Improving Early-adolescent Girls’ Fundamental Movement Skills

Submitted by

Natalie Lander
BAppSc, BHlthSc (Hons)

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy
November, 2016

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Deakin University
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Natalie Lander

Date: 25th November 2016
STATEMENT OF CONTRIBUTION OF OTHERS

Supervisors’ Statement

I, Dr Lisa Barnett, attest that the PhD Candidate Natalie Lander contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscripts which constitute this thesis.

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Dr Lisa Barnett       Date: 25th November 2016

I, Professor Jo Salmon, attest that the PhD Candidate Natalie Lander contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscripts which constitute this thesis.

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Professor Jo Salmon   Date: 25th November 2016

I, Professor Philip Morgan, attest that the PhD Candidate Natalie Lander contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscripts which constitute this thesis.

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Professor Philip Morgan   Date: 25th November 2016
Professional editor Dr Anna Cutler provided proofreading services according to the guidelines laid out in the university-endorsed national ‘Guidelines for editing research theses’, revised by the Institute of Professional Editors (IPEd) and approved by the forerunner to the Australian Council of Graduate Research Inc. (ACGR), the Deans and Directors of Graduate Studies (DDoS) on 12 November 2010. Dr Cutler’s editing services included amending typographical, spelling and grammatical errors, and checking for consistency in thesis formatting.
PUBLICATIONS AND PRESENTATIONS

PUBLICATIONS

The following peer-reviewed publications have been produced as a result of the research conducted for this thesis.

Primary Publications

There are five primary papers, for which I am the lead author. Three papers have been accepted, one is under revision and one is in preparation for submission. Each of these papers is presented as an independent chapter, and provides details relating to the design, implementation, development and evaluation of the separate studies.

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<th>No.</th>
<th>Chapter</th>
<th>Publication</th>
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Secondary Publications

Four secondary papers are included in the appendices of this thesis. These papers were published during my PhD candidacy with me as first author or as co-author. The papers do not directly constitute my PhD research; however, they provided formative research, or relate to the concepts, content and/or processes of this thesis, and thus provide a unique contribution to the literature in these areas of research.

No. Publication


   This publication was written and published during the first year of my PhD. The results are derived from my Honours research, which provided the foundation and formative research for my PhD. I contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscript for publication.


   My contribution to the above systematic review included: identifying and screening relevant articles, assessing articles for eligibility, assessing the risk of bias of each study,
checking extracted data for accuracy, writing sections of the paper and reviewing the paper at all stages of the writing process.


This publication was a research note focusing on the importance of FMS. I was involved in the critical discussion around the stimulus, and in all aspects of writing and reviewing the manuscript for publication.


This publication highlighted the challenges and inconsistencies of interrater assessment using the Test of Gross Motor Development-2 (TGMD-2). My contribution to the above study involved conducting all in-field assessments of students’ fundamental movement skill proficiency using the TGMD-2, and assisting in all aspects of writing and reviewing the manuscript for publication.
PRESENTATIONS

The following peer-reviewed conference abstracts and professional presentations have been produced and presented as a result of the research conducted for this thesis.

Refereed Conference Abstracts


**Invited Speaker**


**Professional Presentations**


GRANTS AND AWARDS

The following awards/grants were awarded for my PhD research:

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<tr>
<td>2014-2016</td>
<td>Deakin University PhD Scholarship</td>
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<td>2014-2016</td>
<td>Deakin University, School of Health and Social Development, Higher Degrees by Research Grant ($4000)</td>
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<tr>
<td>2015</td>
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<td>2015</td>
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<tr>
<td>2016</td>
<td>North American Society for the Psychology of Sport and Physical Activity (NASPSPA), Graduate Student Research Award, Research Grant ($3500)</td>
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ABSTRACT

Regular physical activity (PA) is positively associated with a host of physical, psychological and social outcomes in youth. Despite this, only one-third of children, and one in ten adolescents achieve the recommended 60 minutes of PA per day. Females are significantly less active than males and the most precipitous decline in PA is noted in adolescent girls, where PA levels drop by as much as 83% as they transition through adolescence. Several systematic reviews have provided evidence for the positive and significant association between fundamental movement skill competence and engagement in present and future PA. Fundamental movement skills (FMS) are basic movement skills that have been described as the building blocks of involvement in a wide variety of physical activities. They are typically classified into object control skills (e.g., catching and throwing), locomotor skills (e.g., running and jumping) and stability skills (e.g., balancing and twisting). Developing proficiency in these skills has important health implications for young people, in terms of increased PA, increased cardiorespiratory fitness and obesity prevention. Furthermore, FMS competency in childhood is associated with higher levels of PA and fitness in adolescence, and FMS competence may serve as a protective measure against the decline in PA typically noted in adolescence.

Despite evidence that proficiency in a range of FMS has important health implications for young people, FMS proficiency of many children in Australia, and worldwide, is low. Furthermore, low FMS proficiency often persists into adolescence and beyond. In addition, globally, girls exhibit especially low levels of object control proficiency, which is of concern as proficiency in object
control skills is positively associated with, and predictive of, future PA levels. Therefore, the need to target FMS development in girls is paramount.

Most children are developmentally able to master FMS by the end of Grade 4. Therefore, primary school physical education (PE) should provide the ideal environment to assess, teach and improve these skills. However, many students, especially girls, pass through primary school PE, and the early developmental stages, without mastering the critical threshold of FMS necessary for successful participation in PA and the sports-based curriculum typical of high school PE. Compounding this, skill deficits in girls often remain unidentified in high school PE programs. Subsequently, remediation instruction may be rare, and opportunities for them to improve may be limited. It is therefore evident that investigation into an appropriate form of FMS assessment, feasible for use by PE teachers, is warranted to enable accurate identification of FMS deficiency and proficiency, and subsequently enable more targeted teaching.

The low FMS competency observed among girls may be partially explained by socio-environmental factors, but may also reflect a failure of the ‘traditional’ approach to PE, in regards to skill improvement. It is largely the actions of the teacher that inhibit or facilitate the optimal learning environment, determine whether students’ experiences in PE are positive and regulate whether student learning outcomes in PE are met. Importantly, a positive learning environment, created by effective teaching, enhances girls’ enjoyment in PE, increases their involvement in PA and can improve the development of FMS. Despite the important role PE teachers can play in FMS development, research regarding the effectiveness of PE teacher-led FMS interventions targeting adolescents is limited, and studies targeting adolescent girls even more so. Furthermore, recent research has demonstrated that PE teachers of early-adolescent girls have limited knowledge of how to best teach FMS to engage and motivate students and
subsequently improve FMS outcomes. Therefore, it is imperative to not only educate the teachers about best practice regarding FMS instruction for girls, but also to investigate alternative forms of FMS instruction that may be especially conducive for girls to learn and develop FMS in a PE context.

Given the significant influence of PA on an individual’s health, and the comprehensive evidence for the positive and significant association between FMS competence and engagement in PA, it is crucial to better understand the factors that inhibit and facilitate FMS development among youths, particularly those who are at most risk of being physically inactive, such as adolescent girls. Systematic evidence has demonstrated the potential to improve FMS in children via school-based interventions, specifically those utilising a specialist or highly trained PE teacher. However, current knowledge on FMS intervention effectiveness in the adolescent population is limited, and those targeting early adolescent girls even more so. In light of this, the present thesis aimed to: investigate key characteristics of teacher training in effective school-based PA and FMS interventions; explore the current approaches to FMS assessment and instruction of early-adolescent girls; test the feasibility, validity and reliability of a newly developed FMS instrument; and promote FMS proficiency in early-adolescent girls by improving the quality of assessment and instruction provided to them.

Firstly, to investigate the type and quantity of teacher training in school-based physical education PA and/or FMS interventions, and to identify the role teacher training had on the intervention outcome, a systematic review was conducted (Chapter 1: Part B). A systematic search of eight electronic databases was conducted. Papers included in the review reported on interventions set in school PE classes, were facilitated by school teachers and included quantitative assessments of FMS competence and/or PA levels. Of the 39 studies identified, most did not provide adequate
details of the teacher training provided for the intervention to trace the link between teacher training and student outcomes. Despite this limitation, a few key considerations when designing teacher training programs in school-based PE interventions were identified: (i) include a ‘sustained’ teacher training component (i.e., one day or more); (ii) use a multimodal approach to teacher training delivery, with a focus on ongoing consultation and collaboration; (iii) include comprehensive intervention content (subject and pedagogy content); (iv) view the measurement of teacher satisfaction and fidelity as an essential design element; and (v) report clearly and comprehensively on teacher training characteristics. It is clear that teachers are capable of making substantial improvements in student outcomes in PA and FMS. What remains unclear, due to poor reporting, is the role teacher training is having on these outcomes. The findings of this review suggest the teacher training component of school-based PA and/or FMS interventions is not only poorly reported, but is also under-studied, and perhaps as a result may be undervalued.

To establish a preliminary understanding of the barriers and facilitators of PE-based FMS instruction and assessment of early-adolescent girls, a qualitative descriptive study was performed (Chapter 2). The research aimed to examine PE teachers’ perceptions of the importance and relevance of teaching FMS to Year 7 girls (first year of high school, 11–13 years of age), and the factors influencing effective FMS instruction. Twenty-five participants were recruited from a quantitative online survey of Australian high school specialist PE teachers. Participants took part in semi-structured individual interviews. An inductive content analysis was performed to examine the data collected from the interviews. Two major categories were found in the data: (i) Year 7 was perceived to be a critical period to instruct girls in FMS; and (ii)
teaching practice (i.e., curriculum interpretation, pedagogy, assessment, competence, quality of teacher training) was perceived to be suboptimal for effective FMS instruction.

As assessment was identified (in Chapter 2) as a major barrier to effective FMS teaching of early-adolescent girls, a newly developed FMS assessment tool, the Canadian Agility and Movement Skill Assessment (CAMSA), was investigated. To determine whether the CAMSA was an appropriate FMS assessment for use by teachers of Year 7 girls in an Australian school-based PE context, a feasibility study was performed (Chapter 3). Eighteen teachers and their respective Year 7 classes, participated in the study. Teachers’ perceptions and experiences around the feasibility of the CAMSA course – as reported in teacher surveys, recorded during direct observations of the class, and discussed in focus group interviews with teachers – were investigated. The data was analysed in regards to seven feasibility components (i.e., demand, acceptability, implementation, practicality, adaption, integration and expansion). The CAMSA was shown to be a feasible test of FMS proficiency in girls’ early high school PE. However, some issues arose regarding integration of the assessment data into teaching practice. These considerations were used to improve the design, application and training around the use of the CAMSA within the school-based intervention (Chapter 5).

As the CAMSA was identified (in Chapter 3) as being a feasible FMS assessment for use by teachers in a school setting, the next step was to compare the test-retest reliability and concurrent validity of the CAMSA against a commonly used FMS assessment instrument, the Victorian FMS Assessment (Chapter 4). A convenience sample of Year 7 girls ($n = 34$, mean age 12.6 years) from an independent girls’ school in Melbourne, Australia, participated in the study. The girls were tested on each assessment instrument and then retested seven days later. Both instruments were found to be reliable and valid. However, compared with the Victorian FMS instrument, the
CAMSA achieved both process and product assessment, took less time to administer and had higher authenticity; therefore, the CAMSA may be an attractive alternative to more traditional forms of FMS assessment for early-adolescent girls in school settings.

To address the gaps identified in the literature in regards to teacher-led FMS interventions targeting early-adolescent girls, a pilot cluster randomised controlled trial (RCT) was designed, developed, delivered and evaluated (Chapter 5). The pilot cluster RCT was framed by the interrelated, systematic and methodological research conducted in chapters 1 to 4 of this thesis. The aim was to: (i) evaluate the effectiveness of an intervention on FMS proficiency in early-adolescent girls, and (ii) to report on the process evaluation of the intervention. Four all-girls schools were recruited and randomised at the school level into intervention or control groups. The project included a comprehensive teacher training program, followed by teacher-led delivery of a 12-week FMS intervention focusing on authentic FMS assessment (i.e., CAMSA) in conjunction with a student-centred approach to teaching FMS (i.e., SAAFE teaching principles). In total, 190 Year 7 girls (mean age 12.47±0.34) and eight specialist PE teachers participated in the study. Students’ FMS were assessed at two time points: pre-intervention (i.e., baseline) and post-intervention (i.e., in week 12). Six FMS were assessed using the Victorian FMS Assessment. Process evaluation data were collected via recruitment and retention records, teacher program satisfaction survey responses, early- and post-intervention teacher confidence questionnaires, and fidelity checks via direct observation. The impact of the intervention on student skill was assessed using mixed models with post-test skill (i.e., locomotor, object control and total skill) as the outcome variable, adjusting for baseline skill, intervention and control status, and relevant covariates, as well as accounting for clustering at the school and class level.
The intervention resulted in significant improvements and large effect sizes in locomotor skills, object control skills and total skill competency in the intervention group.

The findings of this thesis demonstrate the crucial role that schools, PE and, importantly, teachers can play in improving the FMS proficiency of early-adolescent girls. Teachers perceived Year 7 to be a critical period to instruct girls in FMS, yet they felt their teaching practice was suboptimal. A commonly expressed barrier to effective FMS teaching was the lack of practical and authentic FMS assessment tools. Subsequently, the CAMSA was evaluated as a feasible, valid and reliable FMS assessment tool for use by Year 7 PE teachers, and thus was viewed as an attractive FMS assessment tool. The CAMSA, when utilised in a pilot cluster RCT in conjunction with a student-centred approach to teaching, yielded significant enhancement of FMS competency. In addition, the intervention had a positive effect on teachers’ perceptions of and confidence in FMS assessment and instruction. Most previous interventions to improve FMS mastery have targeted children, not adolescents, and have been facilitated by a researcher rather than a school teacher. Therefore, the findings of this cluster RCT represent a substantial contribution to knowledge in the field.

The thesis findings clearly demonstrate that if the provisions of instruction and assessment are appropriate, there is capacity for skill improvement in early-adolescent girls. Therefore, developing a comprehensive understanding of and response to adolescent girls’ FMS learning needs achieves the best possible learning environment to attain PE learning outcomes. Accordingly, the findings of this thesis have important implications for teacher education and professional practice, and provide a promising approach for FMS promotion for school students. Ultimately, any improvement in FMS competency, especially for low-skilled girls, may expand potential enjoyment and thus lifelong participation in a wider array of physical activities.
I am eternally grateful to the many people who have been involved in the completion of this thesis.

Firstly, I would like to express my sincere gratitude to my primary supervisor, Dr Lisa Barnett, for the continuous support of me and my research. Over the past three years you have spent countless hours guiding me through my PhD, reviewing my work, and providing me with numerous opportunities to challenge and extend my research capabilities. Your guidance and clarity of thought have helped me in all stages of my research. The level of commitment and dedication you have shown as my supervisor is unparalleled, and very much appreciated. I could not have imagined a better supervisor and mentor for my PhD. Thank you!

I would also like to thank my co-supervisors, Professor Jo Salmon and Professor Philip Morgan. It has been a privilege to have had you as my supervisors. Thank you for the time you have dedicated to me, despite your unbelievable schedules, and thank you for encouraging my research and for inspiring me to be the best researcher I can be.

Secondly, I would like to thank the teachers and students who have participated in this project. Without their involvement, this research would not have been possible.

Thirdly, I would like to thank my research assistants: Chris, Jade, Clare and Naomi. It was wonderful having such capable and reliable staff assisting with my research, with the added bonus of sharing my PhD journey with great friends.

Finally, I would like to thank my family for their endless support in all that I do.
To my parents, Val and David. You are my greatest support and biggest supporters. Dad, the strength you have shown over the past four years has been truly inspiring. Mum, thank you is simply not enough!

To my parents-in-law, thank you for your support and willingness to take care of my children.

To my brothers and their families, thank you for your love, and for always making me smile.

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<tr>
<td>AiL</td>
<td>Assessment for Learning</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<tr>
<td>BOTMP</td>
<td>Bruininks-Oseretsky Test of Motor Proficiency</td>
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<td>CAMSA</td>
<td>Canadian Agility and Movement Skill Assessment</td>
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<td>CAPL</td>
<td>Canadian Assessment of Physical Literacy</td>
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<td>CK</td>
<td>Content Knowledge</td>
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<td>DET</td>
<td>Department of Education and Training</td>
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<td>FMS</td>
<td>Fundamental Movement Skills</td>
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<td>Deakin University Human Ethics Advisory Group</td>
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<td>HPE</td>
<td>Health and Physical Education</td>
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<td>ICC</td>
<td>Intra-class Correlation Coefficient</td>
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<td>KTK</td>
<td>Körper-Koordinationstest für Kinder</td>
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<td>LEAP PE</td>
<td>Lifestyle Education for Activity Program Physical Education</td>
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<tr>
<td>M-ABC</td>
<td>Movement Assessment Battery for Children</td>
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<td>METS</td>
<td>Metabolic Equivalent of Tasks</td>
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<td>MOT 4-6</td>
<td>Motoriktest fur vier-bis sechsjährige Kinder</td>
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<td>MMT</td>
<td>Maastrichtse Motoriektest</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>MVPA</td>
<td>Moderate to Vigorous Physical Activity</td>
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<td>PA</td>
<td>Physical Activity</td>
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<td>PE</td>
<td>Physical Education</td>
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<td>PDMS</td>
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<td>PETE</td>
<td>Physical Education Teacher Education</td>
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<td>PK</td>
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<td>PCK</td>
<td>Pedagogy Content Knowledge</td>
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<td>PLS</td>
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<tr>
<td>RCT</td>
<td>Randomised Controlled Trial</td>
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<td>SAAFE</td>
<td>Safe, Autonomous, Active, Fair, Enjoyable</td>
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<td>TARGET</td>
<td>Task, Authority, Recognised, Grouped Evaluation, Time</td>
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<tr>
<td>TPSR</td>
<td>Teaching for Personal Social Responsibility</td>
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<td>TGfU</td>
<td>Teaching Games for Understanding</td>
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<td>Test of Gross Motor Development-2</td>
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## DEFINITIONS

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<td>Adolescent</td>
<td>For the purpose of this thesis, ‘adolescent’ refers to individuals aged ~13–18 years and attending secondary school</td>
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<tr>
<td>AfL</td>
<td>Assessment for Learning: a cyclic form of assessment including diagnostic, formative and summative assessment processes</td>
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<tr>
<td>Child</td>
<td>For the purpose of this thesis, ‘child’ refers to individuals aged 5–12 years and attending primary school</td>
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<td>CK</td>
<td>Content Knowledge: the facts, concepts, theories and principles that are taught and learnt in specific academic courses</td>
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<td>Early-adolescent</td>
<td>For the purpose of this thesis, ‘early-adolescent’ refers to the period of childhood just before the onset of puberty, designated as between the ages of 10 and 13 years in girls and 11 and 13 years in boys</td>
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<tr>
<td>FMS</td>
<td>Fundamental Movement Skills: gross motor skills that are the basic building blocks of more complex and specialised movement</td>
</tr>
<tr>
<td>MVPA</td>
<td>Moderate to Vigorous Physical Activity: activity equivalent to ≥3 METS (e.g., brisk walking pace)</td>
</tr>
<tr>
<td>PA</td>
<td>Physical Activity: bodily movement produced by the contraction of skeletal muscle that substantially increases energy expenditure</td>
</tr>
<tr>
<td>PK</td>
<td>Pedagogy Knowledge: understanding how to teach the facts, concepts, theories and principles in specific academic courses</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>PCK</td>
<td>Pedagogy Content Knowledge: the combination of content and pedagogy knowledge</td>
</tr>
<tr>
<td>SAAFE</td>
<td>A student-centred approach to teaching; adherence to these principles promotes a mastery climate</td>
</tr>
<tr>
<td>TARGET</td>
<td>An acronym to describe a set of dimensions used by educators to manipulate the environment to affect individual motivation and enhance a mastery climate</td>
</tr>
<tr>
<td>Year 7</td>
<td>First year of high school (students aged between 11 and 13 years)</td>
</tr>
<tr>
<td>Youth</td>
<td>For the purpose of this thesis, ‘youth’ refers to young people aged 7–17 years</td>
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THESIS OVERVIEW AND STRUCTURE

This thesis by publication is presented as a collection of five primary and four secondary peer-reviewed publications. The primary publications are presented as complete manuscripts, and appear as they were published or reviewed. The primary publications are bookended by contextual chapters to provide overall structure. The thesis comprises:

1. An overall abstract including a summary of findings from each chapter.

2. An overview of the thesis and author contribution.

3. Six chapters, including:
   - A review of the literature (Chapter 1), which includes Paper 1
   - Papers 2 to 5 (Chapter 2 to Chapter 5) presenting the results of the four inter-related school-based studies
   - A discussion and summary of all findings (Chapter 6)

Four secondary papers have been included as appendices to this PhD. These four papers directly relate to the content and context of this thesis, and provide a further contribution to the literature in this area of research.

The thesis chapters are as follows:
Chapter 1: Literature review

Part A of the literature review provides a critique and synthesis of the existing literature pertaining to the development of FMS in girls. The rationale for promoting FMS is discussed, highlighting the importance of skill development for girls. Strategies for skill improvement are discussed as well as the limitations of current practices.

Part B of the literature review is Paper 1, entitled: “Characteristics of teacher training in school-based physical education interventions to improve fundamental movement skills and/or physical activity: a systematic review”. In combination with Part A of the chapter, this systematic review highlights that although teachers are capable of making substantial improvements in student PA and FMS outcomes, the teacher training component of school-based PA and/or FMS interventions is often under-reported and under-studied, which indicates that the value of teacher training is not widely understood. The key recommendations from this review provided the background, rationale and framework for the teacher training component of the RCT presented in Paper 5 (Chapter 5).

The systematic review has been published as:

Chapter 2

Paper 2 is a qualitative descriptive study entitled: “Physical education teachers’ perspectives and experiences with instruction and assessment of fundamental movement skills of early adolescent girls”. This study was conducted as formative research and investigated the current practices and perceptions of Year 7 PE teachers regarding FMS assessment and instruction. The findings of this study provided research direction, in order to improve the provisions of FMS teaching to early-adolescent girls.

This paper has been published as:


Chapter 3

Paper 3 is a feasibility study entitled: “Teachers’ perceptions of a fundamental movement skill assessment battery in a school setting”. One of the major barriers to the effective teaching of FMS to Year 7 girls, as identified in Paper 2 (Chapter 2), was the lack of available and practical assessment tools for use by teachers in school PE. This research investigated whether the newly developed Canadian Agility and Movement Skill Assessment (CAMSA) was a feasible and practical assessment instrument for use by Australian PE teachers.

This paper has been published as:

**Chapter 4**

Paper 4 is a validity and reliability study entitled: “The validity and reliability of an authentic motor skill assessment tool for early adolescent girls in an Australian school setting”. Given the CAMSA was shown to be a feasible FMS assessment instrument (Paper 3), this study aimed to compare the test-retest reliability and concurrent validity of the CAMSA with a commonly used FMS assessment instrument, the Victorian FMS Assessment (Department of Education Victoria, 1996), developed for use by teachers in a PE setting.

This paper has been accepted as:


**Chapter 5**

Paper 5 is entitled: “Improving early-adolescent girls’ fundamental movement skill proficiency: a pilot cluster randomised controlled trial”. As the previous studies identified teacher training to be a crucial element of FMS interventions, and the CAMSA as a feasible, valid and reliable FMS assessment tool, the next step was to trial it in a real setting. Therefore, this pilot study evaluated
the effectiveness of a teacher training program, followed by a 12-week teacher-led PE intervention on FMS proficiency of students and teacher competence.

This manuscript is in preparation for submission as:


**Chapter 6: Critical discussion**

This chapter provides a synthesis of the key results of each of the studies and an overview of the thesis findings. The significance and limitations of the study are presented, including the implications for professional practice, pre-service education and teacher training in schools, as well as recommendations for future research.

**AUTHOR CONTRIBUTION**

An outline of the contribution that I, Natalie Lander, made to the program is presented below.

**Program design, development and delivery**

I was responsible for all stages of design, development and delivery for each of the five studies. This involved designing all program components, including: individual and collective program proposals, research questions and aims; outcome measures and data collection instruments and procedures; program schedules and procedures; and program session plans, resources and presentations. This also included the progressive evolution, iterations and improvements of the RCT (Paper 5) in accordance with the findings of the four formative research studies (papers 1–
4) of this thesis. I was also responsible for designing and delivering all aspects of the professional development/teacher training for all four school-based studies. Of particular note, I was responsible for the design, development, delivery and ongoing evaluation of the professional development/teacher training in Chapter 5 (Paper 5), which was a central intervention feature of the RCT.

**Ethics approval**

I was responsible for gaining ethics approval from Deakin University Human Ethics Advisory Group (HEAG), Department Education and Training (DET) and the Catholic Education Office (CEO), for each of the four school-based research studies in this thesis. This included: developing a study proposal and justification; completing all ethics application forms; developing advertisements, information brochures and consent documents for principals, teachers and parents/guardians; developing assessment protocols and score sheets for each of the outcome measures; developing surveys, questionnaires, interview guides and observation checklists for student and teacher data collection; training all research assistants in the ethical requirements outlined by Deakin University, DET and CEO; and completing all school and organisation reports as required by Deakin University, DET and CEO.

**Measurement of study outcomes, data collection and data entry**

In consultation with my supervisors, appropriate outcome measures and methods were chosen for each of the five studies. For the systematic review, I was responsible for identifying and screening relevant articles, assessing articles for eligibility, assessing the risk of bias of each study, checking extracted data for accuracy, writing up all sections of the paper and amending the paper at all stages of publication review. For the four school-based studies, I was responsible for administering, collecting and entering all data. I was responsible for training 10 research
assistants who helped with student management and administration, data collection and video filming and analysis of footage. I was also responsible for training one research assistant in coding video data, which included inter-rater reliability processes.

Analysis of data
After determining the methods of statistical analysis in consultation with my supervisors and the Deakin University faculty statistician, I completed all analyses using the SPSS statistical software package, and interpreted and presented the data in text, table or figure format.

Acquiring funding
I was responsible for applying for grants related to this PhD research. I successfully gained grants from the Sports Medicine Australia Research Foundation (SMA), North American Society for the Psychology of Sport and Physical Activity (NASPSPA) and Deakin University, School of Health and Social Development, Higher Degrees by Research.

Presentation of results and conferences
I was responsible for presenting the results of each of the five studies within this thesis at several conferences, both national and international, and also in the University Three Minute Thesis competition.
This chapter provides a critique and synthesis of the existing literature pertaining to the development of FMS in girls. The rationale for promoting FMS is discussed, highlighting the importance of skill development for girls. Strategies for skill improvement are discussed as well as the limitations of current practices.

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1.1 THE IMPORTANCE OF PHYSICAL ACTIVITY

1.1.1 Physical activity and health

Physical activity (PA) is defined as bodily movement produced by the contraction of skeletal muscle that substantially increases energy expenditure (Caspersen et al., 1985; Okely et al., 2012). The importance of regular PA lies in the widely acknowledged physical, psychological and social benefits from participation (Eisenmann et al., 2005; Janssen & LeBlanc, 2010; Okely et al., 2013; Yang et al., 2007). Regular PA plays a role in the prevention of cardiovascular disease, hypertension, stroke, type 2 diabetes (Lee et al., 2016), colon cancer, breast cancer (Kyu et al., 2016; Warburton, Nicol, & Bredin, 2006), osteoporosis and arthritis (Bauman, 2004; Weeks & Beck, 2010). PA is associated with more favourable serum lipids and lipid protein levels, improved cardiorespiratory fitness, bone health, functional health and cognitive function, and is inversely associated with obesity (Healy et al., 2008; Lee et al., 2016; Reiner, Niermann, Jekauc, & Woll, 2013). In addition to the many physical benefits, PA can have positive effects on psychological health including decreased anxiety levels, stress and depression, and increased self-esteem, cognitive functioning and social skills (Biddle & Mutrie, 2007; Warburton, Charleswoth, Ivey, Nettleford, & Bredin, 2010).

The physical and psychological health benefits of PA seen in adults have also been established in youth (7–17 years). Attaining adequate levels of physical activity assists young people to develop healthy musculoskeletal tissues, a healthy cardiovascular system and neuromuscular awareness (i.e., coordination and movement control), and maintain a healthy body weight (Janssen & LeBlanc, 2010; Strong et al., 2005). PA has also been associated with psychological benefits in young people. For instance, regular PA is associated with higher self-concept, self-
esteem and confidence, improved concentration and academic performance, and decreased anxiety and depression (World Health Organization, 2010). Participation in PA can also assist in the social development of young people by providing opportunities for self-expression, building self-confidence, social interaction and integration. It has also been suggested that physically active young people more readily adopt other healthy behaviours (e.g., avoidance of tobacco, alcohol and drugs), demonstrate higher academic performance at school (World Health Organization, 2010) and display reduced levels of antisocial behaviour, including aggressive and disruptive actions (Howie & Pate, 2012; Jansen et al., 2011; Knox et al., 2012; Strong et al., 2005).

Conversely, physical inactivity is defined as an activity level insufficient to meet present recommendations (Rockhill, Newman, & Weinberg, 1998). Physical inactivity is the fourth leading cause of death due to non-communicable disease worldwide, contributing to 6–10% of deaths globally, including approximately 10% of breast cancers, 10% of colon cancers, 7% of type 2 diabetes and 30% of ischemic heart disease (Andersen, Mota, & Di Pietro, 2016; Blair, 2009; Lee et al., 2012). In 2008, inactivity was responsible for 9% of premature mortality, or more than 5·3 million of the 57 million deaths in 2008 (World Health Organization, 2011). In Australia, physical inactivity is the second greatest contributor, behind tobacco smoking, to cancer (Australian Bureau of Statistics, 2013; Okely et al., 2012). However, a recent systematic review identified that adults who engaged in high levels of moderate intensity physical activity (i.e., about 60–75 min per day) had a reduced risk of premature death generally associated with inactivity (Ekelund et al., 2016), which provides further evidence for the benefits and importance of adequate physical activity.
1.1.2 Prevalence of physical activity

To attain the health benefits of physical activity, children and youth aged 5–17 years should accumulate at least 60 minutes of moderate to vigorous physical activity (MVPA) per day (World Health Organization, 2010). There has been some contention regarding the application of intensity-related accelerometer cut points for children and adolescents (Trost, Loprinzi, Moore, & Pfeiffer, 2011). For the purpose of this thesis, MVPA is defined as activity equivalent to ≥3 METS (e.g., brisk walking pace) (Okely et al., 2012). Despite the known benefits of regular PA, many children do not meet the minimum daily recommendation (Australian Bureau of Statistics, 2014b; Lee et al., 2012; Oja & Titze, 2011). The Australian Health Survey 2011–12 indicates that only one-third of children (5–12 years old) meet the recommended daily MVPA (Australian Bureau of Statistics, 2014a). In addition to inadequate levels in children, PA participation further declines as children approach adolescence (~13–17 years), and drops dramatically during adolescence (Belton et al., 2014; Janz, Dawson, & Mahoney, 2000; Nader et al., 2008; Sallis et al., 2008; Telama et al., 2005). Indeed, only one in ten Australian adolescents achieves the recommended 60 minutes of MVPA per day (Australian Bureau of Statistics, 2014a).

Not only are many adolescents not meeting recommended PA levels, but a significant sex difference is also apparent (Camacho-Miñano et al., 2011). Globally, females are significantly less active than males (Biddle et al., 2005; Kimm et al., 2000; Nader et al., 2008). A recent Australian study demonstrated that early-adolescent girls (~10–12 years old) were 19% less active than boys of the same age (Telford, Telford, Olive, Cochrane, & Davey, 2016). Furthermore, activity declines more precipitously among girls during adolescence (Kimm et al., 2000; Nader, Bradley, Houts, McRitchie, & O’Brien, 2008; Sallis, Prochaska, & Taylor, 2000).
As girls enter adolescence, they tend to engage in less physical activity than they did in late childhood (Beech et al., 2003; Kimm et al., 2002). As early as 10 years of age, girls begin to become less active, whereby their activity levels drop by as much as 83% as they transition through adolescence (Kimm et al., 2002; Wolf et al., 1993). The increasing prevalence of physical inactivity found in early-adolescent and adolescent girls poses serious current and future health risks (Robbins, Gretebeck, Kazanis, & Pender, 2006).

1.1.3 Correlates of physical activity

The factors influencing PA behaviour are complex. Research suggests that, collectively, the social, physical and policy environments impact on the likelihood of individuals participating in PA (Sallis, Prochaska, & Taylor, 2000). Theoretical models are often employed to provide a framework for understanding the factors that enable or inhibit PA participation. Specifically, the models help identify factors related to PA behaviour in at-risk populations (Robbins et al., 2006), thus enabling evidence-based planning of interventions targeting these populations (Bauman et al., 2012). The ‘socio-ecological’ model is one theoretical model that explains the complexity and multifaceted nature of factors influencing PA levels. This model was framed and refined using the work of a number of prominent researchers, but was predominantly influenced by Bronfenbrenner’s (1979, 1994) ecological systems theory, which focuses on the relationship between the individual and the environment, and in which behavioural influences occur as a series of layers, the innermost level representing the individual expanding to broader levels of environmental and policy influence (Bronfenbrenner, 1994).

The socio-ecological model is made up of five levels of influence on PA behaviour: (1) the individual (i.e., knowledge, skills); (2) interpersonal or social environment (i.e., family, friends);
(3) the organisation (i.e., school, work); (4) the community or physical environment (i.e., facilities, spaces); and (5) public policy (i.e., national and local laws) (Figure 1). There has been substantial research into correlates (factors associated with activity) or determinants (those with a causal relationship) of physical activity at an individual level (Sallis, Prochaska, & Taylor, 2000). This level includes personal factors that increase or decrease the likelihood of an individual being physically active, including an individual’s knowledge, attitudes, behaviours, beliefs, perceived barriers, motivation, enjoyment, skills (including fundamental movement skills and sport-specific skills), abilities, disabilities or injuries, age, sex, level of education, socioeconomic status and self-efficacy (Bronfenbrenner, 1979).

**Figure 1:** Socio-ecological influences on physical activity behaviour. **Source:** Modified from McLeroy, Steckler, & Bibeau (1988).

Furthermore, the individual correlates associated with PA in youth have been further classified into three categories: (1) physiological or demographic (e.g., sex, age, ethnicity, motor skill proficiency, body mass index, parental education and socioeconomic status); (2) psychological (e.g., attitude, self-efficacy, perceived barriers, self-perception, enjoyment and motivation); and
(3) behavioural (e.g., smoking, sedentary time, PE and sports) (Biddle & Mutrie, 2007; Biddle et al., 2005; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). Some of these individual correlates are non-modifiable, but others can be changed. The non-modifiable variables (e.g., sex, age and ethnicity) identify at-risk or inactive subgroups that should be targeted for interventions (e.g., sex: female). The modifiable variables (e.g., low level of motor skill) may be considered avenues for intervention within these target groups (Bauman et al., 2012; Sallis, Prochaska, & Taylor, 2000). As research has shown that there is a clear decline in PA among girls from early adolescence, adolescent girls have been identified as a key target population for PA behaviour change (Camacho-Miñano et al., 2011; Pearson, Braithwaite, & Biddle, 2015; Sallis et al., 2000). Furthermore, a recent study has demonstrated that PA in girls is less favourably influenced than boys by several socio-ecological factors at the individual, family, school and environmental levels (Telford et al., 2016). As many of these factors are potentially modifiable, the gap in PA between boys and girls may potentially be reduced via targeted behaviour change interventions (Biddle, Whitehead, O Donovan, & Nevill, 2005).

1.2 FUNDAMENTAL MOVEMENT SKILLS

1.2.1 Fundamental movement skills and health

At the individual level, one modifiable correlate of PA among young people is their motor skill capacity, specifically fundamental movement skill proficiency (Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Fundamental movement skills (FMS) – also referred to as ‘motor skills’, ‘fundamental motor skills’ or ‘gross motor skills’ – have been described as the basic building blocks of PA, and are typically classified into object control skills (e.g., catching, throwing, kicking and striking), locomotor skills (e.g., running, hopping, leaping and jumping) and stability
skills (e.g., balancing and twisting) (Gallahue et al., 2011). Developing proficiency in these skills has important health implications for young people (Robinson et al., 2015).

A systematic review of 21 studies in children found strong positive associations between FMS competency, time spent being physically active and cardio-respiratory fitness, and an inverse association between FMS proficiency and weight (Lubans et al., 2010). More recent reviews have confirmed a positive correlation between FMS competence and organised PA (Holfelder & Schott, 2014) and fitness (Cattuzzo et al., 2016). In further support of the correlation between FMS competence and PA, 12 out of 23 studies found an association between motor competence and PA (Holfelder & Schott, 2014), and of 13 studies specifically examining FMS competence, 12 detected a positive association with PA (Lubans, Morgan, Cliff, Barnett, & Okley, 2010).

With a broader repertoire of FMS, children have a greater chance of finding physical activities that they do well and subsequently enjoy, which maximises PA participation (Cohen, Morgan, Plotnikoff, Callister, & Lubans, 2014; Logan, Webster, Robinson, Getchell, & Pfieffer, 2015; Wrotniak et al., 2006). Furthermore, there is evidence that FMS competence is important throughout life (Stodden et al., 2008). For example, higher FMS competence reduces the decline in PA typically noted throughout late childhood into adolescence (Lopes, Rodrigues, et al., 2011), and FMS competency in childhood is associated with higher levels of PA and fitness in adolescence (Barnett et al., 2008; Barnett et al., 2009). Conversely, children with low FMS competence have exhibited increased body mass index over time (D’Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; Lopes, Stodden, Bianchi, Maia, & Rodrigues, 2011).

FMS proficiency is also an important contributor to prowess in sport. Mastery of the basic elements of movement is required to perform the more complex movement sequences executed
in sport. FMS can be fine-tuned for specialised application in specific sports – for example, throwing ability is transferable between cricket, baseball, volleyball and tennis (Gallahue et al., 2011; Langendorfer, Roberton, & Stodden, 2011) (Figure 2) – thereby providing more prospects for successful participation in sport and expanding opportunities to be physically active.

![Figure 2: Relationship between fundamental movement skills and sport-specific skills using the overhand throw as an example. Source: The Australian Council for Health, Physical Education and Recreation (ACPER), Victorian Branch (2008).](image)

**1.2.2 Models of FMS development**

There are a number of models that attempt to explain the development of FMS proficiency. The ‘proficiency barrier’ theory introduced by Seefeldt (1980) provides one explanation for how FMS proficiency may influence PA levels, suggesting that there is a critical ‘threshold’ of FMS competence above which children will be able to apply FMS in a range of sports, games and other physical activities. If children do not attain sufficient FMS competence to surpass this hypothetical ‘threshold’, they will be less successful in their FMS performance, less willing to participate in games, sports and PA, and ultimately be at a higher risk of dropping out of PA. Gallahue (1982) proposes a similar tiered model of motor development comprising initial,
elementary and mature phases of development, whereby the success achieved at any phase (not including the initial phase) and progress to the next is dependent, at least in part, on the level of proficiency attained in the previous phase. Similarly, Clarke and Metcalfe (2002) propose the ‘mountain of motor development’ model (Figure 3), whereby FMS form the base of the mountain, and as such are the precursors or foundation onto which more context-specific and skilful movement can be built. Clarke & Metcalfe (2002) also acknowledge that individuals may follow different ‘developmental trajectories’ while climbing the motor development mountain, influenced by different individual and environmental constraints.

**Figure 3:** Mountain of Motor Development. **Source:** Clarke & Metcalfe (2002).
Newell (1985) and Stodden et al. (2008) also emphasise that skills do not develop instinctively, nor consistently, but result from external factors (e.g., instruction, practice) influencing the child’s development. Newell (1986) proposes the ‘constraints’ model, explaining that FMS do not naturally ‘emerge’ during early childhood; rather, they are the result of many cooperating subsystems, namely, ‘the task’, ‘the learner’ and ‘the environment’, all of which are dynamic in nature. The resulting FMS performance is therefore a product of the interaction within and between the dynamic, cooperating subsystems a child possesses (Newell, 1986). Similarly, Stodden et al. (2008) suggest that there are four interrelated, dynamic and reciprocal factors associated with FMS competence and PA, namely, motor competence, perceived motor skill competence, health-related fitness and PA. Stodden et al. (2008) propose that in early childhood PA may drive the development of FMS, whereas in middle to late childhood an increased repertoire of FMS offers more opportunity for successful engagement in PA, games and sports. Thus, higher FMS competence results in a ‘positive spiral of engagement’, that is, the more skilled child will self-select into higher levels of PA, further refining their skill. The reciprocal relationship between FMS competence and PA is seen to strengthen over time (Stodden et al., 2008). Conversely, a child with less FMS competence will engage in lower levels of PA, and experience a negative spiral of disengagement (Figure 4).
1.2.3 Prevalence of FMS

There is a worldwide trend of low FMS proficiency in children, which includes Belgium (Bardid et al., 2015), Brazil (Spessato et al., 2013) and the United States (Logan et al., 2014). Similarly, in Australia the prevalence of FMS mastery among children is lower than expected (Booth et al., 2006; Hardy, King, Cosgrove, & Bauman, 2010; Hardy et al., 2013; Pill & Priest, 2009). It has been suggested that children have the developmental potential to master most FMS by the age of...
six (Gallahue & Ozmun, 2006) and should have developed mastery (i.e., all skill components observed) of all FMS by 10 years of age (Booth et al., 1999; Hardy et al., 2010). However, in Australia the prevalence of Year 6 students (11-12 years) with FMS mastery is less than 50% for the sprint run (46%), vertical jump (43%), the kick (40%) and the overhand throw (40%) (Hardy et al., 2010, 2013). It has also been identified that low skill levels persist into late childhood and even adolescence. In a recent Irish study, only 11% of adolescents demonstrated mastery or near mastery of nine FMS tested (O’Brien, Belton & Issartel, 2015). Similarly, in an Australian study less than 50% of the 9–15 year olds tested exhibited FMS mastery (Hardy et al., 2013).

1.2.4 Correlates of FMS

As with PA, to design effective FMS interventions we need to understand which correlates of FMS are most important and/or modifiable and which population groups are most at risk of low skill (Barnett et al., 2016; Bauman et al., 2012). A recent review identified consistently positive correlates of children’s motor competence including high socioeconomic background, increasing age (i.e., older children are generally more proficient than younger), sex (i.e., males are generally more proficient than females) and healthy weight status (Barnett et al., 2016). Accordingly, FMS interventions would be well positioned to target one or more of these at-risk subgroups for low skill.

Numerous researchers have highlighted a significant difference between the sexes in FMS proficiency (Barnett et al., 2016; Booth et al., 2006; Ehl, Roberton & Langendorfer, 2005; Hardy et al., 2010; Hardy et al., 2013; Raudsepp & Pall, 2006). Boys are consistently found to be better than girls at object control skills, such as throwing, kicking or catching (Barnett et al., 2010, 2016; Wrotniak et al., 2006). This gender gap has been detected over several decades of FMS
research, using both product and process measures to evaluate FMS performance (Barnett et al., 2016; Ehl, Roberton & Langendorfer, 2005; Gabbard, 2008; Halverson & Roberton, 1979; Halverson, 1982; Roberton, 1978; Looves & Butterfield, 1995; Roberton & Langendorfer, 1980; Thomas & French, 1983). Using product measures (discussed further below in section 1.6.4), biology or physiology (e.g., stature, size and strength) may influence performance outcome (e.g., distance or velocity a ball is thrown) (Thomas & French, 1983), thus providing some explanation as to why generally stronger and bigger males may outperform females. However, when undertaking process-based assessment of FMS (discussed further below in section 1.6.4) (i.e., looking at the developmental sequencing or descriptions of the quality of the performance), strength and stature becomes less important. Yet, there is conclusive evidence that girls are substantially behind boys in developmental rates when performing object control skills (Roberton, 1978; Roberton & Halverson, 1982). This is of particular concern as proficiency in object control skills is positively associated with and predictive of current and future PA levels (Barnett et al., 2008). Compared with girls, boys often receive more encouragement, support and opportunity to participate in PA and sport at home, at school and in the broader community (Barnett et al., 2016). Thus, girls are given less chance to enhance and refine their FMS competence, which may contribute to the observed gap between girls and boys in skill proficiency (Barnett et al., 2016).

Furthermore, as stated, levels of PA diminish rapidly in girls as they enter adolescence, possibly in part due to their low FMS proficiency (De Milander, 2011). Indeed, physically active girls have higher FMS proficiency than their non-active counterparts (Bouffard, Watkinson, Thompson, Cavsgrove, & Romanow, 1996; De Milander, 2011; Wrotniak et al., 2006). As Stodden et al. (2008) describe, there is a reciprocal benefit between FMS and PA – skilled people
are likely to be more active than their less skilled counterparts, and it is through regular involvement in PA that FMS are learnt and further refined. Thus, the problem compounds over time, with less active girls falling further and further behind their more active peers, and even more behind their active male counterparts (Stodden et al., 2008).

1.3 IMPROVING FMS THROUGH SCHOOL-BASED PROGRAMS

Motor development theorists suggest that while children may acquire rudimentary levels of FMS through exploration and play, they will develop their FMS potential more fully as a result of optimal environmental influences (Clarke & Metcalfe, 2002; Newell, 1986). Specifically, FMS mastery is more likely when children receive specific instruction, immediate feedback and adequate practice in an optimal learning environment (Ehl et al., 2005; Morgan et al., 2013; Rink, 2006; Valentini & Rudisill, 2004). However, the low prevalence of FMS mastery in children from Australia and worldwide, and the particularly low levels of girls’ object control skills, suggests that the current FMS programs may be ineffective, the provision of instruction largely inadequate, and the environmental conditions suboptimal for skill learning. Therefore, there may be great potential, and need, to improve FMS via tailored and targeted FMS intervention programs (Morgan et al., 2013; van Beurden et al., 2003), especially for early-adolescent girls, a well-identified at-risk demographic for low FMS competence.

1.3.1 The importance of school-based interventions to improve PA

Schools have been identified as important settings for the promotion of healthy lifestyles, and provide access to almost all youth including those with poor FMS proficiency and low PA levels (Morgan et al., 2013; Pate et al., 2006; World Health Organization, 2010). Via the curriculum,
ethos and community, schools provide an ideal setting for accessing and educating children and adolescents about the importance of PA, and building the movement skills to maximise PA participation (Kriemler et al., 2011). Indeed, in their policy guidelines aligned to the health behaviour of school-aged children, the World Health Organization (Currie et al., 2012) supports the need for policy interventions in schools to increase PA. Six different types of intervention were identified as capable of achieving sustainable behaviour change in PA (Centers for Disease Control and Prevention, 2010), with school-based interventions reported as one of the most promising.

It is important for school-based PA interventions to be evidenced-based and founded on a theoretical framework. By utilising existing frameworks, researchers are more accurately able to target at-risk populations and possible mediators of PA (King, Stokols, Talen, Brassington, & Killingsworth, 2002; Salmon & King, 2010). Behaviour theories that have been applied to school-based PA interventions include ‘social cognitive’ theory (Bandura, Adams, & Beyer, 1977), ‘socio-ecological’ theory (Bronfenbrenner, 1979), ‘competence motivational’ theory (Harter, 1985) and ‘self-determination’ theory (Ryan & Deci, 2000). In general, these theories assert that PA can be enhanced by physical activity self-efficacy, support (i.e., social support and environmental support) and enjoyment (Bandura et al., 1977; Harter, 1982).

School-based interventions targeting PA have had mixed success, especially those using objective measures of PA (Camacho-Miñano et al., 2011; De Meester, van Lenthe, Spittaels, Lien, & De Bourdeaudhuij, 2009; Kahn et al., 2002; Timperio, Salmon, & Ball, 2004; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; Van Sluijs, McMinn, & Griffin, 2008). The Cochran review of school-based interventions conducted by Dobbins, Husson, DeCorby, & LaRocca (2013) indicates that school-based PA programs could be effective at increasing the
number of children involved in MVPA. However, many of these studies were limited by a moderate risk of bias, so the results must be interpreted with caution (Dobbins et al., 2013; Kriemler et al., 2011; Metcalf, Henley, & Wilkin, 2012; Timperio et al., 2004; van Sluijs, McMinn, & Griffin, 2007). Furthermore, in the Metcalf et al. (2012) paper, the median increase in PA achieved by interventions using objective measures was just 5 minutes per day, suggesting there are potential challenges in increasing children’s PA. While the evidence of intervention effectiveness for PA is mixed, targeting mediators or determinants of PA, such as FMS may be more effective than directly promoting PA.

