are designed with varying levels of complexity to meet the needs of diverse learners (Pot et al.,

2018). Hastie & Wallhead (2015) noted that the model's progressive competition formats provide students with meaningful opportunities to enhance motor skills and tactical awareness within developmentally appropriate environments.

The effectiveness of SE in promoting PL may be understood through Self-Determination Theory (SDT; Deci & Ryan, 2000), a widely applied theoretical framework for explaining motivation in educational, sport, and exercise contexts. According to SDT, individuals achieve optimal motivation and are more likely to sustain their behaviours when three fundamental psychological needs, autonomy, competence, and relatedness, are satisfied (Deci & Ryan, 2000). Within SE, autonomy is cultivated by decentralizing responsibilities from teachers to students, allowing them meaningful decision-making opportunities and role ownership. Competence is developed through structured, progressively challenging tasks that align with students' skill advancement. Finally, relatedness emerges naturally as students collaborate closely within stable team environments, fostering a sense of connection and community (Hastie & Wallhead, 2015). Consequently, SE's inherent design aligns closely with SDT principles, providing an ideal structure for enhancing student motivation and engagement, foundational aspects of PL.

In SE, each student is entrusted with a specific role and responsibility, with the ultimate aim of achieving team success. Roles can range from peer coaches, who assess and correct movement inaccuracies in their peers' skills, to student fitness trainers, who disseminate knowledge and the benefits of health and fitness. Additionally, student officials contribute by promoting the values of fair play, thereby fostering a positive learning environment (Hastie & Wallhead, 2015). This decentralization of responsibility from the teacher to the student underpins the effective promotion of the PL concept (Durden-Myers et al., 2018). Students' assumption of responsibility is integral to developing behaviour management skills, thereby establishing habitual engagement in physical activity. Simultaneously, this devolution helps teachers mitigate potential control over student motivation.

Recent literature has provided a growing body of comparative research between SE and traditional teaching models, particularly regarding their impact on student learning outcomes. A critical systematic review by Bessa, Hastie, Ramos, and Mesquita (2021) synthesized findings from 28 peer-reviewed studies and found that SE consistently outperformed traditional teaching in promoting students' personal and social development (e.g., autonomy, motivation, relatedness), technical and tactical skill acquisition, cognitive engagement, and enjoyment. The review also emphasized that SE's structure, particularly its student-centered approach and incorporation of authentic sport contexts, supported learning across multiple domains. However, Bessa et al. also identified several limitations in the existing literature: few studies included elementary school populations; most SE interventions were short in duration (fewer than the recommended 18 lessons); and nearly half lacked fidelity assessments to confirm accurate implementation of the SE model.

Additionally, recent retrospective research by Farias et al. (2020) provides further compelling evidence of SE's benefits, demonstrating significant transformations in middle school students' PL through a year-long SE curriculum. Specifically, students exhibited increased motivation, enhanced positive attitudes towards PE, and a deeper understanding of sports culture. Despite these strong outcomes, the extended duration and middle-school context used by Farias et al. limit the applicability of findings to younger elementary-aged populations and shorter instructional periods. Furthermore, while qualitative and longitudinal studies, such as those by Choi et al. (2021, 2022), have offered valuable insights into college students' experiences with SE, these studies have largely relied on qualitative data and retrospective recall methods, thus leaving a critical gap in quantitative assessment of SE's effectiveness among younger learners.

These identified limitations highlight a clear need for rigorous quantitative studies that investigate SE's impact on PL specifically among elementary school students and within shorter, practical instructional durations. Our study directly addresses these gaps by (1) focusing explicitly on younger students in grades 3-5, (2) implementing a structured, 10-lesson, handball-based SE intervention, (3) employing validated quantitative measures of PL (Canadian Assessment of Physical Literacy-2, CAPL-2), and (4) rigorously evaluating fidelity through a validated SE observational benchmark. Consequently, our research provides novel, evidence-based insights into the effectiveness of SE in promoting PL within this important yet underrepresented educational setting.

