The A+FMS cluster randomized controlled trial: An assessment-based intervention on fundamental movement skills and psychosocial outcomes in primary schoolchildren

Cecilia H. S. Chan[1], Amy, S. C. Ha[1], Johan, Y. Y. Ng[1], David Revalds Lubans[2,3]

[1] *Department of Sports Science and Physical Education, Faculty of Education, The Chinese University of Hong Kong*

[2]*School of Education. The University of Newcastle, Australia*

[3]*Priority Research Centre for Physical Activity and Nutrition. The University of Newcastle, Australia*

Abstract

Objectives: To evaluate the effectiveness of an assessment-based intervention that emphasizes fun, mastery, and support (A+FMS) on primary schoolchildren's fundamental movement skills (FMS), perceptions of physical and movement skill competence, teacher support and enjoyment.

Design: Cluster randomized controlled trial.

Methods: Ten clusters (classes) (n = 282; mean age 8.4 years, SD 0.56) were randomised to the A+FMS or wait-list control group in a 1:1 ratio. Teachers in the A+FMS group were required to attend six hours of training and integrate 550 minutes of assessment for learning strategies into their PE lessons for up to a maximum of 13 weeks. FMS competence in jump, skip, hop, overhand throw, dribble and catch was the primary outcome assessed using the Test of Gross Motor Development-3rd Edition. Secondary outcome measures included perceptions of physical and FMS competence, teacher support, and student enjoyment using questionnaires. Multilevel modelling for the analysis of clustered data was used to determine the effectiveness of the intervention.

Results: Significant intervention effects were found for locomotor skills (adjusted mean difference, 2.47 units; Cohen's d = 0.76), overall FMS competence (3.72 units; Cohen's d = 0.93) and perceived teacher support (0.21 units; Cohen's d = 0.05). However, there was a group-by-time effect for perceived physical competence (-0.16 units; Cohen's d = -0.07) in favouring of the control group.

Conclusion: An assessment-based teacher-led FMS intervention was effective in improving FMS proficiency in primary schoolchildren. The results highlight the need for increased teacher support to develop positive self-perceptions of competence while promoting children's FMS.

Trial registration CUHK_CCRB00479

Keywords: Object control skills; Locomotor skills; Assessment for Learning; Physical self-perceptions; Enjoyment; Teacher professional development

1. Introduction

Proficiency in fundamental movement skills (FMS), including locomotor and object control skills, may act as a causal mechanism for increasing children's physical activity (PA) levels.[1] The acquisition and mastery of FMS form the foundation for learning advanced sport-specific skills[2] and enable school-age children to be sufficiently active to accrue benefits such as increased cardiovascular fitness and healthy weight status.[3] In addition, the authors of a recent review concluded that higher levels of motor skills can contribute to improved cognitive capacity and academic performance in children.[4] According to Harter's competence motivation theory,[5] perceived competence is considered to more directly affect motivation toward PA than actual movement skill competence. It is identified as one of the most important determinants of PA participation. Children who perceive themselves as competent in the physical domain and receive support from significant adults and peers will be more motivated to participate in physical activity, compared to those with lower levels of perceived competence.[5] It is therefore important to understand how perceptions might be related to competence. Few studies investigating the associations among children have aligned the assessments of actual and perceived movement competence.[6,7] The matched measure is important particularly when children are increasingly able to estimate their real performance as they age.[8]

Physical education (PE) represents an ideal opportunity for students to develop competence, confidence, and foster lifelong motivation to be physically active.[9] As such, PE teachers are highly influential change agents because they can provide instructional support and skill-learning opportunities during class time.[10] Movement skill interventions led by qualified personnel have been identified as a viable approach for improving FMS proficiency in youth.[11] While pedagogy and assessment are two important pillars of effective FMS teaching, a recent study to improve early adolescent girls' motor skills focused on teachers' training in FMS assessment and instruction.[12] FMS education should be a priority for both preservice and in-service PE teachers however, the value of professional development to improve teaching and learning of FMS is under-studied.[13]