1.3.2 School-based interventions have the potential to improve FMS proficiency

Although the reporting of FMS outcomes in school-based interventions is somewhat limited, there is emerging evidence that school-based interventions have the potential to improve FMS proficiency and slow the age-related decline in PA in students (Dudley et al., 2011; Russ & Webster, 2016). As such, FMS outcomes have been the focus of school-based interventions and associated systematic reviews. Most of these FMS interventions have been delivered in early childhood or childhood settings (Morgan et al., 2013). Indeed, in a recent review, 21 of the 22 FMS interventions identified were conducted in a primary school setting (Morgan et al., 2013). Despite the low levels of FMS proficiency demonstrated by older children and adolescents, interventions to improve skill in this demographic are limited. To the author’s knowledge, the only studies conducted in adolescents are a quasi-experimental study in 13-year-old Finnish students (which resulted in significant intervention effects for movement skill sum score; \( p = 0.000 \)) (Kalaja et al., 2012) and a non-randomised controlled trial in 12 to 14-year-old Irish students (which resulted in significant intervention effects for total skill; \( p = 0.019 \)). Although not all school-based FMS interventions have yielded positive outcomes (Russ & Webster, 2016),
many have been generally successful, showing small to moderate effect sizes in FMS (Dudley et al., 2011; Morgan et al., 2013), particularly those facilitated by a specialist PE teacher or highly trained classroom teacher (Morgan et al., 2013).

1.3.3 School-based interventions targeting girls’ PA and FMS

Given the significant gender gap in PA, many school-based programs have been developed to promote PA among adolescent girls, some targeting the curriculum (McKenzie et al., 2004), others school sport (Dudley, Okely, Pearson, & Peat, 2010; Lubans, Morgan, Callister, & Collins, 2009), the school environment or community links (Pate et al., 2005), while others have combined a multi-component school intervention with a community-based intervention (Okely et al., 2011; Webber et al., 2008). Systematic reviews investigating interventions to promote PA among girls have demonstrated small to moderate effect sizes, and have identified that the most effective interventions are school-based, have enjoyable physical education as a main component and address multiple levels of behaviour (e.g., individual, environmental and policy level) using a theoretical framework (Camacho-Miñano et al., 2011; Pearson et al., 2015).

Moreover, researchers across several disciplines highlight that single-sex programs tailored to meet the unique needs of girls are more effective than co-educational interventions (Pearson et al., 2015; Wiese-Bjornstal & LaVoi, 2007). Many researchers have argued that most PA contexts reinforce gender stereotypes in ways that may disadvantage girls, for instance, by celebrating the characteristics associated with masculinity (Duncan, 2007) such as aggression, strength, power and speed (Derry, 2002; Olafson, 2002a; Taylor et al., 2000). Furthermore, research has shown that girls prefer single-sex PA for several reasons, including: freedom from constant comparison with boys, greater opportunity to practise and develop skills, greater chance of developing
supportive relationships and friendships, more enjoyment and fun, more informal and less competitive environments, more attention from the instructor/teacher and less concern about body image (Derry, 2002; Olafson, 2002b; Taylor et al., 2000; Whitehead & Biddle, 2008). Therefore, gender-specific, tailored PA interventions have a greater probability of addressing the needs and preferences of female learners (Biddle, Braithwaite, & Pearson, 2014; Ryan & Lauver, 2002).

The decline in levels of PA noted in adolescent females may be due, in part, to the significant gender gap noted in skill proficiency (Barnett et al., 2016). Yet, research investigating the effectiveness of school-based FMS interventions in adolescents is limited, and interventions targeting adolescent girls even more so (Morgan et al., 2013). Only one intervention, a semi-experimental study, targeting girls’ FMS was identified (i.e., primary school Grade 3 girls) (Bakhtiari et al., 2011), which resulted in statistically significant ($p < 0.001$) intervention effects for overall skill. However, no FMS research has targeted adolescent girls. As mentioned, gender differences in FMS proficiency are not solely physiologically determined, highlighting the need for targeted, school-based, gender-specific interventions with high-quality PE programs focusing on FMS to reduce the skill deficit of girls (Ericsson, 2011; Okley et al., 2001a; Stodden, Goodway, Langendorfoer, Roberton, & Kelbley, 2007; Thomas, Thomas, & Gallagher, 1993), and as such should be the focus of future research (Morgan et al., 2013).

1.3.4 Barriers affecting the effectiveness of school-based FMS interventions

School PE programs provide the ideal environment to develop FMS, and school-based FMS interventions have achieved positive outcomes on student FMS proficiency (Dudley et al., 2011; Morgan et al., 2013), including in girls (Bakhtiari et al., 2011). However, the potential impact
and sustainability of many of these programs may have been hampered by their failure to: address the multiple components that influence behaviour at an individual level; make reference to a behaviour learning theory; and/or empower the teacher to deliver the intervention to facilitate the sustainability of the program (Eather, Morgan, & Lubans, 2013; Lai et al., 2013; Morgan et al., 2013). Indeed, few school-based FMS studies have conducted follow-up assessments to identify the long-term impact or maintenance of the interventions (Lai et al., 2013). The sustainability of a school-based program is largely reliant on the extent to which the existing teachers continue to implement the program (Dusenbury, Brannigan, Falco, & Hansen, 2003). As the majority of school-based FMS programs use existing teachers to deliver interventions (Russ & Webster, 2016), identifying factors that encourage sustained implementation may help achieve long-term change in the quality of FMS teaching in PE programs (Webster, 2011).

### 1.4 THE ROLE OF PE IN THE DEVELOPMENT OF FMS COMPETENCE

#### 1.4.1 The impact of PE programs

The Health and Physical Education (HPE) curriculum is considered the focal point for PA promotion in school settings, and as such has been the avenue for numerous school-based PA interventions (Kriemler et al., 2011; Lonsdale et al., 2013). Physical education (PE) is the area of the school curriculum primarily concerned with developing students’ physical competence and confidence (National Association for Sport and Physical Education & American Heart Foundation, 2012). PE programs are based on a specified sequence of learning, and focus on the skills and knowledge needed to establish and sustain lifelong health (Australian Curriculum Assessment and Reporting Authority, 2014; National Association for Sport and Physical Education & American Heart Foundation, 2012).
Education & American Heart Foundation, 2012). PE is the only area of the school curriculum in which the central purpose is to optimise students’ health, by improving their knowledge, skills and attitudes (Australian Curriculum Assessment and Reporting Authority, 2014).

PE can have a positive effect on students’ physical, psychological, social and cognitive health (Bailey, 2006). Studies have shown that two 45-minute PE classes per week can decrease insulin levels and blood lipids (Telford et al., 2013a, 2013b), increase bone density (Daly et al., 2015) and improve academic performance (Telford et al., 2011). Importantly, PE can create a context in which PA levels can be positively influenced (Sallis et al., 2012). Indeed, providing the opportunity for students to be physically active is a central purpose of the PE program (National Association for Sport and Physical Education & American Heart Foundation, 2012). Moreover, positive environments created within PE classes are critical to the development of girls’ positive or negative feelings towards PA (Pearson et al., 2015), and many researchers concur that positive learning experiences with PA during the adolescent years, especially for girls, affect participation levels of adults (Sallis et al., 2012).

Several studies have reported positive results from PE interventions designed specifically to accommodate the learning needs of adolescent girls (Felton et al., 2005; Jamner, Spruit-Metz, Bassin, & Cooper, 2004; Lubans et al., 2012; Webber et al., 2008). For example, Felton et al. (2005) reported positive changes in girls’ PA levels in their investigation of the Lifestyle Education for Activity Program (LEAP). These researchers highlighted several key features of the LEAP PE program that were effective in promoting PA and engaging girls in PE, which included: gender separation of PE classes; non-competitive activities offered; students being physically active in class; fun and enjoyable classes; and appropriate instructional methods (Felton et al., 2005). These findings emphasise the need for effective teaching in PE to create a
learning environment conducive to meeting the needs of female students (Gibbons & Gaul, 2004; Gibbons, 2009)

1.4.2 PE programs and the development of FMS

In addition to the provision of PA, the development of movement skill is a key aim of PE curriculums worldwide (Australian Curriculum Assessment and Reporting Authority, 2014; Department for Education, 2013; McKenzie & Lounsbery, 2013; Sallis et al., 2012), and as such, FMS have been identified as a priority area in national and international curriculums. The US Active Start National Association for Sport and PE (2013) and England’s National Curriculum (Department of Education, England, 2013) heavily feature motor skill development. The Australian Victorian Essential Learning Standards by the Victorian Curriculum and Assessment Authority (2012) emphasise the importance of FMS in PE by prioritising movement skill acquisition in the ‘movement and PA’ dimension of the ‘health and physical education’ domain. The Health and Physical Education Curriculum, as presented in the ‘Shape of the Australian Curriculum’ paper, also features movement skill proficiency as a core focus of the curriculum (Australian Curriculum Assessment and Reporting Authority, 2012).

PE programs with a focus on optimal FMS development have been found to be superior to traditional PE (Boyle-Holmes et al., 2010; Kalaja et al., 2012; Martin & Rudisill, 2009). Similarly, enhanced PE plus additional PE alongside traditional PE (McKenzie, Alcaraz, Faucett, & Sallis, 1997; van Beurden et al., 2003) and increased PE time have all resulted in significant intervention effects on students’ FMS (Morgan et al., 2013, Sollerhed & Ejlertsson, 2008). Yet, despite the gender disparity in skill, only one PE-based intervention has specifically targeted girls (Bakhtiari et al., 2011), and no PE interventions have focused on adolescent girls. The
results of these studies support the positive influence of quality PE programs in improving the FMS proficiency of students.

1.4.3 Barriers to delivery of effective PE curriculums

Despite the broad focus of FMS in PE curriculums in Australia and internationally (Australian Curriculum Assessment and Reporting Authority, 2014; McKenzie & Lounsbery, 2013; National Association for Sport and Physical Education & American Heart Foundation, 2012; Sallis et al., 2012), and evidence that high-quality PE interventions can enhance FMS proficiency (Bakhtiari et al., 2011; Graf et al., 2005; van Beurden et al., 2003), the low levels of FMS proficiency in young people in Australia and worldwide suggest that ‘traditional’ PE programs may be inadequate (Kriemler et al., 2011). There are several well-documented shortfalls of primary school PE programs that cause students to fail to meet FMS benchmarks (Morgan & Hansen, 2008). These include teacher-related factors, or factors in the teacher’s control (i.e., teacher knowledge, confidence and competence, values and experience, level of training and qualification); and institutional factors, or factors out of the teacher’s control (i.e., time attributed to PE, facilities and equipment, support from school leadership and policymakers, and the low status often accorded to PE) (Morgan & Hansen, 2008, Penney, 2012, Jenkinson & Benson, 2010). Consequently, many students, especially girls, pass through the early developmental stages commonly known as the ‘golden stage of learning’ without mastering the FMS necessary for successful participation in PA and the sports-based curriculum typical of secondary school PE (Okley et al., 2001a; Okley et al., 2001b).

1.4.4 Barriers to effective delivery of PE to girls
Engaging female students in PE has been recognised as a challenge for school teachers, particularly high school teachers (Rich, 2004; Slater & Tiggemann, 2011). ‘Traditional’ PE programs, often dominated by elitist, masculine, competitive and multi-sport structure, often take a ‘one size fits all’ approach and in so doing fail to achieve the broader and more holistic educational outcomes proposed by PE (Metzler, 2005). This traditional approach has been subjected to a sustained critique by scholars worldwide and is frequently viewed as a sexist form of PE (Flintoff & Scraton, 2006; Kirk et al., 2006). Indeed, researchers have noted that PE itself can act as a barrier to girls’ participation (Flintoff & Scraton, 2006).

As with engagement in PA, many socio-ecological, socio-cultural, psychological and contextual factors affect female students’ participation in PE. Factors affecting female students in PE have been shown to relate to social constructs of gender and gender stereotypes (Cockburn & Clarke, 2002; Tinning & Fitz Clarence, 1992; Whitehead & Biddle, 2008); social support and influences (e.g., parents, peers and role models) (Dowda, Dishman, Pfeiffer, & Pate, 2007; McNeill, Kreuter, & Subramanian, 2006; Trost et al., 2003); and the teaching/classroom environment (e.g., the competitive nature of PE lessons, the teacher) (Dudley, Pearson, & Okely, 2006; Dudley et al., 2010; Larsson, Fagrell, & Redelius, 2009; Murphy, Dionigi, & Litchfield, 2014). In fact, in traditional PE programs, female students have reported feelings of embarrassment, low perceived ability, concerns about body image, lack of interest in the activities being offered, and the dominance of boys in class, all of which negatively affect their involvement in and enjoyment of PE (Flintoff & Scraton, 2001; Flintoff & Scraton, 2006; Wright & Macdonald, 2010). Subsequently, many girls transition through primary school and into Year 7 (i.e., the first year of high school in Australia) without the skills, attitudinal disposition or confidence necessary to participate positively in high school PE or PA. Therefore, it is important that PE
programs and PE teaching become more aligned with the factors that positively influence and engage girls in PE.

### 1.5 EFFECTIVE TEACHING IN PE

#### 1.5.1 The importance of effective teaching in achieving learning objectives

Teachers have been described as being effective when important student learning goals are met (Siedentop, 2002). It is largely the actions of the teacher that create the optimal learning environment, determine whether students’ experiences in PE are positive, and regulate whether student learning outcomes are met (Bailey, 2006; Lee, 2004; Lee et al., 2007). Following a synthesis of more than 50,000 studies comprising more than 80 million students that considered the influences on student achievement (e.g. the child, the home, the school, the teacher, the curriculum and the approaches to teaching), it was concluded that the greatest contributor to student achievement is the teacher, and in particular the effectiveness of their teaching (Hattie, 2013, 2012).

#### 1.5.2. Pillars of effective teaching

In regards to influencing behaviour change through the lens of the socio-ecological model, the teacher affects multiple levels of influence on PA behaviour (i.e., individual, interpersonal and environmental), especially for girls. For example, a positive learning environment created by effective teaching and teacher support enhances girls' enjoyment in PE, and subsequently increases their motivation towards, and involvement in MVPA opportunities provided throughout the lesson. Importantly, effective teaching and support provided by the PE teacher can enhance the development of FMS (McKenzie et al., 1998; van Beurden et al., 2003).
Effective teachers are those who display proficiency in several pillars of teaching, namely: (i) curriculum design and implementation, (ii) pedagogy, (iii) learning environment, and (iv) assessment (Tannehill et al., 2013). These factors enable teachers to design, organise and deliver tasks and activities in an environment that optimally motivates students to achieve (Ennis, 2006, 2011; You, 2011). Each of these four pillars of effective teaching are discussed below.

(i) Curriculum design and implementation

The curriculum is the focal point for the study of educational practice (Kirk, 2014). A curriculum model is an overarching frame that encompasses long-term (i.e., yearly) program and content goals. It is based on a conceptual framework and incorporates identification of learning goals and the selection and structuring of program content (Jewett, Bain, & Ennis, 1995). Ideally, the curriculum should frame or guide teaching and learning by providing personally relevant, interesting and enjoyable activities in a developmentally appropriate sequence that positively influences intrinsic motivation to engage in these activities both inside and outside school (Hassandra, Goudas, & Chroni, 2003). This perspective on curriculum purpose is supported by motivational theories such as self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000), which suggests that when students find activities inherently interesting, meaningful and enjoyable, or when activities hold personal relevance, students will be more likely to engage in these activities outside PE (Haerens et al., 2011). There are numerous PE curriculum models, including the ‘health-fitness’ model, the ‘skill-fitness’ model (McKenzie, Sallis, & Rosengard, 2009; Sallis et al., 1997), the ‘self-management’ model (Marcoux et al., 1999) and the more contemporary ‘health-based’ physical education model (Haerens et al., 2011). However, rather than providing relevant, interesting and enjoyable activities, the ‘traditional’ multi-activity sports-based curriculum remains the most typical and preferred model for high school PE.
The traditional curriculum model is characterised by a dominance of adult, masculine, elite-oriented, competitive and sports-based activities. Haerens et al. (2011) suggest that the traditional model fails to address the motivational means to engage students in PE, and develop skills, knowledge and behaviours to sustain a healthy lifestyle, especially for girls (Chen et al., 2008).

It has become increasingly recognised by PE researchers that ‘the problem’ is often located in the PE curriculum contexts within which girls are expected to participate. As mentioned in section 1.4.4, these contexts often relate to the social construct of gender through PE (Enright & O’Sullivan, 2010). The sustained critique of traditional, multi-sport forms of PE suggests the need for alternative approaches that are better suited to meeting the needs of all students, perhaps especially girls, and all ability levels, rather than the already sport-competent minority (Kirk, 2013). Thus, the curriculum should provide a framework in which movement can be made personal, enjoyable and meaningful within a supportive environment. The PE curriculum should not only specify mastery of specific FMS as outcome measures, but should also provide opportunity for this to be achieved in a wide variety of movement experiences within an optimal environment, and covering a diversity of pedagogical approaches (Enright & O’Sullivan, 2010).

(ii) Pedagogy

While curriculum is important, effective delivery of the curriculum material is critical. Teachers are required to be highly qualified in the content of the subject they teach (i.e., high levels of ‘content knowledge’). However, expertise in content alone may be inadequate. Effective teachers also possess a high level of ‘pedagogical knowledge’, that is, the skills and knowledge to successfully plan and implement a diversity of pedagogical approaches that address individual
student learning styles and developmental levels. Pedagogy is defined as the method and practice of teaching, used by one person, designed to enhance learning in another (Watkins & Mortimore, 1999). Importantly, the literature suggests that teachers who demonstrate high levels of both content knowledge and pedagogical knowledge achieve better FMS outcomes for their students (Cohen, Goodway, & Lidor, 2012). The integration of content knowledge and pedagogical knowledge is collectively referred to as ‘pedagogical content knowledge’ (Shulman, 1986). Pedagogical content knowledge concerns how teachers relate their pedagogical knowledge (i.e., what they know about teaching) to their subject matter (i.e., what they know about the content) in a way that is meaningful and meets the needs of specific students. Thus, pedagogical content knowledge is critical to effective teaching in PE (Amade-Escot, 2000).

A thorough understanding of developmental theories and the importance of FMS (i.e., content knowledge) is imperative to effective teaching, and this has been discussed in detail previously in this chapter. Equally important, however, is pedagogical knowledge of the best approaches to deliver PE or FMS content. The theories of PE delivery (i.e., pedagogy) commonly include instructional models (Metzler, 2005) and teaching styles (Mosston & Ashworth, 2002). Metzler (2011) defines an ‘instructional model’ as a comprehensive, coherent plan for both teachers and students to provide a framework for teaching, which includes: a theoretical foundation; intended learning outcomes; the teacher’s content knowledge and expertise; developmentally appropriate and sequenced activities; expectations for the teacher and students; and assessment plans. Instructional models differ from curriculum models, as an instructional model pertains to the teacher’s ability to deliver or translate the content within a given framework (Metzler, 2005).

Several instructional models have been developed for intended use in PE, dependant on the specific learning objectives of the lesson. The instructional model of ‘traditional’ PE is a skills-
drills-games approach, which typically relies on the direct teaching of new skills in isolation followed by a drill to practise the new skill, then concluding with a game (or modification thereof) to apply the skill in context. Several other instructional models have arisen in PE, for example, ‘teaching for personal social responsibility’ (TPSR) (Hellison, 2011) and ‘cooperative learning’ (Dyson, Linehan, & Hastie, 2010), as well as game-centred models such as ‘making games’ (Almond, 1983), ‘sport education’ (Siedentop, 1994), ‘teaching games for understanding’ (TGfU) (Bunker & Thorpe, 1982) and nuances thereof, such as Thorpe and the Australian Sports Commission’s (1990) ‘game sense’ (Kirk & MacPhail, 2002; Light, 2012). These instructional models are considered the blueprints for teaching and learning, and are effectively the architecture that designs the construction of learning (Killen, 2007; Metzler, 2005).

Teaching styles are a broad set of teaching tactics that guide PE teachers towards purposeful teaching to meet specific objectives (Mosston & Ashworth, 2002). Mosston and Ashworth’s (2002) spectrum of ‘teaching styles’ is a continuum of 11 styles, from absolute control of the teacher in the ‘command’ style (Style A), to absolute freedom in learning by the student in the ‘self-teaching’ style (Style K). The 11 styles are divided into two clusters. The first five teaching styles (i.e., ‘command’, ‘practice’, ‘reciprocal’, ‘self-check’ and ‘inclusion’) form a cluster (i.e., the ‘reproduction’ cluster), which represents teaching options that foster reproduction of existing (i.e., known, past) information and knowledge, and where much of the decision-making is governed by the teacher. The remaining styles (i.e., ‘guided discovery’, ‘convergent discovery’, ‘divergent discovery’, ‘learner-designed individual program’, ‘learner-initiated’ and ‘self-teaching’) form a cluster that represents options that invite production (i.e., the ‘discovery’ cluster) of new knowledge; new to the learner, teacher or new to society (i.e., the ‘production’ cluster). In the production cluster, the decision-making process progressively shifts towards the
student (Mosston & Ashworth, 2002). The spectrum is not a single, isolated style, technique or approach. Rather, it is a universal structure that should be learnt and understood, so the extent of the variations, nuances and flexibility of the spectrum can be utilised to meet particular learning needs and intentions, and create optimal learning environments (Mosston, 1992). Due to the diversity of the student population, and the multitude of objectives in PE, teachers must have the skills, knowledge and abilities to integrate a variety of teaching styles within the appropriate instructional models, to meet the ever-changing needs of students (Wright, McNeill, & Schempp, 2005).

In regards to FMS, the most effective teaching style is still evolving. One review disclosed ‘teacher-led’, or ‘direct teaching’ instruction as the most effective (Dudley et al., 2011). Yet many others consider ‘student-centred’ approaches to be the most effective in school-based FMS interventions, and the more traditional direct instruction styles to be less advantageous for promoting development, learning and motivation (Morgan et al., 2013; Ntoumanis, 2001; Valentini & Rudisill, 2004).

Indeed, the effectiveness of student-centred, game-based instructional models are gaining momentum in FMS research, such as ‘teaching games for understanding’ (TGfU), which emerged to counter the perceived shortcomings of student learning inherent in the highly structured traditional teacher-led PE method (Stolz & Pill, 2014). TGfU opposes the traditional PE method of ‘skill to drill to game’ as well as the emphasis on direct teaching. Instead, the TGfU approach starts with the game as its organisational and instructional centre (Metzler, 2011); the teacher acts as a facilitator and the students make their own adaptations and decisions to maximise the level of challenge and fun (Stolz & Pill, 2014). In the TGfU instructional model, teacher questioning is utilised to prompt examination of a game concept and focus game
understanding. Teachers who exhibit a deep understanding of TGfU are capable of balancing the teaching of skills and tactics in a gameplay context, simultaneously improving student outcomes in strategy and skill (Miller et al., 2015). Therefore, a more student-centred approach to learning skills, such as game-based instruction, can produce improvements in FMS without isolating the movement skills from the activities they are used in, providing a more authentic, contextual and enjoyable skill-learning experience (Miller et al., 2015).

In regards to teaching styles, those from both the ‘reproduction’ and ‘production’ clusters can effectively promote motor skill acquisition in students (Goldberger et al., 2012). In Hattie’s (2009) synthesis of research on direct instruction, he found it is one of the most influential teaching strategies linked to student outcomes. In fact, some of the most effective controlled trial studies in FMS in primary schools have used direct instruction teaching methods (Dudley et al., 2011). However, direct instruction may not be the most advantageous for promoting support and motivation, both essential for qualities for engaging students, and particularly girls, in PE. Indeed, the more student-centred the approach, the more engaged girls are with learning (Haerens et al., 2011; Kalaja et al., 2012). Processes in which learners assess a partner’s skill performance (i.e., ‘reciprocal’ style) or their own skill performance (i.e., ‘self-check’ and ‘inclusion’ styles) produce higher gains of knowledge than those in which learners are not required to formally assess performance (i.e., ‘command’ and ‘practice’ styles) (Goldberger et al., 2012). Students who can choose the level of task difficulty (inclusion style) report higher levels of autonomy and perceived control as well as higher levels of physical and cognitive involvement (Doherty, 2003; Goldberger et al., 2012; SueSee & Edwards, 2009). Therefore, exclusively directive teaching styles are unlikely to be appropriate for achieving affective and cognitive learning outcomes that foster and promote skill mastery (Robinson & Goodway, 2009;
Despite the evidence around the importance of content knowledge and pedagogy knowledge in regards to effective teaching, research suggests there is a gap between academic discourse and practitioner delivery (Metzler, Lund, & Gurvitch, 2008). Researchers have found that PE teachers have limited content or pedagogy knowledge of how to develop FMS and improve the motor performance of their students (Ennis, 2011; Lounsbery & Coker, 2008). There continues to be an over-reliance on traditional approaches to PE, such as the teacher-directed command teaching style and the traditional drill-and-practice instructional model, and a void in the implementation of student-centred, innovative instructional models, and more productive teaching styles that encourage skill mastery in girls (Goldberger et al., 2012). A goal for all PE teachers should be to increase students’ motivation to engage in and enjoy PA. By designing, developing and delivering the correct curriculum, suitable instructional model and appropriate teaching style, PE teachers can play a significant role in increasing students’ intrinsic motivation (i.e., the motivation to engage in PA for pleasure and satisfaction) and shaping the optimal environment for learning (Martin, Rudisill, & Hastie, 2009).

(iii) Learning environment

Research emphasises the importance of environmental design in eliciting movement skill development (Rink, 2006). This is reflective of existing models, theories and systematic reviews of PA promotion and motor skill development, which unanimously advocate the promotion of favourable environmental conditions as enablers of PA and/or FMS (Bronfenbrenner, 1979; Clarke & Metcalfe, 2002; Newell, 1986; Pearson et al., 2015). It is largely the actions of the teacher that inhibit or facilitate the optimal learning environment, determine whether students’
experiences in PE are positive, and subsequently regulate whether student learning outcomes in PE are met (Bailey, 2006; Lee, 2004; Lee, Burgeson, Fulton, & Spain, 2007). Creating an optimal environment requires the teacher to have a good grasp of task conditions, task requirements and learner motivation and needs, so they can design conditions appropriate for different learners.

Self-determination theory (SDT) (Deci & Ryan, 1985) can inform the development of the teacher’s role in creating an environment conducive to learning. SDT describes how motivation develops and its influence on behaviour. According to SDT, there are three innate psychological needs – autonomy, competence and relatedness – that determine an individual’s state of motivation (Deci, Eghrari, Patrick, & Leone, 1994; Deci & Ryan, 1985). If an individual’s need for autonomy (having a sense of choice), competence (a sense of efficacy) and relatedness (sense of social attachment) are met, they will be intrinsically motivated to engage in certain behaviour. SDT suggests that teachers can nurture students’ need for autonomy, competence and relatedness by creating a learning environment that is: autonomy-supportive instead of controlling, well-structured and competence-facilitating instead of chaotic and critical, and emotionally warm instead of cold (Haerens et al., 2011). Furthermore, supporting autonomy includes offering choice, minimising controlling language and providing a meaningful rationale for taking part (Deci & Ryan, 1985). Collectively, the three innate psychological needs, according to SDT, are important to foster students’ feelings of competence and autonomy in PE (Haerens, Kirk, Cardon, De Bourdeaudhuij, & Vansteenkiste, 2010; Ntoumanis, 2005; Shen, McCaughtry, & Martin, 2008; Sun & Chen, 2010; Van den Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014), and increasing students’ motivation for, and engagement in, PA within PE (Rosenkranz,
Lubans, Peralta, Bennie, Sanders, Lonsdale, 2012), which is especially important for girls (Wang & Liu, 2007).

Similarly, an understanding of ‘competence motivation theory’ (CMT) (Harter, 1978) may help teachers enhance the environmental conditions to facilitate learning in PE. CMT is a theory of achievement motivation based on a person’s feelings of personal competence (Harter, 1980). According to the theory, competence motivation increases when a person successfully masters a task. This encourages the person to master more tasks. Thus, children who perceive themselves to be competent in PA and are positively influenced by significant adults and peers engage in more and varied types of activities (Harter, 1978). To increase children’s competence and confidence in FMS, movement skill programs that involve teacher support via quality instruction and feedback, adequate skill practice opportunity and fulfilling and fun activities have been identified as a promising approach (Eather et al., 2013; Morgan et al., 2013). Therefore, PE teachers setting challenging yet achievable tasks, and instilling the belief that students can improve can increase intrinsic motivation of students in PE (Ntoumanis, 2001).

Understanding these underlying factors that motivate students is critically important for teachers when creating an environment that has positive effects on student learning (Theeboom, DeKnop & Weiss, 1995). Motivational climate has been identified as an influential construct for determining and developing student motivation in PE (Ames, 1985). The concept of motivational climate refers to an individual’s reasons for approaching a task in an achievement setting. Research has distinguished two major motivational climates, namely, a performance climate (i.e., ego-oriented) and a mastery climate (i.e., task-oriented) (Ames, 1985). A performance climate is highlighted by competition, out-performing others and elitism, and is synonymous with the ‘traditional’ approach to PE. In a performance climate, tasks are absent of variety, the teacher
controls all decisions, and tends to foster social comparison by recognising those who out-perform others (Ntoumanis & Biddle, 1999). Furthermore, a performance climate evaluates success through social comparison, like winning and losing, and external judgement by others (Ames, 1985). Subsequently, performance climates have been linked with anxiety, boredom and decreased motivation (Ames, 1985).

In contrast to performance climate, a mastery climate judges success through individual progress and improvement, personal skill development and skill mastery, and has been linked with increased confidence and enjoyment in a PE setting (Robinson & Goodway, 2009; Valentini & Rudisill, 2004). Research on motivational climates in PE suggest that a mastery climate is associated with positive student outcomes such as increased intrinsic motivation, increased effort and students choosing more challenging tasks (Ping, McBride, & Solmon, 2003). Accordingly, there is growing interest in mastery motivational climates to maximise the benefits of the PE environment.

Promoting a mastery or high-autonomy climate aids learning through autonomous motivation, and can be integrated within either skill-based or game-based pedagogies. A mastery motivation approach promotes the development of skills in a non-competitive, non-threatening learning environment in which students receive instruction and positive reinforcement and are encouraged to improve, which can develop intrinsic motivation, enjoyment and perceived competence in PE (Ntoumanis & Biddle, 1999; Robinson & Goodway, 2009; Valentini & Rudisill, 2004). Previous research has demonstrated that student-centred instructional strategies lead to mastery motivational climates, which subsequently enhance intrinsic motivation and motor skill performance in children (Valentini & Rudisill, 2004). Indeed, a mastery motivational climate
approach, based on success, optimal challenge and autonomy has led to significant improvements in FMS (Kalaja et al., 2012).

Epstein (1988) identified six dimensions of individual motivation, fundamental in any classroom environment, which together form the acronym TARGET: task (i.e., design of activities); authority (i.e., location of decision making), recognition (i.e., use of rewards); grouping (i.e., selection of working groups); evaluation (i.e., assessment criteria); and time (i.e., pacing of instruction and learning). Effective teachers are able to manipulate these environmental dimensions to foster a mastery motivational climate, and subsequently enhance opportunity and desire to learn. Studies adopting the TARGET framework have demonstrated greater changes in locomotor and object control skills than those with traditional approaches (i.e., teacher-led, command style or performance-oriented) to FMS instruction (Robinson & Goodway, 2009; Valentini & Rudisill, 2004).

Similarly, the SAAFE (Supportive, Active, Autonomous, Fair and Enjoyable) teaching principles (Lubans et al., 2012) is a student-centred approach to PE instruction, and adherence to these principles is said to promote a mastery motivational or high-autonomy climate (Ames, 1984; Lubans et al., 2012). The SAAFE principles are reflective of Epstein’s (1988) TARGET framework, and are broadly framed by self-determination theory (Deci & Ryan, 1985) and competence motivation theory (Harter, 1978, 1980). The SAAFE teaching principles have yielded significant success in FMS outcome improvement in recent school-based interventions (Cohen, Morgan, Plontikoff, Callister, & Lubans, 2015; Smith et al., 2014). Consequently, the SAAFE teaching principles have been recommended for school-based FMS interventions (Cohen, Morgan, Plontikoff, Callister, & Lubans, 2015).
Table 2: SAAFE (Supportive, Active, Autonomous, Fair and Enjoyable) teaching principles and strategies (Lubans et al., 2012)

<table>
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<tr>
<th>Principle</th>
<th>Strategies</th>
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| **Supportive** – Lessons conducted in a supportive environment | 1. Publicly recognise all students’ effort, learning, achievements and improvement.  
2. Provide feedback on student effort, process and progress (not results).  
3. Identify and manage inappropriate student behaviour (e.g., teasing, over-competitiveness).  
4. Promote positive social interactions between students. |
| **Active** – Lessons involve a high level of movement and active learning time | 1. Use small-side games, circuits and tabloids to maximise participation.  
2. Ensure equipment is plentiful and developmentally appropriate.  
3. Monitor in-class PA using pedometers (i.e., ~ 75–85 steps/min of PE time is equal to 50% active learning time).  
4. Use student leaders to set up games and activities. |
| **Autonomous** – Lessons involve elements of choice and opportunities for graded tasks | 1. Ensure that tasks incorporate multiple challenge levels, and give students the freedom to select level of difficulty.  
2. Provide students with opportunities to create and modify rules and activities.  
3. Provide students with opportunities for leadership roles.  
4. Encourage students to assess their own skill performances (e.g., detect and correct their own errors). |
| **Fair** – Lessons provide all students with an opportunity to experience success | 1. Ensure tasks are not dominated by the most competent students.  
2. Modify the tasks to increase the opportunity for success (e.g., make the goals bigger, reduce the number of defensive players, alter the equipment used, revise the task rules).  
3. Ensure students are evenly matched in competitive activities. |
### Principle

<table>
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<th>Principle</th>
<th>Strategies</th>
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<tr>
<td><strong>Enjoyable</strong> – Lessons are designed to be enjoyable and engaging for all students</td>
<td>4. Acknowledge and reward participation and good sportsmanship.</td>
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<tr>
<td>1. Include a wide variety of games and activities.</td>
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<td>2. Provide engaging and age-appropriate tasks.</td>
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<tr>
<td>3. Avoid boring and repetitive activity (e.g., running around the field for a warm-up).</td>
<td></td>
</tr>
<tr>
<td>4. Don’t use exercise or activity as punishment.</td>
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The SAAFE teaching principles (Table 2) provide an ideal framework for creating a PE environment conducive for girls to learn. Indeed, many of the strategies promoted by the SAAFE principles are conducive to girls’ engagement in PE (Dudley et al., 2006; Dudley et al., 2010; Gibbons & Humbert, 2008; Leversen, Danielsen, Birkeland, & Samdal, 2012). For instance, the ‘supportive’ SAAFE principle appears to be particularly pertinent for girls, as social relationships play an important role in girls’ engagement and participation in PA, and socialisation or relatedness increases in importance as girls approach adolescence (Hills, 2007; Martin, Rudisill, & Haste, 2009; Ntoumanis, 2001; Pfaeffli & Gibbons, 2010; Shen et al., 2008; Tessier, Sarrazin, & Ntoumanis, 2008). ‘Relatedness’ is defined as the feeling of relating to others in a social context (Ryan & Deci, 2000); ‘relatedness support’ refers to social environments in which individuals can develop inspiring relationships with others, including peers and teachers (Cox, Duncheon, & McDavid, 2009; Ullrich-French, McDonough, & Smith, 2012). Indeed, one study found that feeling socially connected is a stronger predictor of girls’ self-determined motivation and engagement in PE than perceived competence or autonomy (Cox & Williams, 2008). Furthermore, a recent school-based PA program for children (Fit-4-Fun; Eather et al., 2013) identified teacher support as a key mediator of a positive intervention effect.
This highlights the importance of the teacher, not only in regards to the direct provision of instruction, but also in the creation of a learning environment that fosters peer interaction, encouragement and support.

The ‘autonomous’ SAAFE principle encourages student ‘voice’ and ‘choice’ in the types of activities offered during a lesson, again a strategy synonymous with effective PE programs for girls (Azzarito, Solmon, & Harrison, 2006; Fisette, 2013; Oliver & Lalik, 2004). The ‘active’, ‘fair’ and ‘enjoyable’ principles promote inclusivity, pleasure, cooperation, active participation, peer mentoring and leadership, which are all conducive to girls’ enjoyment of PE (Dudley et al., 2006; Dudley et al., 2010; Gibbons & Humbert, 2008; Leversen, Danielsen, Birkeland, & Samdal, 2012). Specifically, a systematic review on effective PA interventions for girls identified that making PE enjoyable for girls by offering a wide range of non-competitive, innovative and enjoyable activities should be a high priority for future school-based PA interventions (Camacho-Miñano, LaVoi, & Barr-Anderson, 2011).

(iv) Assessment

As mention earlier in section 1.5.2 the fourth pillar of effective teaching, as identified by Tannehill et al. (2013), is assessment. Assessment is a major focus area for this thesis, and subsequently will be discussed in detail below in section 1.6.

1.6 THE IMPORTANCE OF ASSESSMENT ‘FOR’ LEARNING

1.6.1 The importance of assessment for effective teaching
Another dimension of effective teaching is the comprehensive integration of meaningful assessment (Hattie & Jager, 1998; Hattie & Timperley, 2007). Assessment can help the teacher understand not only what students know, but also how they learn, which helps to set appropriate lesson objectives to create effective PE programs (McKenzie et al., 2009; Wood, 2003). Assessment is an important enabler of student learning, as it gives purpose and meaning to instruction and informs teachers, students, parents and administrators about student achievement (Fisette & Franck, 2012). Indeed, effective assessment is inseparable from effective teaching (Chan, Ha, & Ng, 2016). Importantly, movement skill assessment to inform teaching and learning strategies, as part of a quality PE program, enables students to acquire the knowledge and skills necessary to develop and improve their skill competency (Chan, Ha, & Ng, 2016).

‘Authentic assessment’ tests skills that can be appreciated in real-life settings, provides an exciting environment and has the potential to increase student accountability, which directly influences student performance in PE (Patrick, Ward, & Crouch, 1998). When assessment addresses key principles, it becomes a pivotal teaching tool and powerful source for improved student learning (Victorian Curriculum and Assessment Authority, 2012). Wiggins (1998) states that good teaching is inseparable from good assessment, and if assessment is performed regularly (i.e., assessment ‘for’ learning) it has the potential to encourage higher student engagement, which maximises their ability to acquire and master new skills (Wright & van der Mars, 2004).

According to the National Association for Sport & Physical Education’s National Standard for Physical Education (Society of Health and Physical Educator, 2010), assessment of student learning plays an important role in motor skill instruction (Watkinson, Causgrove Dunn, Steadward, Wheeler, & Watkinson, 2003). Accurately diagnosing students’ skill deficits allows scope for advancing skill learning (Fisette & Mitchell, 2010). Observing and correcting FMS is a
skill in itself (Turner, 1998). To be proficient in instructing and assessing FMS, the teacher requires an intimate knowledge of the specific components within each skill, as well as the ideal sequence for their instruction and mastery. The teacher also needs to know what the correct performance of the whole skill looks like, and be able to verbally communicate and physically demonstrate it accurately. The teacher must also be able to identify common errors in the skill performance, such as improper body position, poor base of support, incorrect wind-up or follow-through, flawed transfer of weight, incorrect grip on the striking implement or poor or incorrect striking surface angle (Turner, 1998). Rapid identification of faults makes feedback immediate and specific, and providing the right feedback at the right time enhances the likelihood of the student performing the skill successfully (Wright & van der Mars, 2004).

### 1.6.2 Using assessment to improve learning outcomes among girls

During childhood, both boys and girls tend to rely heavily on adult comments to help them judge their competency (Weis & Ebbeck, 1996). During adolescence, a gender difference appears: girls continue to rely on adults and respond well to positive, specific feedback about FMS attempts (Breslin, Murphy, McKee, Delaney, & Dempster, 2012), whereas boys seem to rely more on competitive outcomes and egocentric judgments (Weis & Ebbeck, 1996). These differences highlight the important role teachers’ play in influencing girls’ attitudes to learning. As the involvement of girls in PA is influenced by the attitudes of parents and other role models, such as teachers, their support can encourage (or discourage) involvement (Bunker, 1998).

Motivation to participate in PA for girls also stems from the desire to achieve personal goals (Jaffee & Manzer, 1992). Therefore, it is important to set learning experiences that focus on FMS development by using authentic assessment, so girls not only receive critical feedback from
teachers, but also set their own challenging yet achievable goals. This allows students to monitor their improvement and increase self-efficacy and perceived competence; powerful correlates and motivators of PA in girls (Jaffee & Wu, 1996; Veal, 1995).

1.6.3 Assessment classifications

There are three common classifications of assessment in the school environment: diagnostic, formative and summative (Figure 5). All three of these should be used to create a balanced assessment approach, and combined they have the capacity to generate assessment for the purpose of learning (Black & Williams, 1998; Wiliam, 2011). However, observation of a skill performance by itself is not assessment. Tomlinson (2014) suggests that assessment is today’s means of understanding how to modify tomorrow’s instruction. Assessment ‘for’ learning enables meaningful modifications to foster student learning. If the aim of the assessment is to improve student learning and performance, then assessment ‘for’ learning is the recommended approach (Wiliam, 2011) (Figure 5). The main strategies considered important for assessment ‘for’ learning include shared learning goals, effective questioning, formative feedback, peer and self-assessment, and using assessment information to improve future student performance (Black, Harrison, Lee, Marshall, & William, 2003; Black & Wiliam, 2010). These strategies are conducted during daily classroom practice to allow teachers to meet diverse student needs, and enable feedback to improve learning and inform instruction (Black et al., 2003).
Diagnostic assessment is the first phase of assessment ‘for’ learning, and has the potential to identify student strengths and weaknesses. Diagnostic assessment data help teachers choose appropriate pedagogy to target learning to the needs of the students. This early stage of assessment is important as it provides the scaffold for teachers to build best practice teaching and learning (Saubern, 2010) (Figure 6).

Figure 5: Assessment ‘for’ learning. Source: Black & Williams (1998).

Figure 6: Flow chart showing how diagnostic assessment improves learning. Source: Adapted from the ‘decision-making loop’ (Saubern, 2010).
Formative assessment consists of ongoing observations, questioning, feedback and discussion, which can be performed by the teacher, the student or a peer. Indeed, in regards to FMS, practising the correct technique with consistent and accurate guidance is more important than the overall number of practice attempts (Hattie & Timperley, 2007; Ní Chróinín & Cosgrave, 2013). Formative assessment provides data while the learning is still happening, which promotes reflection on the effectiveness of instruction and learning practices (Rink, 2006). Thus, teachers and students can use formative assessment to adjust and improve their performance in teaching and learning, respectively. Formative assessment emphasises the concept of assessment ‘for’ learning as well as assessment ‘as’ learning (Black et al., 2003), and is considered one of the most effective interventions for educational improvement, raising overall achievement and benefitting low achievers (Black et al., 2003; Hattie & Timperley, 2007). Although research suggests that formative assessment can facilitate learning, exploration in this area is limited (Hay, 2006). Furthermore, the little research that has been conducted in formative assessment in PE has focused on the practice of assessment by the teachers, rather than the impact the assessment has on student learning (Hay, 2006; Kirk & O’Flaherty 2004).

Summative assessment determines what a student has learnt at the end of an instructional unit. This form of assessment, when performed in isolation, is defined as assessment ‘of’ learning. It is often performed at the conclusion of the unit, so cannot facilitate ongoing improvement or the correction of error (Brookhart, 2001). In PE, these assessments have been described as ‘high stakes’ and include fitness test scores and product-based motor skills tests for accuracy or distance conducted at the end of units of work (Metzler & Tjeerdsma, 2000). Although there are obvious benefits to this approach, there are also some shortcomings, including the possible demotivation of students who receive a low mark/score, inaccuracy of the assessment task due to
curriculum distortion and bias (i.e., teaching to the test) (Hay, 2006). Too frequently there is an over-reliance on summative assessment measures (Black & Wiliam, 2010). Ultimately, to best advance student learning, assessment approaches should comprise a cyclic integration of diagnostic, formative and summative forms (Black & Williams, 1998), collectively known as assessment ‘for’ learning. It is assessment ‘for’ learning that has the potential to improve motor skill proficiency among school children (Chan, Ha, & Ng, 2016).

1.6.4 FMS assessment classifications

There are two major divisions of assessment related to the measurement of FMS, namely, ‘process’ (i.e., qualitative) assessment and ‘product’ (i.e., quantitative) assessment (Miller & Silverstein, 2007). These assessments are either norm-referenced or criterion-referenced. Norm-referenced assessment compares the participant’s performance to that of a normative group to quantify competence. Criterion-referenced assessment considers the qualitative aspects of the participant’s performance (Cools, Martelaer, Samaey, & Andries, 2009). Product-based assessment considers the outcome of the skill performance, is often simple to administer and provides an immediate indication of the student’s FMS proficiency using time, distance or accuracy (Miller & Silverstein, 2007). Process-based assessment considers how the skill is performed and the degree to which the execution of the skill and its components compares with the most efficient form. Process-based assessments are often more time-consuming (Hands, 2002); however, if the assessor has the competence to extract data on student FMS proficiency using process-based assessment, it has the potential to provide more specific feedback on individual components of a skill.
There is also some evidence that process and product-oriented assessments capture slightly different constructs (Logan et al., 2014; Rudd et al., 2015). This means that assessment combining both allows for a comprehensive analysis of FMS proficiency and is likely to give a more complete picture of motor competence. A combined method provides an immediate indication of the performance (e.g., the time, distance or accuracy), which enables the teacher to modify instruction without delay, and also allows for a more thorough qualitative analysis (e.g., components within the skill), which enables specific and targeted feedback prompts, as well as direction for program modification in order to target and remediate student skill deficits (Hands et al., 2015; Hands, 2002).

1.6.5 FMS assessment tools

Assessment tools that are not reliable cannot be valid, and thus may be futile (Burton & Miller, 1998). Validity is the degree to which the test or instrument measures what it is supposed to measure, and a reliable assessment tool will yield the same results in consecutive trials (Thomas, Nelson, & Silverman, 2005). Types of validity include: logical validity, when the test involves the performance being measured; content validity, when the test samples what has been delivered in the course or program; and criterion validity, when the test is validated against criteria. Criterion validity can be further divided into concurrent validity (i.e., correlating the results with criteria that are administered at the same time) and predictive validity (i.e., the degree to which the scores of predictor variables accurately predict criterion scores) (Thomas et al., 2005). An additional measure is construct validity, which determines whether the test scores of different groups (e.g., intervention versus control) differ (Thomas et al., 2005).
Numerous assessment tools have been used in FMS interventions. Common FMS tests include: Motoriktest für Vier-bis Sechjährige Kinder (MOT 4-6) (Zimmer & Volkamer, 1987); the Movement Assessment Battery for Children (Movement-ABC) (Henderson & Sugden, 1992); the Peabody Development Scales (PDMS) (Folio & Fawell, 2000); Körperkoordinationstest für Kinder (KTK) (Kiphard & Shilling, 2007); the Test of Gross Motor Development (TGMD) (Ulrich, 2000); the Maastrichtse Motoriek Test (MMT) (Vles, Kroes, & Feron, 2004); and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (Bruininks & Bruininks, 2005).

In a review by Cools et al. (2009), the validity and reliability of the seven aforementioned FMS tools were analysed using Cohen’s (1988) scale, in which a correlation of 0.5 is large, 0.3 is moderate and 0.1 is small. The inter-rater reliability coefficients were high for most of the seven tools (Cools et al., 2009). In regards to concurrent validity, test comparisons may show few large to moderate correlations because of the absence of a golden standard for assessment of movement skill development (Cools et al., 2009).