These identified limitations highlight a clear need for rigorous quantitative studies that investigate SE's impact on PL specifically among elementary school students and within shorter, practical instructional durations. Although prior research by Choi et al. (2021, 2022) and Farias et al. (2020) has provided valuable insights, these studies either focused on older populations (college and middle school students) or relied predominantly on qualitative or retrospective methods. To address these critical gaps, the purpose of the present study was to investigate the effectiveness of a ten-lesson SE intervention on Canadian elementary school children's PL using robust quantitative assessments (CAPL-2) and validated model fidelity procedures. Consequently, our research aims to extend the existing literature by providing empirical, quantitative evidence regarding SE's utility in promoting PL among this younger, less-explored student population.

Method

Design

This study employed a quasi-experimental controlled intervention trial with a matched comparison group to examine the influence of a 10-lesson team handball PE intervention on participants' PL. Classes were matched based on grade level, school type (public), and demographic characteristics (e.g., age distribution and gender balance) to ensure baseline equivalence. Following this matching process, participants were allocated to one of two conditions: the SE group or the Direct Instruction (DI) group.

Team handball was selected as the instructional focus for this intervention due to its suitability for developing multiple domains of PL in a short instructional period. As an invasion game that requires continuous movement, decision-making, and teamwork, handball provides rich opportunities to cultivate physical competence, tactical awareness, and social collaboration (Memmert & Harvey, 2008). The game's rules are accessible to beginners, yet complex enough to support skill progression and strategic understanding, making it appropriate for diverse learners in grades 3-5. Moreover, handball aligns well with the core components of the SE model, such as team roles, formal competition, and student leadership, thus facilitating the development of autonomy, competence, and relatedness (Hastie & Wallhead, 2015). Its fast-paced nature also supports moderate-to-vigorous physical activity, an important contributor to daily behaviour metrics in PL assessments like the CAPL-2.

Participants and Setting

The participants in this study were 62 elementary school students aged between 8 and 11 years (age: 9.58 ± 0.92, 30 boys & 32 girls) from an urban public elementary school located in a prairie province of Canada. Most of the participants were White (80%), with the remainder of Southeast Asian or African origin. Intact classes were randomly assigned to either an SE Group (n = 40) or a DI Group (n = 22).

Students in grades 3 to 5 were purposefully selected for this study because this developmental window represents a critical period for acquiring fundamental movement skills and developing core attributes of PL, including motivation, confidence, and physical competence (Barnett et al., 2016; Cairney et al., 2019). Research has shown that children in this age group are developmentally capable of engaging in structured games and assuming peer leadership roles (Giblin et al., 2014), making them well-suited for the collaborative and role-driven elements of the SE model. Furthermore, this age range aligns with curricular expectations in both Canadian and international PE frameworks, which emphasize the development of a broad repertoire of movement skills during this stage (PHE Canada, 2023). As such, interventions delivered at this time may yield lasting benefits for students' PL trajectories and lifelong engagement in physical activity.

Both the SE and DI interventions were delivered by the same certified PE teacher at the participating school. This teacher had over ten years of experience and held formal training in both general PE instruction and student-centered pedagogical approaches. Prior to the intervention, the teacher participated in two 90-minute professional development sessions led by the research team. These sessions focused on the structure and instructional strategies of the SE model, including how to facilitate student roles, manage team dynamics, and maintain fidelity to the model. During the intervention period, the research team provided in-class support once per week in the SE condition to assist with implementation fidelity (e.g., role assignments, officiating logistics) but did not lead instruction. In the DI condition, the same teacher delivered traditional skill-drill-based handball lessons without support from the research team. This consistent instructor assignment across groups ensured instructional equivalency while minimizing confounding variables related to teacher effects. Participants assented and parents/guardians gave informed consent for their child to participate in the study, which received approval from the university's human research ethics board (IRB # 19237).

Lesson Content

The intervention took place during the spring of 2022 and spanned an eight-week period. Each class participated in two 30-minute PE lessons per week, totaling 10 sessions of instruction after accounting for pre- and post-testing, school holidays, and cultural events. Both instructional conditions, SE and DI, were implemented during this time frame.