Assessment for learning (AfL) emphasizes the use of formative assessment by making the FMS assessment criteria visible, using effective questioning and feedback, and peer and self-assessment to enable students to assess their own and others progress against learning intentions and success criteria.[14] AfL has great potential to improve student FMS performance, particularly when teachers are able to effectively use the data gathered from process-oriented assessment tools (e.g. Test of Gross Motor Development- 3rd Edition, TGMD-3) to create feedback during their instruction and assessment practices Such an approach to assessment helps students understand what is expected from them and remain motivated in learning FMS. Although formative assessments play an important role in planning and guiding instruction, many teachers lack the necessary knowledge and skill to incorporate meaningful assessment in PE.[15] Furthermore, intervention environment encouraging enjoyment of movement and autonomy are likely to enhance perceived and actual competence in FMS.[16] The aim of this study was to evaluate the impact of an assessment-based intervention that emphasizes fun, mastery, and support (A+FMS) in a sample of primary schoolchildren. We hypothesised that application of the principles of formative assessment in primary PE would help improve students' FMS competence, perceived physical competence, perceived movement skill competence, perceived teacher support, and PE enjoyment among primary schoolchildren.

2. Methods

The A+FMS intervention was an assessment-based teacher-led FMS intervention, evaluated using a clustered randomized controlled trial in five primary schools in Hong Kong. Primary schools were sourced from a cross-sectional study[17] and their PE teachers were invited to attend a briefing session about the intervention. All Grade 3 students from the classes of consenting PE teachers were eligible to participate in the study. Ethics approval for this study was obtained from the University and Clinical Research Ethics Committees. The trial was registered with the CCRB Clinical Trials Registry, CUHK, (CUHK_CCRB00479). Children were required to return a signed informed consent letter from their parents/guardian prior to their participation in the study. The design and methods of the A+FMS cluster

RCT have been reported in detail elsewhere.[18] The study carried out from September 2015 to February 2016 and adhered to the CONSORT guidelines.

The sample size calculations were based on the standardised mean difference effect size (SDM = 1.42) of the interventions on overall FMS skill proficiency reported in a systematic review and meta-analysis.[11] Using an alpha of 0.05 and power of 80%, and taking clustering into account, a total sample size of 282 participants from ten classes was needed to detect a between group change in the total raw scores of six FMS measured using the Test of Gross Motor Development- 3rd Edition (TGMD-3).[19] Each of the five participating schools provided one to three classes of Grade 3 students. A total of 10 grade 3 classes (N = 298), and their specialist PE teachers from each class were recruited and asked for the consent to randomization prior the study. Informed written parental consent was obtained for 276 children (93% consent response rate).

Following the initial recruitment processes, baseline assessments were conducted at participating schools, where similar provision of PE is provided under the mandatory standards for time allotment, curriculum, and staffing. Randomization by cluster (i.e. class) was performed following the completion of the baseline assessments, with a 1:1 allocation ratio. The ten classes were randomly assigned to either the A+FMS intervention (5 classes) or a wait-list control group (5 classes) using a free web-based grouping tool. Students and research assistants responsible for data collection were blinded to group allocation. Teachers were not blinded to the group assignment, as they were required to attend a six-hour FMS training workshop if they were allocated to the experimental group and be required to implement the intervention.

During the workshop, intervention teachers were instructed about the testing protocol and the performance criteria of each of the six selected FMS (i.e. jumping, hopping, skipping, catching dribbling, and overhand throwing) included in the TGMD-3.[19] Fun movement activity ideas related to specific skill components were presented, aligning with the evaluation criteria of TGMD-3. They were introduced the AfL strategies to facilitate formative assessment, effective questioning and feedback, and self- and peer

evaluations into FMS instruction, and also received a set of resource tools including a FMS teaching manual and Quick Response (QR) Codes linked to instructional videos developed by the research team.

A standard intervention period (i.e. 550 minutes) was designed to control for the variations in PE lesson frequency (once vs. twice a week) and length (between 45 minutes to 70 minutes) among the participating schools. The experimental group teachers were asked to integrate AfL into FMS teaching and assessment for 550 minutes, while the control group teachers carried out the usual PE curriculum where summative assessment were conducted at the end of a teaching unit or a school term for reporting. This was accepted with the agreement of the control group teachers that the same teaching resource pack and training workshop were provided to them after the post-test assessments as for the intervention group teachers. A detailed description of the A+FMS intervention has been reported previously.[18] Briefly, Harter's competence motivation theory guided the intervention design and components, which aimed to provide children with knowledge and skills required to produce mastery, and positive feedback given for improvement to nurture perceptions of competence and control, positive affect and intrinsic motivation.