Two other process-oriented assessment tools have been used in FMS measurement, namely, Get Skilled: Get Active (Department of Education and Training NSW, 2000) and FMS Skills Assessment: A Manual for Classroom Teachers (Department of Education Victoria, 1996). Although these tests are more suited to older participants, the validity and reliability of these tools have not been fully established. Although Get Skilled: Get Active has had some validation, the existing reliability and validity results are quite moderate (i.e., test-retest reliability mean agreement percentage scores for the 12 skills ranged from 69 (95% CI; 60–87), for the hop with Grade 1 children, to 85 (95% CI; 70–100) for the kick with Grade 3 children) mean agreement percentage scores ranged from 69 to 85), and further validation would be beneficial (Okely & Booth, 2000). FMS Skills Assessment: A Manual for Classroom Teachers has been tested for
test-retest reliability and validity, and although the skills appear largely reliable (Intra-Class Correlation Coefficient (ICC) ≤ 0.7), the sample used was small and the process unclear so the accuracy and authenticity of FMS measurement using this tool is not yet defined.

1.6.6 Barriers to effective FMS assessment

Many of the traditional FMS assessment tools were designed to identify young children with FMS deficits (Brown, 2013). Thus, most have criteria and protocols aimed at the early childhood demographic. Subsequently, the tests require the children to perform each FMS in isolation, and in a closed or controlled environment (Cousins & Smyth, 2005; Folio & Fawell, 2000; Ulrich, 2000). Although there are some obvious benefits to these methods in terms of their capacity to identify specific motor deficiencies, the authenticity is limited (Longmuir et al., 2015). The static testing environment and performance of isolated skills often limits the application of assessment results to the complex PA environments experienced by older children and adolescents (Longmuir et al., 2015). For example, a child may be able to catch a ball thrown by the examiner; however, that same child may or may not be able to catch the ball while running or before/after another fundamental movement skill in a game setting (Longmuir et al., 2015). The goal of monitoring movement skill development in early adolescence may require a more complex, demanding and dynamic task to give a true indication of FMS proficiency (Longmuir et al., 2015). Another noted limitation to traditional FMS assessment tools is the scarcity of discussion of the natural variation in motor skill development of typically developing children, and the over-reliance on chronological age benchmarks (Wiart & Darrah, 2001).

PE teachers are faced with numerous barriers to effective assessment of students’ FMS, including high student numbers per class, limited class time and a lack of preparation time (Johnson, 2005).
Due to these barriers, many teachers resort to using levels of participation, attitude, appropriate clothing and attendance as criteria for assessing students (Lander et al., 2015). Not enough teachers use movement skill test scores or knowledge test scores as assessment criteria to assess student learning (Lee et al., 2007a). Other barriers to effective FMS assessment include the assessment task not being engaging or fun for students, a lack of FMS-specific criteria prescribed in the school’s PE curriculum, and traditional assessment protocols being predominantly summative (Lander et al., 2015). Furthermore, traditional FMS assessment protocols take 15 to 60 minutes per child to administer (e.g., TGMD-2 and the Victorian FMS Assessment; Wiart & Darrah, 2001), and are therefore difficult to implement in a typical PE class. Thus, a major barrier to effective FMS assessment is the lack of an appropriate diagnostic assessment tool that is valid and reliable for early adolescents (Black et al., 2003).

1.6.7 An alternative approach to FMS assessment – the CAMSA

The Canadian Agility and Movement Skill Assessment (CAMSA), designed as part of a larger study of children’s physical literacy, offers an alternative approach to the assessment of FMS proficiency (Lloyd, Colley & Tremblay, 2010; Tremblay & Lloyd, 2010). The CAMSA assesses FMS in a dynamic format that simulates active play and requires students to balance speed with technique to optimise performance. It requires students to run a total distance of 20 metres while completing seven movement skill tasks (Figure 7): two-footed jumping into and out of three hoops on the ground, sliding from side to side over 3 metres, catching a ball and then throwing the ball at a wall target 5 metres away, skipping for 5 metres, one-footed hopping in and out of six hoops on the ground, and kicking a soccer ball between two cones 5 metres away. Performances are evaluated using completion time (i.e. ‘product’ measure) and reference criteria (i.e. ‘process’ and ‘product’ measures).
1. Start behind left yellow hoop.
2. Two-foot jump through left row of hoops (yellow, blue, red).
3. Side slide from green cone 1 to green cone 2, and back to green cone 1.
4. Run towards the throwing/kicking line, catch the ball thrown by examiner and throw hard at the wall target before crossing the line.
5. Run around green cone 2 then skip from red cone 3 to red cone 4.
6. Circle around left side of red cone 4, then hop on one foot once in all six hoops (in any order).
7. Run from hoops to throwing/kicking line and kick the ball sitting on the line (placed by examiner) between yellow cones 5 and 6.

**Figure 7**: Canadian Agility and Movement Skill Assessment (CAMSA) setup. **Source**: Longmuir, Boyer, Lloyd, Borghese, Knight, Saunders, Boiarskaia, Zhu, & Tremblay (2015).

The CAMSA course has been tested for reliability, validity and feasibility in children (n = 1165, 52% female) aged 6 to 14 years (Longmuir et al., 2015). An evaluation of expected patterns of movement skill development was conducted using performance variation by age and sex. Inter- and intra-rater (n = 53, 34% female) objectivity and test-retest (n = 76, 45% female) reliability were assessed by trained study staff. Completion time had excellent evidence of objectivity for inter-rater (ICC = 0.99), intra-rater (ICC = 0.99 to 1.00) reliability, as well as reliability for short (2–4 days; ICC = 0.86) and long (>7 days; ICC = 0.82) test-retest interval comparisons. Skill score objectivity evidence was substantial for inter-rater (ICC = 0.65 to 0.67), intra-rater (ICC = 0.72 to 0.86) and long interval test-retest reliability (ICC = 0.74) (Longmuir et al., 2015).
Due to the protocol and format of the CAMSA, it is well-suited for assessment of FMS of large groups of children in a relatively short period of time, such as within a PE class. Therefore, the CAMSA could be utilised in the early stages of a Year 7 FMS unit. It could be used as a diagnostic assessment tool to generate information on the FMS proficiency level of students as they enter the secondary school system, and subsequently guide teaching. The CAMSA also has the potential to be used as formative assessment to enable the teacher to target specific needs and provide feedback throughout the learning process. The tool can also be used as a summative measure to identify whether teaching and learning objectives have been attained. With the capacity to facilitate all three types of assessment, the CAMSA could be considered an excellent enabler of assessment for learning.

Although the CAMSA shows potential as a valid, reliable and feasible assessment tool, further research is required. To date, all of the assessors or examiners used in trials have been researchers, all with extensive experience in movement skill analysis, rather than teachers. Furthermore, the participants have predominantly been enrolled in summer camps, rather than school-based settings such as PE classes. Therefore, further research is required to evaluate the feasibility and effectiveness of the CAMSA when it is administered by PE teachers in a school setting (Longmuir et al., 2015).

1.7 SUMMARY OF THE PILLARS OF EFFECTIVE TEACHING

In summary, the pillars of effective teaching are: curriculum design and implementation; content and pedagogy knowledge; learning environment; and assessment (Tannehill et al., 2013). Given
that FMS proficiency is low among children and adolescents, especially in girls’ object control skills, it appears that the current quality and provision of these pillars may be inadequate (Bailey, 2006; Ericsson, 2008; Hardy et al., 2013). It is important for teachers to understand the factors enabling and inhibiting students’ FMS developmental status, especially in regards to low-skilled girls. This allows teachers to accommodate for individual skill learning and development by conducting authentic assessment and integrating effective teaching within optimal environmental conditions (Goodway & Branta, 2003). Considering that the greatest influence on the learner is, in fact, the teacher (Hattie, 2003b; Hattie & Timperley, 2007), we should strive to produce high quality or ‘expert’ teachers by better equipping them with the knowledge, skills and confidence to improve the standard of FMS assessment and instruction.

1.8 IMPROVING THE EFFECTIVENESS OF PE TEACHING VIA TEACHER EDUCATION

The main pathways to improving PE teacher effectiveness are early-service education and in-service education or professional development (Penney et al., 2013).

1.8.1 PE teacher pre-service training

Pre-service teacher training is an important step in creating effective teachers (Webster et al., 2015). Effectively and safely teaching PE to students requires specific knowledge about children and their physical and mental development, body composition (i.e., anatomy) and function (i.e., physiology and biomechanics), and motor skills development and acquisition. As previously discussed, effective teaching also requires substantial knowledge and skill in pedagogy to effectively deliver the content (Webster et al., 2015). Therefore, exemplary pre-service
curriculums that are dynamic, engaging and empowering should produce capable and inspiring teachers who are well prepared to incorporate a diverse set of pedagogical strategies designed to enhance the quality of PE teaching in schools (Lee et al., 2007).

However, there may be a disconnect between what is taught in many pre-service programs and what is required in reality as a practising PE teacher in schools (Lander et al., 2015; Lee et al., 2007). Although it is important that future PE teachers understand the theoretical foundations of what they teach (National Association for Sport and Physical Education & American Heart Foundation, 2012), overemphasising theory in pre-service PE programs may come at the detriment of the practical application of teaching, thus diminishing the fundamental essence of PE (Johnson, 2013). Hastie et al. (2005) suggest that experience plays a critical role in the teacher’s ability and willingness to learn, as experience enables them to understand theory in practice and theory through practice. In fact, teachers are said to be more open to learning when they are immersed in an authentic environment, as they can take ownership of their learning, and relate and apply the new knowledge to a more meaningful context (Lee et al., 2007b).

Furthermore, a lack of real-life experience results in pre-service teachers relying on their own PE and sporting experience, which often centres on traditional skill-based approaches to teaching games, where skills are taught in isolation from the games context (Hastie et al., 2005). Thus, pre-service teachers are likely to retreat from student-centred approaches, which are more conducive to FMS learning for girls, and resort to less motivating, more controlling teacher-directed approaches to instruction (Azzarito et al., 2006; Brown & Rich, 2002; Hastie et al., 2005; Keay, 2007; McCaughtry, 2006; Rich, 2004).

Pre-service teacher education programs play a significant role in ensuring that teachers understand the theory behind effective PA and FMS programs in schools (Hart, 2005). However,
helping teachers evoke meaningful long-term behaviour change is likely to extend beyond what is provided in pre-service education (Webster, 2011). Thus, continuing professional development may promote ongoing teacher learning in authentic settings, and improve the instructional practices of teachers (Kulinna, 2012).

1.8.2 PE teacher professional development

In all educational settings, professional development for teachers and administrators should be a continuous process of acquiring new knowledge and skills, and it is essential for improving classroom instruction and student achievement. Indeed, there is a strong link between professional development, teacher learning and practice, and student achievement (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). This aligns with research on effective professional development, which illustrates that: (1) professional development enhances teacher knowledge and skills, (2) better knowledge and skills improve classroom teaching, and (3) improved teaching raises student achievement (Fishman, Marx, Best, & Tal, 2003; Guskey, 2002; Guskey & Sparks, 2004; McCaughtry, Mrtoōartin, Kulinna, & Cothran, 2006). The positive influence that teacher training or professional development programs have on teaching behaviour has been well established in several school disciplines (e.g., science, mathematics) (Hart & Lee, 2003). In addition, some promising results have emerged in student health outcomes after teacher training. For example, using Guskey & Sparks’ (2004) ‘model of teacher change’, Kulinna (2012) detected significant increases in students’ PA after their teacher underwent a one-year professional development program.

However, despite the correlation between teacher training and improved teacher instructional practices, the literature is fraught with concern surrounding the current state of professional
development in PE (Armour & Yelling, 2007). Indeed, a major barrier to implementing quality PE is the lack of appropriate teacher training (Bechtel & O’Sullivan, 2006). Professional development or in-service staff development has typically been haphazard and left primarily to local school districts, which often rely on personnel from within their districts or commercial entities. Rarely are these in-service programs evaluated for their long-term effectiveness (Dowda, Sallis, McKenzie, Rosengard, & Kohl, 2005). It is understood that professional development programs are more likely to improve teaching practices and student learning outcomes if they: are framed by theory, provide academic and pedagogy content, encourage a collaborative approach and active learning, are embedded within the role of a teacher, and occur over more than one day (Garet, Porter, Desimone, Birman, & Yoon, 2001). However, it is unclear what characteristics of teacher training or professional development in regards to the teaching of FMS are the most important in improving teaching and subsequent student outcomes in FMS. It is clear that while teachers are capable of making substantial improvements in student outcomes in PA and FMS, the nature and quality of teacher training in regards to FMS interventions is under-studied and, perhaps as a result, the value of teacher training is not widely understood.

1.9 CHAPTER SUMMARY

The importance of PA lies in the widely acknowledged health benefits to be gained. However, levels of PA among children are low, and decline further during adolescence, with the most marked decline noted in adolescent girls. Competence in a range of FMS can potentially prevent the decline of PA typical during adolescence. However, prevalence of skill competency is low
among children and adolescents, and is particular low in girls. Skills are not mastered via the maturation process alone, but rather are shaped via several environmental influences (e.g., support, feedback and opportunity to practise). Schools are in a position to combat low levels of skill and activity and, in schools, physical education teachers are an important influence on student learning. Systematic evidence has demonstrated the potential to improve FMS in children via school-based interventions, specifically those utilising a specialist or highly trained PE teacher. However, current knowledge on FMS intervention effectiveness in the adolescent population is limited, and those targeting early-adolescent girls even more so. Furthermore, despite the focus of FMS in PE curriculums worldwide, the apparent gender disparity in FMS indicates that the current approach to FMS instruction and assessment by PE teachers in schools fails to address the motivational needs of female students. Subsequently, many girls transition into Year 7 without the skills necessary to participate confidently in high school PE or engage successfully and confidently in PA.

1.10 THESIS AIMS

In light of the above discussion, the aim of this thesis by publication was to synthesise existing evidence and generate new knowledge in regards to FMS improvement in early-adolescent girls. Specifically, this thesis aimed to: investigate key characteristics of teacher training in effective school-based PA and FMS interventions; explore the current approaches to FMS teacher assessment and instruction of early-adolescent girls; test the feasibility, validity and reliability of a newly developed FMS instrument; and promote FMS proficiency in early-adolescent girls by improving the quality of assessment and instruction provided to them.
Each of the five publications included as part of this thesis reports on a specific aim, as outlined below:

1. To investigate the type and quantity of teacher training in school-based physical education PA and/or FMS interventions, and to identify what role teacher training had on the intervention outcome.

2. To examine PE teachers’ perceptions of: (i) the importance and relevance of teaching FMS to Year 7 girls; and (ii) the factors influencing effective FMS instruction.

3. To explore whether the CAMSA is a feasible FMS assessment instrument for teachers of Year 7 girls in an Australian school-based PE context.

4. To compare the test-retest reliability and concurrent validity of the CAMSA with a commonly used FMS assessment instrument, the Victorian FMS Assessment (Department of Education Victoria, 1996), developed to be used by teachers in a PE setting.

5. To investigate whether an intervention focusing on teacher training in and teacher delivery of authentic assessment (i.e., the CAMSA) coupled with student-centred pedagogy (i.e., SAAFE teaching principles) across a 12-week PE program can improve the FMS proficiency of Year 7 girls.
The first thesis aim was investigated in this study: To investigate the type and quantity of teacher training in school-based physical education PA and/or FMS interventions, and to identify what role teacher training had on the intervention outcome.

The outcomes of this study have been previously accepted and published in the paper:


doi:10.1007/s40279-016-0561-6

Pre-service teacher education programs play a significant role in preparing teachers to deliver effective PA and FMS programs in schools. However, helping teachers evoke long-term behaviour change extends beyond what is provided in pre-service education. Thus, there is a clear need for continuing professional development to promote ongoing teacher learning and improve teaching practices. The positive influence that teacher training programs have on teaching behaviour has been well established in several school disciplines (e.g., science, mathematics). Despite the correlation between teacher training and improved instructional practices, the literature is fraught with concern surrounding the current state of professional
development in PE. Furthermore, the quality of teacher training in school-based PA and FMS interventions has received little attention, and research on the impact of the nature and quality of teacher training in PE interventions targeting FMS and PA is largely absent from the literature. Therefore, the aim of this systematic review was to explore characteristics of teacher training used in school-based PE interventions in PA and/or FMS, and to investigate the importance of teacher training on these outcomes. In addition, the review aimed to identify whether there is a link between certain teacher training characteristics and FMS and/or PA improvement. The findings of this study provided an evidence-based framework for the structure, design and delivery of the teacher training component of a randomised controlled trial (RCT) (Chapter 5).
AUTHORSHIP STATEMENT

1. Details of publication and executive author

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3. HDR thesis author’s declaration

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<td>Improving early-adolescent girls’ fundamental movement skills</td>
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I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.

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<td>Philip Morgan: University of Newcastle</td>
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<td>Jo Salmon: Deakin University</td>
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Characteristics of Teacher Training in School-Based Physical Education Interventions to Improve Fundamental Movement Skills and/or Physical Activity: A Systematic Review

Natalie Lander1 · Narelle Eather2 · Philip J. Morgan3 · Jo Salmon3 · Lisa M. Barnett1

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Abstract
Background Fundamental movement skill (FMS) competence is positively associated with physical activity (PA). However, levels of both FMS and PA are lower than expected. Current reviews of interventions to improve FMS and PA have shown that many school-based programs have achieved positive outcomes, yet the maintenance of these interventions is variable. Teachers play a central role in the success and longevity of school-based interventions. Despite the importance of teacher engagement, research into the nature and quality of teacher training in school-based PA and FMS interventions has received little attention.
Objective The aim of this systematic review was to investigate the type and quantity of teacher training in school-based physical education PA and/or FMS interventions, and to identify what role teacher training had on the intervention outcome.
Methods A systematic search of eight electronic databases was conducted. Publication date restrictions were not implemented in any database, and the last search was performed on 1 March 2015. School physical education-based interventions facilitated by a school teacher, and that included a quantitative assessment of FMS competence and/or PA levels were included in the review.
Results The search identified 39 articles. Eleven of the studies measured FMS, 25 studies measured PA and three measured both FMS and PA. Nine of the studies did not report on any aspect of the teacher training conducted. Of the 30 studies that reported on teacher training, 25 reported statistically significant intervention results for FMS and/or PA. It appears that teacher training programs: are ≥ 1 day; provide comprehensive subject and pedagogy content; are framed by a theory or model; provide follow-up or ongoing support; and measure teacher satisfaction of the training, are more effective at improving student outcomes in FMS and/or PA. However, the provision of information regarding the characteristics of the teacher training was largely inadequate. Therefore, it was difficult to ascertain which teacher training characteristics were most important in relation to intervention effectiveness.
Conclusion It is clear that whilst teachers are capable of making substantial improvements in student outcomes in PA and FMS, the findings of this review suggest the teacher training component of school-based PA and/or FMS interventions is not only under-reported but is under-studied, and, perhaps as a result, the value of teacher training is not widely understood. What remains unclear, due to poor reporting, is what role teacher training is having on these outcomes.

Electronic supplementary material The online version of this article (doi:10.1007/s40279-016-0561-6) contains supplementary material, which is available to authorized users.

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1 Introduction

Regular physical activity (PA) is associated with a large number of physical, psychological, and social health benefits for young people [1–3]. It is recommended that adolescents accumulate 60 min or more of moderate to vigorous physical activity per day, yet 80% of adolescents fail to meet this [4–6]. Furthermore, PA declines with age, especially throughout adolescence [7]. Thus, we need to know more about factors associated with low levels of PA and what prevents and motivates participation in PA [8–10]. A well-documented correlate of PA in young people is proficiency in fundamental movement skills (FMS) [11]. FMS are typically classified into ‘object control skills’ (catching and throwing), ‘locomotor skills’ (running and jumping), and ‘stability skills’ (balancing and twisting) [11–13]. Competency in a range of FMS in childhood has been found to be a predictor of PA in adolescence [14]. However, many children fail to meet FMS proficiency level benchmarks [15–18]. As there is strong evidence for a positive association between FMS competency and PA in children and adolescents [11, 19], low FMS proficiency in children may negatively impact on their potential to be physically active in adolescence and adulthood.

School, via the curriculum, ethos, and community has been widely acknowledged as an ideal setting in which to provide PA opportunities, educate students about the importance of PA [20], and provide an important avenue for the delivery of health promotion programs [21]. The Health and Physical Education (HPE) curriculum is considered the focal point for PA promotion and FMS development in the school setting [22]. Indeed, school-based HPE programs have the potential to improve FMS proficiency and slow the age-related decline in PA in students [23, 24]. As such, these outcomes have been the focus of numerous school-based interventions, and multiple associated systematic reviews, and although not all school-based interventions have had positive outcomes [24], many interventions have been generally successful, showing small to moderate effect sizes in PA and/or FMS [25–27]. Furthermore, the variability in these intervention outcomes does not change the need to understand the characteristics and effects of teacher training in such interventions, as it is important to identify what sort of teacher training is most effective, in order to design the most effective FMS/PA interventions.

Few school-based FMS and/or PA studies have conducted follow-up assessments, however, to identify the long-term impact of the interventions [28]. The ultimate goal of an intervention that aims to change behavior and improve outcomes should be maintenance [28]. Interventions that prove to be effective in the long term should arguably be better suited for widespread scalability and translation and therefore influence policy decisions, government spending, and ultimately the health of children and adolescents as they progress to adulthood [28].

The sustainability of a school-based program depends on the extent to which the teachers continue to implement the program [29]. A recent meta-analysis of over 800 students demonstrated that teaching quality is the strongest school-related factor in improving student learning and achievement [30]. The majority of school-based PA programs utilize existing teachers to deliver interventions [24, 31]. Therefore, identifying factors that encourage the sustained implementation of school-based interventions facilitated by existing teachers is a necessary step in understanding and orchestrating the long-term change process required for school-based PA and/or FMS programs to be successful [32].

Pre-service teacher education programs play a significant role in ensuring teacher readiness with regard to delivering effective PA and FMS programs in schools [33, 34]. However, helping teachers evoke long-term behavior change extends beyond what is provided in pre-service education [32]. Thus, there is a clear need for continuing professional development to promote ongoing teacher learning and improve teacher instructional practices [35, 36]. The positive influence that teacher training or professional development programs have on teaching behavior has been well established in several school.
disciplines (e.g., science, mathematics) [37–39]. Despite the correlation between teacher training and improved teacher instructional practices, the literature is fraught with concern surrounding the current state of professional development in physical education (PE) [40, 41]. Indeed, a major barrier to implementing quality PE is the lack of appropriate teacher training [42].

The quality of teacher training in school-based PA and FMS interventions has received little attention [43]. Similarly, research on the impact of the nature and quality of teacher training in PE interventions targeting FMS and PA is largely absent from the literature [24, 28]. There is some evidence, with regard to broader teacher education, that professional development efforts that are guided by, provide both academic subject matter as well as pedagogy content, encourage a collaborative approach and active learning, are embedded within the role of a teacher, and are sustained and intensive, are more likely to result in improving teaching practices and improving student learning outcomes [44]. Therefore, the aim of this systematic review was to explore characteristics of teacher training used in school-based PE interventions in PA and/or FMS, and to investigate the importance of teacher training on these outcomes. The specific objectives of the evidence synthesis were to describe the following teacher training characteristics: the dose of training received; the modality of training; the model or theory used in the training; the characteristics of the trainer or facilitator and the trainee; trainee satisfaction with the program; and fidelity to the prescribed teaching practice. In addition, the review aimed to identify whether there is a link between certain teacher training characteristics and FMS and/or PA improvement.

2 Methods

The conduct and reporting of this review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [45].

2.1 Inclusion Criteria

2.1.1 Types of Participants

Target groups were comprised of:

1. Primary/elementary (approximately 5–12 years of age), middle (approximately 12–14 years of age), and/or secondary school (12–18, or 14–18 years of age in areas with middle school) students.
2. Typically developing children or adolescents, which could include overweight or obese, or disadvantaged students.

2.1.2 Types of Interventions

Studies were included if:

1. The intervention was school-based (primary, middle, or secondary) or curriculum-based, and conducted or facilitated by a school teacher within PE.
2. A component of the intervention targeted physical activity and/or FMS improvement.
3. Quantitative assessment or analysis of FMS competence and/or PA levels was a primary or secondary outcome of the study.
4. The study design included an experimental or quasi-experimental randomized controlled trial (RCT).

2.2 Exclusion Criteria

Studies identified through the literature search were excluded if:

1. They were conducted in school but not in PE (e.g., after-school program, recess or lunchtime).
2. They were conducted in PE but not by a teacher employed by the school (e.g., intervention was facilitated by a member of the research team, or an external specialist employed specifically to facilitate the intervention).
3. Target participants were from special populations (i.e., developmental delay).
4. Interventions were conducted in early childcare, preschool, kindergarten (prior to school), or at university.
5. They were unpublished reports, conference papers, or dissertations.
6. They were not published in the English language.

2.3 Information Sources and Search

2.3.1 Study Selection

Relevant studies were identified by means of electronic searches on EBSCOhost and Informit and scanning reference lists of included articles. The EBSCOhost platform supplied access to: MEDLINE, PsycINFO, Scopus, ERIC, Education Source, Education Research Complete, and SPORTDiscus databases. On the Informit platform the health and education categories were searched. Each of the databases was searched independently. Publication date restrictions were not applied in any search, and the last search was conducted on 1 March 2015.

Search strategies used in the databases included combinations of key search terms, which were divided into four concepts: (1) setting (School* OR "secondary college" OR "secondary education" OR “primary education” OR...
“elementary education” OR “elementary school” OR “primary school” OR “middle school” OR “secondary school” OR “high school”); (2) study design (Intervention* OR program* OR strategy* OR trial* OR experiment* OR “Random Control Trial” OR “quasi-experimental”); (3) intervention type (“Physical*” OR “N2 active*” OR “physical education” OR “fundamental movement skill*” OR “fundamental motor skill*” OR “movement skill*” OR “motor development”); (4) facilitator (Teacher OR Educator OR Leader OR Instructor). Boolean searches were also carried out using “AND” and “OR” to combine concepts. MEDLINE and Informit were searched separately as they have different limitations (e.g., Informit does not allow OR truncations in phrases).

Following the initial search, the first author (NL) removed all duplicates and screened the titles and abstracts. Only articles published or accepted for publication in peer-reviewed journals were considered. A second author (NE) checked decisions, and any disagreements were resolved by discussion and collaboration with a third author (LMB). Full-text articles were further evaluated separately for relevance by two authors (NL and NE) and labeled ‘yes’, ‘no’, or ‘maybe’. The reviewers conferred and, following discussion on any inconsistencies, agreement was reached on all articles. The reference lists of included articles were scanned to identify additional relevant articles.

### 2.3.2 Data Collection Processes

One author (NL) extracted study data relating to the general characteristics of each study (i.e., author, date, study name, country, sample, study design, intervention design and duration, behavioral theories, and measures and outcomes); and the teacher training characteristics (i.e., reporting of teacher training, dose of training, model, theory or framework used in teacher training, trainee characteristics, trainer and trainee characteristics, trainer satisfaction with training, and fidelity of teaching).

### 2.3.3 Risk of Bias

Each of the included studies was independently analyzed by two reviewers (NL and NE) using a standardized process adapted from the Consolidated Standards of Reporting Trials Statements and previously used quality criteria [24] to obtain consistent data across all studies (Table 1). As recommended by the PRISMA statement, these items were not numerically summarized to provide final scores, instead each criterion was considered in isolation. Initial agreement between raters was high (95%). Differences in risk of bias assessment were firstly discussed between NL and NE, and then any unresolved differences at this point were discussed within the group of five authors facilitated by author NL. Consensus was achieved on all included studies. Each item on the scale was coded as yes (Y) if ‘explicitly described and present’, no (N) if ‘absent’, or unclear (?) if ‘unclear or inadequately described’. Methodological ‘risk of bias’ scores are provided in Table 2.

### 3 Results

The initial search identified 5840 papers: 4884 via EBS-COhost, 283 via MEDLINE, and 673 via Informit. After removing duplicates and reviewing the titles and abstracts, 3911 were identified as being potentially relevant, and full-texts were then obtained. Of these, 3795 were excluded for not meeting one or more of the inclusion criteria. The search of reference lists from relevant papers and reviews yielded five more publications. 116 full-text articles were assessed for eligibility, 70 were subsequently excluded for several reasons (Fig. 1). This resulted in the inclusion of 46 publications, which covered 42 interventions. Seven papers described follow-up, protocol, process evaluation, and/or mediation analyses, so papers from a single study were combined and treated as one. The exception was McKenzie and Alcarnaz [46], as the authors reported on a different
<table>
<thead>
<tr>
<th>References</th>
<th>Randomization</th>
<th>FMS/PA measures</th>
<th>Blinded outcome assessment</th>
<th>Participants analyzed in allocated group</th>
<th>Covariates analyzed</th>
<th>Power calculations</th>
<th>Baseline characteristics</th>
<th>Drop out</th>
<th>Summary of results</th>
</tr>
</thead>
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<tr>
<td>Ahmed et al. [66]</td>
<td>✓ (but not clear on process)</td>
<td>✓</td>
<td>×</td>
<td>× (two schools excluded due to incorrect assessment)</td>
<td>✓</td>
<td>✓</td>
<td>✓ (for PA, not FMS)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
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<td>✓</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bakhtiari et al. [48]</td>
<td>✓ (but not clear on process)</td>
<td>✓</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Boyle-Holmes et al. [49]</td>
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<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cohen et al. [50]</td>
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<td>✓</td>
<td>✓ (at baseline)</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Docos et al. [64]</td>
<td>✓</td>
<td>✓</td>
<td>? (unclear on validity with age group)</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ericson [51]</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ (effect size)</td>
</tr>
<tr>
<td>Fairclough and Scnaton [60]</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
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<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Gao et al. [53]</td>
<td>✓ (but not clear on process)</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gorely et al. [69]</td>
<td>×</td>
<td>✓ (PA)</td>
<td>×</td>
<td>?</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Groenmaker et al. [82]</td>
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<td>×</td>
<td>?</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gref et al. [70]</td>
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<td>×</td>
<td>(ilateral jumping –fitness test, not FMS)</td>
<td>× (excluded if no FMS assessment)</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Harrison et al. [71]</td>
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<td>✓ (PA)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>How et al. [54]</td>
<td>×</td>
<td>✓ (PA)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓ (not described)</td>
</tr>
<tr>
<td>Jago et al. [55]</td>
<td>×</td>
<td>✓ (PA)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓ (described but too big dropout)</td>
</tr>
<tr>
<td>Jammer et al. [72]</td>
<td>×</td>
<td>✓ (PA)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kajaja et al. [56]</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
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<td>✓</td>
<td>✓</td>
<td>✓ (for some measures)</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lonsdale et al. [58]</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Luegko et al. [83]</td>
<td>✓ (but not described)</td>
<td>✓ (PA)</td>
<td>✓ (at baseline)</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
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<td>Blinded outcome assessment</td>
<td>Participants analyzed in allocated group</td>
<td>Covariates analyzed</td>
<td>Power calculations</td>
<td>Baseline characteristics</td>
<td>Drop out</td>
<td>Summary of results</td>
</tr>
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<td>--------------------------------</td>
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<tr>
<td>Magnusson et al. [59]</td>
<td>✓ (but not described)</td>
<td>✓ (PA)</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ (no dropout)</td>
<td>×</td>
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<tr>
<td>Maskell et al. [73]</td>
<td>✓ (but not described)</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>McKenzie et al. [46]</td>
<td>✓ (but not described)</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Michaud et al. [60]</td>
<td>✓ (but not described)</td>
<td>×</td>
<td>?</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Naylor et al. [74]</td>
<td>✓ (but not described)</td>
<td>×</td>
<td>×</td>
<td>?</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Neumark-Sztainer et al. [65]</td>
<td>✓ (but not described)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
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<tr>
<td>Pate et al. [75]</td>
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<td>✓</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Pieron et al. [84]</td>
<td>✓ (but not described)</td>
<td>× (reference provided)</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Sacchetti et al. [61]</td>
<td>✓ (but not described)</td>
<td>(PA)</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓ (PA)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sallis et al. [47]</td>
<td>✓ (but not described)</td>
<td>✓</td>
<td>×</td>
<td>× (had to have PA data)</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓ (described but only 62.1 % retention)</td>
</tr>
<tr>
<td>Sallis et al. [76]</td>
<td>✓ (but not described)</td>
<td>✓</td>
<td>✓ (at baseline)</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Siegrist et al. [62]</td>
<td>✓ (but not described)</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Simons-Morton et al. [85]</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>?</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Sollersted and Eijntjeson [77]</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>van Beurden et al. [78]</td>
<td>✓ (but not described)</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Verstraete et al. [79]</td>
<td>✓ (but not described)</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Webber et al. [80]</td>
<td>✓</td>
<td>✓</td>
<td>✓ (at baseline)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>× (just a reference)</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Zettervick et al. [63]</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>?</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

✓ explicitly described and present, × absent, ? unclear. FMS fundamental movement skills, PA physical activity.

* Data obtained from methods papers and follow-up paper.
outcome (i.e., FMS) from the original research conducted by Sallis and McKenzie [47], which was PA; therefore, McKenzie and Alcornaz [46] is included as an independent paper. The final review was conducted on 39 papers. An overview of study characteristics of the 39 eligible studies is presented in Electronic Supplementary Material Table S1.

Seventeen studies were published between 2010 and 2014 [48-64], 16 studies between 2000 and 2009 [65-81], and six studies between 1990 and 1999 [46, 47, 82-85]. Most of the studies were conducted in the USA and Australia. Six studies were conducted in secondary schools (i.e., grades 7–12) [54, 56, 58, 65, 72, 75], three in middle school (i.e., grades 6–8) [55, 76, 80], one study investigated both primary (i.e., kindergarten–grade 6) and secondary school [51], and the remaining 30 were conducted in the primary school setting. There were 23 randomized control trials [46-48, 50, 53-55, 57-62, 65, 66, 70, 73-76, 80, 82, 83], and 17 quasi-experimental studies [49, 51, 52, 56, 63, 64, 67-69, 71, 72, 77-79, 81, 84, 85]. The sample sizes ranged from four [52] to approximately 5106 [83].

Twelve of the 39 studies did not report a behavioral theory or model used to inform the intervention [48, 49, 52, 56, 60-63, 67, 77, 84, 85]. The remaining 27 studies included behavioral theories, with the most predominant being the socio-ecological model [50, 57, 66, 75, 76, 80] and the social-cognitive model [59, 65, 69, 71, 80, 82, 83]. Thirty-three studies had a duration of 12 weeks or more [46, 47, 49-51, 54-66, 69-72, 74-80, 82-85], five of the studies reported an intervention of less than 12 weeks [48, 67, 68, 73, 86], and one study did not report the intervention duration [52].

Eleven of the studies measured FMS [46, 48, 49, 51, 56, 63, 64, 67, 73, 77, 84]. Significant FMS outcomes were reported in all but one [73]. Another 25 studies measured PA [47, 52-55, 57-62, 65, 66, 68, 69, 71, 72, 74-76, 79, 80, 82, 83, 85]. Significant outcomes were reported in 18 of these, and non-significant outcomes were reported in
seven studies [52, 53, 55, 62, 65, 80, 82]. Three studies measured both FMS and PA [50, 70, 78].

3.1 Teacher Training Characteristics

Teacher training was not reported in almost a quarter of the studies (23%, 939) [48, 49, 52, 53, 63, 64, 67, 72, 77]. In one of these studies, it was reported that the teachers had received training prior to the intervention, yet no further teacher training detail was provided in the paper [49]. However, for eight studies, although new practices, content or pedagogy were implemented by the teacher as part of the intervention, teacher training was not reported. The remaining 30 studies did report some aspect of teacher training in the intervention, such as: (1) the dose of teacher training; (2) the model, theory or framework used in the teacher training; (3) the trainer and trainee, and their characteristics; (4) teacher satisfaction with the training; and (5) teacher fidelity in attending the training and delivering the training program (Tables 3, 4).

Of these studies, 25 achieved statistically significant intervention results for FMS and/or PA, yet the effect sizes, or actual changes in the intervention outcomes, were variable. Of the studies which reported a change in PA per day, four reported a change of >10 min per day [50, 57, 69, 83], one reported a change of 7 min per day [66], and five reported small/negligible change (5 min or less per day) [47, 59, 62, 65, 80]. The studies that reported on change in PA during PE reported changes ranging from an 8% [71] to a 23% increase [85]. Four studies reported a small (>10) total percentage increase in PA [68, 70, 75, 78], and two others reported changes in unique measures of PA e.g., 1.4 pentahedron hours [60] or step counts [74]. Of the five studies which reported FMS outcomes, two reported small effect sizes [51, 56], one reported a unit change of 4.9 [50], and two studies reported increases in total FMS of 21% [46] and 26% [78] (Table 4).

3.1.1 Dose of Teacher Training

For the purpose of this review, the ‘dose’ of training that the teacher received was divided into three components: (1) the duration of training, (2) the mode of training (i.e., face-to-face, written resources, follow-up or ongoing support, additional resources, other), and (3) the content of the training (i.e., subject content, pedagogical content). Of the 30 studies that reported teacher training in the intervention, 22 described all three components of the dose [46, 47, 50, 54–62, 65, 66, 70, 71, 74, 76, 78, 79, 82, 83]; however, the degree of detail presented in each category was highly variable. Eight of the studies did not report on one or more of the dose components when reporting on teacher training [51, 68, 69, 73, 75, 80, 84, 85]. Each component of the ‘dose’ of training is described in detail below.

The duration of the teacher training was reported in 24 of the 30 studies that reported teacher training [46, 47, 50, 54–62, 65, 66, 70, 71, 74–76, 78, 79, 82, 83, 85]. Of those, 16 studies reported a training duration of 1 day or greater [46, 47, 50, 55–57, 59, 61, 65, 66, 74–76, 78, 79, 83]. All but one of the 16 studies [85] showed significant intervention results. Seven studies reported teacher training of less than 1 day [54, 58, 60, 62, 71, 79, 82]. The shortest training duration was a 20-min briefing [58]. Two of the studies reported the training descriptively, rather than reporting actual training duration, i.e., ‘comprehensive’ (85); ‘intense entrance workshop’ [70].

The mode of training (i.e., face-to-face, written resources, follow-up or ongoing support, additional resources) was reported in all but four of the 30 studies [51, 68, 84, 85]. Twenty-one studies reported using multi-modal methods of training delivery, whereas five studies provided only a single mode [50, 54, 60–62]. Of the studies that used multi-modal delivery of teacher training, 81% [17] reported significant intervention outcomes. The most frequently used mode of teacher training was face-to-face (i.e., workshops or seminars), with only one study not using this method in their training [58]. The next most frequently used mode was written resources (e.g., electronic or print resource provision), with 19 of the 26 studies including this method [46, 55–59, 65, 66, 69–71, 73–76, 78, 79, 82, 83]. Nine of the 26 studies reported providing additional resources as part of their teacher training (e.g., activity tasks sheets, student workbooks, or activity bins) [55, 59, 66, 69, 71, 74, 76, 78, 83]. Ongoing or follow-up support (i.e., on-site visitations or consultation, or follow-up meetings) was reported by 12 of the studies [46, 47, 55, 57, 59, 65, 66, 75, 76, 79, 80, 83]. In addition, three of the studies provided ‘other’ support or incentives as part of their training delivery, which included financial support or the provision of relief teachers to allow teachers to attend training [46, 55, 82].

Only one of the 30 studies that reported teacher training did not report on the content (i.e., specific lesson content to be taught to students by teachers, and/or the recommended pedagogy to be used) of the teacher training program [85]. Ten of the 29 studies provided comprehensive information regarding teacher training content (i.e., both subject content and pedagogical content) [46, 47, 50, 55, 56, 70, 76, 78, 83] (Table 4). Of those ten studies, 90% reported significant intervention effects. Another nine of the 29 studies partially reported on content (i.e., either specific lesson content or pedagogy was omitted) [51, 54, 58, 68, 69, 71, 73, 80, 82], and ten studies only provided a brief statement of the training content (e.g.,
<table>
<thead>
<tr>
<th>References, country</th>
<th>Source of teacher training data (if not in outcomes paper)</th>
<th>Teacher training</th>
<th>Date of training</th>
<th>Mode</th>
<th>Detail</th>
<th>Model or theory</th>
<th>Trainer(s)</th>
<th>Trainer satisfaction</th>
<th>Fidelity of teaching</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-hamed et al. [66], Canada</td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face, written resources, ongoing support, additional resources</td>
<td>Brief</td>
<td>NR</td>
<td>AS/BC facilitators</td>
<td>Classroom teacher</td>
<td>NR</td>
<td>Self-report: daily PA log (type, frequency and duration of each activity undertaken with the class)</td>
<td>Teachers completed activity logs All but three schools were within 10% of the guideline of 150 min/week</td>
</tr>
<tr>
<td>Cohen et al. [59], Australia</td>
<td>Data obtained from Laban et al. [104]</td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face</td>
<td>Comp</td>
<td>Behavior change strategies Targeted constructs, social support</td>
<td>Researcher</td>
<td>Generalist classroom teachers</td>
<td>Yes</td>
<td>Direct observation: SCORER intervention checklist was used to determine teacher’s adherence to prescribed lesson structure</td>
</tr>
<tr>
<td>Ericson [51], Sweden</td>
<td>Partial</td>
<td>NR</td>
<td>NR</td>
<td>Partial</td>
<td>NR</td>
<td>MUGI model</td>
<td>PE subject and school health service</td>
<td>NR</td>
<td>NR</td>
<td>Teachers expressed that they achieved their planned objectives for each lesson</td>
</tr>
<tr>
<td>Faircloth and Sitton [68], UK</td>
<td>Partial</td>
<td>NR</td>
<td>NR</td>
<td>Partial</td>
<td>NR</td>
<td>First author</td>
<td>PE teachers with more than four years’ teaching experience</td>
<td>Yes</td>
<td>Direct observation: teacher behavior observed and coded using SOFFT to establish levels of PA, lesson context and teacher behavior</td>
<td>Teachers reported using the intervention resources in a variety of ways</td>
</tr>
<tr>
<td>Gortle et al. [69], UK</td>
<td>Partial</td>
<td>NR</td>
<td>Written resources, additional resources</td>
<td>Partial</td>
<td>NR</td>
<td>CD-ROM designed by an education specialist and a panel of PE and classroom staff (key stage 2 level)</td>
<td>Classroom teachers</td>
<td>Teachers were interviewed at mid-point and at the end of the intervention to establish their views on the program</td>
<td>Teachers reported using the intervention resources in a variety of ways</td>
<td></td>
</tr>
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</table>

**Table 3** Intervention teacher training characteristics
<table>
<thead>
<tr>
<th>Reference, source</th>
<th>Teacher training duration</th>
<th>Dose of training</th>
<th>Mode</th>
<th>Detail</th>
<th>Model or theory</th>
<th>Trainer(s)</th>
<th>Trainee(s)</th>
<th>Trainee satisfaction</th>
<th>Fidelity of teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gormaker et al. [82], USA</td>
<td>Yes</td>
<td>&lt;1 day</td>
<td>Face to face, written resources</td>
<td>Partial</td>
<td>NR</td>
<td>Planet Health Project staff</td>
<td>Classroom teachers and PE teachers</td>
<td>NR</td>
<td>Self-report: qualitative data—classroom teacher lesson evaluations</td>
</tr>
<tr>
<td>Graf et al. [78], Germany</td>
<td>Yes</td>
<td>Verbal description (intensive entrance workshop, and yearly follow-ups)</td>
<td>Face to face, written resources</td>
<td>Comp</td>
<td>NR</td>
<td>The CHILET team using materials from various health agencies</td>
<td>Teachers</td>
<td>NR</td>
<td>Informal observation: site visits to all schools to ensure all aspects were being applied as designed</td>
</tr>
<tr>
<td>Harrison et al. [71], Ireland</td>
<td>Yes</td>
<td>&lt;1 day</td>
<td>Face to face, written resource, additional resources</td>
<td>Partial</td>
<td>NR</td>
<td>Health promotion specialists, national education authorities, and primary school teachers</td>
<td>Non-specialist health educators</td>
<td>NR</td>
<td>Direct observation and self-report: schools visited once per fortnight to offer support and check compliance; implementation verified by checking completed workbooks</td>
</tr>
<tr>
<td>Howe et al. [56], Australia</td>
<td>Partial</td>
<td>&lt;1 day</td>
<td>Face to face</td>
<td>Partial</td>
<td>NR</td>
<td>NR</td>
<td>Four PE teachers</td>
<td>NR</td>
<td>Not reported</td>
</tr>
<tr>
<td>References, country</td>
<td>Teacher training</td>
<td>Date of training</td>
<td>Mode</td>
<td>Detail</td>
<td>Model or theory</td>
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<tr>
<td>Jago [55], USA</td>
<td>Training information obtained from McMurray et al. [106] Process evaluation data obtained from Schneider et al. [107]</td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Written resource, face to face, additional resources, ongoing support, other</td>
<td>Business training models that emphasize programs relevant to each specific school setting</td>
<td>Experienced PA coordinator, study staff and assistants</td>
<td>PE teachers</td>
<td>Overall yes</td>
<td>Direct observation: structured observations of a sample of PE classes at each school to assess delivery, intent and design of the HEALTHY lesson plans Self-report: structured interviews to record perceptions of the intervention and identify barriers and facilitators</td>
</tr>
<tr>
<td>Karaja et al. [56], Greece</td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources</td>
<td>Comp</td>
<td>Cooperative planning process</td>
<td>Team of academics</td>
<td>Four PE teachers</td>
<td>NR</td>
<td>Direct observation: one researcher observed every fifth lesson and compared class content with lesson plan Self-report: all teachers reported weekly to the researcher on lesson execution</td>
</tr>
<tr>
<td>Kienzler et al. [57], Switzerland</td>
<td>Partial</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, ongoing support</td>
<td>Brief</td>
<td>Program director and study organizers</td>
<td>Classroom teachers and PE teachers</td>
<td>NR</td>
<td>NR</td>
<td>The children and teachers enjoyed the intervention, which assured compliance</td>
</tr>
<tr>
<td>References, country</td>
<td>Teacher training</td>
<td>Dose of training</td>
<td>Model or theory</td>
<td>Trainer/s</td>
<td>Trainee/s</td>
<td>Trainee satisfaction</td>
<td>Fidelity of teaching</td>
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<tr>
<td>Lonndale et al. [58], Australia</td>
<td>Yes</td>
<td>&lt;1 day</td>
<td>Face to face, written resources</td>
<td>Partial</td>
<td>NR</td>
<td>Principal researcher</td>
<td>PE teachers</td>
<td>NR</td>
<td>Self-report: teachers' verbal communication was recorded in the baseline and post-intervention lessons using a wireless recording device</td>
</tr>
<tr>
<td>Laupker et al. [53], USA</td>
<td>CATCH-PE specific data obtained from McKenzie et al. [109]</td>
<td>≥1 day</td>
<td>Face to face, written resources, additional resources, follow-up</td>
<td>Comp</td>
<td>NR</td>
<td>CATCH-PE consultants</td>
<td>PE specialist teacher</td>
<td>Yes</td>
<td>Direct observation: process measures were developed to monitor implementation fidelity of the program</td>
</tr>
</tbody>
</table>

Follow-up outcome: reports from all study centers indicated staff modeled teaching techniques and lessons segments more often for classroom teachers than for PE specialist
<table>
<thead>
<tr>
<th>References, country</th>
<th>Source of teacher training data (if not in outcomes paper)</th>
<th>Teacher training Duration</th>
<th>Mode</th>
<th>Detail</th>
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<th>Trainers</th>
<th>Trainee(s)</th>
<th>Trainee(s) satisfaction</th>
<th>Fidelity of teaching</th>
<th>Measure</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnusson et al. [50], Iceland</td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face, written resources, additional resources, ongoing support</td>
<td>Brief</td>
<td>Professional learning community</td>
<td>Researchers and a PE expert</td>
<td>General classroom teachers and PE teachers</td>
<td>Yes</td>
<td>Self-report: each teacher kept a log of estimated PA and mean supervised activity was calculated. Researchers conducted semi-structured group interviews in all three intervention schools.</td>
<td>The estimated supervised PA in each school increased during school hours over the course of the study, but there was a drop in PA at the end of the study.</td>
<td></td>
</tr>
<tr>
<td>Maskell et al. [73], USA</td>
<td>Partial</td>
<td>NR</td>
<td>Face to face, written resource</td>
<td>Partial</td>
<td>NR</td>
<td>Primary investigator</td>
<td>PE teacher</td>
<td>NR</td>
<td>Direct observation: skill practice time was assessed on four days</td>
<td>The difference between experimental and control skill practice time was not significant.</td>
<td></td>
</tr>
<tr>
<td>McKenzie et al. [46], USA</td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face, written resource, follow-up, other</td>
<td>Comp</td>
<td>NR</td>
<td>University researchers, specialist PE teachers, trained generalist teachers</td>
<td>Classroom teachers and specialist PE teachers</td>
<td>Yes (mean satisfaction score of 4.83 out of 5)</td>
<td>Informal: trained PE teachers visited classrooms biweekly to provide ongoing support and observe lessons. PE specialists reviewed video tapes of their lessons frequently and received feedback on their instruction</td>
<td></td>
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</tr>
<tr>
<td>Michaud et al. [60], Canada</td>
<td>Yes</td>
<td>&lt;1 day</td>
<td>Face to face</td>
<td>Brief</td>
<td>NR</td>
<td>Researchers</td>
<td>Four PE teachers</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td></td>
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</tbody>
</table>
Table 3 continued