The DI group's lessons adhered to a traditional skill-focused approach, incorporating introductory warm-up activities, structured skill/drill practices targeting key handball techniques (e.g., passing, shooting, defending), and small-sided gameplay to consolidate learning.

The SE group participated in a 10-lesson "season" that followed a progressive competition format (Siedentop et al., 2020), comprising three instructional phases: (1) team formation and foundational skill development, (2) informal preseason scrimmages, and (3) formal inter-team competition and a culminating event. Students were placed into stable teams at the beginning of the unit and collaboratively selected team names, mascots, and colors. Instruction initially focused on core handball skills and understanding of rules and tactics, delivered through whole-class instruction and reinforced through peer-led coaching within teams. As the unit progressed, instructional activities became increasingly student-directed, with teams engaging in officiated preseason scrimmages and culminating in formal league-style games during the final sessions. Detailed lesson content can be found in Table 1.

Table 1
Lesson Plan

Lessons	Direct Instruction	Sport Education Phase	Sport Education
1	Introduce handball and explain its rules and basic skills; skill demonstration and practice passing.	Skill Instruction	Introduce handball and explain its rules and basic skills; skill demonstration and practice passing.
2	Review passing; Instruct throws and receiving.		Divide students into teams and assign team roles. Fundamental skill practice: passing, receiving, shooting.
3	Defensive skills: blocking and stealing. Paired practice: throwing and receiving.	Team Practice	Each team identifies the skills they need to improve Teams work on these skills through individual and team drills. Students provide feedback to their teammates.
4	Offensive strategies: creating space for throwing and receiving. Small group practice offense strategies.		Develop team strategies and tactics. Each team identifies its strengths and weaknesses. Teams create and practice set plays and game strategies; Teams play a small-sided game to apply their strategies and tactics.
5	Pick-up handball games to integrate fundamental skills into handball games.		Pre-Season: Provide games to allow students to practice player and referee roles.
6	Review previous skills and introduce advanced techniques such as jump shots, fakes, and spins.		Pre-Season: Provide games to allow students to practice player and referee roles.
7	Instruct decision-making skills. Small group games to develop game sense and practice decision-making skills	Game Season	Tournament (5 vs. 5)
8	Handball Pick-up Games		Tournament (5 vs. 5)
9	Handball Pick-up Games		Tournament (5 vs. 5)
10	Handball Pick-up Games		Tournament (5 vs. 5) | Award Ceremony

The final phase, referred to as the formal competition, comprised lessons where the outcomes of formal competitions were systematically recorded in a league table, along with the fair play points allocated by the officiating team (Siedentop et al., 2020). The season culminated with a series of playoff matches and a festive event. During this handball game season, the victorious team in a match was awarded three points, a draw resulted in two points, while a loss did not contribute any points to the team's rankings.

Fidelity of Instruction

Hastie and Casey (2014) proposed that for determining the fidelity of a model's execution, it is essential to provide: (a) a comprehensive delineation of the curricular components of the unit, (b) a thorough validation of the model's implementation, and (c) an elaborate description of the program's context. Referring to the curricular components, Table 1 showcases the elements of both the DI and SE unit plans incorporated in the course outline. A thorough review of this table reveals evidence of the crucial aspects that need to be integrated for an accurate representation of either unit. In the DI unit, the content was focused on learning specific handball skills, which then moved to small-sided games and finally pick-up games with larger player numbers, and where teams were created ad hoc each day. The focus was on enjoyable gameplay, and no formal league was created. For those experiencing SE, the students were placed in persisting teams in which they first practiced handball skills and took team roles. These moved to a series of practice games where students also officiated games. Finally, a formal competition, complete with recorded scores, took place in the final four lessons.

In terms of validation, multimedia resources like video recordings and photographs capturing students' active participation in the units were employed. To confirm the behavioral fidelity of the instruction according to DI or SE, the 10-item checklist of Pritchard et al. (2008) was used. It was determined that instruction in both models reached a 100% compliance with respect to what would be expected (Sinelnikov, 2009).

Lastly, to account for any potential constraints that might have led to any misapplication of the SE model, the instructor kept logs after each lesson for cross-referencing with the benchmark instrument, ensuring that any issues or misunderstandings were promptly addressed. All these measures affirmed that the students involved in this study received a substantively grounded version of both models.