During the intervention, the teachers integrated the AfL strategies in their prescribed FMS curriculum content for 550 min of PE class time. For each lesson, the teachers: 1) shared the TGMD-3 assessment criteria with students to demonstrate the standards required; 2) checked students' understanding through effective use of questioning; 3) administered the TGMD-3 to at least 5 students on the six selected FMS; and 4) analysed the assessment data for feedback and subsequent planning for instruction on specific skill components students need practice. Fun movement activities were presented to involve students in the self- and peer assessments. With the QR Codes linked to the activity and demonstration videos, students were able to practice and assess on their own performance by scanning the code using a smartphone camera with a QR code reader. An illustrated student practice handbook included information and pictures of the observable components of each FMS skill and assessment checklists was also provided. The structured approach for learning with teacher support helped students feel more connected to the skills taught and an increased sense of mastery over their learning.

147 The process evaluation measures included observation checklist in a subset of classes, teacher
148 survey, lesson plans, assessment record sheets and a mid-programme meeting. The intervention fidelity
149 was determined based on on-site observations of programme delivery using the AfL strategies checklist
150 evaluated by the lead author, as well as the lesson plans to monitor protocol adherence for the 10 teachers
151 in both the intervention and control groups. Feedback and reinforcement were provided to the
152 experimental group teachers immediately after each of the two observations via a text messaging app and
153 a one-hour mid-programme meeting to help enhance the quality of delivery. Post-intervention teacher
154 satisfaction with all intervention components was measured using a 5-point Likert-scale to inform future
155 implementation efforts. Student involvement was determined using the practice handbook completed by
156 students and their parents.

157 The primary outcome of the study was students' FMS competence in horizontal jump, hop, skip,
158 overhand throw, catch and dribble assessed using the TGMD-3.[20] These skills are considered foundational
159 for playing the common games and sports in Hong Kong, and relevant to the key learning topics
160 suggested in government prescribed PE curriculum[21] such as athletics, ball games, dance and gymnastics.
161 Prior to the assessment of each skill, a standardized video demonstration was shown on a tablet to
162 students. Each of the six skills has between three and five performance criteria. Students were required to
163 perform each skill twice after one practice trial. Their performance was videotaped for later assessments
164 by one trained research assistant with good knowledge and experience in assessing FMS on several
165 hundred of children using TGMD-3. The first author also established over 90% of the coding reliability
166 with the development team of TGMD-3 through electronic videos provided. Inter-rater reliability between
167 the first author and the research assistant was excellent (ICC = 0.97, 95% CI [0.94, 0.98]) on 52
168 observations across 6 skills being rated. The scores of the two trials were totalled to obtain a raw score for
169 skill. The sum of scores from the six skill tests were the primary outcome of the study.

170 Secondary outcomes included students' perceived physical competence, perceived movement
171 skill competence, enjoyment in PE, and perceived teacher support, which were self-reported by
172 participants. The Athletic Competence subscale of the Self-Perception Profile for Children[22] (SPPC–6

items) was used to assess children' subjective evaluation of their athletic ability. The SPPC employs a four-choice structured alternative response format. The child first decided which of the two statements best described him/her, and then chose if the statement was 'sort of true' or 'really true' for him/her. For example, 'Some kids feel that they are better than others their age at sports, BUT other kids don't feel that they can play as well'. This instrument was found to be a reliable and valid self-report measure for assessing children's self-perception, and the observed coefficient (alpha) of the athletic competence was .80.[22]