<table>
<thead>
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<th>Trainee satisfaction</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Naylor et al. [74], Canada</td>
<td>Training data and process evaluation data obtained from Naylor et al. [108]</td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, additional resources</td>
<td>Brief</td>
<td>NR</td>
<td>ASI BC support team</td>
<td>Teachers (primarily generalists)</td>
<td>Satisfaction with ASI BC training was assessed by a six-item questionnaire administered after all ASI BC led workshops. All intervention teachers also completed a feedback survey at the end of the study. Teachers were asked to indicate their satisfaction with resources (written and equipment) and support on a 5-point Likert scale (5 being highest)</td>
<td>Self-report; schools prepared action plans coded into action zones. Fidelity was assessed by comparing actual with prescribed PA</td>
<td>During phase I median compliance with activity logs ranged from 67 to 75%. During phase II, median compliance ranged from 94 to 100% across schools. Schools delivered two-thirds of the prescribed 15 min of additional daily PA</td>
<td></td>
</tr>
<tr>
<td>Neumann-Stritzner et al. [75], USA</td>
<td></td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, follow-up support</td>
<td>Brief</td>
<td>NR</td>
<td>Intervention coordinator and research team</td>
<td>PE teacher</td>
<td>NR</td>
<td>Ongoing contact with research staff to discuss lesson implementation</td>
<td>Direct observation: frequencies of primary activities were tallied. Process evaluation used to rank 12 schools as high or low implementers. Independent process evaluators observed PE classes and reviewed documentation of all intervention elements</td>
<td>LEAP criteria total (LEAP staff ratings of implementation of all LEAP components, and adherence to LEAP criteria for LEAP PE by teachers)</td>
</tr>
<tr>
<td>Pate et al. [75], USA</td>
<td>Training and fidelity data obtained from Ward et al. [110]</td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, follow-up support, additional resources, other</td>
<td>Facilitated approach</td>
<td>University-based project staff used two PE professionals</td>
<td>Teacher responsible for girls’ PE</td>
<td>NR</td>
<td></td>
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<tr>
<td>Table 3 continued</td>
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<td>References, country</td>
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<tr>
<td>Plewnia et al. [84], Belgium</td>
<td></td>
<td>Partial</td>
<td>NR</td>
<td>Informal collaboration between specialist PE teacher and classroom teacher</td>
<td>Principally centered on the child (behavioral problems, learning needs) rather than criteria or content for lessons</td>
<td>NR</td>
<td>Specialist PE teacher and classroom teacher</td>
<td>NR</td>
<td>Yes, but classroom teachers lacked competence</td>
<td>Direct observation: by “master” teachers (Phillips and Carello, 1993; Silverman 1988)</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Sacchetti et al. [61], Italy</td>
<td></td>
<td>Partial</td>
<td>≥1 day</td>
<td>Face to face, follow-up support</td>
<td>Brief</td>
<td>NR</td>
<td>Classroom teacher and PE teachers</td>
<td>NR</td>
<td></td>
<td>Direct observation: using SOPIT, the quality of teaching was monitored by videotapes of PE classes</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Sallis et al. [47], USA</td>
<td></td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face, written resources, additional resources, follow-up, school site visits</td>
<td>Comp</td>
<td>Structural-ecologic model</td>
<td>Intervention staff and three experienced PE teachers</td>
<td>PE specialists and classroom teachers</td>
<td>NR</td>
<td>Yes</td>
<td>Some components of the self-management lessons were not consistently implemented</td>
<td>NR</td>
</tr>
<tr>
<td>Sallis et al. [56], USA</td>
<td>Training information obtained from McKenzie et al. [111]</td>
<td>Yes</td>
<td>≥1 day</td>
<td>Face to face, written resources, additional resources, follow-up, school site visits</td>
<td>Comp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Direct observation: using SOPIT, simultaneous records of student activity levels and lesson context, and teacher behavior</td>
<td>NR</td>
</tr>
<tr>
<td>Siegrist [62], Germany</td>
<td></td>
<td>Yes</td>
<td>&lt;1 day</td>
<td>Face to face</td>
<td>Brief</td>
<td>NR</td>
<td>NR</td>
<td>Teachers</td>
<td>NR</td>
<td></td>
<td>An 18% increase in PA during PE classes was attained; boys increased about equally in PA in PE and out of PE, but girls increased their activity mainly through PE</td>
<td>NR</td>
</tr>
<tr>
<td>References, country</td>
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<td>Trainee(s)</td>
<td>Trainee(s) satisfaction</td>
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<tr>
<td>Simonis-Morton et al. [83], USA</td>
<td>Van Beuren et al. [78], Australia</td>
<td>Partial</td>
<td>Verbal description: “ample training”</td>
<td>NR</td>
<td>NR</td>
<td>Social-cognitive theory</td>
<td>GFH staff</td>
<td>PE specialists</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, additional resources</td>
<td>Comp</td>
<td>NR</td>
<td>Project staff</td>
<td>School principal, teachers, parents, the school’s pre-service teacher, a health worker, and any interested upper primary school students</td>
<td>NR</td>
<td>Direct observation: SOFIT was used to assess PA levels and lesson context</td>
<td>There was an increase in time spent skill training, but no significant change in time spent on instruction, a decrease in time spent on fitness, and a decrease in time spent on games compared to controls. During “fitness” there was a significant increase in %MVPA; during “skill” there was no change; during “game” there was a decrease in %MVPA</td>
<td></td>
</tr>
<tr>
<td>Versluijs et al. [76], Belgium</td>
<td></td>
<td>Yes</td>
<td>≥ 1 day</td>
<td>Face to face, written resources, follow-up support</td>
<td>Comp</td>
<td>NR</td>
<td>Research staff member with a Masters in PE and training in SPARK principles</td>
<td>PE specialists with more than 10 years’ teaching experience</td>
<td>NR</td>
<td>Direct observation: SOFIT was used to obtain information on student activity levels and lesson context</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>
## Table 3 continued

<table>
<thead>
<tr>
<th>References, country</th>
<th>Source of teacher training data (if not in outcomes paper)</th>
<th>Teacher training</th>
<th>Date of training</th>
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<th>Model or theory</th>
<th>Trainers</th>
<th>Trainees</th>
<th>Training satisfaction</th>
<th>Fidelity of teaching</th>
<th>Measure</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webber et al. [86], USA</td>
<td>Yes, NR, face to face, ongoing support, other</td>
<td>Partial NR</td>
<td>Researchers and project staff</td>
<td>PE teachers</td>
<td>NR</td>
<td>Direct observation; trained observers visited health and PE classes to determine extent to which lessons were fully taught and intervention concepts were addressed. Class-level PA in PE class was measured by SOFIT in a minimum of four PE lessons on three visits to each school each semester. Self-report questionnaires and interviews provided additional information, including use of TAAG materials, intervention acceptability, and number of TAAG programs.</td>
<td>Of the more than 300 observations of PE classes, TAAG strategies were observed in 66% (first year) and 68% (second year) of classes. Across schools and grades, 95% and 89% of health education lessons were taught in years 1 and 2, respectively, with 91 and 77% of grade 7 and 8 girls, respectively, receiving the lessons.</td>
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<thead>
<tr>
<th>References</th>
<th>Source of teacher training data (if not in outcomes paper)</th>
<th>Dose of training</th>
<th>Model or theory</th>
<th>Trainers/Teachers reported</th>
<th>Trainers' satisfaction reported</th>
<th>Fidelity of teaching reported</th>
<th>Study total</th>
<th>Significant intervention outcome</th>
<th>Change in PA/FMS (interpretation)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahamed et al. [66]</td>
<td>Training data obtained from Lahar et al. (2012) (186)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>6</td>
<td>6</td>
<td>Increase in PA: 47 min/week (7 min/day).</td>
</tr>
<tr>
<td>Cohet et al. [50]</td>
<td>Training data obtained from Lahar et al. (2012) (186)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>8</td>
<td>Improved overall FMS competency (4.0 units)</td>
<td>Increase in MVPA: 12.7 min/day (13 min/day)</td>
</tr>
<tr>
<td>Ericson [51]</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>0</td>
<td>Overall motor skill difference (Cramer's index = 0.24)</td>
<td>Increase in MVPA: 18.5 % vs. 13.5 % (5 % increase/day)</td>
</tr>
<tr>
<td>Faitheugh and Stratton [68]</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>4</td>
<td>4</td>
<td>Increase in total time MVPA: 19 min/day (19 min/day)</td>
</tr>
<tr>
<td>Gourley et al. [69]</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>3</td>
<td>3</td>
<td>Increase in MVPA: 9.1 % vs. 12.6 % (7 % increase/day)</td>
</tr>
<tr>
<td>Goorntoer et al. [52]</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>5</td>
<td>5</td>
<td>Increase in MVPA: 19.1 % vs. 12.6 % (7 % increase/day)</td>
</tr>
<tr>
<td>Graf et al. [70]</td>
<td>Fidelity data obtained from Graf [105]</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<td>5</td>
<td>5</td>
<td>Increase in MVPA: 19.1 % vs. 12.6 % (7 % increase/day)</td>
</tr>
<tr>
<td>Harrison et al. [71]</td>
<td></td>
<td>✗</td>
<td>✗</td>
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<td>✗</td>
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<td>Increase in PA: 4.84 per 30 min block/day (1 min/PE class)</td>
<td>Increase in mean MVPA in PE: 25.90 vs. 31.25 % (8 % increase/PE class)</td>
</tr>
<tr>
<td>How et al. [54]</td>
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<td>1</td>
<td>Increase in PA days per week: Hynh-Feldt's $F(2,78) = 2.77$ Increase in PA</td>
</tr>
<tr>
<td>Jago [55]</td>
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<td>Increase in PA days per week: Hynh-Feldt's $F(2,78) = 7.99$ (small effect size in FMS)</td>
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<tr>
<td>Kalou et al. [56]</td>
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<td>Increase in MVPA per lesson, proportion of lesson time: 36.47 % vs. 43.67 % (7 % increase/PE class)</td>
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<td>Increase in MVPA per lesson, proportion of lesson time: 36.47 % vs. 43.67 % (7 % increase/PE class)</td>
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<td>Increase in MVPA: 0.61 logged minutes (1 min/day)</td>
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<td>Marshall et al. [72]</td>
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<td>McKean et al. [46]</td>
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<td>7</td>
<td>7</td>
<td>Improved overall FMS: 21 %</td>
</tr>
</tbody>
</table>

* Change in PA/FMS (interpretation): Increase in PA/FMS indicates a positive effect on physical activity or fitness, whereas decrease in PA/FMS indicates a negative effect.
<table>
<thead>
<tr>
<th>References</th>
<th>Source of teacher training data (if not in evidence paper)</th>
<th>Dose of training</th>
<th>Model of theory</th>
<th>Trainee satisfaction reported</th>
<th>Fidelity of teaching reported</th>
<th>Study total of teacher training characteristics</th>
<th>Significant intervention outcome</th>
<th>Change in PA/PIES (interpretation?)</th>
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<td>Michaud et al. [60]</td>
<td>Training data and process evaluation data (obtained from Naylor et al. [109])</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Increase of 1.34 metabolic equivalents per week</td>
</tr>
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<td>Naylor et al. [109]</td>
<td>Training data and process evaluation data (obtained from Naylor et al. [109])</td>
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<td>✓</td>
<td>✓</td>
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Table 4 continued

<table>
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<th>Model or theory</th>
<th>Trainer affected</th>
<th>Trainee satisfaction reported</th>
<th>Fidelity of training reported</th>
<th>Outcome</th>
<th>Study total</th>
<th>Significant intervention outcome</th>
<th>Change in PAFMS (interpretation)</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>Duration ≥ 1 day</td>
<td>Mode (multi-modal)</td>
<td>Content detail (comprehensive: includes both subject and pedagogic content)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Webber et al. [80]</td>
<td>x x</td>
<td>x</td>
<td>x</td>
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</tr>
</tbody>
</table>

Teacher training characteristics, total (30 studies)

✓ explicitly described and present, x absent, FMS fundamental movement skills, PA physical activity, MVPA moderate to vigorous physical activity, PE physical education, MET the ratio of the work metabolic rate to the resting metabolic rate

* Interpretation, conversion of the actual change in outcome, to a more consistent and comparable measure
3.1.5 Teacher Fidelity to Training Program

Seven of the 30 studies did not report on the teachers’ fidelity in delivering the intervention [31, 54, 57, 60, 62, 85]. Of the 22 studies reporting on fidelity, nearly all (20/22) reported overall positive intervention outcomes. Ten studies used direct observation to determine teacher fidelity [47, 50, 59, 73, 75, 76, 78, 79, 83, 84], five used self-reporting [58, 66, 69, 74, 82], and five used both direct observation and self-reporting measures [55, 56, 68, 71, 80]. Three of the studies reported using informal methods, such as verbal feedback on incidental observation or collaboration following lesson implementation to enhance compliance to the intervention [46, 65, 70].

3.2 Risk of Bias in Studies

Table 2 displays the risk of bias for all studies. Five of the 39 studies clearly described randomization [50, 57, 58, 80, 82]. Nineteen studies reported randomization, but were not clear about the process [46, 47, 53, 59–62, 65–67, 70, 73–76, 78, 79, 83, 84]. The remaining 16 studies were not randomized. Four of the 39 studies did not use a valid measure of FMS and/or PA [52, 63, 74, 77], and an additional two studies were unclear [64, 84]. Six studies reported a blinded outcome assessment [50, 57, 58, 76, 80, 83], and one study was unclear [82]. Six studies reported that participants were analyzed in their allocated groups [50, 56–59, 73]. Thirteen of the studies were unclear [48, 49, 54, 60, 62–65, 67, 71, 78, 79, 85], and one did not provide any information [74]. Twenty-four of the studies accounted for covariates in their groups [46, 47, 49, 50, 54–59, 62, 63, 65, 66, 70–72, 75, 76, 78–80, 82, 83]. Seven studies reported a power calculation for FMS or PA outcomes [50, 55, 57–59, 61, 71]. Eleven studies presented baseline characteristics separately for treatment groups [46, 47, 50, 55, 57, 59, 61, 62, 65, 66, 71]. Drop-out was reported in 16 studies [46, 49, 50, 52, 56–59, 61, 62, 66, 71–73, 79, 83]. Summary results, effect size estimates and precision estimates were reported in 15 studies [49–51, 53, 57, 59, 62, 65, 66, 69, 71, 76, 78, 80, 82].

4 Discussion

The aim of this systematic review was to describe the characteristics of teacher training used in school-based interventions and identify which characteristics are common among studies that reported statistically significant, positive changes in PA and/or FMS. Specifically, this review investigated the dose of training received, the modality of training, the model or theory used in the teacher training, the characteristics of the trainer and trainee, trainee satisfaction with the training program, and the fidelity of the prescribed teaching practice in the intervention. In addition, the review aimed to identify whether there was a link between certain teacher training characteristics and FMS and/or PA improvement. Approximately one-quarter of the studies included in this review did not report on any aspect of the teacher training conducted, despite teachers facilitating the school-based FMS and/or PA intervention [48, 49, 52, 53, 63, 64, 67, 72, 77]. Therefore, for these studies it is not possible to determine the extent of the influence that teacher training had on intervention outcomes. This is an important finding, as it shows that future studies in this area should document teacher training characteristics to enable us to understand better the role of teachers in such interventions. Subsequently, it may have the potential to facilitate a clearer understanding of the specific teacher characteristics that improve the quality or effectiveness of teaching in PE [86].

Of the 30 studies that reported on teacher training in the intervention, 25 achieved statistically significant intervention results for FMS and/or PA. Although these figures appear promising, there was a high risk of bias in many of the studies. Indeed, most studies scored poorly for risk of bias items [87], particularly assessor blinding and randomization processes (Table 2). In addition, whilst the p value can inform the reader whether an effect exists, the p value will not reveal the size of the effect, or the meaningfulness or practical significance of the effect. Therefore, reporting effect sizes or similar is recommended [88]. Of the 30 studies that reported on teacher training, the actual changes reported in the intervention outcomes were variable. Furthermore, because there was considerable heterogeneity among interventions, in regards to the measuring, recording and reporting of PA intervention outcome effects (e.g., PA minutes per PE lesson, moderate-to-vigorous physical activity (MVPA) minutes per day, PA per episodes/blocks, logged PA) and FMS outcomes (i.e., multiple assessment instruments reporting on different aspects of FMS in different manners), it made the comparison of intervention effects difficult. However, in general, the changes in FMS outcomes were small to medium, and similar to that found in the review conducted by Morgan et al. [25], and the changes in PA outcomes were generally small, and reflect those commonly identified in other school-based PA interventions [26]. Interestingly, the SCORES intervention [50], an intervention which included eight of the nine teacher training characteristics being investigated in this review (Table 4), reported an increase of 13 min of MVPA per day, which is just under a quarter of the daily MVPA recommendations [4–6], and also reported an improved overall FMS competency of 4.9 skill components. Furthermore, the Middle School Physical Activity and Nutrition (M-SPAN) study [76] reported a
large effect size (d = 0.93) for PA in the total group, and again, eight of the nine teacher characteristics investigated in this review were reported. Although the changes in outcome of the other studies included in this review were generally conservative, the public health implications of these findings are important. As most young people participate in some form of regular school-based PE, it has a vital role to play in their development of FMS, and provision of PA. Indeed, PE is a critical medium for providing instruction and opportunity for practice, which is recognized as one of the most influential factors in FMS development [25]. Therefore, even small increases in MVPA and/or FMS during PE are positive. As such, it is essential that specialist PE teachers, and/or classroom teachers, are provided with extensive and ongoing professional development in the delivery of FMS and/or PA within PE, to enhance the effectiveness of these programs [25]. Furthermore, the FMS interventions appeared to have larger effects than the PA interventions, and nearly all FMS interventions had a significant effect, which suggests FMS PE based interventions may be more successful than PA PE interventions.

Moreover, of the 30 studies that did report on teacher training, minimal information was provided on the details of the training. For example, only eight of the 30 studies addressed all three elements of ‘dose’ (i.e., duration, mode, content). As the detail of information provided by each study varied, it was difficult to ascertain which aspects of teacher training were most important in relation to a positive FMS/PA outcome. Furthermore, there were significant differences in design, mode, duration, content, framework, trainee and trainer characteristics, which made comparisons between studies difficult. This further illustrates that without future effective documentation of the role of teachers in interventions we are unable to understand the contribution of teacher training in intervention outcomes.

The findings of this review did manage to highlight several areas of inadequacies in the quality of teacher training for school-based PA and FMS interventions. While there is agreement that no single approach to teacher training is effective for all teachers all of the time [40, 89], what is commonly acknowledged is that the quality of teacher training is critical to the desired outcome. If teachers receive well-designed, comprehensively integrated, and substantial training they can significantly increase student achievement [40, 90]. Conversely, if the professional development is brief, one-off, or fragmented, there is less likely to be a positive effect on student learning [91]. These inadequacies can be seen in both the design and delivery of the teacher training program, and also in the depth and consistency of the reporting of teacher training. Indeed, it is possible that the teacher training in these studies was inadequately reported, rather than inadequately conducted, and thus the actual quality of the teacher training may have been underestimated. This highlights the need for a consistent approach to teacher training design, delivery and reporting so we can better evaluate the intervention. The key concerns about the design and/or reporting of teacher training programs were: (1) the short durations; (2) lack of information on the provision of content, especially in regard to training the teacher in the pedagogy recommended in the intervention; (3) the lack of theory or framework included in the teacher training component; (4) lack of engagement between the teacher and interventionist, and the variable amount of follow-up or ongoing support provided throughout the intervention; and (5) the limited measure of teacher satisfaction. Each area of concern is expanded on below.

Over one-third of the studies that reported on the duration of teacher training reported less than one day of teacher training [54, 58, 60, 62, 71, 79, 82], with the shortest training being a 20-min briefing [58]. Ongoing teacher training is seen as a critical mechanism to facilitate teacher learning [36] and is viewed as central to improving education [88]. Professional development efforts that engage teachers for 1 day or more of learning have been shown to increase student achievement [92]. Indeed, in the current review 90% of the studies reporting a teacher training duration of one day or more had positive intervention effects. Conversely, if teacher training is not ‘sustained’ (often defined as being less than 1 day of training duration [93]), training may be insufficient, and will be less likely to support teachers or facilitate long-term behavioral change [36, 40, 41, 93]. Indeed, it has been demonstrated that the limited gains of MVPA in previous long-term studies could be partially attributed to inadequate investment in both personnel training programs and training time [55].

There was a considerable lack of information regarding the provision of content, especially in regard to training the teachers in the most effective or appropriate pedagogy to use when instructing the students in the intervention content. Indeed, less than one-third of studies provided comprehensive information on teacher training content (i.e., subject content and pedagogical content) [40, 47, 50, 55, 56, 70, 76, 78, 79, 83]. Of these few studies, nearly all reported positive intervention outcomes. Teachers are required to be highly qualified in the content area of the subject area in which they teach (i.e., high levels of content knowledge [CK]). However, expertise in content alone is inadequate. Effective teachers also possess a high level of pedagogical content knowledge (PCK), that being the skills and knowledge to successfully plan and implement a diversity of pedagogical approaches, which are dependent on individual student learning styles and developmental levels [94]. Importantly, the literature suggests that teachers who demonstrate high levels of both CK and PCK
achieve better FMS outcomes for their students [95, 96]. Thereby, teacher training programs must not only present the lesson content, but, importantly, should also provide teachers with the skills, knowledge, and competence to successfully plan and implement and adapt the most effective teaching approaches to achieve the intervention outcomes [94, 97].

Under one-quarter of the studies presented here integrated a model, theory or framework in the teacher training [50, 51, 55, 56, 59, 76, 85]. It is well recognized that the use of established theory is important to the successful design and development of behavior-change curricula and intervention. Indeed, a recent systematic review [28] highlighted that utilizing a theoretical model may produce a sustained impact in PA and should therefore be a priority in future PA research. However, specifics of how teacher training might incorporate theory in general, and motivational strategies in particular, were largely absent from the studies included in this review. Rink [98] suggests that all instructional methodologies are rooted in some form of learning theory and initiating any change process must involve some understanding of the theories that support it and subsequent assumptions about learning. Therefore, it is also essential to recognize the importance of incorporating theory into all aspects of project design, including teacher training.

Fewer than half of the studies provided ongoing or follow-up support (e.g., on-site visitations or consultation, or follow-up meetings) [46, 47, 55, 57, 59, 65, 66, 73, 76, 79, 80, 83]. This is consistent with a recent review of the sustained impact of PA and FMS interventions [28], which identified that many studies do not include post-intervention follow-up, support, training or consultation. Indeed, the absence of follow-up support may negatively influence the sustainability of a program in the school setting [28]. Teachers require approximately 130 h of engagement with a new intervention or concept, otherwise known as ‘active learning,’ to be able to transfer their learning to their own teaching context successfully [40]. Thus, maintaining face-to-face contact and providing teachers with opportunities to discuss implementation progress is essential in achieving intervention outcomes. Indeed, one of the most significant features of effective teacher training is the opportunity to reflect and collaborate [88, 93]. Furthermore, ongoing support can ensure the design and content of the program are constantly evolving to meet the specific needs of the teachers and school community, and thus can more successfully enable the ‘new’ approach to become embedded into usual teaching practice.

Few studies measured trainee satisfaction in the training program [46, 47, 50, 55, 59, 69, 74, 76, 83]. Of these studies, nearly all reported positive intervention results. To enhance teacher compliance with a program, teachers need to be satisfied with the content and context of the program [40]. Teachers engage more with program material when they perceive it to be practical and ‘hands on’, relevant and applicable [93, 99]. In contrast, if the teachers do not perceive the program to be challenging, thought-provoking, or providing ‘ideas’ and ‘practices’ they can use, they are less likely to value the program [93]. This highlights the importance of teacher collaboration in training program design, content and implementation. Specifically, to tailor programs to teachers and schools it is important to identify teachers’ needs before, and evaluate teacher satisfaction afterward, to determine how to improve or modify design iterations [92]. Furthermore, effectiveness of professional development should be measured not only at the level of teacher participation and satisfaction, but also at the level of the students with which the teachers interact [100]. For interventions to be truly effective, it is also important to consider the student voice, and to investigate the impact that advances in teacher learning have on student outcomes [100]. This enables the creation of teaching and learning processes, as well as outcomes, that are relevant and meaningful to both the teachers and the students [86].

It is clear that teachers play a central role in school-based PA/FMS intervention. However, their agency as effective facilitators will likely be determined, at least in part, by their perceptions, attitudes, and values of PA/FMS [32]. Although not investigated within the scope of this review, it is important to acknowledge the ‘value’ the teacher places on the teaching of PA and/or FMS within the scope of their role as a teacher, and understand that this will have an impact on the quality or effectiveness of their teaching [86, 100]. How teachers feel about playing a more active role in promoting PA or FMS arises from their personal experience as students, via pre service education, and importantly via ongoing professional development [32]. This emphasizes the important role that quality pre-service training, in conjunction with ongoing professional development, can play in preparing teachers to be effective teachers and advocates of PA and FMS in the school setting.

The majority of studies included in the review presented statistically significant intervention results in FMS and/or PA, which may have been due to publication bias [101]. Only four studies [55, 62, 73, 82] did not achieve statistically significant intervention results. Interestingly, in three of these four studies [62, 73, 82] the pedagogy, theoretical model and/or teacher satisfaction were not included. Furthermore, training duration in all three was either less than one day [62, 82] or not reported [73]. In-service training enhances teacher confidence, which leads to more complete implementation and, in some cases, enhanced student outcomes [102]. Therefore, the omission of integral teacher
training components in these three studies [62, 73, 82] may potentially have contributed to the null intervention results.

4.1 Strengths and Limitations

This review had several strengths, including a comprehensive search strategy across multiple databases with no date restrictions, extensive study detail extraction and broad inclusion criteria, high agreement levels for risk of bias, and alignment with PRISMA strategies. Limitations of the review included an English language requirement, and an inability to rule out publication bias.

5 Conclusions

It is clear from this review that both specialist PE teachers and highly trained classroom teachers are capable of making substantial improvements in student outcomes in PA and FMS. What remains unclear, largely due to poor reporting, is what role teacher training is having on these outcomes. Ongoing teacher training and support appears to be a key element of effective PE curricula and successful interventions [40, 47, 103]. However, given the variability of reporting of teacher training characteristics provided by articles in the present review, links between teacher training and student outcomes were difficult to trace. Despite this limitation, the findings of this review suggest the teacher training component of school-based PA and/or FMS interventions is not only under-reported but often under-studied, and perhaps as a result, the value of teacher training is not widely understood. In addition, the findings point to a few key considerations when designing teacher training programs in school-based PE interventions, specifically: (1) a ‘sustained’ teacher training component (i.e., one day or more); (2) a multimodal approach to teacher training delivery, with a focus on ongoing consultation; (3) comprehensive intervention content including pedagogy that translates the content into practice; and (4) viewing the measurement of teacher satisfaction and fidelity as essential design elements. Papers should clearly report on teacher training characteristics to better inform the design of future effective school-based interventions.

Compliance with Ethical Standards

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Conflict of interest Natalie Lander, Narelle Eather, Phillip Morgan, Jo Salmon, and Lisa Barnett declare that they have no conflicts of interest that are relevant to the content of this review.

References


## Supplementary Table 1: Basic intervention characteristics

<table>
<thead>
<tr>
<th>Reference, country</th>
<th>Sample</th>
<th>Study design</th>
<th>Intervention design</th>
<th>Intervention duration</th>
<th>Behavioural theories</th>
<th>Measures</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahamed et al. 2007 (66) Canada</td>
<td>n = 287 Primary school 9–11 years old Co-ed</td>
<td>RCT</td>
<td>Compared academic performance total score between Action Schools British Columbia (ASBC!) and control schools</td>
<td>16 months 15 min of additional PA per school day (75 min per week), in addition to 80 min of PE per week</td>
<td>Socio-ecological model Health promoting schools and comprehensive school health model</td>
<td>PA: PAQ-C</td>
<td>PA level in intervention schools increased by 47 min per week (13 ± 62 vs 92 ≤ 45, p &lt; 0.001) and maintained academic performance</td>
</tr>
<tr>
<td>Akbari et al. 2009 (67) Iran</td>
<td>n = 40 Primary school 7–9 years old Boys</td>
<td>Quasi</td>
<td>Traditional games program: warm up; traditional games (culturally appropriate); cool down Control: football, computer games and cycling</td>
<td>8 weeks 3 × 60 min sessions per week</td>
<td>NR</td>
<td>FMS: TGMD 2</td>
<td>Traditional games with a mean difference in FMS (17.12, p &lt; 0.001) were significantly more effective than daily activities in improving FMS</td>
</tr>
<tr>
<td>Bakhtiari et al. 2011 (48) Iran</td>
<td>n = 40 Primary school Mean 8.9 years old Girls</td>
<td>RCT</td>
<td>Selected exercises according to specific lesson plan: heating, cooling</td>
<td>8 weeks 3 × 45 min sessions per week</td>
<td>NR</td>
<td>FMS: TDMD-2</td>
<td>Intervention group showed significant difference in locomotor skill (8.433, p &lt; 0.05), manipulation skills (10.951, p &lt; 0.001) and overall motor development (13.203, p &lt; 0.001) than the control group</td>
</tr>
<tr>
<td>Boyle-Holmes et al. 2010 (49) USA</td>
<td>n = 1464 Primary school students Grades 4 and 5 Co-ed</td>
<td>Quasi</td>
<td>Compared impact of developmental PE curriculum (Michigan’s exemplary PE curriculum, EPEC) on PA levels, PA competence and physical fitness with students in existing PE curriculums</td>
<td>44 × 30 min lessons per grade (2 days per weeks)</td>
<td>NR</td>
<td>FMS: leap ( locomotor) and forehand strike (object control)</td>
<td>Significant increase in indicators of motor skill self-efficacy and PA levels</td>
</tr>
<tr>
<td>Cohen et al. 2015 (50) Australia</td>
<td>n = 460 Primary school 8.5 +/- 0.6 years old Co-ed</td>
<td>RCT</td>
<td>Supporting children’s outcomes using rewards, exercise and skills (SCORES) Multi-component PA and FMS intervention for children attending primary schools in low income community</td>
<td>12 months</td>
<td>Socio-ecological model Behavior change guided by self-determination and competence motivation theory</td>
<td>PA: SOFIT FMS: TGMD-2</td>
<td>The intervention improved daily MVPA (12.7 MVPA min/day), improved overall FMS competency (4.9 units) and increased cardio-respiratory fitness</td>
</tr>
<tr>
<td>Dobras et al. 2013 (64) Serbia</td>
<td>n = 255 Primary school Grades 6, 7 and 8</td>
<td>Quasi</td>
<td>Tested genuine motivational program in PE and assessed its contribution toward improvement of motor abilities and decrease in truancy</td>
<td>17 weeks (one semester) Two PE classes per week</td>
<td>Motivational climate</td>
<td>FMS: Milanovic 1981; Metikos 1989</td>
<td>Experimental group had significantly greater improvement in motor abilities than control and significantly less truancy</td>
</tr>
<tr>
<td>Study Description</td>
<td>Study Design</td>
<td>Sample Size &amp; Characteristics</td>
<td>Intervention Details</td>
<td>Outcome Measures</td>
<td>Findings</td>
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<tr>
<td>Ericsson 2011 (51) Sweden</td>
<td>Co-ed</td>
<td>$n = 263$ Primary and secondary school Years 1–9 Co-Ed</td>
<td>Quasi Longitudinal PEH was increased from two to three lessons per week and different local sports clubs had physical activities with the students’ two lessons per week, based on games and playful motor training Control: regular PEH two × 90 min lessons per week Treatment: PEH and physical activities five × 25 min lessons per week and one extra 60 min lesson if needed</td>
<td>9 years One motor training lesson every school day</td>
<td>The MUGI model of motor skills training Motor skill: MUGI check list – hand–eye coordination (throw and catch, bounce, obstacle course); balance ability and bilateral coordination (skip, hop on one leg, balance on one leg, involuntary movements) Students’ motor skills improved and differences in motor skills between boys and girls decreased After 1 year: intervention group had better motor skills than control. Difference rather large (Cramer’s index = 0.24). School year 3: the differences were very large (Cramer’s index = 0.37) and in year 9 the differences were even larger (Cramer’s index = 0.62) The intervention group had significantly higher marks in PEH than in the control group</td>
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<tr>
<td>Fairclough &amp; Stratton 2006 (68) UK</td>
<td>Quasi</td>
<td>$n = 62$ Primary school Grade 7 (11–12 years old) Girls</td>
<td>Teachers enhanced the PA levels of students Aim to increase cardio respiratory health by manipulating teachers’ behavior (i.e. pedagogical intervention)</td>
<td>6 × 2 h lessons</td>
<td>Effective pedagogical practice (Silverman, 1991) PA: direct observation Intervention students took part in significantly more MVPA than control (18.5% vs 13.5% of lesson time, $p &lt; 0.5$)</td>
<td></td>
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</tr>
<tr>
<td>Fogel et al. 2010 (52) USA</td>
<td>Quasi</td>
<td>$n = 4$ Primary school Grade 5</td>
<td>Compared the effects of regular PE classes and exergaming on PA Students rotated 9 stations (11 activities) every ~10 min</td>
<td>NR NR</td>
<td>PA: personal digital assistants programmed for data collection of duration of PA Exergaming provided more opportunity to engage in PA than standard PE program</td>
<td></td>
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<tr>
<td>Gao 2011 (53) USA</td>
<td>RCT</td>
<td>$n = 163$ Primary school Mean age 12.39 years, SD = 0.95 Co-ed</td>
<td>Investigated whether student motivational belief (self-efficacy and outcome expectancy), MVPA and persistence in PE classes varied as a function of learning activity (e.g. soccer vs fitness)</td>
<td>Four weeks 90 min per session</td>
<td>Self-efficacy theory PA: questionnaires and accelerometers Students exhibited higher MVPA in soccer classes than fitness classes Only self-efficacy significantly predicted MVPA, while both self-efficacy and outcome expectancy were predictors of persistence</td>
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<tr>
<td>Gorely et al. 2009 (69) UK</td>
<td>Quasi</td>
<td>$n = 589$ Primary school Mean age 8.1 years Co-ed</td>
<td>GreatFun2Run: multi-component intervention aiming to increase children’s PA and fruit and veg consumption through PE lessons Highlighted PA events and outreach to families</td>
<td>Ten months Two hours per week</td>
<td>Social-cognitive theory PA: pedometer Intervention schools increased total time in MVPA (by 9 min/day vs a decrease of 10 min/day), and their time in MVPA bouts lasting at least one minute (10 min/day increase vs no change).</td>
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<tr>
<td>Study Authors</td>
<td>Country</td>
<td>Sample Size</td>
<td>Study Type</td>
<td>Intervention Details</td>
<td>Duration</td>
<td>Outcome Measures</td>
<td>Positive Changes</td>
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<tr>
<td>Gortmaker et al. 1999</td>
<td>USA</td>
<td>1295</td>
<td>RCT</td>
<td>Planet health intervention (Teacher training, PE materials, wellness sessions and fitness funds)</td>
<td>Two years</td>
<td>Behavioural-choice theory, Social-cognitive theory</td>
<td>No statistically significant outcomes in PA were obtained. Changes in MVPA (hours/day) from baseline to follow up: Control: 2.44 (±0.03) Intervention: 2.44 (±0.10)</td>
</tr>
<tr>
<td>Graf et al. 2005</td>
<td>Germany</td>
<td>651</td>
<td>RCT</td>
<td>Children’s health interventional trial (CHILT) (Designed to promote a healthy lifestyle in primary schoolchildren)</td>
<td>20.8 ± 1.0 (19.1–22.6) months</td>
<td>Theory of planned behaviour, Precaution adoption process model (Weinstein, Rothman &amp; Sutton, 1998)</td>
<td>The increase in lateral jumps was significantly higher in IS than CS (p &lt; 0.001) The 6-min run distance was significantly improved in IS (p = 0.020) Overweight and obese children in both IS and CS had significantly poorer coordination and endurance than normal and underweight children (p ≤ 0.001)</td>
</tr>
<tr>
<td>Harrison et al. 2006</td>
<td>Ireland</td>
<td>312</td>
<td>Quasi</td>
<td>Switch off-Get Active aimed to increase PA and decrease screen time</td>
<td>16 weeks</td>
<td>Social-cognitive theory</td>
<td>Differences in self-reported PA (intervention + 0.84 30 min blocks/day, 95% CI 0.11–1.57, p &lt; 0.05) and self-efficacy for PA (p &lt; 0.05) but not for self-reported screen time (intervention −0.41 blocks/day, 95% CI = 0.93−0.12, p = 0.13)</td>
</tr>
<tr>
<td>How et al. 2013</td>
<td>Australia</td>
<td>257</td>
<td>RCT</td>
<td>Three separate 5-week units of netball, tennis and tee-ball. The intervention group chose between: (a) participating in the unit presented by their PE teacher, (b) acting as a “PE development officer”, or (c) planning and undertaking their own personal PA program</td>
<td>15 weeks</td>
<td>Self-determination theory</td>
<td>A lack of choice in PE aligned with less positive perceptions of autonomy support among students in the control group, compared with their counterparts in the intervention group In some choice formats, students exhibited significantly higher PA levels than students who undertook normal PE</td>
</tr>
<tr>
<td>Reference</td>
<td>n =</td>
<td>Setting</td>
<td>Study Design</td>
<td>Intervention Description</td>
<td>Follow-up</td>
<td>Outcome Measure(s)</td>
<td>Method of Measurement</td>
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<tr>
<td>Jago et al. 2011 USA</td>
<td>4063</td>
<td>Middle school; Grade 6 baseline assessment; post-assessment grade 8</td>
<td>RCT</td>
<td>HEALTHY intervention to improve: school food, PA, social marketing and PE</td>
<td>2.5 years</td>
<td>HEALTHY multicomponent intervention</td>
<td>PA: self-reported</td>
</tr>
<tr>
<td>Jamner et al. 2004 USA</td>
<td>47</td>
<td>Secondary school; Mean age 14.9 years</td>
<td>Quasi</td>
<td>FAB intervention, Participant-directed curriculum with one day per week devoted to PA and exercise</td>
<td>Four months</td>
<td>Self-efficacy, social support, perceived barriers, perceived benefits, and enjoyment of exercise</td>
<td>PA: self-reported</td>
</tr>
<tr>
<td>Kalaja et al. 2012 Greece</td>
<td>446</td>
<td>Secondary school; Grade 7 (~13 years old)</td>
<td>Quasi</td>
<td>Intervention aimed to increase student FMS via training in naturalistic PE classes</td>
<td>One year</td>
<td>NR</td>
<td>FMS: Flamingo test, rolling test, leaping test, shuttle run test, rope jumping test, accuracy throwing test, figure 8 dribbling test</td>
</tr>
<tr>
<td>Kriemler et al. 2010 Switzerland</td>
<td>502</td>
<td>Primary school; Grades 1 and 5</td>
<td>RCT</td>
<td>Multi-component PA program that added two PE lessons to the existing three per week, as well as adding short activity breaks and PA homework</td>
<td>One year</td>
<td>Socio-ecological model</td>
<td>PA: accelerometer</td>
</tr>
<tr>
<td>Study (Year)</td>
<td>Country</td>
<td>n</td>
<td>Study Type</td>
<td>Intervention Details</td>
<td>Duration</td>
<td>Principle</td>
<td>PA Method</td>
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<tr>
<td>Lonsdale et al. 2013 (58)</td>
<td>Australia</td>
<td>288</td>
<td>RCT</td>
<td>Classes were randomly assigned to one of four teaching strategies: (1) explaining relevance; (2) providing choice; (3) complete free choice; or (4) usual practice</td>
<td>3 months</td>
<td>Self-determination theory</td>
<td>Accelerometer</td>
</tr>
<tr>
<td>Luepker et al. 1996 (83)</td>
<td>USA</td>
<td>5106</td>
<td>RCT</td>
<td>This study examined the prevention of cardiovascular disease risk factors using school health behavior, food service, PE, and the CATCH classroom health curriculums</td>
<td>2.5 years</td>
<td>Organizational change</td>
<td>Self-report and direct observation</td>
</tr>
<tr>
<td>Magnusson et al. 2011 (59)</td>
<td>Iceland</td>
<td>320</td>
<td>RCT</td>
<td>Increased PA at school to a minimum of 60 min during school hours, utilizing PE, recess and PA integrated into various subjects. After the first year, an additional PE class, on top of two 40 min PE sessions per week and two swimming lessons taught over 6 weeks</td>
<td>2 years</td>
<td>Social-cognitive theory</td>
<td>Accelerometer</td>
</tr>
<tr>
<td>Martin et al. 2009 (81)</td>
<td>USA</td>
<td>64</td>
<td>Quasi</td>
<td>School A: mastery climate School B: low autonomy climate</td>
<td>Six weeks</td>
<td>Motivational climate (TARGET structures)</td>
<td>FMS: TGMD-2</td>
</tr>
<tr>
<td>Study</td>
<td>Sample size</td>
<td>Setting</td>
<td>Study design</td>
<td>Intervention</td>
<td>Duration</td>
<td>Outcomes</td>
<td>Findings</td>
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<tr>
<td>Maskell et al. 2004</td>
<td>n = 42</td>
<td>Primary school</td>
<td>RCT</td>
<td>Lessons followed a mastery goal orientation to accomplish four criteria of the overhand throw (TGMD-2) Intervention group: BrainGym warm up and other activities</td>
<td>Five weeks</td>
<td>Mastery goal orientation</td>
<td>The mastery group improved significantly while the low autonomy group did not</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td>Mean age 6.98 years Co-ed</td>
<td></td>
<td></td>
<td></td>
<td>FMS: TGMD-2</td>
<td>No significant pre- or post-group differences in the TGMD-2 scores</td>
</tr>
<tr>
<td>McKenzie et al. 1998</td>
<td>n = 709</td>
<td>Primary school</td>
<td>RCT</td>
<td>SPARK-PE: manipulative skill development as part of a larger study of the efficacy of an experimental health-related PE curriculum and professional development program Assessed effects of a professional development program on three manipulative skills Seven schools were randomly assigned to three treatments: PE specialists, trained classroom teachers, or control</td>
<td>Two years</td>
<td>SPARK-PE</td>
<td>In the fall baseline, boys scored higher than girls; 5th-graders scored higher than 4th-graders</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td>Grades 4 and 5 Co-ed</td>
<td></td>
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<td>FMS: overhand throw (ball to hit target), catch (ball tossed underhand), kick (stationary ball into target)</td>
<td>Gain scores were significant for catching ($p = 0.005$) and throwing ($p = 0.008$) Intervention effects did not differ by gender or grade; adjusting for condition, boys made significantly greater gains than girls</td>
</tr>
<tr>
<td>Michaud et al. 2011</td>
<td>n = 168</td>
<td>Primary school</td>
<td>RCT</td>
<td>To examine the impact of team pentathlon on girls’ and boys’ PA: 1. A 3-week baseline measure of PA for both intervention and control 2. A 5-week intervention program and weekly PA measures 3. A 2-week recess for both groups 4. PA measured for both groups</td>
<td>12 weeks</td>
<td>NR</td>
<td>Intervention students were significantly more active at the time of the pentathlon and three weeks after the intervention program</td>
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<tr>
<td>Canada</td>
<td></td>
<td>Grade 5</td>
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<td>PA: volume measured in pentathlon hours (developed for the study)</td>
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<tr>
<td>Naylor et al. 2006</td>
<td>n = 42</td>
<td>(teachers/classes)</td>
<td>RCT</td>
<td>Action Schools provided tools for teachers to create individualized action plans for: schools; scheduled PE; classroom action; family and community; extra-curricular</td>
<td>11 months</td>
<td>Action Schools BC (AS/BC)</td>
<td>After intervention and follow-up, groups 1 and 2 had significantly more ($p = 0.05$) PA min per week than the control group (group 3)</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td>Grades 4–6 (9–11 years old)</td>
<td></td>
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<td>PA: self-reported</td>
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<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Study Design</td>
<td>Data Collection</td>
<td>Time Frame</td>
<td>Intervention</td>
<td>Outcome Measures</td>
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<tr>
<td>Neumark-Sztainer et al. 2010 (65) USA</td>
<td>n = 201</td>
<td>Secondary school, Mean age 15.4 years, Girls</td>
<td>RCT</td>
<td>Five months</td>
<td>Social-cognitive theory</td>
<td>PA: self-reported</td>
<td>Girls in the intervention significantly progressed in their stage of behavioral change for PA from baseline to follow-up. Intervention group did more PA per week than control. Post intervention: Intervention group 6.21 hours PA per week, Control 5.87 hours PA per week, but not significant (p = 0.66)</td>
</tr>
<tr>
<td>Pate et al. 2005 (75) USA</td>
<td>n = 2744</td>
<td>Secondary school, Mean age 13.6 years, Girls</td>
<td>RCT</td>
<td>One year</td>
<td>Socio-ecological model</td>
<td>PA: self-reported</td>
<td>At follow-up, 45% of the girls in the intervention and 36% of the girls in the control reported vigorous activity 1 or more 30-min time blocks over a 3-day period</td>
</tr>
<tr>
<td>Pieron et al. 1996 (84) Belgium</td>
<td>n = 1131</td>
<td>Primary school, Grades k–6, Co-ed</td>
<td>Quasi</td>
<td>Three years</td>
<td>NR</td>
<td>FMS: 36 skills</td>
<td>At post-test, intervention group was better at catching, rotation and throwing than control (p = 0.05). However, the control group was better at handstand (p = 0.05)</td>
</tr>
</tbody>
</table>

Co-ed: Students and teachers assigned to either:
1. Champion school – given PE resources, initial training and support to champion teachers
2. Liaison school – given weekly contact with PE specialists
3. Usual PE curriculum

Teachers who received Action Schools! BC training and resources provided 55–67 min of PA per week than usual practice.
<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>School Level</th>
<th>Age</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Duration</th>
<th>Follow-Up</th>
<th>Control</th>
<th>Assessment</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Sacchetti et al. 2013</td>
<td>247</td>
<td>Primary school</td>
<td>8-9</td>
<td>Co-ed RCT</td>
<td>Intervention group: PA program with enhanced durations, intensity and frequency, as recommended by the International Guidelines and the European Heart Study, and Helena Study. Study targeted gym, classroom and school yard. Control: standard program of two 50 min PE lessons per week.</td>
<td>Two years</td>
<td>NR</td>
<td>PA: self-reported</td>
<td>The enhanced program improved physical ability and determining a decrease (boys: 10%, girls 12%). In daily sedentary activities (pre-intervention versus post-intervention, ( p &lt; 0.05 ); intervention versus control group, ( p &lt; 0.01 ))</td>
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<tr>
<td>Sallis et al. 1997</td>
<td>1538</td>
<td>Primary school</td>
<td>9.49–9.62</td>
<td>Co-ed RCT</td>
<td>SPARK</td>
<td>Two years</td>
<td>Three PE classes per week</td>
<td>SPARK</td>
<td>PA: direct observation</td>
<td>Specialist teachers spent more time in PE classes, provided students with more PA, and enhanced female students’ fitness. Specialist-led students participated in twice as much MVPA and expended twice as many calories during PE each week as control students. Teacher-led students were intermediate. Approximate improvement of MVPA of 3.69 (-6.01, 13.39)</td>
</tr>
<tr>
<td>Sallis et al. 2003</td>
<td>1109</td>
<td>Middle school</td>
<td>Grade 6 to middle school</td>
<td>Co-ed RCT</td>
<td>The middle school PA and nutrition (M-SPAN) study</td>
<td>Two years</td>
<td>Structural ecological model</td>
<td>PA: direct observation</td>
<td>The intervention caused significantly greater PA for the total group ( F[1.46] = 7.53, (p &lt; 0.009), ) with a large effect size ( (d = 0.93) ). Time by condition was significant for boys ( (p &lt; 0.001) ), but not girls ( (p &lt; 0.04) ). The intervention did not reduce total fat ( (p &lt; 0.91) ) or saturated fat ( (p &lt; 0.79) ). The intervention reduced body mass index of boys ( (p &lt; 0.05) )</td>
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<tr>
<td>Siegrist 2011</td>
<td>724</td>
<td>Primary school</td>
<td>8.4 ± 0.7</td>
<td>Co-ed RCT</td>
<td>JuvenTU</td>
<td>One year</td>
<td>10 × 45 min health-related lessons</td>
<td>Parents attended two and teachers attended three</td>
<td>PA: moderate to vigorous PA index</td>
<td>PA and physical fitness increased in intervention groups, but there were no significant effects. Approximate physical activity improvement in IS from 4.6 ±</td>
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</table>
School environments were altered to promote more PA health-related lessons

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Setting</th>
<th>Age at Baseline</th>
<th>Age at Follow-up</th>
<th>Program</th>
<th>Duration</th>
<th>Control Group</th>
<th>Interventions</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sollerhed et al. 2008 (77) Sweden</td>
<td>n = 132 Primary school Mean age 6–9 years at baseline; 9–12 years at follow-up Co-ed</td>
<td>Quasi</td>
<td>Increased allocated time for PE, from 1–2 40 min lessons per week to four lessons over four days On the 5th day, classes had outdoor physical activities with their classroom teacher for about 1 hour Obese children had the option of one extra voluntary lesson per week, with special attention paid to motor skills and self-esteem</td>
<td>Three years</td>
<td>NR</td>
<td>FMS: rope skip and ball bounce (developed for study) Physical performance Physical index: EUROFIT (1993)</td>
<td>Children in the I-school showed significant greater improvements in physical index than in the N-school (1.09 vs −1.19; ( p = 0.003 )), as well as in endurance performance (1.42 vs −1.16; ( p &lt; 0.001 )) and motor skill performance (0.57 vs −0.65; ( p = 0.010 )) Strength performance did not differ between the two schools Changes in BMI were significantly greater in the I-school than in the N-school (−0.32 vs 0.25; ( p = 0.033 ))</td>
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<tr>
<td>Simons-Morton et al. 1991 (85) USA</td>
<td>n = NR (4 schools) Primary school Grades 3 and 4 Co-ed</td>
<td>Quasi</td>
<td>Go for Health Teachers received PD in implementing the intervention Control school: regular PE curriculum</td>
<td>Three years</td>
<td>NR</td>
<td>PA: direct observation</td>
<td>The intervention significantly increased MVPA (( p = 0.05 ))</td>
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<tr>
<td>van Beurden et al. 2003 (78) Australia</td>
<td>n = 1045 Primary school Years 3 and 4 (7–10 years old) Co-ed</td>
<td>Quasi</td>
<td>MIGI Aimed to support teachers and create supportive environments and healthy school policies Included: school project teams, a buddy program, professional development for teachers, a project website, and funding for purchase of equipment</td>
<td>One year</td>
<td>Multi-strategic approach including all elements recommended by the Ottawa Charter for Health Promotion PA: direct observation FMS: Get Skilled: Get Active</td>
<td>The intervention delivered substantial improvements in every FMS for both genders (ranging from 7.2% to 25.7%; 13 of 16 comparisons were significant) The intervention was associated with a significant 3% increase in MVPA</td>
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<tr>
<td>Verstraete et al. 2007 (79) Belgium</td>
<td>n = 764 Primary school Mean age 11.2 +/- 0.7 years Co-ed</td>
<td>Quasi</td>
<td>Based on the SPARK program Focused on providing teachers with didactical guidelines to teach health-related PE and to increase children’s MVPA levels during PE lessons</td>
<td>Two years</td>
<td>SPARK PA: direct observation</td>
<td>MVPA engagement during PE was significantly higher in the intervention than control MVPA during PE increased by 14% in the intervention No significant effects were found on the accelerometer data</td>
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<td>Study</td>
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<td>Design</td>
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<td>Webber et al. 2008 (80) USA</td>
<td>n = 3504 (post-intervention)</td>
<td>RCT</td>
<td>Trial of Activity for Adolescent Girls (TAAG) targeted schools, community agencies, and girls to increase opportunities and incentives for increased PA. Components included: programs linking schools and community agencies, PE, health education, and social marketing. A third-year intervention used school and community personnel to direct intervention activities.</td>
<td>Two years</td>
<td>Operant learning theory, social-cognitive theory, organizational change theory, and the diffusion of innovation model in a socio-ecologic framework.</td>
<td>PA: direct observation</td>
<td>There were no differences (mean = −0.4, 95% CI = −8.2 to 7.4) in adjusted MET-weighted MVPA between intervention and control schools. Girls in intervention schools were more physically active than girls in control schools (mean difference 10.9 MET-weighted min of MVPA, 95% CI = 0.52–21.2), but this difference was only equivalent to about 1.6 min of daily MVPA or 80 kcal per week.</td>
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<tr>
<td>Zrnzevic et al. 2013 (63) Macedonia</td>
<td>n = 185</td>
<td>Quasi</td>
<td>Experimental program composed of athletic exercises, sports games, exercises on floor equipment, rhythms and dancing.</td>
<td>One year</td>
<td>NR</td>
<td>FMS: Various measure of motor abilities devised for the study (MTAP, MPOL, MS2M, MDPR, MBPR, MBAS, MKOP, MSDM, M3OV, MBMD, MVIS, MDNO, MDTR)</td>
<td>The intervention had a significant influence on all motor abilities. There was a significant intergroup differences in motor abilities between the intervention and the control (p = 0.000).</td>
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Co-ed, co-educational (both girls and boys); FMS, fundamental movement skills; MVPA, moderate to vigorous PA; n, sample size (number of students unless otherwise indicated); NR, not reported; PA, physical activity; PE, physical education; PEH, physical education and health; Quasi, quasi-experimental; RCT, randomized controlled trial.