Data Collection

Student Surveys

In addition to demographic information (age, gender, and grade), all students completed a three-item *Handball Experience Survey* adapted from Hastie and Sinelnikov (2006) at two time points, prior to the first lesson (pre-test) and after the final lesson (post-test). Although originally used in SE contexts, the survey items were rephrased to broadly assess students' experiences across both instructional models. Items included: (1) "I believe I have excellent handball skills" (perceived skill competence), (2) "I understand the rules and I always practice fair play when I play handball" (perceived handball literacy), and (3) "I really enjoyed my handball experience" (perceived enthusiasm). Responses were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), with an additional "do not know" option. Because the items were phrased generally (i.e., not referencing specific pedagogies), we administered the survey to all participants regardless of group. This allowed for comparative analysis of perceived outcomes across instructional conditions.

Physical Literacy

All participants completed the Canadian Assessment of PL, 2nd Edition (CAPL-2; HALO, 2017; Longmuir et al., 2018), one week before the intervention (pre-test) and one week after completing all lessons (post-test). CAPL-2 is a validated, comprehensive protocol designed to assess PL among children aged 8-16 years, including measures of physical competence, motivation and confidence, knowledge and understanding, and daily behaviour (Blanchard et al., 2020).

Assessment Administration

The CAPL-2 assessment was administered by the first and second authors, and two trained graduate student research assistants who had previously administered this testing battery. Prior to assessment, these research assistants received comprehensive training on CAPL-2 protocols through a standardized training session led by the second author, who was previously trained by CAPL-certified trainers. Training involved detailed instructions on test administration procedures, data collection protocols, ethical considerations, and scoring guidelines.

Physical Competence Assessment

The physical competence domain consisted of musculoskeletal fitness and motor competence evaluations. Motor competence was specifically assessed using the Canadian Agility and Movement Skill Assessment (CAMSA; Longmuir et al., 2015), conducted in the school's indoor gymnasium during scheduled PE classes. To ensure reliability, CAMSA assessments were video-recorded, and inter- and intra-rater reliability were established prior to analysis. Specifically, two trained raters independently scored a randomly selected subset (20%) of participant assessments. Intra-class correlation coefficients (ICCs) indicated excellent inter-rater reliability (ICC = 0.93) and intra-rater reliability (ICC = 0.95), supporting the consistency of scoring procedures.

The musculoskeletal assessments included the isometric torso plank protocol (Boyer et al., 2013) and the Progressive Aerobic Cardiovascular Endurance Run (PACER) (Scott et al., 2013). Both followed the protocols described by Longmuir et al., 2018. Trunk muscular endurance was determined by the length of time the participants were able to hold the isometric plank position without losing form. Scores were recorded to the nearest 0.1 second for one trail. Aerobic fitness was measured using the 15m PACER test (laps were later converted to 20-m distance scores; Longmuir et al., 2018).

Daily Behaviour Assessment

Daily behaviour was measured using pedometers (SC-StepRx pedometer (StepsCount, Deep River, ON, Canada). Participants were instructed on pedometer placement and usage and were asked to wear pedometers for seven consecutive days, from waking to bedtime, excluding water-based activities (swimming or shower). Step counts were recorded daily by classroom teachers trained by the primary investigator to ensure consistent and accurate recording.

Motivation and Confidence & Knowledge and Understanding Assessments

These two domains were assessed via validated CAPL-2 surveys administered in a printed version provided to students in their classroom. The motivation and confidence survey evaluated students' perceived benefits, barriers, adequacy, and enjoyment of physical activity. The knowledge and understanding survey assessed comprehension of physical activity and sedentary behaviour guidelines based on the Grade 4-6 Canadian PE curriculum (Canadian Society for Exercise Physiology, 2018).