Apart from assessing a more general perception of physical competence, perceptions of the same movement skills that clearly align with children's actual movement skills were also measured. Perceived movement skill competence of the six FMS (jump, hop, skip, dribble, catch, and overhand throw) objectively measured using TGMD-3 was assessed using The Pictorial Scale of Perceived Movement Skill Competence for Young Children.[23] This pictorial scale based on the same locomotor and ball skills assessed in TGMD-3 to provide a better understanding of how children's perceived movement skill competence aligns with their abilities. The format and item structure were taken from the physical competence subscale of Harter and Pike's instrument,[24] with separate cartoon illustrations provided for boys or girls performing each of the 13 skill 'competently' or 'less competently'. This pictorial scale based on TGMD-2 has acceptable face validity and reliability with strong construct validity.[23]

PE enjoyment was measured using the PE Enjoyment Rating Scale.[25] This face scale provides an indication of the direction and intensity of PE enjoyment. The response options are six 'sad/happy' faces, from a frowning face (coded 1) to a smiling face (coded 6), for the question 'How do you feel about PE classes'?

Students' perceived teacher support was measured using Harter's Social Support Scale for Children.[26] The subscale includes six questions to assess the degree to which teachers- help them if they are upset, help them do their very best, care about them, are fair to them, and treat them as a person. The format and item structure is similar to Harter's SPPC.[22] Children were asked to read two statements and decided which one was more like them. For example, 'Some kids don't have a teacher who helps them to

do their very best BUT other kids do have a teacher who helps them to do their very best'. Then, students decided if the statement was sort of true or really true for them. The scores were coded as follows: Really True for Me = 1, Sort of True for Me = 2, Sort of True for Me = 3, and Really True for Me = 4. The higher the score is, the greater the child's sense of teacher support. This self-report subscale is appropriate for elementary schoolchildren aged 8 to 13 (grades 3 to 6), and the internal consistency reliability was .82.[26]

The analyses were performed separately for FMS measures (i.e., locomotor skills, object-control skills, and total FMS competence), and psycho-social measures (i.e. perceived physical competence, perceived FMS competence, perceived teacher support and enjoyment of PE). A 3-level (time within individual within class) multilevel analysis was used to determine the interventions effects (i.e., the time x group term) for both primary and secondary outcomes, and effect sizes were calculated using Cohen's *d*.[27] Potential confounding variables (i.e. sex, age and BMI) were added to the model as they may influence the change in the magnitude of the intervention effect.[28] Analyses were performed with the intention-to-treat population according to their original allocation group. The MLwiN multilevel modelling software package was employed for all analyses and alphas levels were set at $p < .05$.

3. Results

A total of ten Grade 3 classes from five schools were recruited, with one specialist PE teacher from each class consenting to involvement and randomisation. Three schools had both intervention and control classes, and two schools with either intervention or control class. In total, 276 Grade 3 students (68% girls, M_{age} = 8.4 years, SD = 0.56, range = 7.67-11.58) from the recruited classes provided parental consent and were assessed at baseline. There were no significant differences ($p > .05$) between control and intervention groups at baseline for any the measured variables. Five classes were randomized assigned to the A+FMS intervention (n = 149) and five to the wait-list control (n = 129) group. Follow-up measurements were obtained from 100% of the sample (n = 276). Descriptive statistics of the measured variables are presented in Table 1.

****Table 1 near here****

The A+FMS intervention effects are shown in Table 2. For primary outcomes, significant positive Time x Group intervention effects were found for locomotor skills (B = 2.47, SE = 0.85, 95% CI [0.81, 4.14], p = .004), and overall FMS competence (B = 3.72, SE = 1.17, 95% CI [1.43, 6.01], p = .001), suggesting that changes in locomotor skills (Cohen's d = 0.76), and overall FMS competence (Cohen's d = 0.93) from baseline to post-intervention was greater ($p < .001$) in intervention-group children compared to the control-group children. For object control skills, there was no significant difference between the groups (B = 1.23, SE = 0.79, 95% CI [-0.31, 2.77], p = .116). For secondary outcomes, there were significant Time x Group interactions for perceived teacher support (B = 0.21, SE = 0.10, 95% CI [0.00, 0.41], p = .047) and perceived physical competence (B = -0.16, SE = 0.08, 95% CI [-0.31, -0.01], p = .029). We found it interesting that there was a declining trend in perceived physical competence in the experimental group but an increase in the control group. Although the results were not statistically significant, these findings diverged from the hypothesis. Table 3 shows the effects of covariates of the measured variables.