AS!BC, Action Schools! British Columbia; CATCH-PE, Child and Adolescent Trial for Cardiovascular Health, Physical education program; CHILT, Children’s Health Intervention Trial; GFH, Go For Health; HEALTHY, multicomponent school-based, cluster randomized controlled trial on the physical activity, fitness and Met-S prevalence; LEAP, Lifestyle Education for Activity Program; M-SPAN, Middle School Physical Activity and Nutrition; MUGI, Motor Development as Ground for Learning [Motorisk Utveckling som Grund for Inlarning]; SCORES, Supporting Children’s Outcomes using Rewards, Exercise and Skills; SPARK, Sports, Pay and Active Recreation for Kids; TAAG, Trial for Active Adolescent Girls.
The second thesis aim was investigated in this study: To examine PE teachers’ perceptions of: (i) the importance and relevance of teaching FMS to Year 7 girls; and (ii) the factors influencing effective FMS instruction.

This study has been previously accepted and published in the following paper:


It was presented in Chapter 1 that children are developmentally able to master FMS by the end of Grade 4. Therefore, primary school PE should provide the ideal environment to assess, teach and improve these skills. However, many Australian students, especially girls, pass through primary school PE and the early developmental stages without mastering the critical threshold of FMS necessary for successful participation in PA and the sports-based curriculum typical of secondary school PE. The poor FMS competency observed among girls may be partially explained by socio-environmental factors (e.g., working parents, lack of PA opportunities and unsafe neighbourhoods), but may also reflect a failure of the ‘traditional’ approach to teaching PE.
The aim of this study was to establish a preliminary understanding of FMS instruction and assessment in early high school by examining PE teachers’ perceptions of the importance and relevance of teaching FMS to Year 7 girls, and the factors influencing effective FMS instruction. This study provided formative research of the perceived barriers and facilitators of effective FMS teaching for Year 7 girls.
# AUTHORSHIP STATEMENT

1. Details of publication and executive author

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<th>Publication details</th>
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<td>Physical education teachers’ perspectives and experiences when teaching FMS to early adolescent girls.</td>
<td><em>Journal of Teaching in Physical Education</em></td>
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<th>Name of executive author</th>
<th>School/Institute/Division if based at Deakin; Organisation and address if non-Deakin</th>
<th>Email or phone</th>
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<tr>
<td>Natalie Lander</td>
<td>Deakin: Organisation and address if non-Deakin</td>
<td><a href="mailto:nlander@deakin.edu.au">nlander@deakin.edu.au</a></td>
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2. Inclusion of publication in a thesis

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<th>If Yes, please complete Section 3 If No, go straight to Section 4.</th>
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3. HDR thesis author’s declaration

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If there are multiple authors, give a full description of HDR thesis author’s contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)

I contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscript for publication.

*I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.*

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4. Description of all author contributions

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<td>Jo Salmon: Deakin University</td>
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<td>Amanda Telford: RMIT</td>
<td>Supervision</td>
</tr>
<tr>
<td>Lisa Hanna: Deakin University</td>
<td>Qualitative analysis expertise</td>
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5. Author Declarations

I agree to be named as one of the authors of this work, and confirm: that I have met the authorship criteria set out in the Deakin University Research Conduct Policy, that there are no other authors according to these criteria, that the description in Section 4 of my contribution(s) to this publication is accurate, that the data on which these findings are based are stored as set out in Section 7 below. If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further consent to the incorporation of the publication into the candidate’s HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

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<td>Lisa Hanna</td>
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<td>Amanda Telford</td>
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6. Other contributor declarations

I agree to be named as a non-author contributor to this work.

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<th>Name and affiliation of contributor</th>
<th>Contribution</th>
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* If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author.

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

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Note. This article will be published in a forthcoming issue of the *Journal of Teaching in Physical Education*. The article appears here in its accepted, peer-reviewed form, as it was provided by the submitting author. It has not been copyedited, proofread, or formatted by the publisher.

**Article Title:** Physical Education Teachers’ Perspectives and Experiences When Teaching FMS to Early Adolescent Girls

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Abstract

**Purpose:** Competence in fundamental movement skills (FMSs) is positively associated with physical activity, fitness, and healthy weight status. However, adolescent girls exhibit very low levels of fundamental movement skill (FMS) proficiency. **Method:** In the present study, interviews were carried out with physical education teachers to investigate their perspectives of: (i) the importance and relevance of teaching FMSs to Year 7 girls, and (ii) the factors influencing effective FMS instruction. **Results:** There were two major findings in the data: Year 7 was perceived to be a critical period to instruct girls in FMSs; and current teaching practices were perceived to be suboptimal for effective FMS instruction. **Conclusion:** Apparent deficits in current FMS teaching practice may be improved with more comprehensive teacher training (both during physical education teacher education (PETE) and in in-service professional development) in pedagogical strategies, curriculum interpretation, and meaningful assessment.

**Keywords:** teaching effectiveness, physical education, fundamental movement skills
Fundamental movement skills (FMSs) are basic learnt movement patterns that generally do not occur naturally, and are suggested to be the foundations for more complex physical and sporting activities. They are typically classified into object control skills (e.g., catching and throwing), locomotor skills (e.g., running and jumping) and stability skills (e.g., balancing and twisting) (Gallahue, Ozmun, & Goodway, 2011; Ulrich, 2000). Developing competency in these skills may have important health implications for young people (Lubans, Morgan, Cliff, Barnett, & Okley, 2010), with positive associations established between FMS competence and physical activity and cardio-respiratory fitness, and an inverse relationship with weight status (Lubans et al., 2010).

Childhood is the optimal time to develop FMSs, and it has been suggested that by Year 4 students should have mastered all FMSs (Hardy, King, Epinol, Cosgrove, & Bauman, 2010). However, in Australia, the skill mastery of Year 6 students is less than 50% for the sprint run, vertical jump, kick, and overarm throw (Hardy et al., 2010). This trend is particularly marked in girls, with many not mastering object control skills even by adolescence (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010). Furthermore, several studies have found that boys are not only more proficient performing object control skills, but are also more active, fitter, and have a higher perception of their sport competence than girls (Barnett, Morgan, van Beurden, & Beard, 2008; Barnett et al., 2010, Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Seefeldt (1980) argued that a child who has not acquired basic fundamental skills is likely to experience a “proficiency barrier” or have difficulty learning context-specific or sport skills. As many Australian students transition into junior high school under-skilled in FMSs, especially girls, they are often ill-prepared for the predominantly sports-based junior high school PE curriculum (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010; Hardy et al., 2013; Goodway et al., 2010; Pill & Priest, 2009).
Physical education (PE) programs can help students develop FMSs (Martin, Rudisill, & Hastie, 2009); however, research suggests that primary (elementary) school PE is often ineffective, owing to a number of institutional and teacher-related barriers (Morgan & Hansen, 2007, 2008). Furthermore, there is beginning evidence that junior high school teachers are not aware of this problem, and if they are, they do not have the assessment, self-efficacy or capabilities to address the issue of low FMS proficiency in the Year 7 cohort (Lander, Brown, Barnett & Telford, 2015). Thus, skill deficits largely remain unidentified as students enter high (middle) school (Year 7, approximately 12 to 13 years of age), and opportunities to improve FMS may be missed (Ehl, Roberton, & Longendorfer, 2005; Lander et al., 2015).

To date, there has been little research on the FMSs of adolescents (Morgan et al., 2013) nor on FMS instruction and assessment in schools. Therefore, the aim of this study was to examine PE teachers' perspectives on: (i) the importance and relevance of teaching FMSs to Year 7 girls, and (ii) the factors influencing effective FMS instruction. This research is significant because it aims to confirm whether or not teachers are aware of the deficit in students' FMSs, and whether teachers have appropriate assessment and instruction knowledge and practices, and adequate motivation and intention, for improving FMSs. The results are intended to highlight the issue of low FMS in girls and as such, inform education policy, pre-service education and professional development.

**Method**

**Design**

As the purpose of the present study was to explore teachers’ perspectives of instruction and assessment of early adolescent girls’ FMSs, and to obtain formative descriptions of the ‘teacher
voice’, a qualitative descriptive approach was utilized (Sandelowski 2000). The research was approved by Deakin University Human Ethics (HEAC) in February, 2014.

Data collection

Twenty-five participants took part in semi-structured individual interviews. Participants were recruited from a quantitative on-line survey of Australian high school specialist PE teachers ($n = 168$) (Lander, Brown, Barnett & Telford, 2015). All participants were specialist PE teachers who had taught PE to Year 7 girls in the past five years (experience ranged from one to over 25 years). Catholic, government, independent, co-educational and all-girls schools from rural and metropolitan areas were represented (Table 1).

All interviews were conducted by the lead author either face-to-face ($n = 13$) or by telephone ($n = 12$). The diversity in participants and the multiple sites of data collection enhanced both source and location triangulation (Miles, Huberman, & Saldana, 2014). Interview questions and prompts were developed to guide the interview, clarify ambiguous statements, and encourage the interviewee to expand on their answers (Rubin & Rubin, 2005). Interviews ranged in duration from 18 to 45 minutes, and were audio-recorded and transcribed verbatim by the lead author to ensure consistency (DiCicco-Bloom and Crabtree 2006). ‘Member checking’ was performed during the interviews by summarizing and relaying participant information to establish accuracy (Miles, Huberman, & Saldana, 2014). Additionally, after the interviews, each participant was emailed their transcript and invited to comment and confirm accuracy. The lead researcher also kept written notes and a personal journal throughout the interview process to enhance confirmability (Shenton, 2004).
Data analysis

An inductive content analysis (Miles, Huberman, & Saldana, 2014) was performed to examine the data. A systematic data analysis process, with regular ‘peer debriefing’ sessions with the authorship team was conducted to generate categories and explanations, and thus produce the best qualitative evidence (Green et al., 2007; Miles, Huberman, & Saldana 2014). Firstly, interview transcripts were reviewed multiple times to facilitate data immersion (Hunter, Lusardi, Zucker, Jacelon, and Chandler 2002). Open coding was conducted on all interview transcripts. Descriptive labels were written in the transcript margins, prompting systematic judgements about each segment of text within the data set (Ryan & Russell, 2000). As the topics evolved, new codes were added and existing codes were revisited and refined to ensure depth and validity of the analysis process (Neuman, 2006). Thirdly, the researchers sorted the labels that shared ‘like’ values or relationships into clusters, creating categories, which facilitated interpretation of patterns (Green et al., 2007).

Results/Discussion

Two major categories and several subcategories were identified in the data, which are discussed below.

Year 7 – a critical time for FMS instruction

The first major category was that teachers identified Year 7 to be a critical period for FMS instruction. Three subcategories indicated the main justifications for this: low student FMS proficiency; the sports focus of secondary school PE curricula; and Year 7 girls’ attitudes to FMSs.

Low student FMS proficiency. The primary justification for teaching FMSs in Year 7 was that teachers were aware that many of their students had low levels of FMS proficiency, often due to the poor quality of primary school PE: “We can have up to 60 primary schools feeding into
Year 7; some have never had exposure to a specialist PE teacher, so come in with very low level skill” (Female teacher, Catholic girls’ school). Participants perspectives of low levels of FMS proficiency of Year 7 girls are congruent with findings of previous studies highlighting lower than expected FMS proficiency levels of students (Hardy et al., 2013), particularly girls’ object control skills (Barnett et al., 2010).

**The sports focus of secondary school PE curricula.** The second subcategory involved the predominantly sports-focused program of the secondary school PE curriculum. One teacher pointed out that “if [FMSs] are not addressed in Year 7 they rarely will, because the focus of the curriculum moves to sport strategy or games, rather than skill development in higher year levels” (Male teacher, Catholic girls’ school). According to Seefeldt (1980), children who cannot competently throw, kick or run are less willing and less likely to engage in sports, or in this case curriculum units, in which these skills are needed. Thus, Year 7 was seen as a critical time to remediate FMS deficiencies before students undertake more complex PE units.

**Year 7 girls’ attitudes to FMSs.** In the third subcategory, teachers recognized that the physical, social and emotional developmental stage of Year 7 girls meant they were still attitudinally receptive to skill development instruction. For example, one teacher observed that Year 7 girls are “still keen and enthusiastic” (Female teacher, independent girls’ school). In accordance with this receptiveness to learning FMSs, teachers identified Year 7 PE to be the last ‘window of opportunity’ for skill development. Although FMS interventions in junior high school are understudied, a recent systematic review (Morgan et al., 2013) identified only one school-based FMS intervention in adolescent girls (Kalaja, Jaakkola, Liukkonen, & Digelidis, 2012), which did improve FMSs. Therefore, interventions to promote FMS development in junior high school girls are recommended.
Suboptimal teaching practice

The second major category that was established from the data was that teachers felt their own teaching practices were not optimal for effective FMS instruction. Five key features of inadequate teaching emerged as subcategories, namely: curriculum interpretation and application; pedagogical strategies; assessment strategies; teacher competence; and the quality of FMS training teachers received. These will now be addressed in turn.

Curriculum interpretation and application. The vast majority of participants reported that if FMSs were not prescribed in the curriculum, they would not teach them. It was evident that many participants failed to interpret the curriculum or identify opportunities to enhance FMSs across the PE curriculum, and subsequently failed to meet the learning needs of their students. Without “specific curriculum criteria for FMSs” one teacher found it “very difficult to target teaching to skill development” (Female teacher, co-educational Catholic school). Effective teaching requires a sound knowledge of the curriculum, but, more importantly, demands the selection and design of creative and appropriate learning activities to foster learning outcomes set out by the curriculum (You, 2011). Therefore, skill in interpreting the curriculum determines the effectiveness of teaching (Tinning et al., 2001).

Pedagogical strategies. The ‘misperception’ of FMSs as a teaching approach emerged as another subcategory. The literature suggests that teachers who demonstrate high levels of both content knowledge and pedagogical content knowledge achieve better FMS outcomes for their students (Cohen, Goodway, & Lidor, 2012). Pedagogical content knowledge refers to the skills required to plan and implement diverse pedagogical approaches, which depend on individual student learning styles and development levels (Lieberman & Houston-Wilson, 2009). However, most participants in the current study used a predominantly teacher-centered approach when
teaching FMSs. While they recognized that this approach lacked creativity and often left the students disengaged, they persisted as they were not confident to attempt alternative methods.

“Students are not interested in skill development – the first question they ask is: when are we playing the game?” (Female teacher, independent girls’ school). Participants felt that when they integrated ‘game play’ into their classes the opportunities for skill development were reduced. However, it appears that the teachers in the current study were playing games ‘without a purpose’, and were therefore omitting skill development. Conversely, teachers with a deep understanding of game-centered pedagogy are capable of incorporating the teaching of skills in a game play context (Dudley & Baxter, 2009, 2013; Miller et al., 2015). Thus, teachers need to use a variety of evidenced-based approaches, incorporating a diversity of ‘instructional models’ (Gurvitch & Metzler, 2013) and ‘teaching strategies’ (Mosston & Ashworth, 2008), according to specific student needs, when teaching FMSs.

Assessment strategies. Another element of suboptimal FMS teaching was assessment. It is comprehensively agreed that assessment plays a critical role in effective teaching, by providing information to modify activities to better meet the needs of individual students (Black & Williams, 1998). Although many participants recognized the importance of assessment in teaching FMSs, assessment of FMSs was rarely conducted, and when it did take place it was conducted in a summative form only, that is, to produce a final grade. None of the participants reported using assessment ‘for’ learning, that is, for diagnostic or formative purposes as a means of enhancing learning (Black & Williams, 1998). The barriers to effective FMS assessment identified by the teachers included: a lack of specific FMS criteria to assess to or against; broad, sports-based assessment criteria; lack of teacher knowledge or insight; large student numbers; and short lesson time. One assessment (Canadian Agility and Movement Assessment, CAMSA) that addresses
these limitation has been recently developed in Canada (Longmuir et al., 2015) and tested for feasibility in an Australian school setting (Lander et al., 2015). The CAMSA was designed to more authentically measure the ‘real world’ skills required for sport and physical activity, such as catching then throwing while on the move (Longmuir et al., 2015). Such a measure may potentially provide a suitable FMS assessment for teachers of Year 7 girls.

**Teacher competence.** The majority of the teachers believed that low confidence in teaching practices was a central factor in their suboptimal FMSs instruction. Thus, teacher competence may largely underpin the overall effectiveness of FMSs programs. With confidence, “your passion for teaching and for the content comes through, and this is such a powerful motivator” (Female teacher, co-educational Catholic school). Indeed, effective teaching has been considered the single most powerful influence on student achievement in PE (Hattie, 2013; Bailey, 2006; Lee, Burgeson, Fulton, & Spain, 2007); therefore, enhancing teacher competence in FMS teaching should be a focus in future teacher training programs.

**Quality of FMS teacher training.** The deficits in teacher effectiveness in FMS instruction detailed here perhaps demonstrate insufficient teacher training. Teachers indicated that the FMS training they had received did not sufficiently equip them with the skills, knowledge or confidence to teach FMSs effectively; a finding consistent with previous studies in PE (Morgan & Bourke, 2005). Specifically, although teachers felt they had a significant amount of training in FMS instruction during their pre-service teacher training degree, it was thought to give “a false sense of confidence to teach FMSs, as the diversity of skill and the reality of teaching in schools is not replicated in the university setting” (Female teacher, co-educational independent school). A key limitation of pre-service FMSs training that emerged was that it focused on lower primary school levels, so teachers felt unprepared to teach other age groups, in particular, “we needed to know
more mature and developmentally appropriate activities so we can cater for engage and motivate older students with low levels of FMSs” (Female teacher, co-educational government school).

In addition to more practical pre-service training, participants felt that more effective professional development (PD) could enhance their skill in instructing FMSs. The current approach to PD was identified as “rarely rigorous enough to be truly meaningful and transferable” (Female teacher, Catholic girls’ school). The majority of teachers indicated that PD seminars lacked the depth needed to elicit improvement in their teaching of FMSs, and they felt disillusioned by one-off PD opportunities that left them feeling unsupported: “as soon as you exited the PD you were on your own again” (Female teacher, co-educational Catholic school). Indeed, research into PD suggests that single events do not result in sustainable change (Pritchard & Marshall, 2002). It is clear that the current approach to PD is not addressing the teaching deficits in FMS education. Therefore, we recommend a more integrated and ongoing approach to supporting teacher education in FMSs.

**Conclusion**

Most participants in the present study felt that their approach to teaching FMSs to Year 7 girls was not effective. However, several factors were identified that may provide scope for intervention relating to FMS education. In particular, teachers of Year 7 girls may benefit from integrating an authentic and meaningful FMS assessment tool, such as the CAMSA (Longmuir et al., 2015), so that proficiency levels of their students can be accurately identified as they enter Year 7. Subsequently, an enhanced understanding of curriculum interpretation to identify teachable moments across the Year 7 PE curriculum, in conjunction with a diverse range of evidenced based pedagogical strategies may enable the teachers to more specifically target their
teaching to meet the diverse learning needs of their students. The apparent deficits in current teacher effectiveness may be improved by more comprehensive teacher training in FMSs, both during pre-service and subsequent in-service PD. These strategies aimed at teachers may enhance the FMSs of early adolescent girls in the hope of improving their lifelong levels of physical activity.
References


Physical Education Teachers’ Perspectives and Experiences When Teaching FMS to Early Adolescent Girls” by Lander N et al.

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Table 1: Participant demographics

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<td>11 years or more</td>
<td>11</td>
</tr>
<tr>
<td>School type represented (n = 25)</td>
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</tr>
<tr>
<td>All girls</td>
<td>14</td>
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<tr>
<td>Co-education</td>
<td>11</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Government</td>
<td>5</td>
</tr>
<tr>
<td>Catholic</td>
<td>10</td>
</tr>
<tr>
<td>Independent</td>
<td>10</td>
</tr>
</tbody>
</table>
CHAPTER 3: TEACHERS’ PERCEPTIONS OF A FUNDAMENTAL MOVEMENT SKILL ASSESSMENT BATTERY IN A SCHOOL SETTING

This study investigated the third aim of this thesis: To explore whether the CAMSA is a feasible FMS assessment instrument for teachers of Year 7 girls in an Australian school-based PE context.

The outcomes of this study have been previously accepted and published in the following paper:


Chapter 2 indicated that teachers perceived the teaching of FMS to be highly important and relevant for Year 7 girls. However, the teachers also highlighted several barriers of effective FMS teaching. One of the major barriers identified by the teachers was the lack of appropriate and practical FMS assessment available for use in a PE setting. Therefore, this study aimed to determine whether the Canadian Agility and Movement Skill Assessment (CAMSA) (Longmuir et al., 2015), a dynamic FMS assessment battery newly designed as part of the Canadian Assessment of Physical Literacy (CAPL) (The Healthy Active Living and Obesity Research Group (HALO), 2014), is a feasible form of FMS assessment for use by teachers of Year 7 girls in an Australian school-based PE context.
## AUTHORSHIP STATEMENT

Details of publication and executive author

<table>
<thead>
<tr>
<th>Title of Publication</th>
<th>Publication details</th>
</tr>
</thead>
</table>

<table>
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<th>School/Institute/Division if based at Deakin; Organisation and address if non-Deakin</th>
<th>Email or phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natalie Lander</td>
<td></td>
<td><a href="mailto:nlander@deakin.edu.au">nlander@deakin.edu.au</a></td>
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</table>

### Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis? **Yes / No**

If Yes, please complete Section 3

If No, go straight to Section 4.

### HDR thesis author’s declaration

Name of HDR thesis author if different from above. (If the same, write “as above”)

As above

School/Institute/Division if based at Deakin

Faculty of Health/School of Health and Social Development

Thesis title

Improving early-adolescent girls’ fundamental movement skills

If there are multiple authors, give a full description of HDR thesis author’s contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)

I contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscript for publication.

I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.

**Signature and date**

### Description of all author contributions

<table>
<thead>
<tr>
<th>Name and affiliation of author</th>
<th>Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)</th>
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<tr>
<td>Lisa Barnett: Deakin University</td>
<td>Supervision</td>
</tr>
<tr>
<td>Philip Morgan: University of Newcastle</td>
<td>Supervision</td>
</tr>
<tr>
<td>Jo Salmon: Deakin University</td>
<td>Supervision</td>
</tr>
</tbody>
</table>
Author Declarations

I agree to be named as one of the authors of this work, and confirm: that I have met the authorship criteria set out in the Deakin University Research Conduct Policy, that there are no other authors according to these criteria, that the description in Section 4 of my contribution(s) to this publication is accurate, that the data on which these findings are based are stored as set out in Section 7 below. If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further consent to the incorporation of the publication into the candidate’s HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

<table>
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<th>Signature*</th>
<th>Date</th>
</tr>
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<td></td>
<td>25th November</td>
</tr>
<tr>
<td>Jo Salmon</td>
<td></td>
<td>25th November</td>
</tr>
<tr>
<td>Philip Morgan</td>
<td></td>
<td>25th November</td>
</tr>
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</table>

Other contributor declarations

I agree to be named as a non-author contributor to this work.

<table>
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<tr>
<th>Name and affiliation of contributor</th>
<th>Contribution</th>
<th>Signature* and date</th>
</tr>
</thead>
</table>

* If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

<table>
<thead>
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<td>Interview transcripts</td>
<td>Deakin University: Locked cabinet</td>
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</table>
Teachers’ Perceptions of a Fundamental Movement Skill (FMS) Assessment Battery in a School Setting

Natalie Lander*, Phillip J. Morgan†, Jo Salmon‡, and Lisa M. Barnett§

* School of Health and Social Development, Deakin University, Burwood, Victoria, Australia; † Priority Research Centre in Physical Activity and Nutrition, New South Wales, Australia; § Centre for Physical Activity and Nutrition Research, School of Exercise and Nutrition Sciences, Deakin University, Burwood, Victoria, Australia

ABSTRACT
Fundamental movement skills (FMS) competence is low in adolescent girls. An assessment tool for teachers is needed to monitor FMS in this demographic. The present study explored whether the Canadian Agility and Movement Skill Assessment (CAMSA) is feasible for use by physical education (PE) teachers of Australian Year 7 girls in a school setting. Surveys, focus group interviews, and direct observation of 18 specialist PE teachers investigated teachers’ perceptions of this tool. Results indicated that the CAMSA was usable in a real-world classroom setting and was considered a promising means to assess FMS in Year 7 girls. However, future iterations may require minor logistical alterations and further training for teachers on how to utilize the assessment data to enhance teaching practice. These considerations could be used to improve future design, application, and training of the CAMSA in school-based PE.

KEYWORDS
Australian; feasibility; fundamental movement skills; teaching

Fundamental movement skills (FMS) are typically classified into object control skills (e.g., catching and throwing), locomotor skills (e.g., running and jumping), and stability skills (e.g., balancing and twisting) (Gallahue, Ozmun, & Goodway, 2012; Ulrich, 2000). Developing FMS may have important health implications for young people, as there is a positive association between FMS competence and physical activity, and an inverse relationship between FMS proficiency and weight status (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). Quality instruction and feedback are significant factors in the development of these skills (Martin, Rudisill, & Hastie, 2009). Therefore, the ability to accurately and reliably assess FMS is essential, to allow teachers to identify the FMS learning needs of students, and subsequently develop, and deliver more meaningful and effective FMS learning experiences to their students (Longmuir, Boyer, Lloyd, Borghese, & Knight, 2015).

Elementary (primary) school physical education (PE) programs are designed to help students develop FMS (Martin et al., 2009). Indeed, a recent systematic review (Morgan et al., 2013) showed FMS could be improved in PE when taught by specialist PE teachers or highly trained classroom teachers. However, research suggests that the quality of elementary school PE is often poor (Morgan & Hansen, 2007). There are several well-documented institutional and teacher-related barriers that adversely impact on the effectiveness of elementary school PE programs (Morgan & Hansen, 2008), and the quality of assessment within the programs (Lander, Brown, Telford, & Barnett, 2015; Morgan & Hansen, 2007), resulting in many children falling well below the recommended FMS benchmarks of their age and year level (Hardy, Barnett, Espinel, & Okely, 2013).

Ideally, students should have demonstrated mastery of all FMS by Year 4 (Hardy et al., 2013); however, in 2010 the prevalence of Australian Year 6 students with skill mastery was less than 50% for the sprint run, vertical jump, kick, and overarm throw (Hardy, King, Espinel, Cosgrove, & Bauman, 2010). Of particular concern is the low level of object control proficiency among girls (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010). Consequently, many Australian students, especially girls, transition into junior high (secondary) school under-skilled in FMS (Barnett et al., 2010; Hardy et al., 2013). Despite the low levels of FMS in junior high school girls, recent research indicates that teachers of junior high girls do not have a structured way to assess or teach FMS (Lander et al., 2015). Therefore, skill deficits in girls are likely to
remain unidentified in junior high school PE programs (Lander et al., 2015), and opportunity to improve actual competence may be limited (Ehl, Robertson, & Longendörfer, 2005; Lander et al., 2015).

Assessment is an integral facet of improving FMS proficiency. Indeed, assessment is a critical component of effective teaching, and thus is an important enabler of student learning (Black & Wiliam, 2010; Fiset & Franck, 2012). Effective teaching in PE hinges on obtaining accurate information on student skill levels (Hands, 2002). To enhance the effectiveness of teaching, and thus improve learning, assessment for learning is recommended. Assessment for learning is regular, systematic, and comprehensively integrated into the teaching process. Furthermore, assessment for learning is "authentic," that is, applicable to real-life situations (Hay & Penney, 2009; Kirk & O’Flaherty, 2004; Mintah, 2003; Wiggins, 1998). It is assessment for learning, that has the potential to promote and advance learning, rather than to simply judge achievement at one point in time (Assessment Reform Group, 2002; Black, Harrison, Lee, Marshall, & William, 2003; Glasson, 2008; Wiliam, 2011).

Existing FMS assessment protocols—for example, Bruininks-Oseretsky test of motor proficiency (Bruininks & Bruininks, 2005), Peabody Development Motor Scales (Folio & Fawell, 2000), or the Test of Gross Motor Development (Ulrich, 2000)—are intensive to administer and analyze, both in time and resources (Wiart & Darrah, 2001), making them difficult to implement within a typical PE class, and by a PE teacher. Many existing assessments have complex criteria, which are hard to interpret unless extensive training is provided: They require students to be tested one at a time, and in isolation (i.e., one teacher or assessor per child); the scoring protocols require students to perform the one skill several times (sometimes up to five); and can take 20–60 min to administer per child (Watkinson, Casgrove Dunn, Steadward, Wheeler, & Watkinson, 2003; Wiart & Darrah, 2001). Furthermore, existing tests are often limited in their authenticity, as they focus on isolated skill performance. These static testing environments do not adequately assess combined and complex movement, nor reflect the open, dynamic, and complex physical activity environments typical of childhood play, physical activity, and sport (Longmuir et al., 2015; Watkinson et al., 2003).

To address the current limitations of existing FMS assessment, the Canadian Agility and Movement Skill Assessment (CAMSA) was developed. The CAMSA was designed to measure movement skill, and was part of a larger study of children’s physical literacy—the Canadian Assessment of Physical Literacy (CAPL) (Healthy Active Living and Obesity Research Group [HALO], 2014; Lloyd, Colley, & Tremblay, 2010; Tremblay & Lloyd, 2010). The administration and assessment protocol for this assessment has been explained in detail elsewhere (https://www.capl-ecspf.ca/). However, in brief, the course requires students to run 20 meters while completing seven movement skill tasks (i.e., 2-foot jump, side step, catch, overhand throw, skip, 1-foot hop, kick; Figure 1). It was designed to reflect “real world” abilities required for sport and physical activity (Longmuir et al., 2015), such as transitioning from one skill to the next, e.g., catching then throwing while on the move. Performances are evaluated using completion time, which is then converted to a point score (range 1 to 14). In addition, the quality of each skill (2-foot jump, side step, catch, overhand throw, skip, 1-foot hop, kick) is scored as either performed (score of 1) or not observed (score of 0) across 14 reference criteria (range 0 to 14). The total score is calculated as the sum of the skill and the time scores (maximum score of 28 points) (Longmuir et al., 2015). The test is suitable for the FMS assessment of large groups of children in a relatively short time frame, as the test requires limited equipment and space, and only takes between 1.5 and 2 min to assess per child (Longmuir et al., 2015).

The feasibility, validity, objectivity, and reliability of the CAMSA have been demonstrated for Canadian children 6–14 years of age, and discussed in detail elsewhere (Longmuir et al., 2015). In brief, face validity was established through a Delphi expert review process. Convergent validity was evaluated by age and sex associations with obstacle course assessment performance. Inter-rater and intra-rater objectivity evidence was excellent for completion time and substantial for skill score, and similarly, test–retest reliability was excellent for completion time and substantial for skill score (Longmuir et al., 2015). However, these assessments were conducted in a Canadian research setting, administered by highly trained researchers (all with degrees in kinesiology and qualified in motor skill assessment) who had received three additional hours of training specific to this protocol.

Therefore, the aim of this study was to explore whether the CAMSA is a feasible FMS assessment instrument for use by teachers of Year 7 girls, in an Australian school-based PE context. Year 7 girls were the focus of this study because there is no FMS assessment currently available for this age group, and many girls transition into high school significantly under-skilled for the sports-based secondary PE curriculum (Barnett et al., 2010; Hardy et al., 2013). In addition, the
Figure 1. CAMSA (Longmuir et al., 2015).

greatest decline in physical activity is evidenced in girls between the ages of 13 and 18 (Australian Bureau of Statistics, 2013). Furthermore, Australian secondary school PE must be taught by a specialist (i.e., certified) PE teacher (Rink, Hall, & Webster, 2008), whereas Australian elementary school PE can be taught by non-specialist teachers.

Methods

This feasibility study was conducted to determine whether the CAMSA is a practicable measure of FMS for use by PE teachers of Year 7 girls, in a school setting and thus appropriate for further testing, specifically, efficacy testing. The usability of the CAMSA was evaluated in this study by examining teachers’ feedback and reflections. Bowen et al. (2009) identified eight areas to address in a feasibility study: demand, acceptability, implementation, practicality, adaption, integration, expansion, and efficacy. The eighth concept, efficacy testing, was not included in the present study, as it was considered outside the scope of this preliminary feasibility research, and will be a focus of future research efforts. In the current study, teachers’ perceptions of the seven areas were investigated via teacher surveys, focus group discussions, and observations (Tables 3, 4 and 5). Participant responses were analyzed in relation to the suggested outcomes of interest, as suggested by Bowen et al. (2009; Table 2), to determine whether the instrument could be a feasible FMS assessment tool for Australian Year 7 PE programs for girls, and appropriate for further research.

Participants

Nineteen specialist (i.e., certified) PE teachers of Year 7 girls were initially recruited. Eighteen of the 19 participants completed all three surveys (one teacher opted out of the study due to perceived work overload); therefore, 18 teachers, and their respective Year 7 girls PE class (approximately 405 Year 7 girls, age range 11–13), participated in the study (Table 1). Previously, a qualitative descriptive study was conducted to investigate barriers and facilitators of FMS assessment as perceived by Year 7 PE teachers (Lander et al., in press). A purposeful sample (Sandelowski, 1995) of four teachers from this study, all of whom had indicated interest in further involvement, was selected for the current study.
Table 1. Participant demographics.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Sex (n = 18)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
</tr>
<tr>
<td>Teaching years of experience (n = 18)</td>
<td></td>
</tr>
<tr>
<td>0–5 years</td>
<td>2</td>
</tr>
<tr>
<td>6–10 years</td>
<td>9</td>
</tr>
<tr>
<td>11–15 years</td>
<td>5</td>
</tr>
<tr>
<td>≥ 16 years</td>
<td>2</td>
</tr>
<tr>
<td>Schools types represented (n = 4)</td>
<td></td>
</tr>
<tr>
<td>All girls</td>
<td>2</td>
</tr>
<tr>
<td>Co-education (only data from teaching girls was collected)</td>
<td>2</td>
</tr>
<tr>
<td>School sector represented (n = 4)</td>
<td></td>
</tr>
<tr>
<td>Government (public)</td>
<td>2</td>
</tr>
<tr>
<td>Independent (private)</td>
<td>2</td>
</tr>
<tr>
<td>School location represented (n = 4)</td>
<td></td>
</tr>
<tr>
<td>North-west Melbourne (metro)</td>
<td>1</td>
</tr>
<tr>
<td>Melbourne (metro)</td>
<td>1</td>
</tr>
<tr>
<td>South-east Melbourne (metro)</td>
<td>1</td>
</tr>
<tr>
<td>North-east Victoria (rural)</td>
<td>1</td>
</tr>
</tbody>
</table>

as they represented diverse school types, sectors, locations, and had varying attitudes, perceptions, and experiences in regard to FMS instruction and assessment. An e-mail invitation was sent out to each teacher, and invitations, plain language statements, and consent forms were forwarded to principals of the four schools. After consent was received, a snowball sampling strategy (Streeton, Cooke, & Campbell, 2004) was implemented within each school, whereby an e-mail was sent to all Year 7 PE teachers at each school inviting them to participate in the study. The research was approved by Deakin University Human Ethics (HEAG) in December 2014, and the Department of Education and Training (DET), Victoria, in January 2015.

**Procedure**

Teacher training was provided by the researcher prior to Term 1, 2015. The teacher training included a 2-hour face-to-face seminar, written resources, an interactive workshop, and ongoing support. The seminar content included the background and importance of teaching and assessing FMS, as well as specific administration and evaluation protocols of the CAMSA, as specified in the CAPI training manual (https://www.capl-ecsfp.ca/). The written resources provided instructions on how to set up, administer, and evaluate the CAMSA, including a template for scoring and evaluating student performance, and also provided teachers with links to both the CAPI training manual (https://www.capl-ecsfp.ca/) and video demonstrations of the CAMSA (https://www.capl-ecsfp.ca/capl-training-videos). The interactive practical workshop comprised a step-by-step demonstration of the setup, administration and evaluation protocol, and teachers had the opportunity to practice the CAMSA several times, receiving feedback and guidance from the researcher. Teachers were also offered ongoing support in the form of telephone consultation, e-mail contact, or on-site visitation by the researchers (the level of support

Table 2. Appropriate areas of feasibility focus.

<table>
<thead>
<tr>
<th>Focus area</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Acceptability</td>
<td>How the intended individual recipients—both targeted individuals and those involved in implementing programs—react to the intervention.</td>
</tr>
<tr>
<td>Demand</td>
<td>Demand for the intervention can be assessed by gathering data on estimated use or by actually documenting the use of selected intervention activities in a defined intervention population or setting.</td>
</tr>
<tr>
<td>Implementation</td>
<td>The extent, likelihood, and manner in which an intervention can be fully implemented as planned and proposed.</td>
</tr>
<tr>
<td>Practicality</td>
<td>The extent to which an intervention can be delivered when resources, time, commitment, or some combination thereof are constrained in some way.</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Changing program contents or procedures to be appropriate in a new situation. It is important to describe the actual modifications that are made to accommodate the context and requirements of a different format, media, or population.</td>
</tr>
<tr>
<td>Integration</td>
<td>The level of change needed to integrate a new program into an existing infrastructure. The documentation of which can help to determine if the new venture is truly feasible.</td>
</tr>
<tr>
<td>Expansion</td>
<td>The potential success of an already-successful intervention with a different population or in a different setting.</td>
</tr>
</tbody>
</table>

Sample outcomes of interest

- Satisfaction
- Intent to continue use
- Perceived appropriateness
- Fit within organizational culture
- Actual use
- Expressed interest or intention to use
- Perceived demand
- Degree of execution
- Success or failure of execution
- Amount, type of resources needed
- Factors affecting implementation ease or difficulty
- Efficiency, speed, or quality of implementation
- Positive/negative effects on target participants
- Ability of participants to carry out intervention activities
- Degree to which similar outcomes are obtained in new format
- Perceived fit with infrastructure
- Perceived sustainability
- Fit with organizational goals and culture
- Positive or negative effects on organization
- Disruption due to expansion component
Table 3. Survey 1—Baseline data, completed before CAMSA training session.

<table>
<thead>
<tr>
<th>Survey topic</th>
<th>Disagree</th>
<th>Neither disagree nor agree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMS are an important component of the PE curriculum for Year 7 girls</td>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>I am confident in my ability to teach FMS effectively when teaching Year 7 girls</td>
<td>5</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>I am confident in using a diverse range of teaching styles and methods to deliver FMS content</td>
<td>17</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>The assessment of FMS is not important when teaching FMS to Year 7 girls</td>
<td>6</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>I am confident in my ability to assess FMS proficiency of Year 7 students</td>
<td>7</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>I am confident in using a diverse range of assessment strategies to assess FMS proficiency</td>
<td>2</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Assessing student FMS proficiency at the beginning of the unit or program is the most important time</td>
<td>2</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Assessing student FMS proficiency throughout the unit or program is the most important time</td>
<td>7</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>I do not use the data gathered from FMS assessments to guide my teaching</td>
<td>6</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>I currently use a predefined set of FMS criteria to assess the student's FMS proficiency against</td>
<td>12</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>FMS learning outcomes are prominently featured in the Year 7 PE curriculum at my school</td>
<td>6</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>I encounter several challenges when attempting to assess the FMS proficiency of Year 7 girls</td>
<td>5</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>I am interested in learning more about FMS assessment</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey responses were all based on a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree. In addition, teachers were encouraged to keep a log of when, where, and how they used the assessment tool and/or data derived from the assessment tool throughout the term. These logs were then used as reference points for the teachers when they participated in the focus group discussions. The post-trial focus groups discussions, using semi-structured discussion prompts, were used as an additional method of evaluation. Four focus groups (one focus group per school), with all teachers (n = 18), were conducted to discuss the teacher logs and expand on aspects of the focus areas in more depth. In addition, the researcher observed and recorded one teacher per school as they implemented and evaluated the CAMSA with their Year 7 girls PE class. The focus area for the direct observation was "implementation." Specifically, teachers were observed to determine how effectively they were able to integrate the assessment tool itself, and the data gleaned from the assessment data into the teaching process in their Year 7 girls PE class.

Data collection

Evaluation of the CAMSA was achieved via teacher surveys, focus group interviews with teachers, and direct observation of the administration of the assessment tool. Figure 2 describes the timing of the evaluation tools in relation to implementation. Teachers were surveyed three times. Survey 1 was conducted before the initial training session, and sought baseline data on teachers' perceptions and experiences of teaching and assessing FMS to Year 7 girls, and also about the perceived need of an instrument such as the CAMSA (Table 3). Survey 2 was conducted after the 2-hour training session, and investigated the teachers' views and intentions regarding whether the tool could and would be implemented in their current PE practice (Table 4). Survey 3 was conducted after the teachers had administered the tool, either in the last week of Term 1 or in the first week of Term 2, to evaluate the teachers' experiences using the CAMSA in their Year 7 PE program when teaching girls (Table 5).

Survey 2 and Survey 3 were designed to determine the feasibility of the CAMSA in a PE setting as perceived by the teachers, and the questioning revolved around the seven areas of feasibility outlined earlier.
Table 4. Survey 2—Pre-trial data, completed after the CAMSA training session, before the administration and evaluation of the program.