An overall CAPL-2 score is calculated out of 100 points, with the domains of Physical Competence (measured based on musculoskeletal fitness and motor competence) and Daily Behaviour (measured through pedometers and self-report surveys) contributing 32 points each. The domains of Motivation and Confidence (assessed via a survey evaluating benefits and barriers, adequacy, and predilection) and Knowledge and Understanding (a survey grounded on the grade 4 - 6 Canadian PE curriculum, including knowledge of Canadian Physical Activity and sedentary guidelines; Canadian Society for Exercise Physiology, 2018) contribute 18 points each. The development of CAPL-2 was steered and finalized through a 3-round Delphi expert review process, ensuring the model, evaluation metrics, and procedures effectively assess PL (Francis et al., 2016).

All assessment sessions occurred at the school, under standardized conditions (i.e., same location, times of day, and testing order) to maintain consistency. Ethical approval for all procedures was secured from the university's Institutional Review Board (IRB #19237), and informed consent/assent was obtained from parents/guardians and participants.

Data Analysis

To explore participants' physical competence, daily behaviour, knowledge and understanding, motivation and confidence, and overall PL in the SE and the DI class, all raw scores were calculated by the CAPL-2 R package, designed to compute and visualize CAPL-2 scores and interpretations from raw data (Barnes & Guerrero, 2021). After raw scores were calculated, all tests were investigated for potential outliers, and normality tests were also examined before the preliminary analyses.

A series of repeated measures multivariate analyses of variance (MANOVA) with a 2 (Group: SE vs. DI) × 2 (Time: Pre-test vs. Post-test) design was conducted to examine differences in PL outcomes. The dependent variables included the four CAPL-2 subdomains: (1) Physical Competence, (2) Daily Behaviour, (3) Motivation and Confidence, and (4) Knowledge and Understanding. Pillai's F statistic was used for the MANOVAs to determine the statistical significance of the multivariate model because it controlled for the type I error rate with unequal sample sizes (Ntoumanis & Myers, 2016). Follow-up univariate ANOVAs were then conducted based on the statistical significance of the MANOVAs. A Bonferroni post hoc test was employed if there were any statistical differences among CAPL-2 domains. All statistical analyses were conducted using SPSS Version 28.0 (IBM Corp., Armonk, NY).

Results

All pre- and post-test survey and performance item scores are listed in Table 2. No outliers were detected, and the Shapiro-Wilk test indicated that pre- and post-CAPL scores are normally distributed (pre-test, $p = 0.808$; post-test, $p = 0.486$). Before each RM-MANOVA was tested, preliminary assumptions included non-multicollinearity with correlations below .80 (Stevens, 2002). Also, each model showed a nonsignificant Box's test of equality of covariance ($p > .05$). These results suggested that group scores shared equal covariance and all repeated measures comparisons could be compared with confidence (Tabachnick & Fidell, 2014).

The RM-MANOVAs revealed several significant overall changes in CAPL-2 scores from pre- to post-scores (F (1, 60) = 4.64, $p < .04$, $\eta_p^2 = .07$. There was a significant multivariate effect for the dependent variables combined (physical competence, daily behaviour, motivation and confidence, knowledge and understanding (F (4, 57) = 411.84, $p < .001$, $\eta_p^2 = .97$). Additionally, a significant group-by-time interaction was detected (F (4, 57) = 4.27, $p < .004$, $\eta_p^2 = .23$).

A time x group effect was detected in the CAPL-2 composite score, repeated measures ANOVA indicates the PL tests showed a significant change over time (Wilk's Λ=.810, F (4, 57) = 4.642, $p < .001$). The SE group significantly improved in CAPL-2 scores, while there was no statistically significant effect in the DI group after the intervention (post-test). Though there was a significant increase in PL (F= 5.071, p = .028, η_p^2 = .08), no significant difference was found for physical competence (F= 2.368, p = .129, η_p^2 = .04), self-reported physical activity (F= .086, p = .770, η_p^2 = .09), nor knowledge and understanding (F= 2.503, p = .119, η_p^2 = .04). There was, however, a significant increase in motivation and confidence was found (F= 14.621, p = .001, η_p^2 = .21).