****Table 2 near here****

****Table 3 near here****

The participating teachers (n = 10) delivered all planned PE lessons during the intervention. Overall, they reported high satisfaction ratings after they attended the six-hour workshop (4.9 out of 5). They strongly agreed that the workshop i) increased their FMS knowledge (5 out of 5); ii) increased their AfL knowledge (4.8 out of 5); iii) enabled FMS application in classrooms (4.9 out of 5); iv) enabled AfL application in classrooms (4.4 out of 5); v) helped teachers to improve students' FMS performance (4.8

out of 5); vi) enhanced teaching confidence (4.7 out of 5); and vii) motivated teachers to learn more (4.8 out of 5). The high teachers' ratings of the training session were reported, supporting the assessment approach used in professional development was effective to improve FMS teaching quality. During the mid-programme meeting, all experimental teachers attended and reported that the teaching support provided such as the teacher manual and demonstration videos was highly appropriate for them to update and develop their practical and theoretical knowledge in FMS. The A+FMS intervention was generally well-received among the teachers, however one teacher did question the increased time needed for planning and implementing a range of formative assessment strategies within one PE lesson in face of limited class time and large class sizes.

Fidelity to AfL strategies was evidenced by the lesson plans and the class observation checklists. Across the two class observations by the lead authors, intervention teachers' practical understanding of AfL was gradually enhanced. They generally displayed improving competencies in using the predefined TGMD performance criteria to provide effective questioning, feedback and involve students to take part in peer and self-assessment activities. It was noticeable that the students were becoming sensitive to their skill errors and encouraged to make individual progress and compete with their previous efforts in the evaluation process. Follow-up was complete in all participating students. While no incentives were provided, only about half of the students completed and returned the practice handbooks as requested.

4. Discussion

The purpose of this cluster RCT was to investigate the effects of an assessment-based teacher-led FMS intervention on children's FMS proficiency, perceived physical competence and movement skill competence, enjoyment in PE, and perceptions of teacher support. The school-based A+FMS intervention was effective in increasing children's FMS proficiency and perceptions of teacher support, but not their perceived competence or enjoyment of PE. Our findings are consistent with a recent study confirming that FMS intervention through teacher professional development related to instruction and assessment produced a significant increase of FMS competency on early-adolescent girls.[12] The adoption of a theory-

informed teaching and assessment approach (i.e. AfL strategies) through teacher training is a promising strategy to improve both boys' and girls' FMS proficiency.

The mean differences in overall FMS competency of +3.72 units and locomotor skill competency of +2.47 units between intervention and control groups are greater than the aggregate effect reported in a meta-analysis of FMS interventions for young people.[11] Although not statistically significant, there was a meaningful effect on intervention-group students' object control skills at post-test. This further supports the effectiveness of school-based FMS interventions delivered by specialist PE teachers through effective instruction and assessment practices, and continuing professional development for teachers in improving children's FMS proficiency.[14]

Perhaps the most surprising findings are that perceived teacher support was increased but perceived physical competence tended to decline among the students in the experimental group after the intervention. According to Ryan and Deci,[29] teacher support includes three dimensions: support for autonomy, structure, and involvement. It is possible that the intervention teachers overemphasised on providing structure by communicating expectations, providing guidance, optimal challenges, and feedbacks, but giving less autonomy support to allow students in determining their own behaviours. This indicates the importance and influence of autonomy supportive learning environment on FMS learning.[16]

Central to the practice of AfL is the concept that students are engaged in the evaluation process by informing of the assessment criteria to make individual progress to compete with their previous efforts. AfL has the potential to create a non-competitive environment for FMS teaching and assessment and shift the pedagogy towards a more student-centred approach where students are held accountable for their learning. Taken together, the findings in the current study demonstrated that AfL emphasises learning and personal improvement significantly improved FMS competency of primary schoolchildren. The sharing of clear learning expectations enhanced students' perceptions of teacher support. Further research, with a focus on examining the influence of autonomy-supportive climates and psychosocial variables on children's actual and perceived competence, is warranted.