<table>
<thead>
<tr>
<th>Survey topic</th>
<th>Disagree</th>
<th>Neither disagree nor agree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand:</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>There is not a need for CAMSA in the Year 7 curriculum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you see the CAMSA as an appropriate FMS assessment tool for Year 7 PE</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will be able to successfully administer the CAMSA</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>I will be able to successfully evaluate the CAMSA assessment data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will be able to successfully use the assessment data to plan and deliver FMS teaching and learning</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Practicality:</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>I will be able to administer and evaluate the CAMSA without any support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>The CAMSA will fit into my current PE curriculum and lesson structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAMSA will be a disruption to class/student learning/curriculum</td>
<td>15</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Students will engage well in the CAMSA</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Expansion</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>I will modify my lesson content, teaching approach and delivery, according to student needs, following the administration and evaluation of the CAMSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAMSA will enhance my FMS delivery</td>
<td>1</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>The integration of the CAMSA will enhance the FMS proficiency of the students</td>
<td>2</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>The CAMSA could be an ongoing measure of FMS in the PE curriculum</td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

verbatim by the first author. The interview data were used for process evaluation, with a particular focus on the implementation of the CAMSA relative to program plan, barriers and problems encountered, and the teachers’ actual use or engagement with the CAMSA throughout Term 1, 2015 (Baranowski & Stables, 2006; Patton, 1982)

Results

Survey 1 (pre-training; Table 3) and Survey 2 (post-training, pre-trial; Table 4) responses, reporting on teachers’ pre-trial perceptions, were coupled with the teachers’ actual experiences (Survey 3; post-trial: Table 5), and are presented below by focus area. Direct observations and quotes from interview responses are integrated and provided as examples of certain points.

Demand

Survey 1 (pre-training) revealed that all participants (n = 18) agreed that teaching FMS was important in the Year 7 PE curriculum, and that assessment of FMS was also important (Table 3). However, the majority of the teachers (14/18) reported barriers to effective FMS assessment in the PE context, including a lack of objective and effective assessment tools available, and therefore accurate and meaningful FMS assessment was often neglected.

We don’t have up-to-date or accurate assessment protocols to identify what is the most important area to

Table 5. Survey 3—Completed after administration and evaluation of the CAMSA in the teachers’ PE program.

<table>
<thead>
<tr>
<th>Survey topic</th>
<th>Disagree</th>
<th>Neither disagree nor agree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training:</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>I was satisfied with the training program provided for the CAMSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAMSA was an appropriate FMS assessment tool for Year 7 PE</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I successfully administered the CAMSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I successfully evaluated the CAMSA assessment data</td>
<td>2</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>I successfully used the assessment data to plan and deliver subsequent FMS teaching and learning</td>
<td>3</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Practicality:</td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>I did not require additional support to implement the CAMSA successfully</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>The CAMSA was successfully integrated in my PE curriculum and lesson structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAMSA was a disruption to class/student learning curriculum</td>
<td>15</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>The students were actively engaged in the assessment process</td>
<td>1</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Expansion</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>The CAMSA enhanced my FMS delivery</td>
<td>3</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>The CAMSA enhanced the FMS proficiency of the students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The CAMSA could be an ongoing measure of FMS in the PE curriculum</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel more confident in my ability to assess the FMS proficiency of Year 7 girls</td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>
focus on: i.e., catching or throwing or kicking. (Female teacher, independent girls’ schools)

All teachers indicated there was a significant need for an assessment tool that could be easily administered to measure student FMS competency.

This is so much easier than other FMS manuals that schools are using where the criteria is so complex that you get lost in the performance. (Female teacher, independent girls’ school)

**Acceptability**

Survey 2 (pre-trial) results indicated that all teachers \((n = 18)\) anticipated that the CAMSA would be a suitable assessment tool (for both students and teachers) for measuring FMS proficiency in Year 7 PE students (Table 4). All teachers were satisfied with the training session provided for the administration and evaluation of the CAMSA. All participants intended to use the tool in their Year 7 program, and perceived it to be an appropriate method of FMS assessment for their PE class. All teachers predicted that the tool would fit into their organizational culture and structure without major disruption, and also speculated that it would have positive effects on teaching and learning. After using the CAMSA, teachers affirmed that the format was well accepted by students.

The girls adapted to the CAMSA course quickly, they were engaged and seemed to really enjoy themselves; it made administering the assessment fun and easy. (Male teacher, independent girls’ school)

Teachers unanimously suggested that the CAMSA was a vast improvement on existing FMS assessments they had attempted in Year 7 PE. In particular teachers appreciated the clear criteria and agreed that it was simple and easy to observe and assess.

**Implementation**

All teachers anticipated that they would be able to successfully administer the test (Survey 2; pre-trial: Table 4). Teachers’ actual experiences (Survey 3; post-trial: Table 5) were consistent with initial predictions and revealed that all teachers could, and did, set up and administer the tool successfully in their PE class. Teachers expressed that their efficiency, speed and quality of implementation improved with practice and familiarity.

At first the test was a bit daunting as it was new to me—but it was so easy to administer and I gained confidence very quickly. (Female teacher, independent girls’ school).

The duration of the initial administration of the tool ranged from 40 min to 75 min per class. All teachers implemented the tool at least once per class (the recommended minimum) in Term 1, 2015, within the first 2 weeks. All teachers reported they had scheduled repeat episodes of the course later in the year, with the intention to monitor progress and reassess student needs. However, only one school (with six participating teachers) conducted the test twice in Term 1, once in the first week (diagnostic) and once in the last (summative), to determine progress throughout the term.

It was great to get a baseline measure of the students’ skills, use the criteria to provide feedback to the
students and then re-test them to show them and me what progress, if any, had been made. (Male teacher, government co-education school)

All teachers predicted they would be able to evaluate the test results successfully (Survey 2; pre-trial: Table 4). Again the teachers’ initial expectations of successful analysis largely aligned with their actual experience of the process, with the majority of teachers (15/18; Survey 3; post-trial: Table 5) stating that they were able to analyze and evaluate the data obtained from the assessment tool successfully. The three teachers who did not feel they could successfully analyze the data requested assistance via email.

The actual scoring system was quite simple to follow and pretty easy to undertake. (Male teacher, government co-education school)

In addition, the majority of the teachers (17/18) reported that their students (~405 students) were actively engaged in the assessment, participated in the CAMSA successfully and enjoyed the process, regardless of their level of skill (Survey 3; post-trial: Table 5).

Every one of my students completed the assessment with some level of success. Even if they dropped a catch, there were several other skills included that the student could move on to, so that one dropped catch wasn’t the focus. (Female teacher, co-educational government school)

Survey 2 (pre-trial) results indicated that teachers unanimously expected they would be able to successfully use the data gleaned from the assessment tool to guide subsequent teaching (Table 4). However, Survey 3 (post-trial) data revealed that not all teachers (13 of the 18) reported using the data generated from the CAMSA to plan, prepare or guide subsequent teaching (Table 5). In addition, from the interview data, it appeared that the majority of the teachers were referring only to preparing lesson content (i.e., specific skills to focus on), rather than improving or modifying teaching approaches. Indeed, from interview accounts it appeared that many teachers were not confident in selecting and/or integrating the optimal pedagogy into their lesson to better engage their students.

It’s great that we have the information, but knowing what to do with it, and how to change our teaching is the challenge. (Male teacher, independent girls’ school)

Furthermore, direct observation by the researcher identified that, while all schools were implementing the tool, the extent and efficiency of implementation varied. In the least effective implementation, only one CAMSA was set up, so assessment “of” learning, rather than assessment “for” learning, was the single and central purpose. In this scenario there were extended waiting periods for students, lack of physical activity and engagement, and a greater focus on single episodes of assessment. The most successful implementation occurred when several other activities, stations or tasks were set up in conjunction with the CAMSA. This approach better engaged students, decreased student waiting time, decreased the emphasis on high stakes assessment, and better integrated assessment as part of learning.

Practicality

Survey 2 (pre-trial) indicated that all teachers thought they would be able to administer and evaluate the CAMSA independently. Although many teachers (12/18; Table 4) reported that no additional support was required, six teachers suggested they would have liked or they did need additional support throughout the assessment and evaluation process. When this was discussed in focus group interviews it became apparent that the support required largely regarded pedagogy, or how to integrate assessment into subsequent FMS teaching practice, rather than the administration, implementation or evaluation of the tool. Although ongoing support was offered to all teachers throughout the term, three out of the four schools did not request any additional assistance. The one school that required assistance asked for clarification via e-mail about the scoring protocol, personal assistance with the setup of the course, and feedback after their first attempt of the test to ensure they were following the protocol accurately.

Despite the general success in administration of the tool within the PE context, some teachers reported some negative factors affecting implementation (although teachers often provided intuitive and insightful solutions to overcome these barriers). First, the necessity of two teachers to perform the two assessor roles, as prescribed by the protocol, was often unrealistic within the “real-life” school PE setting. Therefore, some teachers compromised by setting up a video camera in the position of assessor 1, which allowed for thorough evaluation of student performance via the recorded footage. Another perceived difficulty was the burden on the one teacher to complete all the assessor roles outlined in the protocol (timing student, instructing via the script, and feeding the balls), while still keeping the rest of the class engaged. As a solution, some teachers used injured or out-of-uniform students as timers, while other teachers brought in older students as assessors.
Another perceived difficulty was the time burden of the assessment; first, in regard to the physical setup of the test itself, requiring a number of cones, hoops, and precise measurements. Teachers felt this was time-consuming as they often had to set it up after the class was underway, which reduced their teaching time. However, there were several suggestions to resolve this, including colored tape markings on the floor to replace the cones and hoops. Another suggestion was a thin floor mat with all required markings painted on it that could be quickly rolled out and folded away afterward. However, overall, teachers stated that, in regard to practicality, the positive effects of the course far outweighed the negatives.

The tool was so easy to administer, it was realistic and practical, perfect for PE. Girls were very engaged and very competitive to beat their previous score. (Male teacher, government co-educational school)

Adaptation

Survey 3 (post-trial) data suggested that the CAMSA was perceived to be a major improvement on previous forms of FMS assessment teachers had been using, which were often subjective and, therefore, not reliable. All teachers reported that the clear and valid criteria coupled with the format of the course allowed them to identify student skill levels quickly and accurately.

This CAMSA course made it very easy to identify students at either end of the proficiency spectrum. The high performers and the low level performers really stood out, and therefore, you could identify these students immediately and begin to tailor programs for these students. (Female teacher, independent girls' school)

The participants concurred that the dynamic nature of the assessment led to a higher level of fun and engagement. Students enjoyed taking part and were very keen to better their scores. They also agreed that the format of the CAMSA course allowed several skills to be observed at one time and, therefore, had more reach and relevance across the different units that were scheduled across the Year 7 curriculum.

I loved the variety of skills that were included in the test, because they are skills that are included in nearly every unit we cover in Year 7 PE, from athletics to many of the ball sports. The test would be relevant for all the units. (Female teacher, co-educational government school)

The teachers also reported that the skills course format, rather than tests that assess single skills in isolation, was hugely valuable. Participants suggested that it provided a truer picture of the students' skills, as they had to transition from one skill to the next, which was more like sport and physical activity. Teachers also indicated that it was the transitions that largely differentiated low and high performers.

The better skilled kids would move from one skill to the next quickly and smoothly, therefore, the teachers would be faster—it was the opposite for the less skilled kids. (Female teacher, independent girls' school)

Furthermore, several teachers valued the combined method of assessment, integrating both qualitative and quantitative measures.

Integration

Survey 2 (pre-trial) results indicated that all but one teacher predicted the CAMSA would fit into their current school PE curriculum and structure (Table 4). Survey 3 (post-trial) data supported this, with the majority of the teachers (14/18; Table 5) agreeing that the CAMSA was successfully integrated into their school PE infrastructure (i.e., curriculum, lesson allotment, scope, sequence, and structure). For example, one school had an athletics unit in Term 1, but were able to utilize and specify the test and test data for the purpose of analytics. Conversely, four of the teachers reported that, as their curriculum was already established for Term 1, it was difficult to integrate the assessment and the assessment data.

The majority of teachers (15/18; Table 5) reported that the tool was not a disruption to their class, curriculum, or student learning objectives, and teachers inferred that once familiar with the protocol, the CAMSA was a valuable inclusion not only as an assessment tool but also as a guide for teaching and planning.

The content of the [CAMSA] course gave me a framework for any lesson that included skills tested in the course. I knew the teaching points to give, which were clear and simple. … The kids and I loved using this tool! (Female teacher, independent girls' school)

Survey 2 (pre-trial) responses indicated that all teachers anticipated students would enjoy and be engaged with the tool, and in reality these perceptions were largely supported, with 17 of the 18 teachers reporting their students were actively engaged and enjoyed the task (Table 5).

Furthermore, interview accounts indicated that the students became familiar with the course very quickly, and displayed a desire to improve their scores.
It is a fantastic tool that the kids took ownership of and really enjoyed completing. (Male teacher, co-educational government school)

One school planned to modify their reporting system to align it with that of the CAMSA, so that not only teachers and students were aware of student progress, but the parents were also informed about student proficiency and progress.

We are redeveloping our reporting system in PE to coincide with the standards provided in the CAMSA—we are using pre-test and post-test results to report on improvement over the semester. (Female teacher, independent girls' school)

**Expansion**

All teachers, in both Survey 2 (pre-trial) and Survey 3 (post-trial), agreed the CAMSA could be expanded to provide an ongoing measure of FMS proficiency for Year 7 girls at their school. When asked about modifications for future iterations, some interesting suggestions were made. A couple of teachers indicated that the prescribed distance in the overhand throw and kick component in the course was too short, and reduced the need for a forceful execution of those two skills.

Make the throw and kick distance longer [suggested 10 m] so it makes them perform the skills properly with more power. (Male teacher, independent girls' school)

One participant indicated that the small target also restricted the execution of the throw.

I didn't like the use of the target for the throw as student were too focused on getting it in the target, they didn't focus on technique and ended up lobbing it rather than (overarm) throwing. (Female teacher, independent girls' school)

Indeed, throughout the interviews, a few teachers expressed concern that students were so focused on performing the course as quickly as possible that it often jeopardized the quality of their performance.

I don't really see the value in attaching time, as the students get so attached to how fast they can do it that their technique goes out the window, this is especially true in the side step and skip, where they end up just running. (Male teacher, independent girls' school)

Survey 2 (pre-trial) results indicated that all teachers perceived that the tool would enhance their FMS teaching (Table 4). Survey 3 (post-trial) results showed this was true for 14 of the 18 teachers (Table 5). Interview accounts of these four teachers indicated that additional pedagogical education, in conjunction with comprehensive training on the assessment tool, would have greatly benefited their teaching practice.

I see the assessment tool as just that... an assessment tool. I don't see it as enhancing my teaching, as assessment alone doesn't change much—you need to know how to teach. (Male teacher, independent girls' school)

The majority of the teachers indicated they thought the tool would enhance the FMS proficiency of their students. Indeed, in Survey 3 (post-trial), 11 out of the 18 teachers reported that the CAMSA course actually enhanced the FMS proficiency of the students (Table 5). Three out of the four schools did not conduct post-test assessment, so did not have data to compare student progress reliably. However, one school (with six participating teachers) monitored student progress across Term 1, and believed there were improved results in overall skill scores for many students.

Teachers unanimously agreed that they felt more confident in their ability to assess the FMS proficiency of Year 7 girls after the training and implementation of the CAMSA. Furthermore, interview accounts indicated that many teachers were interested in, or intended to use the tool in the future, and reported that the benefits to both teacher and student would only continue to increase as their familiarity and confidence expanded.

There is so much potential with what we can do with this tool. I can see this changing the face of Year 7 PE. If we have students' skill level data from day one of Year 7, we know what to do and how to do it. Our teaching will have much more impact as we know what we are dealing with. (Female teacher, independent girls' school)

**Discussion**

This study aimed to address two research questions: (1) whether the CAMSA was a feasible FMS assessment instrument for use by teachers of Year 7 girls, in an Australian school-based PE context and (2) whether the CAMSA could be successfully integrated into the teaching process (i.e., used as assessment "for" learning) in the context of a PE class when teaching Year 7 girls. The CAMSA was found to be feasible for use in the real-world context of Year 7 PE classes, as perceived by the teachers. However, some issues were raised by the teachers in regard to integrating the assessment tool into the teaching-learning process.

Teachers universally agreed that there was a significant demand for the tool in the Year 7 girls PE program. FMS are not a key focus in the National Curriculum for Australian junior high (secondary)
school PE, nor do they feature prominently in many junior high PE programs across Australia, perhaps because, theoretically, students should have mastered these skills by age 10 (Ulrich, 2000). However, in reality, many students transition into secondary school falling well below the recommended FMS benchmarks of their age and year level (Hardy et al., 2013), indicating that FMS education is a required and necessary component of the Year 7 curriculum. In the present study, the participating teachers indicated that the CAMSA provided an effective means to accurately identify where students are in their learning, and therefore, it was viewed as not only a needed tool, but also as an acceptable and valuable inclusion to the Year 7 PE curriculum.

The majority of teachers managed to successfully implement and evaluate the tool, sometimes several times in one term, and most were able to do so independently. Encouragingly, all teachers administered the test within the first couple of weeks of term, allowing for early and accurate identification of learner needs. This is congruent with research on effective assessment, whereby conducting assessment early in the teaching process provides valuable information to best meet the needs of individual students (Black & William, 2010; Harrison, 2013).

Although this study differed from the Canadian feasibility study (Longmuir et al., 2015), in regard to protocol, context, assessors, and participants, the positive results regarding the format and the structure of the tool were shared. The teachers valued the practical and dynamic nature of the tool, which they believed provided a truer picture of girls' FMS proficiency. The teachers also agreed that the number and variety of skills measured in one test provided scope for transferability of the findings across a diverse range of units in the Year 7 PE curriculum, supporting the notion that incorporating movement skills within a skills course format enables a more accurate and complete profile of whether the child can combine more complex and dynamic skills that enable them to succeed in being physically active with peers (Longmuir et al., 2015). Overall, teachers agreed that the CAMSA was a significant improvement on assessment strategies they had implemented in the past.

Although the CAMSA course was largely viewed by teachers as a feasible measure of FMS proficiency in girls, several issues were raised regarding successful integration of the test into the teaching process, predominantly about how to best use results to support student learning (i.e., assessment “for” learning). Indeed, to more comprehensively integrate this assessment tool into effective teaching practice, the teachers may have benefited from additional training in pedagogy or teaching strategies that translate the data gleaned from the CAMSA course into practical teaching methods. Indeed, research strongly suggests to promote and advance student learning, assessment must be comprehensively integrated into effective pedagogy (Black & William, 2010).

Another concern raised by several teachers was time restraints, which is often stated as a barrier to effective PE (Morgan & Hansen, 2008). The protocol for the CAMSA requires two assessors. This was considered unrealistic by many of the teachers, as they did not have the luxury of two teachers available. Although participants found inventive alternatives, such as iPad usage or the inclusion of student assessors, they still perceived this as a barrier to feasibility in a PE context. In addition, they felt that conducting all the specified assessor roles limited their capacity to keep all students active and on task. Indeed, having only one CAMSA set up, and being completely engrossed in this formal assessment, as the protocol demands, detracts from the ability of the teacher to be present for the other students in the class. As well as being difficult for teachers, this scenario emphasizes “high stakes” assessment, which can demotivate students (Ntoumanis, 2001).

**Future recommendation**

Issues that surfaced here may be used to improve future iterations of this type of assessment tool for the education context. For the CAMSA to facilitate assessment “for” learning, or “authentic” assessment, and to be better integrated into the teaching process, several recommended amendments to the protocol are suggested. First, class setup needs to be prepared in advance, for instance, several activities or CAMSA courses set up rather than one single assessment. Formative assessment should also be encouraged, that is, using the results to plan and deliver subsequent FMS lessons. The assessment procedure should be shared with the students, for instance, via peer assessment, or self-assessment using video footage. Multiple assessment episodes should be integrated into the teaching process, using assessment regularly to monitor, promote and improve learning, to de-emphasize summative or high stakes assessment. These recommendations not only provide direction or focus for teacher training or professional development programs, but indeed suggest there is a need for more comprehensive teacher training program, when testing the tool further.

A limitation to this study was the isolated testing of the CAMSA, which reflects only one component (physical
competence) of the CAPL. The CAPL is capable of assessing multiple aspects of physical literacy, including daily behavior, motivation and confidence, knowledge and understanding, and physical competence. Indeed, physical literacy moves beyond measuring fitness, motor skill or motivation in isolation. Therefore, further research is recommended to investigate the feasibility of the CAPL in its entirety within an Australian school-based PE context. Furthermore, this study focused on the teaching and assessing of girls FMS, therefore, the findings are limited to Year 7 girls only. Future research is recommended in co-education settings, where the findings can apply to both males and females. In addition, further research is needed to ascertain the students' reflections and feedback of the CAMSA, and importantly to determine the efficacy and effectiveness of the CAMSA, on the actual FMS proficiency of the students.

Conclusion

For an intervention to be worthy of testing for efficacy, it must address the relevant questions within feasibility (Bowen et al., 2009). The results of this study provide evidence that the CAMSA is feasible FMS assessment instrument, for use by PE teachers of Australian Year 7 girls, in a PE context, among a sample of secondary school teachers. Teachers thought there was a significant demand for the tool, perceived the approach to be appropriate, and expressed that use of the assessment tool enhanced their confidence in conducting FMS assessment. However, the current findings suggest that, for the tool to be integrated as an “authentic” assessment of FMS in the Year 7 PE environment, the provision of comprehensive training in pedagogical practices promoting the integration of the assessment into effective teaching practice would further enhance the successful utilization of the tool. It is reasonable to assume that a more comprehensive teacher training package coupled with the integration of the CAMSA into Year 7 curriculums may lead to better student outcomes in movement skill competence than pre-existing FMS assessment practices.

Acknowledgments

The authors would like to thank the students, teachers, and schools for participating in the study.

References


**Supplementary Table 1: Skill score: Canadian Agility and Movement Skill Assessment**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Criteria</th>
<th>Skill Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-foot jumping</td>
<td>Two feet in and out of blue, orange and purple hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No extra jumps and no touching the hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Body and feet are aligned sideways sliding in one direction</td>
<td>1</td>
</tr>
<tr>
<td>Sliding</td>
<td>Body and feet aligned sideways sliding in opposite directions</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Touch cone when changing direction after sliding left</td>
<td>1</td>
</tr>
<tr>
<td>Catching</td>
<td>Catches ball (no drop or trap against body)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Uses overhand throw to hit target</td>
<td>1</td>
</tr>
<tr>
<td>Throwing</td>
<td>Transfers weight and rotates body</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Correct step-hop foot pattern</td>
<td>1</td>
</tr>
<tr>
<td>Skipping</td>
<td>Alternates arms and legs, arms swinging for balance</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Land on one foot in each hoop</td>
<td>1</td>
</tr>
<tr>
<td>1-foot hopping</td>
<td>Hops once in each hoop (no touching of hoops)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Smooth approach to kick ball between cones</td>
<td>1</td>
</tr>
<tr>
<td>Kicking</td>
<td>Elongated stride on last stride before impact</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>Skill scored out of a maximum of 14</td>
<td>/14</td>
</tr>
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</table>
**Supplementary Table 2:** Time score: Canadian Agility and Movement Skill Assessment

<table>
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<th>Time (Seconds)</th>
<th>Number of Points</th>
</tr>
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<tbody>
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</tr>
<tr>
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<td>16–17</td>
<td>11</td>
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<td>17–18</td>
<td>10</td>
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<td>18–19</td>
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<td>7</td>
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<td>26–28</td>
<td>3</td>
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<td>28–30</td>
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**Supplementary Table 3:** Combined score: Canadian Agility and Movement Skill Assessment

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CHAPTER 4: THE RELIABILITY AND VALIDITY OF TWO MOTOR SKILL ASSESSMENTS FOR USE IN A SCHOOL SETTING

This research addressed the fourth research aim: To compare the test-retest reliability and concurrent validity of the CAMSA with a commonly used FMS assessment instrument, the Victorian FMS Assessment, developed to be used by teachers in a PE setting.

The outcomes of this study have been accepted with revisions, and the resubmission is currently under review:


As reviewed in Chapter 1, there is a limited number of FMS assessment tools for primary school PE, and very few appropriate for teachers in secondary school PE. The limitations of current instruments include: complex and extensive assessment criteria; protocols requiring students to be tested one at a time, and taking 20–60 minutes per child to assess; measurement of isolated skill performance in a closed or controlled environment; and assessment not reflecting the skills and movement patterns required for play, sport and PA. In Chapter 4, it was demonstrated that the CAMSA is one instrument that shows promise, but has not been validated or tested for reliability. Therefore, this study aimed to investigate the test-retest reliability and concurrent validity of the CAMSA against a commonly used FMS assessment instrument, the Victorian FMS Assessment (Department of Education Victoria, 1996), developed for use by teachers in a PE setting.
**AUTHORSHIP STATEMENT**

Details of publication and executive author

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<th>Email or phone</th>
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<tr>
<td>Natalie Lander</td>
<td>Deakin; Organisation and address if non-Deakin</td>
<td><a href="mailto:nlander@deakin.edu.au">nlander@deakin.edu.au</a></td>
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Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis? **Yes** / **No**

If Yes, please complete Section 3
If No, go straight to Section 4.

HDR thesis author’s declaration

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If there are multiple authors, give a full description of HDR thesis author’s contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)

I contributed substantially as first author, in terms of study concept and design, data collection and analysis, and preparation of the manuscript for publication.

*I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.*

Signature and date: 25th November

Description of all author contributions

<table>
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<th>Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)</th>
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<td>Lisa Barnett: Deakin University</td>
<td>Supervision</td>
</tr>
<tr>
<td>Philip Morgan: University of Newcastle</td>
<td>Supervision</td>
</tr>
<tr>
<td>Jo Salmon: Deakin University</td>
<td>Supervision</td>
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</table>
Author Declarations

I agree to be named as one of the authors of this work, and confirm: that I have met the authorship criteria set out in the Deakin University Research Conduct Policy, that there are no other authors according to these criteria, that the description in Section 4 of my contribution(s) to this publication is accurate, that the data on which these findings are based are stored as set out in Section 7 below. If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further consent to the incorporation of the publication into the candidate’s HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

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<td>Samuel Logan</td>
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Other contributor declarations

I agree to be named as a non-author contributor to this work.

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<th>Contribution</th>
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* If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author.

7. Data storage

The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

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The reliability and validity of an authentic motor skill assessment tool for early adolescent girls in an Australian school setting

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Running head: Comparison of two motor skill assessment instruments

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Abstract

Objectives: Proficiency in fundamental movement skills (FMS) is positively correlated with cardiorespiratory fitness, healthy weight status, and physical activity. Many instruments have been developed to assess FMS in children. It is important to accurately measure FMS competency in adolescent populations, particularly in girls, who are less proficient than boys. Yet these tests have not been validated or tested for reliability among girls in this age group. Design: The current study tested the concurrent validity and reliability of two FMS assessment instruments; the newly developed Canadian Agility and Movement Skill Assessment (CAMSA), against the Victorian FMS Assessment from Australia, among a sample of early adolescent girls. Methods: In total, 34 Year 7 females (mean age 12.6 years) from Australia were tested and retested on each instrument in a school setting. Results: Test-retest reliability was excellent for the overall CAMSA score (ICC = 0.91) and for the isolated time and skill score components (time: ICC = 0.80; skill: ICC = 0.85). Test-retest reliability of the Victorian FMS Assessment was also good (ICC = 0.79). There was no evidence of proportional bias in either assessment. There was evidence of strong concurrent validity ($r = 0.68$, $p < 0.05$). Conclusions: Both instruments were found to be reliable and valid. However, compared to the Victorian FMS instrument, the CAMSA has the advantage of both process and product assessment, less time needed to administer and higher authenticity, and so may be an attractive alternative to the more traditional forms of FMS assessment, for use with early adolescent girls, in school settings.

Keywords: Movement components, assessment, physical education, adolescents
1. Introduction

Fundamental movement skills (FMS) have been described as the building blocks of physical activity, typically classified into object control skills (e.g., catching), locomotor skills (e.g., running) and stability skills (e.g., balancing)\(^1\)\(^2\). Developing proficiency in these skills has important health implications for young people\(^3\), in terms of increased physical activity\(^4\) and cardiorespiratory fitness\(^5\), and obesity prevention\(^6\). Yet less than 50% of Australian Year 6 students have mastered the run, jump, kick, and throw\(^7\). This finding is indicative of a worldwide trend of lower FMS proficiency\(^8\),\(^9\),\(^10\). Low FMS proficiency often persists into adolescence and beyond\(^11\),\(^12\), and furthermore, globally, girls exhibit especially low levels of object control proficiency, which is of great concern, as proficiency in object control skills is positively associated with future PA levels\(^13\).

Most children are developmentally able to master FMS by the end of Grade 4\(^1\). Therefore, primary school physical education (PE) should provide the ideal environment to assess, teach, and improve these skills. However, many students, especially girls, pass through primary school PE, and the early developmental stages, commonly known as the ‘golden stage of development’ without mastering the critical threshold of FMS necessary for successful participation in PA and the sports-based curriculum typical of secondary school PE\(^1\),\(^7\). Furthermore, research suggests that skill deficits in girls often remain unidentified in high school PE programs\(^14\). Subsequently, remediation instruction may be rare, and opportunities to improve may be limited\(^14\).

Accurate identification of skill deficiency is a critical step in the cyclic process of skill improvement. Assessment allows teachers to identify student needs and subsequently accommodate for individual skill learning, by providing specific feedback, targeted instruction and developmentally appropriate tasks\(^15\). Valid and reliable assessment provides purpose and meaning to instruction and enables effective program delivery to advance student learning\(^15\). Assessment of FMS has been researched extensively in childhood\(^15\). Therefore, the assessment criteria and protocols are developed specifically for younger age groups\(^16\),\(^17\). Despite the low levels of FMS proficiency in older children and
adolescents, and even adults, there is a lack of appropriate FMS assessment available. Indeed, in a recent review of five motor skill assessment instruments, none emerged as capable of consistently determining adolescents or young adults, as novice or expert performers of FMS. As the quality of primary school Physical Education (PE) programs varies, and FMS instruction is often poor, many students reach adolescence without mastering FMS, which can have lifelong consequences in terms of physical inactivity. Therefore, there is a need for a valid and reliable FMS assessment appropriate for adolescents, especially girls.

Many instruments are not ideal for use in ‘real world’ settings such as in schools, despite recommendations that FMS should be assessed in schools by PE teachers. Assessment protocols have complex criteria, often require students to be tested one at a time, and can take 20–60 minutes per child. Furthermore, existing instruments often focus on isolated skill performance, in closed or controlled environments, and subsequently are not reflective, nor do they assess the complex series of skills involved in play, sport and physical activity. Furthermore, PE teachers are faced with numerous barriers including: high student numbers per class; limited class time and a lack of preparation time; and assessment not being engaging nor fun for students. Due to these barriers, many teachers resort to using levels of participation, attitude, appropriate clothing and attendance as criteria for assessing students, rather than movement skill based criteria to assess, monitor and advance student learning.

The Canadian Agility and Movement Skill Assessment (CAMSA) was recently developed, as part of the Canadian Assessment of Physical Literacy (CAPL). The CAMSA was designed to more authentically measure the ‘real world’ skills required for sport and physical activity, such as linking several skills together in succession, and transitioning from one skill to another efficiently (e.g., catching then throwing while on the move). The feasibility, validity and reliability of the CAMSA has been demonstrated for Canadian children (8–12 years) and feasibility has also been established in an Australian school setting. The aim of the current study was to investigate the test-retest reliability and
concurrent validity of the CAMSA when administered by teachers in an Australian school setting, against a commonly used FMS assessment instrument in Victorian schools, the Victorian FMS Assessment.

2. Methods

A convenience sample of female Year 7 students (n = 34, mean age 12.6 years) from an independent girls’ school in Melbourne, Australia, participated. Students were eligible if they were in Year 7, and could actively participate in a Physical Education class. All students who were invited, agreed to take part with their parents or legal guardians consent. The research was approved by Deakin University Human Ethics (HEAG) in August 2015.

The CAMSA requires students to cover a distance of 20 meters of an agility and movement course, completing seven different movement skills in succession, namely: two-footed jump, side slide, catch, throw, skip, hop, and kick. Therefore, skills cannot be added or omitted from the course. As the study aim was to test the CAMSA against the Victorian FMS Assessment, skills measured by the latter instrument were matched to the CAMSA.

The Victorian FMS Assessment was selected as a benchmark for concurrent validity for the following reasons: (i) the reliability and validity for all skills used in this study from the Victorian FMS Assessment have been established (ICC ≥ 0.7); (ii) it was designed for use by Australian teachers, and is the most common source of FMS assessment used in Victorian school; (iii) the skills align to those required in the Year 7 PE curriculum; (iv) the instrument has been used in FMS research in school settings, in children of similar age; (v) the skills selected closely align with those in the CAMSA.

Six skills from the Victorian FMS Assessment were selected. Four skills were identical in both assessments (i.e., overhand throw, catch, kick, and jump) (Supplementary Table 1). As the Victorian FMS Assessment does not include the skip, hop or side slide, two additional locomotor skills from the Victorian FMS Assessment instrument (i.e., dodge and the leap) were selected, as they comprise similar
movement patterns to the aforementioned CAMSA locomotor skills (i.e., skip, hop and side slide). The ‘dodge’ was also included as it broadly measures agility (i.e., the ability to change the direction of the body in an efficient and effective manner) 21.

The CAMSA requires students to complete the seven different movement skills as fast and well as possible 21. Performances of the CAMSA are evaluated using the aggregate of time taken to complete the course, and the quality of skill performance (process-oriented assessment e.g., ‘Transfers weight and rotates body’, and product-oriented assessment e.g., ‘ball hits the target’). Time required to complete the course is recorded, and then converted to a predefined point score (range 1–14), the faster the course completion, the higher the score (Supplementary Table 2). The quality of each skill is scored as either performed (score of ‘1’) or not (score of ‘0’) across 14 reference criteria (Supplementary Table 3). The total score is calculated as the sum of the skill and the time scores, total score range 1–28, per single trial (Supplementary Table 4) 23.

In contrast to the CAMSA, the Victorian FMS instrument assesses individual skills in isolation, and has several more behavioural components per skill than the CAMSA (Supplementary Table 1). The assessment and administration protocol has been described in detail elsewhere 23, however, in brief, behavioural components of each skill are scored ‘1’ if the component was demonstrated and ‘0’ if it was not demonstrated. The correctly performed components are summed to create a total score per trial, with a higher score indicating greater proficiency. In the current study the total skill score range for the Victorian FMS Assessment was 0–33, per trial (Supplementary Table 1).

All 34 students performed both assessments in Test 1, and all were retested in both assessment instruments seven days later (Test 2), using the same location, equipment, protocol, and staffing conditions as Test 1. For the purpose of this study, the administration protocol for both instruments aligned with the CAMSA. Specifically, the facilitators provided clear verbal instructions, and two practical demonstrations of each assessment. Each participant was then given two practice trials, followed by two consecutive test trials. When performing the CAMSA, the students were instructed to perform the
movement course as fast *and* as well as possible 21. When performing skills in the Victorian FMS Assessment they were instructed to perform with maximum effort, which produces the most advanced movement pattern of ballistic skills 26.

All student test trials were video recorded and later analysed. All footage was observed and coded by the lead author, who had prior training and experience in administering and analysing both the CAMSA 19, and the Victorian FMS Assessment instrument as well as with other motor skill assessments 28. The two test trials, per assessment instrument, were combined to provide an overall score for Test 1, and the same procedure repeated for Test 2. Thus, the CAMSA had a total score range of 2–56, and the Victorian FMS Assessment 0–66. In addition, the CAMSA score was separated into independent scores on time (1–28) and skill (0–28). Furthermore, score data from Test 1 (the best score of the two trials, potential range 1–28) per student was extracted, to enable a comparison between the sample’s performance and the predefined standards for 12-year-old children, as provided by the CAPL 21, 22. ‘Mastery’ or ‘near mastery’ 28 levels (i.e., all skill components observed, or all but one skill component observed, respectively) of the Victorian FMS Assessment were identified for total skill. Standards and mastery levels are presented in Supplementary Tables 4 and 5, and in text in the results section.

Data were analysed using SPSS (version 21). Test-retest reliability was determined by comparing results of Test 1 with Test 2 of each instrument using intra-class correlation coefficient (ICC). Bland-Altman plots assessed whether there were any associations between the mean difference between the trials and the mean of the trials for each instrument. In addition, the bivariate correlation between the inter-trial difference (Test 2 – Test 1) and the mean of trials [((Trial 2+Test 1)/2] was conducted to determine proportional bias. Concurrent validity between the CAMSA and the Victorian FMS Assessment was assessed using Spearman’s Rho rank-order correlations coefficients. Validity was rated as weak (0.10–0.29), moderate (0.30–0.49), or strong (>0.50) 29.

3. Results
Of the sample of 36 girls, two were excluded due to incomplete Test 2 results, leaving 34 participants (mean age 12.6 years ± 0.04). Half were Australian (17/34), just over one-quarter Asian (9/34) and just under one-quarter (8/34) European. Just over half had parents with a tertiary education (20/34, 59%) and the remainder with secondary education. Just over half (56%) were involved in out-of-school-hours sports (school or community), while the remainder were not.

Time taken to finish one complete assessment trial (seven skills) was shorter for the CAMSA (mean: 15 seconds, range 13–25 sec) than it was to finish one complete trial (six skills) of the Victorian FMS Assessment (mean: 1 min and 12 sec, range: 1 min 4 sec to 1 min 21 sec). When the data from one single CAMSA trial per student was extracted to identify the CAPL standards, 29.4% (10/34) were considered as beginning (<21), 52.94% (18/34) were progressing (21–24), 17.65% (6/34) were achieving (>24–27), and no student was ranked as excelling (>27). In the Victorian FMS Assessment, no student achieved ‘mastery’ or ‘near mastery’ for total skill. Means and standard deviations of performance scores for two trials for both instruments are presented in Table 1. A high degree of test-retest reliability was found for the overall CAMSA score (i.e., the aggregate of skill and time score) (ICC = 0.91), the isolated time score (time: ICC = 0.80) and isolated skill score (skill: ICC = 0.85). The test-retest reliability of the Victorian FMS Assessment was also good (ICC = 0.79) (Table 1).

The Bland-Altman plots for both the CAMSA (mean −1.29, [LoA] −5.62 and 3.04) and the Victorian FMS Assessment (mean −0.38, limits of agreement [LoA] −6.82 and 6.06) did not show systematic bias (Figures 1 and 2). In addition, the bivariate correlation between the inter-trial difference (Test 2 – Test 1) and the mean of the trials [(Trial 2 + Test 1)/2] indicated no evidence of proportional bias between the two trials of the CAMSA (r = 0.02, p = 0.89), nor the two measures of the Victorian FMS Assessment instrument (r = −0.12, p = 0.49).

Spearman’s Rho rank order analysis using a two-tailed test of significance indicated a strong positive correlation between the finishing position of students in the CAMSA using their total CAMSA score and Victorian FMS Assessment in Test 1 ($r_s = 0.68, p = <0.05$). When isolating the skill score of the
CAMSA, with the total skill score of the Victorian FMS Assessment, the correlation was slightly weaker, but still considered strong ($r_s = 0.60, p < 0.05$).

4. Discussion

This study examined the test-retest reliability and the concurrent validity of the CAMSA and the Victorian FMS Assessment, among a sample of female Year 7 students, in a junior high school setting. The CAMSA provided reliable estimates of students’ FMS proficiency. Indeed, the test-retest reliability of the CAMSA was stronger than the Victorian FMS Assessment, which was still highly reliable. In addition, the concurrent validity between the CAMSA and the Victorian FMS Assessment instrument was strong.

The isolated time score reliability for the CAMSA (7 days: ICC = 0.80) was the same as that of the Canadian study (8 to 14 days: ICC = 0.80). When isolating the skill score component of the CAMSA, reliability was slightly stronger (ICC = 0.85) in the current study, and even more so than skill reliability in the Canadian study, which was moderate over a short (2–4 days) interval (ICC = 0.46), but strong over a long (8–14 days) interval (ICC = 0.74). The lower test-retest reliability correlations across the shorter intervals in the Canadian study were explained by a possible learning effect due to participants remembering the CAMSA over the shorter period, and thus improving their performance. However, the learning effect was not apparent in the longer test-retest interval of the Canadian study, nor in the current study. Therefore, when assessing reliability, a minimum of a 7-day test-retest interval is recommended.

From a research and educative perspective, there is a trade-off between the number of performance criteria required for adequate analysis, and the burden on time for both students and teachers. The CAMSA took significantly less time to administer than the Victorian FMS Assessment. The administration time was reduced as the CAMSA requires only a small space (20 meters), for all seven skills to be performed, so potentially more courses can be set up, and more students assessed. In addition, several skills (seven) are performed in succession, and are analysed live (in-field); resulting in a mean
completion time, and thus analysis time, of 15 seconds per student. This is in contrast to the Victorian FMS Assessment instrument, which took over a minute to complete, and other common FMS assessments which can take 20–60 minutes per child. This reduces administration and assessment burdens, which are two major barriers for teachers in PE. Subsequently, there is more class time available for targeted instruction, delivery of appropriate learning tasks, and ultimately skill improvement.

Furthermore, findings demonstrated no evidence of proportional bias in either assessment. This is important, as other reliability assessments in this field have found some evidence of proportional differences. This finding is also encouraging in relation to the potential use of the CAMSA to extend beyond research to be used as an educative assessment instrument within a school setting. Particularly promising is the potential for the CAMSA to be integrated as a teaching tool, whereby the instrument is conducted on multiple occasions across a curriculum unit to monitor progress, with the intention to advance and promote teaching, and improve learning outcomes.

Based on the current study, the CAMSA appears to have strong concurrent validity when compared with the Victorian FMS Assessment instrument, meaning that the instruments are ranking the girls in a similar order in terms of their FMS proficiency. Although the latter cannot be considered the ‘gold standard’ of assessment in adolescents, the validity and reliability of the Victorian assessment has been previously established in children, and the instrument has been used in a number of previous FMS studies in children of a similar age. Therefore, these findings in regards to the strong concurrent validity between the CAMSA and the Victorian FMS Assessment are positive.

Both assessment instruments in this study involve a process-based assessment of skill. When aiming to assess FMS improvement, process-oriented instruments such as the Test of Gross Motor Development-2 (TGMD-2) are recommended, as they are effective in identifying skill deficits. Indeed, the CAMSA skill criteria was drawn from the TGMD-2 skill criteria. The CAMSA, however, has an additional advantage of including a product-oriented assessment as well. As there is some evidence that process- and product-oriented assessments are capturing slightly different constructs, an assessment
that combines both aspects of product and process assessment is likely to give a more complete picture of motor competence level.

The CAMSA has only been tested before in children aged up to age 12. Although the girls in this study were at the upper end of this age group (i.e., mean age of 12.6 years) they predominantly performed in the lower two standards (i.e., beginning or progressing), and no student was considered to be at ‘mastery’ or ‘near mastery’ in the Victorian FMS Assessment. The results of the current study are congruent with several other studies highlighting lower than expected movement skill proficiency in girls.

There were some limitations of this study. Although the skills and movements required by the CAMSA were selected to represent a more authentic picture of the students’ movement capacity, other aspects of agility and movement skill (e.g., bilateral coordination, twisting) may not be assessed by the CAMSA. However, the Delphi panel used in the CAMSA, supported the choice of movement skills in the protocol as being reflective of the skills that children should acquire through school PE. Also, the skills, although well matched, were not identical in the two assessment instruments; however, this does not appear to have reduced the concurrent validity between the two instruments. In addition, it should be acknowledged that other aspects of validity and reliability remain unverified (e.g., construct and convergent validity, and inter-rater reliability). In the interest of promoting use of the instrument in school setting, further investigation into the reliability and validity of the CAMSA is important. Furthermore, the generalisability of the findings may be limited due to the relatively small, homogenous, girls-only sample. Therefore, future research may seek to investigate the reliability and validity of the CAMSA further in boys and also, larger, diverse samples.

5. Conclusion

The results demonstrate excellent test-retest reliability for both FMS instruments, and strong concurrent validity between them. In addition, the CAMSA required less time to administer, is a more authentic measure of movement skill proficiency, and is feasible for use in Australian schools. FMS
assessment should be an integral part of the teaching and learning process within PE. Not only does the assessment need to be valid and reliable, but also authentic, meaningful, and relevant to the students’ age and development \(^{19,21}\). In addition, the assessment must be feasible for teachers to integrate within PE, to enable the assessment process to facilitate more informed teaching, thus more effective FMS programs. Therefore, the CAMSA may be an attractive alternative, for use by teachers of early adolescent girls, to the more traditional forms of FMS assessments.

**Practical Implications**

- There is a lack of valid and reliable instruments for early adolescent and adolescent fundamental movement skill assessment.
- Both the Victorian FMS Assessment and the CAMSA are highly reliable.
- The CAMSA may be an attractive alternative as it was comparable to the Victorian FMS Assessment, involved less time to administer and has higher authenticity than traditional FMS assessments.

