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Can physical education and physical activity outcomes be developed simultaneously using a game-centered approach?

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Table 1. PLUNGE curriculum overview (Australia from September to December 2012)

Curriculum focus	Description
1. Game play	Aim of the session is to start participants playing games with the major emphasis on working in small teams to devise ways of performing the tasks required by the games more efficiently. Tactical complexity of the activities is kept low, with the emphasis on target games. Games are constrained with rules requiring overhand throw and two-handed catch.
2. Moving targets	Aim of the session is to increase tactical complexity to net/wall style games whilst still utilising the catch and throw skills (no racquets used). With the increase in complexity, the use of space within the court becomes part of the tactics of the games played, with throw and catch skills now important to achieving success in the games.
3. Finding space	Aim of the session is to develop the ability to support attacking play with off ball movement. Tactical complexity increases to invasion style games that revolve around maintaining possession, with the emphasis on students moving into space to create options for the player who has the ball. Throwing (overarm) and catching skills are used within a major portion of the activities, with modification emphasis on students using throw and catch via rules and equipment constraints.
4. Defence	Aim of the session is to develop personal tracking skills for defence and the ability of students to place them-selves into an advantageous defensive position. Tactical complexity of games remains the same as the previous session, with the emphasis placed on the defensive skills required to obtain or disrupt possession during the familiar games introduced previously.
5. Attacking play (movement & decision making)	Aim of the session is to develop the combination of on and off ball skills when creating attacking raids. Tactical complexity of activities is increased to incorporate modified invasion games that focus on invasion to score. Emphasis is on students executing throwing skills and then providing support to become the next on ball player.
6. Attacking play (adaptation)	Aim of the session is to develop the skills of maintaining possession and invading to score when skills have been constrained. Cone catching (each player has a soft cone that must be used with two-hand to catch with) is incorporated to previously utilized simple and complex invasion games. Tactical complexity increases as players adapt to increased skill demand required to move the ball around.

Table 2. PLUNGE intervention components (Australia from September to December 2012)

Professional development content	In-class mentoring content
Theoretical content: <ul style="list-style-type: none"> - Physical activity research findings - Theoretical grounding (competence motivation theory) for improving students' physical and game skills (Harter 1978) - Game Centered Approach research overview - Comparison of instructional methodology (Game Centered Approach and Skills based instruction) Structural: <ul style="list-style-type: none"> - Connection of a Game Centered Approach to the existing NSW Personal Development Health and Physical Education syllabus (Board of Studies NSW 2007) - Active Learning Time (ALT) - Classroom management for improved ALT - Development of motor skills, cognition of game play and socio-cultural (team-work, co-operation, game appreciation) outcomes within game play - Fundamental movement skill review (throw and catch) - The use of questioning to assist student cognition - Identification and use of Teachable Moments in PE classes - Creation of positive class environment: <ul style="list-style-type: none"> - Positive support of classmates - Contribution by all - Fun and fair games - Diminishing over-competitive behavior/reaction - Promotion of personal improvement over peer comparison 	Structural: <ul style="list-style-type: none"> - Establishing expectations - Efficient game setup and instruction - Classroom management during stoppages Promotion of student learning: <ul style="list-style-type: none"> - Creating effective games - Establishing questioning - Promoting FMS use and development within activities - Promote cognition of game play within activities - Promote socio-cultural (team-work, co-operation, game appreciation) outcomes within game play - Establish equity based constraints to promote involvement by all students - Recognizing teachable moments - Promote personal improvement of process outcomes within activities (Ames 1992, Meece 1991) Student outcomes: <ul style="list-style-type: none"> - Game appreciation - Throw and catch skills - Positive support of classmates - Contribution by all - Fun and fair games - Diminishing over-competitive behavior/reaction

Table 3. Modified coding for game play decision making (Australia from September to December 2012)

Game skill	1 = good	0 = poor
On-the-ball (decision)	Pass to a team mate who is open	Pass to a covered team mate
	Holding the ball (no team mate open)	Holding the ball (pass or shoot more appropriate)
	Good scoring attempt	Blocked shot or inappropriate distance
	Situation happens to fast for player to react	
Off-the-ball (support)	Movement required by flow of the game	Inappropriate movement as required by the flow of the game
	No movement needed (in space)	No movement when needed (standing covered)
	Moving into a position to receive a pass (appropriate distance)	Poor movement (too far or into crowded position)

Table 4. Modified coding for game play skill performance (Australia from September to December 2012)

Action	1 = successful	0 = unsuccessful
Passing	Own team mate maintains possession of the ball	Opponent interrupts, gains possession of the ball or ball out of bounds
Shot	Own team mate maintains possession of the ball during scoring opportunity	Opponent interrupts, gains possession of the ball or ball out of bounds during scoring opportunity

Table 5. Baseline characteristics of students randomized to the intervention and control groups (Australia from September to December 2012)

Characteristics	Control		PLUNGE intervention		<i>P</i>
	(n = 55)		(n = 52)		
	Mean	SD	Mean	SD	
Age (years)	10.78	0.70	10.55	1.00	0.160
Gender (Male) <i>n</i> (%)	32	(63)	27	(49)	
FMS					
Throw ^a	2.10	1.66	1.93	1.17	0.545
Catch ^b	4.37	1.15	4.24	1.23	0.558
Affective					
Enjoyment ^c	42.71	4.82	43.40	5.25	0.519
SOFIT (% lesson time)					
MVPA	36.25	10.81	23.75	10.24	0.144
	(n = 15)		(n = 15)		
Game play assessment					
Decision index	72.14	13.41	69.52	15.14	0.619
Support index	59.87	14.57	54.68	17.67	0.388
Skills index	67.11	18.22	68.86	16.92	0.787

^a Values range 0 – 8.^b Values range 0 – 6.^c Values range 0 – 50.

Table 6. Intervention effects among primary school students (Australia from September to December 2012)

Outcome	Treatment group		Adjusted mean difference between groups (95% CI) ^a	Group * Time P	Effect size (Cohen's d)
	Mean change from baseline (95% CI)				
	Control	PLUNGE intervention			
	(n = 50)	(n = 54)			
FMS					
Throw	-0.37 (-0.80 – 0.07)	1.46 (0.98 – 1.95)	1.83 (1.18 – 2.48)	<0.001*	1.0
Catch	-0.08 (-0.51 – 0.34)	0.61 (0.18 – 1.04)	0.69 (0.09 – 1.29)	0.028*	0.4
Affective					
Enjoyment	-0.95 (-2.29 – 0.39)	-0.49 (-1.59 – 0.61)	-0.87 (-2.02 – 0.28)	0.635	0.1
SOFIT (% lesson time)					
MVPA	-4.75 (-96.87 – 87.37)	26.25 (16.72 – 35.78)	31.01 (-0.36 – 62.32)	0.001*	1.6
	(n = 15)	(n = 15)			
Game play assessment					
Decision index	2.41 (-7.85 – 12.67)	13.86 (8.10 – 19.62)	11.45 (0.211 – 22.68)	0.039*	0.7
Support index	-3.06 (-10.71 – 4.58)	14.82 (2.60 – 27.04)	17.88 (4.12 – 31.64)	0.010*	0.9
Skills index	7.73 (-4.05 – 19.50)	4.54 (-3.60 – 12.67)	-3.19 (-16.85 – 10.47)	0.624	-0.2

* significance at $p < 0.05$ ^a Between group difference of change score (intervention minus control).