The strengths of this study include the systematic development of the intervention and the study design, which were based on the current recommendations and best practice.[12,16] Other strengths are the beneficial effect on FMS proficiency was found for both boys and girls, this would strengthen the generalisability of our findings. Furthermore, psychosocial variables were included and follow-up measurements were obtained from the full sample. We acknowledge that our study has limitations. By maintaining the randomness in the allocation of clusters (class), teachers of the same school were assigned inadvertently to both intervention and control classes. Trials of educational intervention may be particularly susceptible to contamination because participants are often un-blinded to group assignment, and adoption of intervention-targeted behaviours is ethically beyond the control of the researcher.[30] For reducing the potential risks of contamination in the current study, we monitored the protocol adherence, provided education to trial participants and used the wait-list control design.

5. Conclusions

This assessment-based FMS intervention provides compelling evidence of using ongoing assessments and teacher support to improve FMS competence. Further research is warranted to explore the effects of autonomy-supportive climates and teacher behaviours on both perceived and actual competence among children.

6. Practical Implications

- It is possible to improve students' FMS in a brief time frame through well planned interventions using professional development to support PE teachers in FMS instruction and assessment practices.
- AfL strategies appear to be effective in PE classrooms to increase students' FMS and enhance their perceptions of teacher support.
- Greater effort is needed to help children build and develop their actual and perceived physical competence necessary to take part in PA.

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Table 1. Descriptive statistics of the measured variables.

		Baseline		Post-Intervention	
		Intervention N=147 Mean (SD)	**Control N=129 Mean (SD)**	**Intervention N=147 Mean (SD)**	**Control N=129 Mean (SD)**
Locomotor Skills	Boys	11.18 ± 4.80	10.84 ± 4.26	15.11 ± 4.22	11.34 ± 4.54
(Range: 0-22)	Girls	11.96 ± 3.35	12.59 ± 3.65	14.45 ± 3.33	13.18 ± 3.66
	Total	11.72 ± 3.85	11.99 ± 3.94	14.65 ± 3.62	12.55 ± 4.06
Ball Skills	Boys	10.07 ± 3.76	10.5 ± 2.92	12.71 ± 3.33	11.39 ± 2.92
(Range: 0-20)	Girls	9.16 ± 2.64	9.28 ± 2.67	11.27 ± 2.75	10.27 ± 2.77
	Total	9.44 ± 3.40	9.70 ± 2.81	11.71 ± 3.01	10.65 ± 2.86
Overall FMS	Boys	21.24 ± 7.20	21.34 ± 5.71	27.82 ± 6.33	22.73 ± 5.86
(Range: 0-42)	Girls	21.12 ± 4.77	21.87 ± 4.92	25.73 ± 4.72	23.45 ± 5.18
	Total	21.16 ± 5.60	21.69 ± 5.19	26.37 ± 5.33	23.20 ± 5.41
		Intervention N=147 Mean (SD)	**Control N=123 Mean (SD)**	**Intervention N=147 Mean (SD)**	**Control N=122 Mean (SD)**
Perceived Physical Competence	Boys	3.34 ± 0.57	3.00 ± 0.66	3.35 ± 0.59	3.34 ± 0.55
(Range: 1-4)	Girls	3.07 ± 0.57	3.22 ± 0.59	3.00 ± 0.60	3.24 ± 0.64
	Total	3.15 ± 0.59	3.15 ± 0.62	3.11 ± 0.62	3.28 ± 0.61
Perceived FMS Competence	Boys	3.56 ± 0.96	3.25 ± 0.55	3.39 ± 0.56	3.45 ± 0.46
(Range: 1-4)	Girls	3.25 ± 0.54	3.46 ± 0.47	3.19 ± 0.64	3.51 ± 0.39
	Total	3.34 ± 0.71	3.39 ± 0.51	3.25 ± 0.62	3.49 ± 0.41
Perceived Teacher Support	Boys	3.22 ± 0.81	3.17 ± 0.72	3.43 ± 0.59	3.11 ± 0.81
(Range: 1-4)	Girls	3.39 ± 0.56	3.44 ± 0.68	3.35 ± 0.56	3.22 ± 0.71
	Total	3.34 ± 0.65	3.34 ± 0.70	3.37 ± 0.57	3.18 ± 0.74
Enjoyment of PE	Boys	5.16 ± 1.24	5.16 ± 1.26	5.34 ± 1.02	5.38 ± 0.92
(Range: 1-6)	Girls	5.69 ± 0.54	5.62 ± 0.93	5.40 ± 0.81	5.48 ± 1.03
	Total	5.53 ± 0.85	5.45 ± 1.08	5.38 ±0.87	5.44 ± 1.00