**Acknowledgements**

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**References**


Table 1: Test 1 and Test 2 mean and Standard Deviation (SD), Intra-Class Correlation Coefficient (ICCs), and 95% Confidence Interval (CI) for the CAMSA and the Victorian Fundamental Movement Skills (FMS) Assessment

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<td>CAMSA: Time score</td>
<td>24.471 ± 3.077</td>
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<td>CAMSA: Skill score</td>
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Figure 1: Bland–Altman plot of error scores across Test 1 and Test 2 of the CAMSA against the average of the two assessments. The mean error score (solid horizontal line) and 95% confidence intervals above and below (broken horizontal line).
Figure 2: Bland–Altman plot showing error scores across Test 1 and Test 2 of the Victorian FMS Assessment against the average of the two assessments. The mean error score (solid horizontal line) and the 95% confidence intervals above and below (broken horizontal line) shown on plot.
**Supplementary Table 1:** The CAMSA and Victorian FMS Assessment: individual skills and skill criteria tested

<table>
<thead>
<tr>
<th>CAMSA Skills</th>
<th>CAMSA Assessment: Skill Criteria</th>
<th>Vic FMS Skills</th>
<th>VIC FMS Assessment: Skill Criteria</th>
</tr>
</thead>
</table>
| Throw        | 1. Uses overhand throw to hit target  
2. Transfers weight and rotates body | Throw | 1. Eyes are focused on the target throughout the throw  
2. Stand side-on to the target  
3. Throwing arm nearly straightened behind the body  
4. Step towards the target with foot opposite throwing arm during the throw  
5. Marked sequential hip to shoulder rotation during the throw  
6. Throwing arm follows through and down across the body |
| Catch        | 1. Catches ball (no drop or trap against body) | Catch | 1. Eyes are focused on the ball throughout the catch  
2. Preparatory position: elbows bent and hands in front of body  
3. Hands move to meet the ball  
4. Hands and fingers positioned correctly to catch the ball  
5. Catch and control the ball with hands only |
| Kick         | 1. Smooth approach to kick ball between cones  
2. Elongated stride on last stride before impact | Kick | 1. Eyes are focused on the ball throughout the kick  
2. Step forward with non-kicking foot placed near the ball  
3. Bend knee of kicking leg during the backswing for the kick  
4. Hip extension and knee flexion of at least 90° during preliminary kicking movement  
5. Contact ball with top of foot  
6. Forward and sideward swing of arm opposite kicking leg  
7. Kicking leg follows through towards the target after ball contact |
| Jump         | 1. Two feet in and out of 3 hoops | Jump | 1. Eyes focused forwards or upwards throughout the jump |
2. No extra jumps and no touching the hoops  
2. Crouch with knees and arms bent behind body  
3. Forceful up thrust of arms as legs straighten to take off  
4. Contact ground with front part of feet and bend knees to absorb force of landing  
5. Balanced landing with no more than one step in any direction

<table>
<thead>
<tr>
<th>Hop</th>
<th>Leap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Land on one foot in each hoop</td>
<td>1. Forward movement sustained throughout the leap</td>
</tr>
<tr>
<td>2. Hops once in each hoop</td>
<td>2. Eyes focused forward throughout the leap</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skip</th>
<th>Dodge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correct step-hop foot pattern</td>
<td>1. Eyes focused in direction of travel throughout the dodge</td>
</tr>
<tr>
<td>2. Alternates arms and legs</td>
<td>2. Change direction by pushing off outside foot</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Side step</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Body and feet are aligned sideways sliding in one direction</td>
<td>2. Change of direction occurs in one step</td>
</tr>
<tr>
<td>2. Body and feet aligned sideways sliding in opposite direction</td>
<td>3. Body lowered during change of direction</td>
</tr>
<tr>
<td>3. Touch cone when changing directions after sliding left</td>
<td>4. Change of direction occurs in one step</td>
</tr>
<tr>
<td>5. Dodge repeated from right to left, left to right etc.</td>
<td>5. Dodge repeated from right to left, left to right etc.</td>
</tr>
</tbody>
</table>
**Supplementary Table 2**: Time score: Canadian Agility and Movement Skill Assessment (CAMSA)

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;14</td>
<td>14</td>
</tr>
<tr>
<td>14–15</td>
<td>13</td>
</tr>
<tr>
<td>15–16</td>
<td>12</td>
</tr>
<tr>
<td>16–17</td>
<td>11</td>
</tr>
<tr>
<td>17–18</td>
<td>10</td>
</tr>
<tr>
<td>18–19</td>
<td>9</td>
</tr>
<tr>
<td>19–20</td>
<td>8</td>
</tr>
<tr>
<td>20–21</td>
<td>7</td>
</tr>
<tr>
<td>21–22</td>
<td>6</td>
</tr>
<tr>
<td>22–24</td>
<td>5</td>
</tr>
<tr>
<td>24–26</td>
<td>4</td>
</tr>
<tr>
<td>26–28</td>
<td>3</td>
</tr>
<tr>
<td>28–30</td>
<td>2</td>
</tr>
<tr>
<td>≥30</td>
<td>1</td>
</tr>
</tbody>
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### Supplementary Table 3: Skill score: Canadian Agility and Movement Skill Assessment (CAMSA)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Criteria</th>
<th>Skill score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-foot jumping</td>
<td>Two feet in and out of blue, orange, and purple hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No extra jumps and no touching the hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Body and feet are aligned sideways sliding in one direction</td>
<td>1</td>
</tr>
<tr>
<td>Sliding</td>
<td>Body and feet aligned sideways sliding in opposite direction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Touch cone when changing directions after sliding left</td>
<td>1</td>
</tr>
<tr>
<td>Catching</td>
<td>Catches ball (no drop or trap against body)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Uses overhand throw to hit target</td>
<td>1</td>
</tr>
<tr>
<td>Throwing</td>
<td>Transfers weight and rotates body</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Correct step-hop foot pattern</td>
<td>1</td>
</tr>
<tr>
<td>Skipping</td>
<td>Alternates arms and legs, arms swinging for balance</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Land on one foot in each hoop</td>
<td>1</td>
</tr>
<tr>
<td>One-foot hopping</td>
<td>Hops once in each hoop (no touching of hoops)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Smooth approach to kick ball between cones</td>
<td>1</td>
</tr>
<tr>
<td>Kicking</td>
<td>Elongated stride on last stride before impact</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>Skill scored out of a maximum of 14</td>
<td>/14</td>
</tr>
</tbody>
</table>
**Supplementary Table 4:** Combined score: Canadian Agility and Movement Skill Assessment (CAMSA)

<table>
<thead>
<tr>
<th>Age</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years old</td>
<td>&lt;14</td>
<td>14–18</td>
<td>&gt;18–23</td>
<td>&gt;23</td>
</tr>
<tr>
<td>9 years old</td>
<td>&lt;17</td>
<td>17–21</td>
<td>&gt;21–24</td>
<td>&gt;24</td>
</tr>
<tr>
<td>10 years old</td>
<td>&lt;19</td>
<td>19–23</td>
<td>&gt;23–26</td>
<td>&gt;26</td>
</tr>
<tr>
<td>11 years old</td>
<td>&lt;20</td>
<td>20–24</td>
<td>&gt;24–27</td>
<td>&gt;27</td>
</tr>
<tr>
<td>12 years old</td>
<td>&lt;21</td>
<td>21–24</td>
<td>&gt;24–27</td>
<td>&gt;27</td>
</tr>
</tbody>
</table>
**Supplementary Table 5**: Victorian FMS Assessment: ‘mastery’ and ‘near mastery’ for each skill (per single trial)

<table>
<thead>
<tr>
<th></th>
<th>Near Mastery a (components)</th>
<th>Mastery a (components)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catch</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Throw</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Kick</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Object Control</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Jump</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Leap</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Dodge</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Locomotor</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Total Skill</td>
<td>27</td>
<td>33</td>
</tr>
</tbody>
</table>

*Mastery is defined as all skill components observed; Near mastery is defined as all but one skill component observed*

CHAPTER 5: IMPROVING FUNDAMENTAL MOVEMENT SKILL PROFICIENCY IN EARLY-ADOLESCENT GIRLS: A CLUSTER RANDOMISED CONTROLLED TRIAL

This pilot study addressed the final aim of the thesis: To investigate whether an intervention focusing on teacher training in and teacher delivery of authentic assessment (i.e., CAMSA) coupled with student-centred pedagogy (i.e., SAAFE teaching principles) across a 12-week PE program improved the FMS proficiency of Year 7 girls.

This manuscript is in preparation for submission as:


Chapter 1 identified several recommendations of key characteristics of effective teacher training in PA and/or FMS interventions, including: ‘sustained’ teacher training; a multimodal approach to teacher training delivery, with a focus on ongoing consultation and collaboration; a comprehensive intervention content (subject and pedagogy content), and; the inclusion of teacher satisfaction and fidelity as essential design elements.

It was established in Chapter 2 that teachers of early-adolescent girls perceive Year 7 to be a critical period to teach FMS, yet recognise several barriers to effective teaching, including lack of assessment, ineffective pedagogy and poor teacher training. Chapters 3 and 4 demonstrated
that the CAMSA is a feasible, valid and reliable FMS assessment tool for Australian high school PE teachers. However, several modifications to the CAMSA were suggested by the teachers to integrate the assessment more comprehensively into the teaching/learning process. Therefore, the final aim of the thesis was to design and develop an intervention framed by the evidence presented in these previous chapters, and to examine the effectiveness of the intervention in a real-world setting.
AUTHORSHIP STATEMENT

1. Details of publication and executive author

<table>
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<th>Publication details</th>
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<tbody>
<tr>
<td>Improving fundamental movement skill proficiency in early-adolescent girls: a cluster randomised controlled trial</td>
<td>Medicine &amp; Science in Sport &amp; Exercise</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of executive author</th>
<th>School/Institute/Division if based at Deakin; Organisation and address if non-Deakin</th>
<th>Email or phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natalie Lander</td>
<td>Deakin; Organisation and address if non-Deakin</td>
<td><a href="mailto:nlander@deakin.edu.au">nlander@deakin.edu.au</a></td>
</tr>
</tbody>
</table>

2. Inclusion of publication in a thesis

Is it intended to include this publication in a higher degree by research (HDR) thesis?  
Yes / No

If Yes, please complete Section 3  
If No, go straight to Section 4.

3. HDR thesis author’s declaration

<table>
<thead>
<tr>
<th>Name of HDR thesis author if different from above. (If the same, write “as above”)</th>
<th>School/Institute/Division if based at Deakin</th>
<th>Thesis title</th>
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</thead>
<tbody>
<tr>
<td>As above</td>
<td>Faculty of Health/School of Health and Social Development</td>
<td>Improving early-adolescent girls’ fundamental movement skills</td>
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</table>

If there are multiple authors, give a full description of HDR thesis author’s contribution to the publication (for example, how much did you contribute to the conception of the project, the design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)

I declare that the above is an accurate description of my contribution to this paper, and the contributions of other authors are as described below.

Signature* and date 25th November

4. Description of all author contributions

<table>
<thead>
<tr>
<th>Name and affiliation of author</th>
<th>Contribution(s) (for example, conception of the project, design of methodology or experimental protocol, data collection, analysis, drafting the manuscript, revising it critically for important intellectual content, etc.)</th>
</tr>
</thead>
</table>

5. Author Declarations

I agree to be named as one of the authors of this work, and confirm: that I have met the authorship criteria set out in the Deakin University Research Conduct Policy, that there are no other authors according to these criteria, that the description in Section 4 of my contribution(s) to this publication is accurate, that the data on which these findings are based are stored as set out in Section 7 below. If this work is to form part of an HDR thesis as described in Sections 2 and 3, I further consent to the incorporation of the publication into the candidate’s HDR thesis submitted to Deakin University and, if the higher degree is awarded, the subsequent publication of the thesis by the university (subject to relevant Copyright provisions).

<table>
<thead>
<tr>
<th>Name of author</th>
<th>Signature*</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisa Barnett</td>
<td></td>
<td>25th November</td>
</tr>
<tr>
<td>Jo Salmon</td>
<td></td>
<td>25th November</td>
</tr>
<tr>
<td>Philip Morgan</td>
<td></td>
<td>25th November</td>
</tr>
</tbody>
</table>

6. Other contributor declarations
I agree to be named as a non-author contributor to this work.

<table>
<thead>
<tr>
<th>Name and affiliation of contributor</th>
<th>Contribution</th>
<th>Signature* and date</th>
</tr>
</thead>
</table>

* If an author or contributor is unavailable or otherwise unable to sign the statement of authorship, the Head of Academic Unit may sign on their behalf, noting the reason for their unavailability, provided there is no evidence to suggest that the person would object to being named as author.

7. Data storage
The original data for this project are stored in the following locations. (The locations must be within an appropriate institutional setting. If the executive author is a Deakin staff member and data are stored outside Deakin University, permission for this must be given by the Head of Academic Unit within which the executive author is based.)

<table>
<thead>
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<th>Data format</th>
<th>Storage location</th>
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<th>Name of custodian if other than the executive author</th>
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</tbody>
</table>
Improving Fundamental Movement Skill Proficiency in Early-Adolescent Girls: A Pilot Cluster Randomised Controlled Trial

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\textbf{Running Title:} Improving girls’ fundamental movement skill

\textbf{Source of Funding:} Sports Medicine Australia Research Foundation, NASPSPA Research Grant

\textbf{Conflict of interest:} None to declare
ABSTRACT

Background: Physical activity levels decline substantially during adolescence, and are consistently lower in girls than boys. Competency in a range of fundamental movement skills (FMS) may serve as a protective factor for the decline in physical activity typically observed in adolescent girls; yet, girls’ mastery levels of FMS are low. Purpose: To evaluate the effectiveness of a school-based intervention, delivered by teachers, in improving girls’ FMS.

Method: Four all-girls Melbourne secondary schools were recruited and randomised into intervention or control groups. In total, 190 Year 7 girls (103 control/87 intervention, mean age 12.4 ± 0.3 years) completed baseline measures and post-test measures at 12 weeks. Six FMS (i.e., catch, throw, kick, jump, leap and dodge) were measured using the Victorian FMS Assessment instrument. Mixed models with post-test skill (i.e., locomotor, object control and total skill) as the outcome variable, adjusting for baseline skill, intervention and control status, and relevant covariates, as well as accounting for clustering at the school and class level, were used to assess the impact of the intervention. Results: At post-test there were significant intervention effects, and large effect sizes (Cohen’s d) noted in locomotor (p = 0.04, t = 5.15, d = 1.6), object control (p = <0.001, t = 11.06, d = 0.83) and total skill (p = 0.02, t = 7.22, d = 1.36).

Conclusion: A school-based FMS intervention focusing on authentic assessment and student-centred instruction significantly improved FMS competency in Year 7 girls.
INTRODUCTION
Regular physical activity (PA) is positively associated with a host of physical, psychological and social outcomes in youth (28, 53). Despite this, only one-third of children, and one in ten adolescents achieve the recommended 60 minutes of PA per day (30, 39). Females are significantly less active than males (9, 10, 31, 51), indeed, the most precipitous decline in PA is noted in adolescent girls, where PA levels drop by as much as 83% as they transition through adolescence (31).

Several systematic reviews have provided evidence for the positive and significant association between fundamental movement skill (FMS) competence and engagement in present and future PA (26, 42, 46; 56). FMS are basic skills and have been described as the building blocks of involvement in physical activity (19). They are typically classified into object control skills (e.g., catching and throwing), locomotor skills (e.g., running and jumping) and stability skills (e.g., balancing and twisting) (19). FMS competency in childhood is associated with higher levels of PA and fitness in adolescence (8, 44).

Despite evidence that developing proficiency in FMS has important health implications for young people (56), FMS proficiency of many children in Australia, and worldwide is low (6; 23, 41; 59, 60), and those from disadvantaged backgrounds often demonstrate the lowest levels of skill competency (23). Furthermore, girls exhibit especially low levels of object control proficiency (7). This is of great concern, as proficiency in object control skills is positively associated with, and predictive of, future PA levels (8; 56).

Most children are developmentally able to master FMS by the end of Grade 4 (19). Therefore, Primary School physical education (PE) should provide the ideal environment to assess, teach,
and improve these skills (48). However, many students, especially girls, pass through primary school PE, and the early developmental stages, without mastering the critical threshold of FMS necessary for successful participation in PA and the sports-based curriculum typical of secondary school PE (54). Furthermore, research suggests that skill deficits in girls often remain unidentified in high school PE programs (34, 37). Subsequently, remediation instruction may be rare, and opportunities to improve may be limited (17).

The low FMS competency observed among girls may be partially explained by socio-environmental factors (7), but may also reflect a failure of the ‘traditional’ approach to Physical Education (PE), in regards to skill improvement (14). The ‘traditional’ approach to PE is characterised by a dominance of elite-oriented, competitive, and multi-sport activities, and has been subjected to a sustained critique by scholars worldwide, as it fails to address the motivational means to engage girls in PE, and develop skills, knowledge and behaviours to sustain a healthy lifestyle (32). Compounding this, recent research has demonstrated, that although teachers are aware of the low skill levels in displayed by their students, and acknowledge the importance of FMS assessment and instruction, they have limited knowledge of how to best teach and assess female students, in order to improve FMS performance (18, 34, 37, 45).

In regards to pedagogy, it appears that exclusively directive teaching styles may not be the most advantageous for promoting support and motivation, nor achieving affective and cognitive learning outcomes, in regards to skill mastery (55, 63, 21, 29). However, despite this, there continues to be an over-reliance on traditional approaches to PE (i.e., teacher-directed teaching), and a void in the implementation of student-centred approaches that encourage skill mastery (20, 34, 37). The SAAFE (supportive, active, autonomous, fair and enjoyable) teaching principles
are a student-centred approach to instruction, which promote a mastery motivational climate (2), and has had significant success in school-based FMS interventions in recent years (13, 57). Furthermore, several FMS interventions, utilizing a mastery motivational approach, have demonstrated positive outcomes in FMS proficiency (55, 63, 29). However, despite adolescent girls being an at-risk group for low FMS, the influence of a mastery motivational climate on skill improvement in this demographic, has not yet been investigated.

Accurate identification of skill deficiency is a critical step in the cyclic process of skill improvement (22). The Canadian Agility and Movement Skill Assessment (CAMSA), designed as part of a larger study of children’s physical literacy, offers an alternative approach to the assessment of FMS proficiency (43). The CAMSA has been tested for reliability, validity and feasibility in Canadian children aged 6 to 14 years (43), and the feasibility, reliability and validity of the CAMSA has been tested for use by teachers in an Australian school setting (36). However, further research is required to determine the efficacy and effectiveness of the CAMSA, on the actual FMS proficiency of the students, when used by teachers in a school setting.

Current knowledge on FMS intervention effectiveness in the adolescent population is limited, and those targeting early-adolescent girls even more so. Therefore, the aim of this pilot clustered randomized controlled trial was to (i) evaluate the effectiveness of a PE based teacher led intervention, on early-adolescent girls’ FMS proficiency, and (ii) to report on the process evaluation of the intervention.

METHODS

Design
The project was a pilot cluster randomised controlled trial. Four schools were randomised, at the school level, into intervention (two schools, four classes, \( n = 87 \) students) or control groups (two schools, four classes, \( n = 103 \)). All eligible students completed baseline assessment measures (i.e., FMS), and follow-up measures were conducted immediately after the intervention (12 weeks). The design, conduct and reporting of the project adhered to the Consolidation Standards of Reporting Trials (CONSORT) guidelines (62). This research was approved by Deakin University Human Ethics (HEAG-H 96_2015) and the Catholic Education Office (2119-Lander).

**Participants**

200 Year 7 girls were (mean age 12.47±0.34) recruited from four Melbourne-based, all-girls schools (Figure 1). Eight teachers (four intervention; and four control) participated in the research. All teachers (n=8) were: (i) involved in the researcher led pre- and post-FMS testing of their students; and (ii) completed the teacher confidence questionnaires (pre- and post-intervention). The intervention teachers (n = 4) were observed by the researcher, at three time points (program beginning, mid program, program end), in regards to program implementation and fidelity, via the SAAFE teacher checklist (explained below).

**Recruitment**

Girls-only schools in mid to low socio-economic areas were the target population for this study. Schools were listed from low (index of \( \leq 5 \)) to high socio-economic rating using the socio-economic index for area (SEIFA) (4), and those with a lower rating were the first invited to participate in the project. School principals were contacted via email or phone, and then face-to-face meetings were arranged with interested principals. A formal letter of invitation, Plain Language Statement (PLS) and consent were sent to the principals, and consenting schools were
recruited. Subsequently, Year 7 PE teachers, and Year 7 students of consenting schools received a PLS and consent form inviting them to participate in the study. Students were eligible to participate in the program if they were in Year 7, able to actively participate in PE, and returned a signed consent form from their parents/guardians.

**Randomisation**

Randomisation by school was performed before teacher training and baseline assessments. The schools were randomly assigned to the intervention or a 3-month wait list control group. Schools were numbered one to four and an independent third party blindly allocated the schools into intervention or control treatments (Figure 1).

**Intervention**

The intervention included two main components (i) teacher training followed by (ii) 12-week FMS intervention delivered in PE lessons by the trained teacher.

(i) *Teacher Training Program*

The training program was designed to enhance the confidence and competence of the PE teachers in two important pillars of effective teaching of FMS: pedagogy and assessment; and to subsequently create a more student-centred, motivating learning environment. The teacher training was conducted at each intervention school in Term 4, 2015 and included: (i) a 4-hour face-to-face interactive workshop/seminar; (ii) written resources (i.e., teacher manuals including protocols and procedures, score sheets, example lesson plans, activity suggestions, and lesson planning and delivery checklists); (iii) three onsite teaching observations (SAAFE teaching principles), with three accompanying 30 minute post-observation consultations per teacher, and;
(iv) regular teacher prompted on-going support (e.g., phone consultation, email support, and feedback provision in regards to their implementation and analysis of the CAMSA and fidelity to SAAFE teaching checklist).

Teacher training content included the background, context and importance of FMS assessment and instruction in regards to girls FMS development, the administration and evaluation procedures of the CAMSA (43), as well description and rationale for the SAAFE teaching principles (47). The CAMSA assesses FMS in a dynamic format that requires students to run a total distance of 20 metres while completing seven movement skill tasks: two-footed jumping into and out of three hoops on the ground, sliding from side to side over 3 metres, catching a ball and then throwing the ball at a wall target 5 metres away, skipping for 5 metres, one-footed hopping in and out of six hoops on the ground, and kicking a soccer ball between two cones 5 metres away. Performances are evaluated using completion time and reference criteria (i.e. ‘process’ and ‘product’ measures). The SAAFE teaching principles are a student-centred approach to teaching, broadly framed by self-determination theory (15), competence motivation theory (24, 25). Effective teachers are able to manipulate the SAAFE teaching environmental dimensions (i.e., supportive, active, autonomous, fair and enjoyable), to foster a mastery motivational climate, and subsequently enhance opportunity and desire to learn (47). The combined effect of authentic assessment (i.e., CAMSA), while providing an environment where the students are optimally motivated to learn (i.e., SAAFE teaching principles), may enable the teacher to more accurately identify skill deficiency and proficiency and more effectively meet the learning needs of the girls.

The structure and format of the teacher training program was framed by the recommendations identified in a recent systematic review on the characteristics of teacher training in PE-based
FMS/PA interventions (35) and successful elements of FMS interventions (50). Specifically, the teacher training was multi modal, contained subject and pedagogy content, included onsite and ongoing consultation, and included satisfaction and fidelity checks.

(ii) *Curriculum Program*

The intervention involved a 12-week × 90-minute HPE program delivered during regular Health and Physical Education (HPE) sessions by the HPE teacher. The teachers: (i) administered the CAMSA to each Year 7 student in week 2 of Term 1, 2016; (ii) analysed the CAMSA assessment data to provide a baseline level of skill for each student; and (iii) used CAMSA assessment data and SAAFE teaching principles to plan, develop and deliver subsequent PE lessons targeting FMS across Term 1, 2016. The teachers implemented their prescribed curriculum content, but were encouraged to utilise the CAMSA assessment data, in regards to identifying the baseline level of skill proficiency of their students, and adhere to the SAAFE teaching principles in order to create an optimal learning environment for skill improvement.

*Control (Wait List Control Group)*

The control group participated in their usual 90-minute HPE lesson over the 12-week intervention period with their regular PE teacher. The units covered during this period included softball, soccer and athletics. The control group teachers then received the teacher training after the completion of the study period.

**Outcome Measures**

*Primary Outcome Measure: Student FMS Proficiency*
Students’ actual FMS were assessed at two time points: baseline which occurred in Week 1, Term 1 2016; and at post-intervention, which occurred 12 weeks later (Figure 1). Six FMS (catch, overhand throw, kick, sprint run, dodge and vertical jump) were assessed using the Victorian FMS Teachers’ Manual (16). The battery was selected because: the reliability and validity of the skills has previously been established (16), the instrument has been used in FMS research in school settings, in children of similar age (27, 52, 54); the skills align to those required in the Year 7 PE curriculum and to activities and sports the students are most likely to participate in; and the skills closely align to those measured in the CAMSA.

Each skill is composed of observable behavioural components, which together constitute a mature performance of the skill. Students received a score of ‘1’ if they performed the component correctly and a score of ‘0’ if it was not performed correctly. The students performed two scored trials of each skill, and the components performed correctly were summed to create a total score (i.e., locomotor skill 0–30, object control skill 0–36, total skill 0–66), with a higher score indicating greater proficiency. Students were divided into groups of six and rotated through the six skill stations. Video cameras were used to tape each student’s performance in each skill. The lead researcher analysed all baseline assessments. A total of 10% of the assessments were randomly selected, and an expert evaluator performed a quality control check of each assessment. An interrater reliability analysis using the Kappa statistic was performed to determine consistency per skill among raters, and an ‘almost perfect’ inter-observer agreement was found (Kappa = 0.90, p = <0.001) (38). To enhance the rigour of the study and to ensure ‘blindness’ to intervention status the roles of the expert rater and lead researcher were reversed for post-test data analysis, and again an ‘almost perfect’ inter-observer agreement was attained (Kappa = 0.87, p = <0.001) (38).
Demographic Measures

Parents/Guardians of participating students completed a questionnaire as part of the consent process to obtain demographic details of the student such as: age (date of testing – date of birth); cultural background; primary language spoken at home; and parent education. The demographic data was investigated as potential covariates of the intervention effect.

Teacher demographic information such as age (date of birth), sex, years of teaching experience and qualifications were obtained from the demographics section in Teacher Questionnaire 1.

Process Evaluation

The following aspects of process evaluation of the program were examined: (i) recruitment and retention; (ii) pre and post intervention teacher competence surveys; (iii) teacher program satisfaction; and (iv) fidelity to the SAAFE teaching principles.

Recruitment and Retention

Recruitment and retention was ascertained via record keeping of recruitment success, teacher attendance at workshops, and student/teacher retention.

Teacher Competence Questionnaire

The teacher competence questionnaire was administered to all teachers (intervention and control) prior to baseline assessments, and prior to the teacher training session for the intervention teachers. The second teacher questionnaire was again administered to all teachers (n=8) at the end of the 12 weeks (post-intervention). The questionnaire was a modified version of The Primary School PE questionnaire developed by Morgan and Hansen (49), and was used to collect
information about the teachers’ experiences, feelings and practices when assessing and instructing FMS to Year 7 students (Supplementary Table 1). The same set of questions were asked in the pre and post intervention surveys, and each question was measured on a 6-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = disagree slightly, 4 = agree slightly, 5 = agree, 6 = strongly agree).

**Teacher Satisfaction**

Teachers also completed a questionnaire regarding satisfaction in the provisions of training, resources, onsite consultation and ongoing support. The rating scale responses ranged from 1 to 6 (1 = very unsatisfied, 2 = somewhat unsatisfied, 3 = neither unsatisfied nor satisfied, 4 = somewhat satisfied, 5 = satisfied, 6 = very satisfied).

**Fidelity to SAAFE Teaching Principles**

Fidelity to the SAAFE principles was determined via direct observation of each intervention teacher on three occasions (early, mid and late intervention), using the SAAFE teaching check list (Supplementary Table 2). Each teaching principle (Supportive, Active, Autonomous, Fair and Enjoyable) was assessed according to three predefined criteria per principle. For example, the supportive teaching principle is characterised by the following three criteria: (i) teacher provides individual skill specific feedback; (ii) teacher provides feedback on student effort and involvement; and (iii) teacher promotes positive interactions between students. Each criteria is assessed on a 5 point Likert scale (i.e., 1 = not at all true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very true). Scores for each criterion were accumulated to provide an aggregate score across the three observations, resulting in a potential score range of 3–15 per teaching principle. Teachers were aware that they would be observed on three separate occasions.
throughout the program; however, in an attempt to ascertain a more authentic observation, they were unaware of the observation date, and thus could not plan specifically or differently for observation lessons.

**Data Management and Analysis**

All quantitative analyses were conducted using the statistical software package SPSS (version 23.0), and statistical significance was set at $p = 0.05$. Descriptive statistics were used to investigate the student sample characteristics. Student demographic data was initially coded as: cultural background (Australian = 1, European = 2, Asian = 3); primary language (English = 1, other = 2); parent education (Year 10 = 1, secondary = 2, tertiary = 3). Variables with insufficient numbers were collapsed to allow for analysis (i.e., parent education – Yr 10 variable removed due to no respondents; cultural background – Asian and European variables collapsed due to small numbers and a dichotomous variable of Australian = 1, other = 2 was created).

Differences between groups at baseline, for relevant covariates were examined using independent sample t-tests for continuous data (i.e., age; baseline locomotor skill, object control skill, and total skill level) and chi-square tests of independence for categorical data (i.e., primary language – English/other; parent education-secondary/tertiary, and; cultural background – Australian/other). Variables with associations of $p < 0.20$ with object control or locomotor skill were entered as covariates in the mixed model. The less stringent significance level ($p < 0.20$) was chosen for variable inclusion in the model, because variables may contribute to a regression model in unexpected ways due to the potentially complex inter relationships among the variables (1). Mixed models with post-test skill (i.e., locomotor, object control and total skill) as the outcome variable, adjusting for baseline skill, intervention and control status, and relevant
confounders, as well as accounting for clustering at the school and class level, were used to assess the impact of the intervention on student skill.

As part of the process evaluation, descriptive analysis was used to investigate the teacher competence questionnaires. To determine if there was a change in scores across the intervention period, Questionnaire 1 (pre-intervention) rankings were subtracted from Questionnaire 2 (post intervention) rankings. Ranking score comparisons between the intervention and control groups were also made to investigate the change in the teachers’ experiences, perceptions and practices when teaching and assessing FMS following the intervention.

RESULTS

Student Demographics

The characteristics of the student sample at baseline are presented in Table 1. Initially 200 students from eight Year 7 classes (four Melbourne based all-girls secondary schools) were recruited to the study. However, 10 students (control=7, intervention=3) were absent at post-test. Therefore, the total student sample with pre-intervention and post-intervention measures was 190 Year 7 girls, with a mean age of 12.47±0.34 years. The cultural background of the sample was largely Australian. The primary language spoken at home was English. Just over three-quarters of the sample’s parents had a tertiary education, and the remainder had completed secondary education.

Teacher Demographics

All teachers (n = 8) were specialist PE teachers, seven female and one male. Their ages ranged from 26 to 58 years, teacher experience ranged from two years to 32 years, six of the teachers
had a four-year bachelor degree, and two had a three-year degree (plus one year diploma) (Supplementary Table 3).

**Intervention Effect on Girls’ FMS**

When investigating potential covariates, chi-squared tests revealed that there was no significant association observed in cultural background ($x^2 = 1.904, p = 0.168$), nor primary language spoken ($x^2 = 0.484, p = 0.487$) between groups at baseline in regards to skill. However, there was a significant association observed in parent education ($x^2 = 4.097, p = 0.043$). Independent $t$-tests showed no association between groups at baseline for age ($t = 0.283, df = 180.816, p = 0.777$), locomotor skill ($t = -0.760, df = 180.063, p = 0.448$), object control skill ($t = 0.232, df = 183.757, p = 0.817$), nor total skill ($t = -0.224, df = 180.398, p = 0.823$). As parent education and cultural background showed associations of $p < 0.20$ they were entered as covariates in the mixed models (1).

Table 2 describes the means and standard deviations for the primary outcome of skill, at baseline and post intervention, for both the intervention and control groups. Relative to the control group, there were very large effects sizes noted in the locomotor skill scores (Cohen’s $d = 1.6$), large effect size for object control skill (Cohen’s $d = 0.83$), and a very large effect size for total skill (Cohen’s $d = 1.36$) (62), all in favour of the intervention group.

Table 3 presents the intervention effects on students’ skill, when adjusting for all relevant covariates, as well as accounting for clustering and the school and class level. Parent education and cultural background were entered into the model as covariates. However, neither appeared significant. Subsequently, both were removed. The final models show that at post-test there were
significant intervention effects in locomotor skill \((p = 0.04, t = 5.15)\), object control skill \((p < 0.001, t = 11.06)\), as well as total skill \((p = 0.02, t = 7.22)\).

**Process Evaluation**

There was a 95% student and 100% teacher retention rate. All intervention teachers \((n = 4)\) attended the four-hour training session and all three of the individualised consultation sessions.

*Teacher Competence Questionnaire*

Results of the teacher questionnaires indicated that the intervention teachers’ feelings, experiences and competence around teaching and assessing FMS improved across the intervention, whereas the control teachers remained stable. The greatest improvements were noted in the intervention teachers’ perceptions around FMS reporting; program evaluation; and, FMS assessment, with an average improvement of approximately two points (on the 6 point Likert scale), per survey domain from pre to post. There were also noteworthy differences for intervention teachers in their perceptions of confidence when teaching and assessing FMS (improvement of one point on the 6 point Likert scale). Furthermore, there was a decrease in the perceived barriers to effective FMS assessment and instruction noted in the post-test responses of intervention teachers in comparison to post-test results of the control teachers.

*Teacher Satisfaction*

All teachers were satisfied or very satisfied with the four-hour training workshop and with the amount and quality of resources provided. All teachers were very satisfied with the onsite/ongoing consultation.
Fidelity to SAAFE Teaching Principles

The intervention teachers’ fidelity to each individual SAAFE teaching principle was recorded across the three observation episodes. In all SAAFE teaching principles there was an upward trend observed from the first to third observation point. It appears that most of this change was accounted for between observation two and three, which occurred after two observations and feedback in regards to the teachers’ fidelity to SAAFE teaching, and two 30 minute individualised consultations. At baseline observations the teachers generally displayed a moderate level of fidelity to the teaching principles (‘sometimes true’), with the greatest baseline fidelity observed in the supportive principles, and least fidelity to the autonomous principle. At observation three (end program) the adherence had improved in each of the principles, generally rating one or two categories above for each principle, rating predominantly in the highest two categories (‘true’ or ‘very true’). However, despite this improvement, the teachers’ adherence to the autonomous principle still remained below all others (Adherence to SAAFE Principles presented in Supplementary Figures 1–5).

DISCUSSION

The aim of this pilot cluster randomized controlled trial was to evaluate the effectiveness of an intervention to improve early-adolescent girls’ FMS proficiency, and to report on the process evaluation of the intervention. The PE-based FMS intervention resulted in considerable favourable effects. Significant improvements and large effect sizes were observed in locomotor skills, object control skills and in total skill competency among girls in the intervention group compared with the control group. The teachers were satisfied with all aspects of the intervention program, and demonstrated high levels of adherence. Importantly, the intervention teachers’
feelings, experiences and competence around teaching and assessing FMS improved across the intervention.

The positive findings of the intervention are congruent with findings from recent reviews demonstrating that interventions can improve FMS competence in both children and adolescents (33, 40, 50). The current intervention effect was large, and similar to that presented in a meta-analysis of FMS interventions conducted by Morgan and colleagues (50). However, all but one of the interventions presented in the review targeted children, not adolescents. The only study in that review to have targeted adolescents’ (boys and girls) FMS (29), demonstrated a small effect size in total skill (Cohen’s $d = 0.06$). The present study clearly demonstrates the capacity for skill improvement to occur in older children and adolescence, when the provision of instruction and assessment are optimal.

In the current study, a large effect size was attained for object control skills. This is an important finding as a recent systematic review identified that girls perform more poorly in object control skills than boys (7) and object control skill is a predictor for adolescent physical activity engagement (8, 11, 12, 56). The only other study to have targeted girls’ FMS, focused on younger children (Year 3) (5); and although there was a large effect size noted, the risk of bias for that study was high (50).

The findings of this study demonstrate that quality instruction is of utmost importance in improving FMS competence (19). Adherence to the SAAFE teaching principles created a mastery climate (2). These findings are congruent with other pre-school and school based interventions implementing a mastery climate (55, 63), and align with recent studies implementing the SAAFE teaching principles (13, 57). Therefore, strategies such as the SAAFE
teaching principles, which operationalize optimal environmental conditions, are strongly encouraged in future school based FMS interventions, especially those targeting girls.

The use of the CAMSA (43) as assessment ‘for’ learning, was another central focus of this intervention. According to the National Association for Sport & Physical Education’s National Standard for Physical Education (58), assessment plays an important role in motor skill instruction. Meaningful assessment is more than observation, it requires teachers to possess the skills and knowledge to design lessons in accordance with existing abilities, and to provide appropriate feedback for all learners with formative assessments in order to promote and advance proficiency (58). In the current study, training in, and implementation of the CAMSA, allowed the teachers to more authentically identify the baseline level of skill the Year 7 students entered the intervention with. The findings of this study support integrating the CAMSA as a form of assessment ‘for’ learning into school-based FMS interventions. Therefore, this instrument may be an alternative to the more traditional forms of FMS assessment used in school settings.

The current study focused on evidence-based teacher training as the foundation for effective intervention implementation (35), to improve the provisions of assessment and instruction in order to promote girls’ FMS. The ongoing teacher engagement and measurement of teacher satisfaction and fidelity were used to encourage teacher collaboration, engagement and ownership, and thus compliance with the program (3, 35, 50). The positive results of this study demonstrated that a high-quality teacher training program has the potential to enhance teacher knowledge, competence and skills in FMS assessment and instruction. Therefore, comprehensive teacher training, framed by evidenced based recommendations, should be seen as critical component of future school-based FMS interventions.
Strengths and Limitations

To the authors’ knowledge, this is the first study to investigate the effects of a teacher delivered, PE based intervention, on the FMS proficiency of adolescent girls. There are several strengths of this pilot study, these include the cluster randomised controlled trial design, the objective assessment of FMS, the very high level (95%) of retention in the student sample, and the monitoring of intervention compliance/fidelity. Furthermore, the fact that this intervention was integrated into the school’s regular curriculum and was teacher-led, may enhance the potential for program sustainability. However, the small number of teachers was a limitation and allowed for only descriptive analysis in regards to process evaluation. In addition, there was not an inclusion of follow-up measures, so it is not possible to determine whether FMS changes persisted (33). Furthermore, the generalisability of the findings may be limited due to the relatively homogenous, girls-only sample. Therefore, future research is recommended to: use larger samples of teachers to investigate further the effect of the intervention on teachers’ perceptions and practices on FMS instruction and assessment; to conduct follow up measures on student skill to investigate the maintenance effect of the program, and; future research may also seek to investigate the effectiveness of the intervention in boys and also, larger, diverse samples.

Conclusions

The teacher-led PE-based FMS intervention focusing on teacher training in authentic assessment and student-centred instruction resulted in significant intervention effects on girls’ locomotor skill, object control skill and overall FMS competency. The intervention also had a positive effect on the perceptions, confidence and feelings of the teachers in regards to FMS assessment and instruction. The findings clearly demonstrate the crucial role that schools, physical education
programs, and importantly teachers can have on improving FMS in early-adolescent girls, potentially increasing the physical activity opportunities available to them and ultimately enhancing their health profile.

Acknowledgements

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Conflict of Interest

The authors do not have any professional relationships with companies or manufacturers who will benefit from the results of the present research. The results of the present study do not constitute endorsement by ACSM. The results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation

References


Figure 1: Study design and flow of participants through the study with primary and secondary outcome measures.

List of all-girls schools provided by DET, CEO, Independent Schools Office (n=42 schools)

4 schools removed due to different amount of PE exposure to all other schools (n = 38 schools)

Schools recruited in rounds; lowest SEIFA index schools contacted first

Four schools consented (2 independent, 2 Catholic)

Randomization at school level

2 Intervention schools (1 Catholic, 1 independent)
  n=90 students
  n= 4 teachers

2 Control schools (1 Catholic, 1 independent)
  n=110 students
  n=4 teacher

Baseline Testing
Primary Outcome: n=200 students, Secondary outcome: n=8 teachers

12-week intervention/12 week regular practice

Post Testing
Primary Outcome: n=190 students, Secondary Outcome: n=8 teachers

23 schools declined:
  Too busy: 10
  Overcrowded curriculum: 11
  Already engaged in research: 2
11 schools not contacted as target sample reached
Table 1: Baseline characteristics of study sample (students)

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Intervention (n = 103)</th>
<th>Control (n = 87)</th>
<th>Total (n = 190)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Years (SD)</td>
<td>12.48</td>
<td>12.46</td>
<td>12.47 (±.34)</td>
</tr>
<tr>
<td>Cultural Background</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian</td>
<td>78 (75.7)</td>
<td>58 (66.7)</td>
<td>136 (71.6)</td>
</tr>
<tr>
<td>Other</td>
<td>25 (24.3)</td>
<td>29 (33.3)</td>
<td>54 (28.4)</td>
</tr>
<tr>
<td>Primary Language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>93 (90.3)</td>
<td>81 (93.1)</td>
<td>174 (91.6)</td>
</tr>
<tr>
<td>Other</td>
<td>10 (9.7)</td>
<td>6 (6.9)</td>
<td>16 (8.4)</td>
</tr>
<tr>
<td>Parent Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>17 (16.5)</td>
<td>25 (28.7)</td>
<td>42 (22.1)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>86 (83.5)</td>
<td>62 (71.3)</td>
<td>148 (77.9)</td>
</tr>
</tbody>
</table>
Table 2: Primary outcome measure (student FMS proficiency) at baseline and post-test

<table>
<thead>
<tr>
<th>Measure</th>
<th>Control Mean (SD)</th>
<th>Intervention Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Post-Test</td>
</tr>
<tr>
<td>FMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locomotor Skill</td>
<td>22.06 (3.35)</td>
<td>22.21 (3.37)</td>
</tr>
<tr>
<td><em>Potential Range</em> (0–30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Control Skills</td>
<td>23.03 (4.65)</td>
<td>23.16 (4.54)</td>
</tr>
<tr>
<td><em>Potential Range</em> (0–36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Skill</td>
<td>45.09 (6.70)</td>
<td>45.37 (6.61)</td>
</tr>
<tr>
<td><em>Potential Range</em> (0–66)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3: Intervention effect on locomotor skill, object control skill and total skill

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Locomotor Skill</th>
<th>Object Control Skill</th>
<th>Total Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95% Confidence Interval</td>
<td>95% Confidence Interval</td>
<td>95% Confidence Interval</td>
</tr>
<tr>
<td></td>
<td>Unst. Beta</td>
<td>Std. Error</td>
<td>df</td>
</tr>
<tr>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.29</td>
<td>4.87</td>
<td>184.73</td>
</tr>
<tr>
<td>Intervention/ control status</td>
<td>4.29</td>
<td>0.84</td>
<td>1.96</td>
</tr>
<tr>
<td>Age</td>
<td>0.17</td>
<td>0.38</td>
<td>185.13</td>
</tr>
<tr>
<td>Baseline Skill</td>
<td>0.78</td>
<td>0.04</td>
<td>184.63</td>
</tr>
</tbody>
</table>

*dependent variable: post-test skill (locomotor, object control, total skill)*
Supplementary Table 1: Perceived teacher competence questionnaire

<table>
<thead>
<tr>
<th>Survey domain</th>
<th>Example of survey questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain 1. Feelings and perceptions about FMS and FMS teaching</td>
<td>I enjoy teaching FMS; FMS is an important component in the PE curriculum; I am generally enthusiastic about teaching FMS</td>
</tr>
<tr>
<td>Domain 2. Confidence in teaching individual PE units</td>
<td>I am confident in teaching sports I am confident in teaching fitness I am confident in teaching FMS</td>
</tr>
<tr>
<td>Domain 3. Confidence in FMS planning, teaching, assessing, reporting and evaluating</td>
<td>I am confident in lesson planning for FMS I am confident in implementing teaching and learning strategies in FMS I am confident in assessing students learning in FMS</td>
</tr>
<tr>
<td>Domain 4. Adequacy of Training (pre-service and in service) in specific PE curriculum units</td>
<td>My training prepared me adequately to teach modified games My training prepared me adequately to teach modified games My training prepared me adequately to teach modified games FMS</td>
</tr>
<tr>
<td>Domain 5. Success of PE programs in achieving specific PE curriculum units outcomes</td>
<td>The PE programs have been successful in achieving modified games unit outcomes The PE programs have been successful in achieving sports unit outcomes The PE programs have been successful in achieving FMS unit outcomes</td>
</tr>
<tr>
<td>Domain 6. Success of PE programs in achieving student outcomes</td>
<td>The PE programs have been successful in improving the level of physical activity The PE programs have been successful in improving students’ interpersonal skills The PE programs have been successful in improving students’ confidence</td>
</tr>
<tr>
<td>Domain 7. PE Planning within the school</td>
<td>The school has a formal planning team that meets routinely to monitor and initiate programs to promote PE in the school Teaching programs are developed from an overall PE policy A school level scope and sequence overview guides planning in PE</td>
</tr>
<tr>
<td>Domain 8. FMS programming within PE</td>
<td>FMS programs cater for the diversity of student learning needs Previous outcomes achieved by students are considered when implementing lessons Learning experiences selected in FMS programs engage student interest and provide appropriate challenge</td>
</tr>
<tr>
<td>Domain 9. FMS Assessment</td>
<td>A range of assessment strategies used to assess student FMS learning in PE Indicators are used to make judgements about student achievement of outcomes The assessment process is based on syllabus outcomes and reflect syllabus content</td>
</tr>
<tr>
<td>Domain 10. FMS reporting</td>
<td>Students FMS achievement outcomes are reported and communicated to the relevant audience Parents/caregivers are given feedback regarding what their child knows and what skills they have gained</td>
</tr>
<tr>
<td>Domain 11. FMS evaluation</td>
<td>Evaluation of FMS programs in PE is comprehensive. FMS programs in PE are modified and improved as a result of evaluation.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Domain 12. Barriers to the effective delivery of FMS in my PE program</td>
<td>Low levels of FMS teaching confidence. Inadequate training in FMS. Low levels of personal interest and enthusiasm in teaching FMS. Inadequate facilities or equipment.</td>
</tr>
</tbody>
</table>
Supplementary Table 2: Adherence to SAAFE teaching principles

<table>
<thead>
<tr>
<th>Adherence to SAAFE teaching principles (circle and provide comments)</th>
<th>(1 = Not at all true to 5 = Very true)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPORTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>i) Teacher provides individual skill specific feedback</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>ii) Teacher provides feedback on student effort and involvement</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>iii) Teacher promotes positive interactions between students</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>ACTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>i) Activities involve small-sided games or tabloids and children spend minimal time waiting for a turn</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>ii) Equipment is plentiful and developmentally appropriate</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>iii) Transitions between activities are efficient</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>AUTONOMOUS</strong></td>
<td></td>
</tr>
<tr>
<td>i) Some activities incorporate multiple challenge levels</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>ii) Students are given choices about the tasks and activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>iii) Students are involved in the set-up, decision-making or running of activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>FAIR</strong></td>
<td></td>
</tr>
<tr>
<td>i) Teacher ensures that students are evenly matched in activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>ii) Teacher acknowledges and rewards good sportsmanship</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>iii) If necessary, teacher modifies activities to maximise opportunities for success</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>ENJOYABLE</strong></td>
<td></td>
</tr>
<tr>
<td>i) Lesson starts with an enjoyable activity and concludes with an enjoyable experience</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>ii) Activities are meaningful and not repetitive</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>iii) Lessons involve a wide range of appropriate activities (based on the lesson focus)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>General comments:</strong></td>
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**Supplementary Table 3:** Participant (teacher) demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Frequency (n)</th>
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</thead>
<tbody>
<tr>
<td><strong>Sex (n = 8)</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>21–30</td>
<td>3</td>
</tr>
<tr>
<td>31–40</td>
<td>2</td>
</tr>
<tr>
<td>41–50</td>
<td>1</td>
</tr>
<tr>
<td>≥51</td>
<td>2</td>
</tr>
<tr>
<td><strong>Years of teaching experience (n = 8)</strong></td>
<td></td>
</tr>
<tr>
<td>0–5 years</td>
<td>1</td>
</tr>
<tr>
<td>6–10 years</td>
<td>5</td>
</tr>
<tr>
<td>11–20 years</td>
<td>0</td>
</tr>
<tr>
<td>≥21 years</td>
<td>2</td>
</tr>
<tr>
<td><strong>Qualifications (n = 8)</strong></td>
<td></td>
</tr>
<tr>
<td>4-year bachelor degree</td>
<td>6</td>
</tr>
<tr>
<td>3-year degree (+ 1-year diploma)</td>
<td>2</td>
</tr>
<tr>
<td><strong>School sector represented (n = 4)</strong></td>
<td></td>
</tr>
<tr>
<td>Catholic</td>
<td>2</td>
</tr>
<tr>
<td>Independent (Private)</td>
<td>2</td>
</tr>
</tbody>
</table>
**Supplementary Figure 1:** Adherence to the *supportive* teaching principle.

**Supplementary Figure 2:** Adherence to the *active* teaching principle.
Supplementary Figure 3: Adherence to the *autonomous* teaching principle.

Supplementary Figure 4: Adherence to the *fair* teaching principle.
Supplementary Figure 5: Adherence to the enjoyable teaching principle.
CHAPTER 6: DISCUSSION

In this chapter, the key findings of each thesis aim are presented, followed by a synthesis of the overall thesis significance. Implications for professional practice, pre-service education and in-service teacher training in schools are also discussed, along with a presentation of the thesis limitations. Finally, recommendations for future research are provided.

6.1 KEY FINDINGS

Aim 1. To investigate the type and quantity of teacher training in school-based physical education PA and/or FMS interventions, and to identify what role teacher training had on the intervention outcome.

In Chapter 1 (Paper 1), the systematic review, we investigated the first thesis aim. The search identified 39 relevant articles. However, in regards to teacher training, these studies differed in design, mode, duration, content, framework, and trainee and trainer characteristics; in addition, the depth of detail provided on each characteristic varied significantly. Variability in reporting made links between teacher training and student outcomes or intervention effects difficult to trace. Despite these limitations, the review identified several key characteristics of teacher training in effective PA and/or FMS interventions, which included as essential design elements: a ‘sustained’ teacher training program; a multimodal approach to teacher training delivery, with a focus on ongoing consultation and collaboration; comprehensive intervention content (i.e., subject and pedagogy content); and the inclusion of teacher satisfaction and fidelity evaluation. Therefore, to better inform the design of future school-based interventions, and to allow
comparison between interventions, comprehensive reporting of teacher training is recommended. In addition, teacher training should be viewed as a central aspect of study design, development and delivery.

**Aim 2. To examine PE teachers’ perceptions of: (i) the importance and relevance of teaching FMS to Year 7 girls; and (ii) the factors influencing effective FMS instruction.**

Chapter 2 (Paper 2) revealed that teachers unanimously agreed Year 7 was a critical time to teach FMS to girls. Teachers presented several justifications for this. Firstly, many female students commenced secondary school with very low levels of FMS proficiency, often due to the poor quality of primary school PE. Secondly, Year 7 was considered a critical time to remediate FMS deficiencies before students undertake more complex units in the predominantly traditional or multi-sport program of secondary school PE curriculums. Thirdly, teachers perceived that the physical, social and emotional developmental stage of Year 7 girls meant they were still attitudinally receptive to skill development instruction, providing the last ‘window of opportunity’ for skill development. Therefore, although FMS interventions in early high school are limited and under-studied (Morgan et al., 2013), the findings of Chapter 2 clearly highlighted the demand and pertinence of FMS interventions at the Year 7 level for girls.