Follow-up repeated-measures ANOVAs indicated a significant time-by-group interaction for the CAPL-2 composite score (Wilk's Λ = .810, F (4, 57) = 4.642, $p < .001$). Specifically, post-hoc analyses showed that students in the SE group significantly improved their overall CAPL-2 composite scores from pre- to post-test (p = .028, η_p^2= .08), whereas the DI group demonstrated no statistically significant change over time.

Further analyses of individual CAPL-2 domains revealed the following findings:

1. Physical Competence: No statistically significant change from pre- to post-test in either group (F (1, 60) = 2.37, p = .129, η_p^2 = .04).
2. Daily Behaviour (self-reported physical activity): No statistically significant change from pre- to post-test in either group (F (1, 60) = .09, p = .770, η_p^2 = .001).
3. Knowledge and Understanding: No statistically significant change from pre- to post-test in either group (F (1, 60) = 2.50, p = .119, η_p^2 = .04).
4. Motivation and Confidence: Significant improvement was observed exclusively in the SE group from pre- to post-test (F (1, 60) = 14.62, p = .001, η_p^2 = .21), whereas no significant change occurred in the DI group.

In addition, the Handball Experience Survey showed a significant change over time (Wilk's Λ= .858, F (2, 59) = 4.867, $p < .01$). Among variables, significant changes were identified for positive increases in perceived skill competence (F = 11.198, p = .001, η_p^2 = .16), perceived handball literacy (F = 53.801, p = .001, η_p^2 = .47), and perceived enthusiasm (F = 45.126, p = .001, η_p^2 = .43). Time and group interaction was also detected in perceived skill competence (F = 24.785, p = .001, η_p^2 = .29), perceived handball literacy (F = 34.082, p = .001, η_p^2 = .36), and perceived enthusiasm (F = 45.83, p = .001, η_p^2 = .43).

Table 2

Outcomes of PL Measures Prior to and on Completion of the Units

	Variables	Score Range	Conditions	Pre-intervention	Post-intervention	Within-Group p	Between-Group p
				M (SD)	*M (SD)*		
CAPL-2	Physical Competence	0-32	DI	4.67 (2.89)	6.48 (3.95)		
			SE	6.79 (4.99)	7.13 (4.93)	.174	.129
	Physical Activity	0-32	DI	3.55 (1.40)	3.68 (1.39)		
			SE	3.66 (1.72)	3.75 (1.41)	.678	.77
	Knowledge & Understanding	0-18	DI	2.68 (0.57)	2.59 (0.50)		
			SE	2.40 (0.67)	2.53 (0.60)	.884	.119
	Motivation & Confidence	0-18	DI	18.87 (7.89)	19.55 (6.36)		
			SE	23.45 (4.77)	24.27 (4.30)	.383	.001*
	Overall Physical Literacy	0-100	DI	43.49 (11.70)	46.92 (14.92)		
			SE	48.95 (9.60)	53.09 (13.09)	.057	.028*
Handball Unit Survey	Competency	1-5	DI	2.50 (0.86)	2.55 (0.96)		
			SE	2.23 (1.44)	4.20 (0.72)	.001*	.001*
	Literacy	1-5	DI	1.73 (0.63)	2.14 (0.71)		
			SE	1.98 (1.51)	4.60 (0.55)	.001*	.001*
	Enthusiasm	1-5	DI	1.77 (0.69)	1.82 (0.80)		
			SE	1.88 (1.60)	4.53 (0.60)	.001*	.001*

**Note:* DI = Direct Instruction; SE = Sport Education; * denotes significant changes from pre to post intervention.

Discussion

The SE group demonstrated significant improvements in overall PL following the 10-lesson intervention in elementary PE classes. Among the CAPL-2 domains, it was the motivation and confidence dimension that contributed most to the observed gains. Specific outcomes related to the handball unit also improved significantly in the SE group, including perceived skill competence, handball literacy, and enthusiasm. While both instructional groups showed improvements, the SE group achieved the largest gains, underscoring the potential of SE to support affective and cognitive aspects of PL. It is noteworthy that both groups showed significant within-group improvements in handball literacy, skill competency, and enthusiasm following the intervention. This finding suggests that structured instruction in team handball, regardless of the pedagogical approach, can yield positive student outcomes. However, the SE group exhibited significantly greater gains across these measures, emphasizing the added value of its student-centered framework.