Abbreviation: FMS = fundamental movement skills. PE = physical education. SD = standard deviation.

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Table 2. The A+FMS intervention effects.

	Interaction Group*Time			Effect Size		Variance at each level		
				Intervention	Control	Level 1	Level 2	Level 3
	B	**(95% CI)**	***p****	***d***	***d***	**Time**	**Individual**	**Class**
Primary Outcomes:								
Locomotor Skills	2.47	(0.81, 4.14)	0.004	0.76	0.14	0.000	13.583	1.266
Ball Skills	1.23	(-0.31, 2.77)	0.116	0.67	0.34	0.000	8.114	0.166
Overall FMS Competence	3.72	(1.43, 6.01)	0.001	0.93	0.29	0.000	28.010	1.534
Secondary Outcomes:								
Perceived Physical Competence	-0.16	(-0.31, 0.02)	0.029	-0.07	0.21	0.000	0.347	0.011
Perceived FMS Competence	0.33	(-0.30, 0.95)	0.302	-0.13	0.20	0.000	0.340	0.000
Perceived Teacher Support	0.21	(0.00, 0.41)	0.047	0.05	-0.23	0.000	0.421	0.017
Enjoyment of PE	-0.20	(-0.68, 0.28)	0.410	-0.18	-0.01	0.000	1.107	0.000

Abbreviation: FMS = fundamental movement skills. PE = physical education. CI = Confidence Interval. *B* = unstandardised coefficient. *d* = sample effect size (Cohen).

Notes: *Significance at $p < 0.05$. For intervention, control is the reference group.

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Table 3. Effects of covariates on the measured variables.

	Locomotor Skills			Ball Skills			Overall FMS Competence		
Parameter	*B*	(*SE*)	95%CI	*B*	(*SE*)	95%CI	*B*	(*SE*)	95%CI
Sex	0.74	(0.45)	-0.13, 1.62	**-1.24**	**(0.25)**	**-1.73, -0.75*** **	-0.37	(0.64)	-1.63, 0.88
Age	**0.58**	**(0.28)**	**0.03, 1.12***	0.07	(0.18)	-0.28, 0.43	0.72	(0.41)	-0.08, 1.51
BMI	**-0.21**	**(0.08)**	**-0.36, -0.06***	0.00	(0.05)	-0.09, 0.09	**-0.23**	**(0.11)**	**-0.45, -0.02***

	Perceived Physical Competence			Perceived FMS Competence			Perceived Teacher Support			Enjoyment of PE		
Parameter	*B*	(*SE*)	95%CI	*B*	(*SE*)	95%CI	*B*	(*SE*)	95%CI	*B*	(*SE*)	95%CI
Sex	-0.14	(0.07)	-0.27, 0.00	**-0.18**	**(0.08)**	**-0.33, -0.03***	0.06	(0.08)	-0.10, 0.21	**0.24**	**(0.12)**	**0.01, 0.47***
Age	-0.09	(0.05)	-0.18, 0.00	-0.07	(0.05)	-0.17, 0.04	0.02	(0.05)	-0.08, 0.12	-0.07	(0.08)	-0.23, 0.08
BMI	0.01	(0.01)	-0.02, 0.03	0.01	(0.01)	-0.02, 0.04	-0.01	(0.01)	-0.04, 0.01	-0.01	(0.02)	-0.05, 0.04

Abbreviation: *B* = unstandardized regression coefficient. CI = Confidence Interval. *SE* = standard error.
Note. Significant effects indicated in bold: *$p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.
For sex, boys are the reference groups.

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