The present study addresses several gaps identified in the recent systematic review by Bessa et al. (2021). Specifically, this study contributes to the evidence base by focusing on elementary school children, an underrepresented population in SE research, whereas prior studies have often involved college or secondary students (Choi et al., 2021; Farias et al., 2020). Furthermore, by using a pre-post quantitative research design and formally assessing implementation fidelity, the current study improves upon prior research that has relied predominantly on qualitative or retrospective methods. In line with the findings of Farias et al. (2020), who demonstrated that a year-long SE curriculum enhanced middle school students' PL and attitudes toward PE, this study shows that even a short-duration, 10-lesson SE intervention can yield similar benefits in younger students. These results reinforce previous evidence (Bessa et al., 2021) that SE offers meaningful, student-centered experiences that support PL development across age groups (Coyne et al., 2019).

The outcomes observed in this study can be understood through the lens of SDT (Deci & Ryan, 2000), which posits that motivation is enhanced when three basic psychological needs, autonomy, competence, and relatedness, are fulfilled. In SE, students assumed distinct roles and responsibilities, such as peer coach or fitness trainer, fostering autonomy by shifting control from the teacher to the learner (Hastie & Wallhead, 2015). Competence was promoted as students progressively developed essential handball skills and adapted to increasingly complex game environments. Relatedness was cultivated through stable team affiliations, the selection of team names, mascots, and colors, and working toward shared goals. The gains in motivation and confidence observed in this study align with SDT's theoretical predictions and reinforce the motivational value of SE in PE contexts.

Limitations

One limitation of the present study was the lack of long-term follow-up. It remains unknown whether students' enhanced feelings of competence, autonomy, relatedness, and motivation were sustained in subsequent PE units. Future research would benefit from tracking these affective outcomes over time to evaluate their durability and long-term impact on physical activity engagement. In addition, exploring the experiences and perceptions of the PE teacher could yield valuable insights into the feasibility of independently implementing the SE model without continuous support from a research team. Another limitation of the present study is the potential mismatch between the CAPL-2 assessment and the developmental readiness of some Grade 3 participants. Although CAPL-2 is validated for children aged 8 and older, younger

students or those with less advanced cognitive or motor skills may have encountered difficulties completing the assessment accurately. This challenge was compounded by the school's class structure, which grouped students from Grades 3 to 5 into intact, mixed-grade classes, making it impractical to separate participants or tailor the assessment to individual developmental levels. Future research may benefit from employing stratified sampling or selecting alternative, developmentally appropriate instruments for younger children.

Future Directions

Although the intervention was implemented during the final quarter of the school year, the lack of improvement in the physical competence domain is unlikely due to a plateau in motor development. In fact, research has shown that many Canadian children in this age group demonstrate below-average levels of fundamental motor skill proficiency (Longmuir et al., 2015; ParticipACTION, 2022), suggesting significant room for improvement. A more likely explanation lies in the content and structure of the intervention. The SE unit was narrowly focused on handball-specific technical and tactical skills, rather than on the general physical competencies (e.g., aerobic endurance, muscular strength, coordination) assessed by the CAPL-2's physical competence domain. Additionally, the volume and intensity of physical activity across the 10-lesson period may have been insufficient to yield measurable physical gains. Future interventions could consider integrating explicit fundamental motor skill development or extending instructional duration to more effectively target physical competence.

Conclusion

Despite these limitations, this study makes several meaningful contributions to the PL and PE literature. To our knowledge, it is the first study to directly compare SE and DI using CAPL-2 as a validated outcome measure among elementary school children. These findings offer a valuable baseline for future research and provide practical insights for PE teachers and program designers. Notably, results suggest that practitioners may benefit from integrating sport- or activity-specific assessments of knowledge and understanding, rather than relying solely on broad, curriculum-wide metrics developed to track progress over the course of an entire academic year. In conclusion, the findings support the use of SE as a pedagogical model that effectively promotes key affective components of PL, particularly motivation and confidence, even within relatively short instructional timeframes.

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