In Chapter 2 we also investigated the factors influencing effective FMS instruction, as perceived by teachers. Although teachers considered the teaching of FMS at Year 7 to be important, they perceived their own FMS teaching practices to be sub optimal. Two major barriers to effective FMS teaching as perceived by the teachers, included: limited knowledge of appropriate pedagogy to promote FMS development in girls, and; the lack of appropriate FMS assessment,
available for use by teachers in a PE setting. These findings provided research direction for the thesis, in order to improve the quality of FMS assessment and instruction to Year 7 girls.

Teachers also indicated that the depth and quality of FMS training they received during their pre-service education had not sufficiently equipped them with the skills, knowledge or confidence to teach FMS effectively. In addition, participants felt that more effective professional development could enhance their skill in instructing FMS.

**Aim 3. To explore whether the CAMSA is a feasible FMS assessment instrument for teachers of Year 7 girls in an Australian school-based PE context.**

In Chapter 3 (Paper 3) we investigated the third research aim. The study explored whether the CAMSA is a practical form of FMS assessment for use by PE teachers of Year 7 girls in Australia. The teachers unanimously agreed that the CAMSA was a feasible test of FMS proficiency in girls’ Year 7 PE, and an attractive alternative to the traditional forms of FMS assessment. However, some recommendations for modification were provided, including setting up several CAMSA courses simultaneously to facilitate more timely assessment, using the data to plan subsequent classes and sharing the process with the students (i.e., self-assessment and/or peer-assessment). The recommended alterations were included in the teacher training component for use of the CAMSA in Chapter 5 (Paper 5).

**Aim 4. To compare the test-retest reliability and concurrent validity of the CAMSA with a commonly used FMS assessment instrument, the Victorian FMS Assessment (Department of Education Victoria, 1996), developed to be used by teachers in a PE setting.**
In Chapter 4 (Paper 4) we addressed the fourth thesis aim. The study tested the concurrent validity and reliability of the newly developed CAMSA and compared it with the Victorian FMS Assessment from Australia in a sample of early adolescent girls. Test-retest reliability was excellent for the CAMSA and good for the Victorian FMS Assessment. There was no evidence of proportional bias in either assessment, and there was evidence of strong concurrent validity. Thus, both instruments were found to be reliable and valid; however, the CAMSA was considered to be the superior of the two as it encapsulated both process and product assessment, took less time to administer and had higher authenticity than the Victorian FMS Assessment in a school setting.

Aim 5. To investigate whether an intervention focusing on teacher training in and teacher delivery of authentic assessment (i.e., the CAMSA) coupled with student-centred pedagogy (i.e., SAAFE teaching principles) across a 12-week PE program can improve the FMS proficiency of Year 7 girls.

In Chapter 5 (Paper 5) we undertook a cluster randomised controlled trial and addressed the final research aim. The PE-based FMS intervention focused on teacher training in authentic assessment (i.e., the CAMSA) (Longmuir et al., 2015) and student-centred instruction (i.e., the SAAFE teaching principles) (Lubans et al., 2012) and resulted in very large intervention effects. Significant improvements were observed in the treatment group in locomotor skills, object control skills and total skill competency. Thus, the SAAFE teaching principles, which facilitate class conditions that foster motivation, are recommended for future school-based FMS interventions, especially those targeting girls. In addition, use of the CAMSA as a form of assessment ‘for’ learning contributed to the success of the intervention. The positive results of this study demonstrate that a high-quality teacher training program can enhance teacher
knowledge, competence and skills in FMS assessment and instruction, and ultimately improve student skill.

6.2 STUDY SIGNIFICANCE

Given the significant influence of PA on an individual’s health, and the comprehensive evidence for the positive and significant association between FMS competence and engagement in PA, it is crucial to better understand the factors that inhibit and facilitate FMS development among youth, particularly those who are at most risk of being low skilled and physically inactive, such as adolescent girls. Systematic review evidence has demonstrated the potential to improve FMS in children via school-based interventions, specifically those utilising a specialist or highly trained PE teacher. However, current knowledge on FMS intervention effectiveness in the adolescent population is limited, and those targeting early-adolescent girls even more so. To the author’s knowledge, this is the first research to synthesise existing evidence and generate new knowledge in regards to FMS improvement in early-adolescent girls. The inter-related research studies of this thesis culminated in the development of an intervention evaluated using a pilot cluster RCT to improve FMS in adolescent girls. Participants who were randomised into the intervention group showed significant improvements in FMS proficiency compared with those in the control groups. The findings of this thesis reinforce the important role of the teacher in fostering FMS in early-adolescent girls. It is hoped that by advancing the FMS of girls, their opportunities and interests in various physical activities may be expanded, ultimately improving their lifelong health profile. The findings of this study demonstrate that with a comprehensive understanding of the learning needs of adolescent girls, an optimal learning environment to achieve PE outcomes can be created. The results also illustrate that, with sufficient training,
resources and support, teachers have the capacity to significantly advance the physical skills of their students.

6.3 IMPLICATIONS FOR PROFESSIONAL PRACTICE, PRE-SERVICE EDUCATION AND IN-SERVICE TEACHER TRAINING

6.3.1 Implications for professional practice

The research conducted for this thesis clearly identified and addressed the barriers and facilitators of teaching and learning of FMS in early-adolescent girls. One of the major barriers identified by the teachers was a lack of appropriate assessment instrumentation. The present research identified the CAMSA as a feasible, valid and reliable assessment instrument for use by Australian PE teachers. Using this program as a means of diagnostic assessment, by screening students’ skill levels as they transition from Year 6 (primary school) to Year 7 (first year of high school), could identify the entry level FMS proficiency of Year 7 students. Subsequently, FMS programs could be developed and delivered in a more targeted, meaningful and effective manner. By improving student FMS proficiency of adolescent girls, they may be more likely to find physical activities they enjoy and want to participate in, which would ultimately boost their health. Used as a diagnostic tool, the CAMSA has the potential to be expanded state-wide or nation-wide and used alongside established literacy and numeracy transition reports to provide baseline movement skill proficiency data as students enter Year 7. In addition to use as a diagnostic tool, the CAMSA could be utilised in assessment ‘for’ learning, in ongoing monitoring and evaluation of both teaching and learning progress. Further, the CAMSA could be
used as a summative measure to identify whether FMS teaching and learning objectives have been attained.

Furthermore, continuing to develop a comprehensive understanding of adolescent girls’ learning needs in PE informed the creation of a learning environment conducive to achieve learning outcomes for girls (Chapter 5). The findings of this study demonstrate that adherence to the SAAFE teaching principles, which are underpinned by self-determination theory and competence motivational theory, can create a learning environment in PE suitable for girls, as verified by the significant improvement in FMS. Therefore, frameworks such as the SAAFE teaching principals are strongly encouraged not only in future school-based FMS interventions, but also in current PE practice, especially when teaching girls.

Considerations and implications for dissemination of the program on a larger scale are discussed further below, in section 6.5.5 ‘Scalability of the program’.

6.3.2 Pre-service and in-service teacher training

Pre-service education plays a critical role in the development of teacher competence, skills, knowledge and attitude; however, the present research identified that the depth and quality of FMS training teachers receive does not sufficiently equip them with the skills, knowledge or confidence to teach FMS effectively. For instance, teachers felt they lacked creative and engaging methods of teaching FMS. Another key limitation of pre-service FMS training was the focus on lower primary school levels, so teachers felt unprepared to teach older students. Firstly, teachers need to understand the importance of FMS mastery in overall student health. Secondly, they need to know how to identify baseline skill levels of their students. And thirdly, teachers need appropriate pedagogy to optimally motivate and educate their students. Ideally, pre-service
teachers should receive practical teaching experience in FMS from Foundation to Year 12, and have the opportunity to observe experienced teachers and seek mentors to demonstrate the application of assessment and instruction in FMS.

After initial pre-service education, professional development or in-service programs are the next critical mechanism to improve teaching (Bechtel & O’Sullivan, 2006). However, this thesis revealed that the current approach to professional development in PE is inadequate and thus unlikely to evoke meaningful change, which has been reported elsewhere (Armour & Yelling, 2007). Indeed, professional development courses appear to be in need of an overhaul if they are to truly impact on teaching practice and improve student learning. As recommended in Chapter 1, and adhered to in Chapter 5, to enhance in-service teacher training program effectiveness, programs should be: sustained in duration; multimodal in training approach and delivery; collaborative in design and delivery; and provide comprehensive subject and pedagogy content. These considerations are not only relevant to in-service teacher education, but also to the design of teacher training programs in school-based PE interventions.

6.4 THESIS LIMITATIONS

Overall, although the results were very promising, there were some limitations in the design of the research. This section will firstly present a brief overview of the limitations specific to each independent paper. Then the overall thesis limitations will be presented in more depth.

6.4.1 Study-specific limitations

The limitations of each independent study within this thesis have been presented in the associated chapters/publications. In brief, the limitations of the systematic review (Chapter 1)
included an English language requirement and an inability to rule out publication bias. In Chapter 2, the small sample size of the teacher population allowed for only descriptive analysis of the results regarding teachers’ perceptions of FMS assessment and instruction. Isolated testing of the CAMSA in Chapter 3 reflects only one component (i.e., physical competence) of the CAPL, which was designed to measure broader physical literacy, and omits other aspects, including daily behaviour, motivation and confidence, and knowledge and understanding, therefore limiting the scope of understanding around a more complete picture of students’ physical literacy. Chapter 4 investigated the test-retest reliability and concurrent validity of the CAMSA, however, other aspects of validity and reliability remain unverified (e.g., construct and convergent validity, and inter-rater reliability). In the interest of promoting use of the instrument in schools, further investigation into the reliability and validity of the CAMSA would be required. In Chapter 5, the small sample size of the teacher population allowed for only descriptive analysis of the results regarding process evaluation. Furthermore, long-term follow-up was not undertaken to investigate the sustainability of the project.

Although the CAMSA was shown to be a feasible, valid and reliable FMS assessment tool for use by teachers in a PE context, there are some limitations to the tool. Primarily the process variables of the CAMSA are somewhat limited. A number of the process criteria do not align with what we know about the development of skill from the literature (Hands, 2002). For example, the criteria for the hop and jump (i.e. hops/jumps once in each hoop without touching hoop) do not tell us anything about what the body is doing, rather these criteria assess whether the hoop has been hit, and as such they are more product oriented (Miller & Silverstein, 2007), and as such may capture slightly different constructs of FMS performance (Logan et al., 2014; Rudd et al., 2015). Therefore, for a teacher to have a truly comprehensive understanding of a
student’s skill development, a combination of a more detailed process assessment (i.e. The Victorian FMS Assessment) in conjunction with the CAMSA may be beneficial (Hands et al 2015).

6.4.2 Thesis limitations

Generalisability

Randomised controlled trials are considered the ‘gold standard’ for evaluating interventions (Turner et al., 2012), as they enable comparison between treatment and control groups. The RCT presented in Chapter 5 had high population validity, as the groups were randomly selected and assigned to treatment or control. In addition, the random assignment of classes (within schools) into treatment or control enhanced the internal validity. Sample sizes were sufficient to allow for meaningful statistical analysis; however, the generalisability of the findings may be limited due to the relatively homogenous, girls-only samples. Due to the budget and time constraints of a PhD, large-scale studies with heterogeneous populations, in which the size of the group allows for statistics to be extrapolated to the entire population, are not feasible. Therefore, it is reasonable to assume that the findings of this thesis may apply (i.e., have greater external validity) to similar subgroups as those investigated in the thesis (e.g., sex, age, socioeconomic class, education system, exposure to PE); however, the findings may not be representative of the whole population. Similarly, the small number of clusters (i.e., schools) limits the generalisability of the results across different school types and population groups.

Lack of follow-up
Due largely to the time constraints of a PhD program, the studies were relatively short and follow-up measurement of intervention effects from the RCT were not included. Therefore, it was not possible to determine whether the behaviour modifications continued for the intervention participants. Interventions that are effective in the long term are better suited for widespread scalability and translation and are therefore likely to influence policy decisions and government spending. In order to determine the maintenance of effects over a longer time period, it is recommended that studies introduce a one- to two-year follow-up evaluation.

Omission of stability skill measurement

In motor development literature, FMS are divided into three constructs: locomotor (e.g., running, jumping and skipping), object control (e.g., throwing, catching and kicking) and stability skills (e.g., body rolling, bending and twisting) (Gallahue, Ozmun & Goodway, 2011). Stability is an important underlying construct of motor skill performance (Rudd et al., 2016), yet most FMS studies, including this thesis, focus on competency in locomotor and object control skills. Furthermore, as movement competence is a multidimensional concept, it may not be measured adequately by only one test battery (Rudd et al., 2015). To date, the stability skill construct has been poorly measured. Omitting the measurement of this construct limits our understanding of how stability correlates to other FMS assessment and FMS performance outcomes.

Single PA correlate focus

Factors influencing the physical activity behaviour of children and adolescents are multifaceted, with several underlying factors (Biddle et al., 2005; Stodden et al., 2008). Although the findings of this thesis were positive, it measured only one correlate of PA in early-adolescent girls, namely, FMS. Other well-identified correlates, such as those clustered around positive
psychology (i.e., enjoyment, positive body image, positive motivation, self-efficacy and physical self-perceptions) (Biddle et al., 2005, 2012) were not investigated. Other important mediating variables, as proposed in Stodden et al. (2008) (i.e., perceived motor skill competence, health-related physical fitness and obesity), were not investigated. Thus, the influence of the intervention on other important elements of PA remains unknown.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

6.5.1 Feasibility of the Canadian Assessment of Physical Literacy (CAPL) in Australian schools

In chapters 3, 4 and 5, the CAMSA was extracted from the CAPL and investigated in isolation. This was discussed as a potential study limitation in section 6.4.1 above, as physical literacy extends beyond physical competence. A prominent definition of physical literacy, proposed by Whitehead (2001), is “the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life”. However, there have been many other definitions and descriptions of ‘physical literacy’, which commonly encompass three themes: (i) that physical literacy is a lifelong process; (ii) that acquisition (competence) of FMS is a core component; and (iii) that physical literacy also embraces knowledge, attitudes and motivations that facilitate confident movement (Edwards, Bryant, Keegan, Morgan, & Jones, 2016). It is clear that the concept of FMS competence is an important and well-established construct of physical literacy; however, physical literacy and FMS are not synonyms (Edwards et al., 2016). FMS focuses on progressing physical skills only, whereas physical literacy also considers affective and cognitive elements (Almond, 2013). Therefore, further research is recommended to investigate the feasibility of the CAPL in its
entirety within the context of Australian school-based PE, to enable a more comprehensive measurement of the status of physical literacy in Australian school children.

6.5.2 Investigation into the interrelationship of multiple PA correlates

As presented in the limitations in section 6.4.2 above, the focus of this thesis was on a single correlate of adolescent girls’ PA, namely, FMS. Due to the complexity and multitude of factors influencing PA behaviour, it may be important for future studies to investigate several correlates in combination, rather than one in isolation. As presented in Chapter 1, there is consistent evidence to suggest that we should ensure the physical activity environment for adolescent girls allows for choice and the development of perception, confidence and competence, which is likely to lead to higher levels of enjoyment and engagement (Biddle et al., 2005). The intervention content in regards to pedagogy and learning environment, as presented in Chapter 5, focused on teaching training in and teacher delivery of the SAAFE teaching principles (Lubans et al., 2012). These principles are framed by self-determination theory (Deci & Ryan, 1985), competence motivation theory (Harter, 1978, 1980) and reflect Epstein’s (1988) TARGET framework, and thus are said to promote a mastery motivation learning environment. In light of this, it would be beneficial to not only investigate the effects of the intervention on the participants’ perceived competence, but also investigate the interrelationship between perceived competence and actual competence in early-adolescent girls.

In addition, although the relationship between actual FMS and PA is the primary focus of Stodden et al.’s (2008) conceptual model of development, they do propose that perceived FMS, health-related fitness and obesity represent important mediating variables of PA. And therefore, simultaneous investigation of several variables within this developmental perspective is
recommended, as it may provide a better understanding of PA influences. Furthermore, it would also be beneficial to objectively measure the PA levels of participants, to explore whether the positive effects of the intervention on the participants’ skill do indeed have an influence on PA levels.

6.5.3 Sustainability of intervention effects

Investigating the maintenance of the RCT intervention program effects is an important next step, and should be examined at two levels. Firstly, the extent to which the teachers have continued with the program, and the extent to which they embedded the program into their teaching practice. Secondly, it would be beneficial to conduct longitudinal research to identify the long-term effects of the program on the FMS of students. Ideally, follow-up measures would be conducted more than six months after the intervention.

6.5.4 Generalisability

To investigate the effectiveness of the RCT program in other population groups, the intervention could be conducted in different locations (e.g., rural or urban) with different age groups (e.g., primary school), in different school settings (e.g., co-educational, state or independent), with different facilitators (e.g., generalist or specialist teachers) and with both sexes. Importantly, it could be beneficial to target younger students, to build the skills of students at the so-called ‘optimal stage’ of FMS development, that is, in primary school.

6.5.5 Scalability of the program

In the RCT, the magnitude of the effect of the intervention was a key indicator of its capacity to translate from PhD research to an education program. Therefore, the next phase would be to
disseminate the program on a larger scale, to explore the program effects in a broader population, in a translational trial. Therefore, evaluation of the scalability of the program, for instance using the RE-AIM (i.e., reach and effectiveness at the individual level, adaption and implementation at the organisational level and maintenance at the individual and organisational level) framework (Glasgow, Vogt, & Boles, 1999), could be an appropriate next phase. From a research perspective, the goal of RE-AIM would be to evaluate the internal and external validity of the program. From a practice perspective, the goal would be to provide information for educators on the acceptability of the program for a broader population, in a variety of school settings, at a reasonable cost, to effectively change outcomes, and be sustained over time (Gaglio, Shoup, & Glasgow, 2013). Therefore, maximising the reach and effectiveness of the program requires analysis of how variables (e.g., sex, age, location, school setting, facilitator) impact on the effectiveness of the program, and how to adapt the program to fit population and context.

Transitioning the program from a PhD study to a large-scale translational trial would have several challenges. Expanding the reach of the program would not be feasible without the support and/or partnership of government and non-government organisations such as the Department of Education and Training (DET), the Catholic Education Office (CEO), the Department of Health and Human Services (DHHS), as well as professional development providers such as the Australian Council for Health, Physical Education and Recreation (ACHPER) and PEAK Phys ED, to be competitive in applications for research funding such as National Health and Medical Research Council (NHMRC), or the Australian Research Council (ARC) linkage research grants. Therefore, dissemination of program results among these stakeholders is an important step.
In addition, in a large-scale program, the capacity for ongoing one-on-one teacher support (a focal point in the RCT) would be diminished. Therefore, investigation of an alternative means of ongoing teacher training (e.g., online platforms, video link, school champions, regional or cluster trainers) would be important to monitor and support program implementation and teacher fidelity. Subsequently, investigation into the effectiveness of the program using alternative methods of teacher support would be warranted.

Furthermore, it would be beneficial to investigate whether this program could become a key feature of a comprehensive multicomponent school-based intervention that not only targets the educational/curriculum influences on students’ FMS, but also includes recess/lunch breaks, school environment, family and community links.

6.6 CONCLUSIONS

The findings from this thesis indicate the crucial role that teachers play in advancing the skill proficiency of their students. Teachers perceived Year 7 to be a critical period to instruct girls in FMS, yet their teaching practice was considered suboptimal. The CAMSA was found to be a feasible, valid and reliable FMS assessment for use by Year 7 PE teachers, and thus is viewed as an attractive alternative to the traditional forms of FMS assessment. The school-based FMS intervention focusing on teacher training in authentic assessment and student-centred instruction resulted in considerable intervention effects for locomotor skills, object control skills and total fundamental movement skill competency. Ultimately, any improvement in FMS, especially for low-skilled girls, may expand potential enjoyment and thus lifelong participation in a wider array of physical activities.
This section provides references for Chapters 1: Part A and Chapter 6. The references for Chapters 1: Part B to Chapter 5 have been presented within each independent paper.


doi:10.1249/mss.0000000000000452


to 18. Cochrane Database Systematic Reviews, 2, Cd007651.
doi:10.1002/14651858.CD007651.pub2


Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise, 15*(4), 382-391. [http://dx.doi.org/10.1016/j.psychsport.2014.03.005](http://dx.doi.org/10.1016/j.psychsport.2014.03.005)


doi:10.1016/j.jadohealth.2008.06.020


Screen-time’ (ATLAS) group randomized controlled trial: An obesity prevention intervention for adolescent boys from schools in low-income communities.

*Contemporary Clinical Trials, 37*(1), 106-119. doi:10.1016/j.cct.2013.11.008


Minneapolis, Minnesota: University of Minnesota.


APPENDICES

APPENDIX 1: SECONDARY PAPERS
APPENDIX 1.1: Physical education teacher training in fundamental movement skills makes a difference to their instruction and assessment in this area.

Physical Education Teacher Training in Fundamental Movement Skills Makes a Difference to Instruction and Assessment Practices

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Helen Brown
Deakin University

Amanda Telford
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The purpose of this study was to investigate instruction and assessment of fundamental movement skills (FMSs) by Physical Education (PE) teachers of Year 7 girls. Of 168 secondary school PE teachers, many had received little FMSs professional development, and although most assessed student FMSs proficiency, the quality of assessment was variable. Neither years of experience nor confidence influenced the quality of assessment tools used; however, greater FMSs training improved assessment practice regularity. Teachers more recently out of preservice were more confident in demonstrating FMSs. The results suggest that FMSs education for teachers should be a priority inclusion in both the training of preservice teachers and the ongoing professional development of in-service teachers.

**Keywords:** assessment, FMSs, girls, in-service, pre-service, professional development

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There are numerous health benefits associated with physical activity (Janssen & LeBlanc, 2010). Despite this, a decline in physical activity across the lifespan has been observed and this effect is most striking in females aged 13–18 (Nadar, Bradley, Houts, McRitchie, & O’Brien, 2008). A well-documented positive correlate of physical activity is an individual’s fundamental movement skill proficiency (Lubans, Morgan, Cliff, Barnett, & Okley, 2010). Fundamental movement skills (FMSs) consist of locomotor skills (running and hopping), object control skills (catching and throwing) (Haywood & Getchell, 2009) and stability skills (Gallahue & Ozmun, 2006). General FMS proficiency of children is low (Hardy, King, Epinel, Cosgrove, & Bauman, 2010) and, again, is even more marked in adolescent females, particularly so in object control skills (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010). Instruction and opportunity for practice are essential in the development of FMSs (Ehl, Robertson, & Longendorfer, 2005). Therefore, it is imperative that girls receive effective instruction and adequate opportunity to practice, to reduce the observed gender difference in both FMSs and physical activity (Hardy, Reiten-Reynolds, Espinel, Zask, & Okley, 2012; Barnett et al., 2010).

Theoretically, Physical Education (PE) programs provide the ideal environment to instruct and develop these skills. Indeed, a central goal of primary school PE is to set up the foundations of FMSs and provide the skills, knowledge and values to attain lifelong physical activity (Australian Curriculum Assessment Reporting Authority, 2012). However, the reported low levels of physical activity and FMSs proficiency in young people (Hardy et al., 2010), suggest that primary school PE might be failing in these attempts. There are several well documented barriers that restrict the quality of primary school PE including: the dominance of traditional, adult and elite-oriented sports provision models; inadequate teacher knowledge and confidence; variable support from school management; low status accorded to PE in schools; limited time and equipment; poor quality of facilities; lack of funds; large class sizes; and the lack of a specialist PE teacher in some primary schools (Morgan & Hansen, 2008; Penney, 2012). In addition, the omission of assessment ‘for’ learning throughout the instructional process, and a lack of ‘process’ based assessment of the skill performance, may further inhibit the effectiveness of instruction (Black, Harrison, Lee, Marshall, & William, 2003; Hattie, 2003; Shepard, 2008). Therefore, many students pass through the ideal time to develop FMSs and their primary PE without receiving the instruction, assessment and practice opportunities required for FMSs mastery (Okley, Booth, & Patterson, 2001) and transition into the secondary system ‘under-skilled’ in FMSs.

The target audience for the majority of FMSs intervention research to date has been young children, with only one such intervention reported in the junior high school cohort (Morgan et al., 2013). To date, there has not been any research conducted specifically investigating FMSs assessment of Year 7 girls. Therefore, the aim of the current study was to investigate the assessment processes used by PE teachers in relation to FMSs in Year 7 girls. Specifically, the current study sought to understand, via an on line survey, important features of: (i) FMSs training for teachers (preservice and in-service); (ii) teachers’ perceptions of the importance of and barriers to FMSs education; (iii) current FMSs instruction and assessment practices; and (iv) teacher confidence in FMSs demonstration and instruction.
Method

A pilot survey was conducted in November 2012 with three experienced PE teachers to check face validity. Suggested changes were made to the survey design, clarity, readability, content and structure. A test–retest was then conducted on six PE teachers to assess the repeatability of the survey. As our sample size for testing the tool was small, rather than using statistical measures such as the Kappa agreement (Thomas, Nelson, & Silverman, 2011), we assessed consistency qualitatively. Despite this limited validation of the survey instrument, the test–retest indicated consistency for all survey items with the exception of the ‘barriers’ section, where format was altered to enhance clarity. The final survey instrument was then launched on February 2013 onto two of Australia’s largest online PE professional networks: Peak Phys Ed (www.peakphysed.com.au) and the Australian Council of Health Physical Education and Recreation (ACHPER), Victorian Branch (www.achper.vic.edu.au). Invitations to participate were also emailed to affiliates of the research team. This study was approved by the University Research Human Ethics Committee.

Participating teachers were asked to provide demographic information (sex, school type and sector), and outline qualifications, years of teaching experience, and training in FMSs during preservice (i.e., undergraduate or postgraduate teaching degree) and in-service (i.e., professional development). Response options were discrete (e.g., nonexistent = 1; a little = 2; some = 3; substantial = 4). Participants were also asked to rate their opinion of the importance of FMSs education compared with other units in the Year 7 PE curriculum, and the importance of FMSs assessment within the unit.

The survey also gathered information on FMSs instruction and assessment practices, including type, regularity, confidence, feedback strategies and perceived barriers. Six response categories were provided for assessment ‘type’, and the ideal assessment tool was considered to be ‘FMSs process tests’ (Rink, 2006). The ideal regularity of assessment was considered to be ‘before, throughout and after’ the instructional unit (Black & Williams, 1998). Participants were also asked to rank their confidence in demonstrating FMSs (i.e., verbally and visually), indicate feedback strategies used (i.e., praise, corrective, neutral or questioning) (Mosston & Ashworth, 2002), and identify major barriers to effective FMSs instruction and assessment.

Raw data from the online study were exported from the online survey tool into Excel and then transferred into SPSS ver. 21 (Chicago, IL). Descriptive statistics such as percentages and frequencies were used for: sex, qualifications, FMSs training both time and type, years of teaching experience, and school types and sectors represented. Descriptive statistics were also used for teachers’ perceptions toward FMSs, the instruction and assessment practices used, as well as for identifying what teachers perceived to be the major barriers to effective FMSs assessment.

Independent samples t tests were conducted to investigate whether certain factors—specifically, the level of FMSs training the teacher had received, the level of confidence the teacher had in demonstrating FMSs, and years of teaching experience—were associated with the teacher using process-based assessment. The same factors were also investigated to see whether they were associated with the teacher using the ‘ideal’ assessment timing to enhance FMSs development (that is, before, during and after the FMSs unit).
Two general linear models were performed to explore factors which may have influenced teachers’ confidence levels when demonstrating FMSs to students. In the first model, the outcome variable was ‘confidence in presenting verbal FMSs instructions’, and predictors were the amount of FMSs training and years of teaching experience. The second model was a repeat of the first in terms of predictors; however, the outcome variable was ‘confidence in presenting FMSs demonstrations’.

Results

In total, 168 PE teachers were surveyed. Not all participants responded to every question, so proportions and statistics reflect only those that responded to relevant questions. The majority of participants were female (75.0%, n = 126/168), worked at a coeducational government school (72.3%, n = 120/168) and had a 4-year bachelor’s degree (75.8%, n = 119/168). Most participants (84.3%, n = 107/127) had received more than five hours of training in FMSs during their degree as preservice teachers; however, many (71.2%, n = 116/163) had undertaken no more than four hours of professional development in FMSs since finishing their degree. All participants stated that FMSs education held some level of importance in the Year 7 PE curriculum, with 85.4% (n = 135/158) rating it as at least ‘just as important’ as other units.

Most participants (97.9%, n = 143/146) used some form of assessment to identify the FMSs proficiency of their female Year 7 students. However, the quality of the assessment was variable: under half (43.8%, n = 64/146) did not use process-based assessment, and just over half (56.2%, n = 82/146) used the ‘ideal’ assessment frequency for improved learning. Neither years of experience nor confidence level influenced assessment practice. However, the more training a teacher had received in FMSs, the more likely they were to assess at the ‘ideal’ regularity (t = 4.168; p = .001), and use the ‘ideal’ tool (t = 1.541; p = .002) for improved FMSs performance. Years of teaching experience was not significantly associated with use of process-based assessment (t = 1.662; p = .099). The most common assessment tools (teachers could select more than one) were informal feedback (81.5%, n = 119/146), performance-based product tests (78.8%, n = 115/146) and peer assessment (64.4%, n = 94/146). The most common verbal feedback style (teachers (n = 146) could select more than one) was neutral (59.6%), followed by corrective (13.0%), praise (10.3%) and questioning (6.8%).

The first general linear model found years of teaching experience (t = -0.056; p = .955), and training in FMSs (t = -0.049; p = .961) did not explain confidence in presenting verbal FMSs instructions (Table 1). The second general linear model revealed that while training in FMSs was still unassociated with confidence levels (t = 1.277; p = .203), the variable of years of teaching experience was significantly and negatively associated with confidence in practical demonstrations of FMSs (t = -2.308; p = .022); that is, teachers with more teaching experience had less confidence demonstrating FMSs (Table 1).

The three most cited barriers of effective FMSs instruction and assessment were: ‘insufficient time scheduled into the PE curriculum’ (71.2%, n = 104/146), ‘insufficient teacher knowledge or confidence’ (64.4%, n = 97/146) and ‘the school
Table 1  Univariate General Linear Model Analysis for The Effect of Years of Teaching Experience and Amount of FMSs Training on Teachers' Confidence Levels in Verbal Instructions and Practical Demonstrations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence interval LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>13.091</td>
<td>0.644</td>
<td>20.316</td>
<td>0.000</td>
<td>11.818</td>
<td>14.364</td>
</tr>
<tr>
<td>Years</td>
<td>−0.001</td>
<td>0.020</td>
<td>−0.056</td>
<td>0.955</td>
<td>−0.040</td>
<td>0.038</td>
</tr>
<tr>
<td>Training FMSs</td>
<td>−0.005</td>
<td>0.092</td>
<td>−0.049</td>
<td>0.961</td>
<td>−0.187</td>
<td>0.178</td>
</tr>
</tbody>
</table>

Model 2: Effect of years of teaching experience and amount of FMSs training on teachers’ confidence levels in practical demonstrations of FMSs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence interval LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>12.996</td>
<td>0.451</td>
<td>28.811</td>
<td>0.000</td>
<td>12.105</td>
<td>13.887</td>
</tr>
<tr>
<td>Years</td>
<td>−0.043</td>
<td>0.019</td>
<td>−2.308</td>
<td>0.022</td>
<td>−0.080</td>
<td>−0.006</td>
</tr>
<tr>
<td>Training FMSs</td>
<td>0.110</td>
<td>0.086</td>
<td>1.277</td>
<td>0.203</td>
<td>−0.060</td>
<td>0.280</td>
</tr>
</tbody>
</table>

not having assessment criteria specific to FMSs in the PE curriculum’ (64.4%, n = 94/146).

Discussion

Teachers who participated in this survey believed FMSs education to be an important inclusion in the Year 7 girls’ PE curriculum. This is encouraging as PE programs with a strong FMSs focus can improve the FMSs proficiency of students (Bakhitiari, Shafina, & Zaee, 2011; van Beurden, Barnett, Zask, Dietrich, Brooks, & Beard, 2003). Most teachers performed some form of FMSs instruction and assessment and perceived assessment to be an important inclusion in the FMSs unit. Again, this is promising, as assessment gives purpose and meaning to instruction and informs teachers, students, parents and administrators about student needs (Fisette & Franck, 2012).

Although the majority of teachers understood the primary aim of assessment to be identifying and addressing students’ skill shortfalls, only about half implemented assessment with the ‘ideal’ regularity for improved FMSs performance, that is, a combination of diagnostic (before), formative (throughout) and summative (after) assessment (Black & Williams, 1998; Johnson, 2005; Wiggins, 1998). Regular assessment carried out during the instructional process can improve student engagement, thereby maximizing a student’s ability to acquire and master new skills (Black & Harrison, 2001; Wright & van der Mars, 2004; Shepard, 2008). Our results identified that assessment regularity was not influenced by years of experience as a teacher; however, it was significantly associated with increased FMSs training.
This finding is congruent with studies suggesting that highly trained specialist PE teachers are more effective at planning and delivering PE lessons (Jurak, Strel, Leskošek, & Kovač, 2011; Kriemler, Zahner, Schindler, Meyer, Hartmann et al., 2010; Stare & Strel, 2012).

Similarly, only about half of the teachers used the ‘ideal’ assessment tool for enhanced FMSs performance, namely, process-based assessment, which has the capacity to provide specific feedback for individual skill components. Feedback constitutes an important facet of assessment and when combined with effective instruction it can be a powerful learning enhancer (Hattie & Timperley, 2007). Feedback is an important element of both assessment and instruction, and can positively or negatively influence students’ self-esteem, especially in girls (Biddle, Fox, Boudcher & Faulkner, 2000). A significant proportion of participants in the current study preferred process-based feedback strategies. This is reassuring as process-based feedback provides greater opportunity for skill remediation and positive affirmation of performance (Australian Council of Health, Physical Education and Recreation, 2008). Again, the only factor investigated that influenced the choice of assessment tool was the amount of FMSs training. Specifically, teachers with more training in FMSs (preservice and/or in-service) were more likely to use process-based assessment.

There have been a number of process-based assessment tools developed for FMSs measurement, for example: Get Skilled Get Active (Department of Education and Training NSW, 2000); Test of Gross Motor Development (TGMD 1 and 2) (Ulrich, 2000); and Fundamental Motor Skills Assessment—a manual for classroom teachers (Walkley & Holland, 1996). These tools provide the criteria to assess level of FMSs mastery; however, if the teacher fails to effectively use the data gathered from these tools as assessment ‘for’ learning the benefits may be negligible. If assessment is used simply to generate a one-off grade (summative, or assessment ‘of’ learning), the assessment becomes one-dimensional and of limited use for skill development.

Low teacher knowledge and confidence were identified by the participants as a major barrier to effective FMSs assessment and instruction, which has been reported previously (DeCorby, Halas, Dixon, Wintrup, & Janzen, 2005; Robinson & Goodway, 2009). Interestingly, in the current study teachers with more years of teaching experience actually reported lower confidence in demonstrating FMSs. Compounding this reduction in confidence with increasing time since graduation, many participants had undertaken no or limited professional development in FMSs since their initial degree. These findings underscore the necessity of PE teachers undertaking specialist training in PE and, specifically, FMSs training, to enhance their confidence. This aligns with other research that highlights the importance of ongoing professional development to improve teacher knowledge, confidence and practice (Guskey, 2002). Indeed, significant improvements to student FMSs proficiency have been detected after teachers received training in FMSs, particularly in object control skills (Murphy, 2012).

Another barrier to effective FMSs instruction perceived by participants was insufficient time scheduled into the curriculum. This is a widely reported barrier (Morgan & Hansen, 2008), but is perhaps hard to address, except at a policy level. Another major barrier reported by just under half of participants was ‘the school
not having assessment criteria specific to FMSs in the PE curriculum. This is of concern, as without specified criteria neither the student nor the teacher know the outcome to be achieved or the purpose of the learning, and students are more likely to be confused and waste time (Black & Williams, 1998). However, this barrier could be more easily addressed; for instance, by further educating teachers in the use of formative assessment to glean information on individual students’ abilities from their performance, rather than relying solely on set curricular standards. This information can be then used to inform remediation, reteaching, and enhanced instructional strategy (William, Lee, Harrison & Black, 2004).

In conclusion, this study revealed that although FMSs assessment is being conducted by PE teachers, there are significant deficits in the quality of their assessment practices: just over half used the ‘ideal’ assessment frequency, and under half implemented process-based assessment. The strongest indicator of ideal assessment practices was training in FMSs, which was also correlated with greater teacher confidence in demonstrating FMSs. However, training levels in FMSs were low, in particular in terms of professional development in FMSs. Thus, specialist professional development training for in-service teachers, with specific attention to FMSs, is recommended. These improvements to PE class practices may improve FMS learning in girls and, potentially, impact on their levels of physical activity in the future.

References


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APPENDIX 1.2: Systematic Review of the Validity and Reliability of Field-Based Measures for Assessing Movement Skill Competency in Lifelong Physical Activities

SYSTEMATIC REVIEW

Validity and Reliability of Field-Based Measures for Assessing Movement Skill Competency in Lifelong Physical Activities: A Systematic Review

Ryan M. Hulteen1 · Natalie J. Lander2 · Philip J. Morgan1 · Lisa M. Barnett2 · Samuel J. Robertson3 · David R. Lubans1

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Abstract

Background It has been suggested that young people should develop competence in a variety of ‘lifelong physical activities’ to ensure that they can be active across the lifespan.

Objective The primary aim of this systematic review is to report the methodological properties, validity, reliability, and test duration of field-based measures that assess movement skill competency in lifelong physical activities. A secondary aim was to clearly define those characteristics unique to lifelong physical activities.

Data Sources A search of four electronic databases (Scopus, SPORTDiscus, ProQuest, and PubMed) was conducted between June 2014 and April 2015 with no date restrictions.

Study Selection Studies addressing the validity and/or reliability of lifelong physical activity tests were reviewed. Included articles were required to assess lifelong physical activities using process-oriented measures, as well as report either one type of validity or reliability.

Study Appraisal and Synthesis Methods Assessment criteria for methodological quality were adapted from a checklist used in a previous review of sport skill outcome assessments.

Results Movement skill assessments for eight different lifelong physical activities (badminton, cycling, dance, golf, racquetball, resistance training, swimming, and tennis) in 17 studies were identified for inclusion. Methodological quality, validity, reliability, and test duration (time to assess a single participant), for each article were assessed. Moderate to excellent reliability results were found in 16 of 17 studies, with 71 % reporting inter-rater reliability and 41 % reporting intra-rater reliability. Only four studies in this review reported test-retest reliability. Ten studies reported validity results; content validity was cited in 41 % of these studies. Construct validity was reported in 24 % of studies, while criterion validity was only reported in 12 % of studies.

Limitations Numerous assessments for lifelong physical activities may exist, yet only assessments for eight lifelong physical activities were included in this review. Generalizability of results may be more applicable if more heterogeneous samples are used in future research.

Conclusion Moderate to excellent levels of inter- and intra-rater reliability were reported in the majority of studies. However, future work should look to establish test-retest reliability. Validity was less commonly reported than reliability, and further types of validity other than content validity need to be established in future research. Specifically, predictive validity of ‘lifelong physical activity’ movement skill competency is needed to support the assertion that such activities provide the foundation for a lifetime of activity.
Key Points

Lifelong physical activities are typically performed individually or in small groups, involve minimal structure and minimal physical contact, are characterized by varying levels of intensity and competitiveness, and may be easily carried into adulthood and old age.

Additional research is needed to establish the validity and reliability of lifelong physical activity movement skill tests for activities not included in this review, such as yoga, Pilates, tai chi, aerobics, and running.

Future research would benefit from determining the predictive validity of competency in lifelong physical activities to ascertain the strength and direction of association between competency levels and future physical activity.

1 Introduction

Developing adequate movement skill competency across a broad range of activities is important for individuals of all ages [1–3], and competency in a range of fundamental movement skills (FMS) in childhood has been found to be a predictor of physical activity in adolescence [4]. Movement skills are often learned and developed throughout childhood [5–7], initially in the form of FMS, of which there are three types: locomotor (i.e., running, jumping), object control (i.e., catching, kicking), and stability (i.e., balancing, twisting) [8]. If children fail to develop competency in FMS [9, 10], they may find it difficult to learn and master more refined movement skills, such as sport-specific skills (i.e., pitching a ball, serving in tennis) [7].

Previous movement skill competence theory [7, 11] posits that individuals ascend a hypothetical mountain of motor development, whereby more advanced movement acquisition is dependent upon the foundation established in the previous level. The proposed levels of movement skill acquisition are (1) reflexive, (2) preadapted, (3) fundamental motor patterns, (4) specialized sports skills [11], and (5) skillful [7]. These models are based on the premise that individuals cannot be physically active throughout the lifespan without achieving proficiency in FMS. However, some lifelong physical activities do not require a foundation in FMS that are often assessed, meaning children who are not competent in FMS may alternatively perform lifelong physical activities to be physically active. As such, it has been suggested that young people need to be exposed to, and develop competency in, a range of movement skills associated with ‘lifelong physical activities’ that can be easily carried into adulthood [12–17].

Schools may present a possible setting for learning and testing competency in lifelong physical activities, as they may have access to personnel and resources, such as qualified teachers, equipment, space, and the ability through physical education to provide exposure to these activities [14, 16, 18, 19]. A noted decline in physical activity occurs during adolescence [20]; thus, this may also be a critical period in which individuals should learn and develop competency in a range of lifelong physical activities. Indeed, lifelong activities learned at this time may have health benefits both at the time they are learned and later on in adult years [14].

Although a variety of definitions and alternative terminology for lifelong physical activities (i.e., lifetime [14], lifestyle physical activities [13, 16, 21]) have emerged in the literature [13, 22–24], different characteristics appear regarding what defines a lifelong physical activity, which consequently makes identifying and promoting these activities difficult. Of note, the term ‘lifelong physical activity’ can also be used to describe how an individual can be physically active across the lifespan. It is proposed that the term ‘lifelong physical activity’ will only be used to describe a subset of physical activities defined as those sports and leisure-time activities typically performed individually or in small groups (typically four or fewer people) that involve minimal structure, avoid physical contact, are characterized by varying levels of intensity and competition, and, importantly, may be easily carried into adulthood and old age. Examples of lifelong physical activities that fit this definition include aerobics, badminton, cycling, dance, golf, Pilates, racquetball, resistance training, running, swimming, tai chi, tennis, and yoga.

Many team sports, such as basketball, hockey, and soccer can be played throughout adulthood, but do not fit the definition of a lifelong activity due to the number of participants and the higher levels of organization required [14]. In addition, due to the physical contact involved, many team sports have higher incidences of injury (number of injuries/1000 occurrences), such as soccer (64.4/1000), rugby (95.7/1000), and hockey (62.6/1000) [25–27]. In comparison, popular lifelong physical activities, such as tennis (23.1/1000), resistance training (11.9/1000), and swimming (6.1/1000) [25–27] have considerably lower injury rates.

One characteristic of lifelong physical activities included in previous definitions, but not in this study, is the use of minimal equipment. While this may be true for most lifelong activities, there are some notable exceptions, including golf and resistance training. Although golf could be played with only two clubs (i.e., an iron and a putter),
this is neither ideal nor representative of how golf is usually played. Similarly, resistance training is often performed with free weights (e.g., barbells and dumbbells) and equipment (e.g., cables and pulleys) typically found in a health club, yet it can also be performed using only body weight exercises (e.g., squats, lunges, push-ups). Regardless of equipment, these two activities are undoubtedly lifelong activities, as shown by their high levels of participation amongst individuals of all ages [28]. Although equipment considerations may be important in performing an activity, the inclusion of this characteristic in the definition of lifelong physical activities would exclude relevant lifelong physical activities from this review.

The assessment of movement skills (e.g., FMS, sport-specific, lifelong) is vital for informing individuals of their competency levels, as well as informing teachers and researchers of potential movement skill deficiencies in a population, so programs or interventions can be designed and implemented [29]. Movement skills are commonly assessed through product or process measures [8]. Product measures quantify outcomes [8], which are expressed, for example, in terms of how fast a ball is thrown (i.e., speed), time it takes to swim 100 m, or distance a soccer ball is kicked. Product measures are quick and easy to assess and interpret, but they cannot be used to determine how an outcome was achieved [29]. Conversely, process-oriented measurement is concerned with the qualitative characteristics that describe successful movement patterns [8] and allow movement component deficiencies to be more easily identified and corrected. The ability to correct individuals on specific components of a movement may help prevent injury [30], may help contribute to an individual’s feeling of competence, and can enable the identification of specific skill components to be addressed in future interventions to enhance performance proficiency. For example, when an individual is introduced to a new activity, such as weightlifting, the technique, as opposed to the outcome (i.e., amount of weight lifted), is more important for the safety of the individual [1]. Over time, if the technique is practiced and utilized, strength gains may be achieved with reduced possibility of injury [1].

Previous reviews have examined the validity and reliability (alternatively called objectivity) of assessments in both FMS [31] and sport-specific skills [32]. No such review exists for the assessment of field-based measures (i.e., not taking place in a laboratory setting, but rather in, for example, a school or community sporting ground) of lifelong physical activities. Given the widespread use [33–35] and previous success of process-oriented skill assessment in FMS (e.g., Test of Gross Motor Development-2 (TGMD-2)) [36], an analysis of measurement properties of current assessments examining qualitative aspects of lifelong physical activities is warranted. Therefore, the purpose of this systematic review is to review the methodological properties, validity, reliability, and test duration of current field-based measures to assess movement skill competency in lifelong physical activities, as well as clearly define the characteristics unique to lifelong physical activities.

2 Methods

2.1 Search Strategy

A systematic review of four search engines (PubMed, Scopus, ProQuest, and SPORTDiscus) was conducted, focused on field-based measures of lifelong activities. No time restrictions were applied when searching for articles. Searches conducted in the individual databases included various combinations of the following terms: 'reliability' OR 'validity' AND 'fitness' OR 'physical activity' OR 'sport' OR 'motor' OR 'movement' OR 'skill' OR 'battery' OR 'instrument' OR 'quantitative' OR 'technique' OR 'components' OR 'criteria' OR 'measurement' OR 'test' OR 'assessment'. A secondary search for specific lifelong physical activities (aerobics, badminton, cycling, dance, golf, Pilates, racquetball, resistance training, running, swimming, tai chi, tennis and yoga) was performed. Additional articles were found by examining the reference lists of included articles. After the initial searches, the titles and abstracts of all relevant articles were assessed. If the articles were deemed appropriate, then a full-text review was performed, and the application of inclusion and exclusion criteria allowed for further evaluation of included review articles.

2.2 Inclusion Criteria

Two authors independently assessed articles for inclusion in the study. If an agreement could not be reached, a third author reviewed and made the final decision on whether the article should be included. The criteria for inclusion in the study were as follows: (1) articles must have been peer reviewed; (2) full abstract, article, and reference list must be present; (3) articles must report at least one lifelong physical activity movement skill; and (4) article must report at least one aspect of validity or reliability relating to the movement skill. If a movement battery was used to test multiple skills, then the skill was only included if the skill and corresponding validity or reliability information could be extracted.

As assessments examining skill proficiency should display adequate measurement properties, it is important to consider the validity (e.g., content, construct, and/or criterion) of the measure. Content validity is concerned with
whether a test is a measure of all skills relevant to a particular activity [37, 38]. For example, it could be assumed that the content validity of a tennis assessment is higher in a test that assesses the forehand, backhand, volley, and serve, as opposed to a test that examines just the forehand. Construct validity is a measure of whether a test can measure a quality or attribute that cannot be operationalized. It consists of discriminative (ability to assess performers of different ability by another measure) and convergent (relation of a test with another measure of the same construct or associated measures) validity [38, 39]. Finally, criterion validity refers to the ability of a test to show agreement with a “gold standard” or external measure. Criterion validity can also constitute concurrent (relating score with a ranking in an alternative measure) or predictive (relationship of a score to a future performance) validity [38].

Three main types of reliability were reported for the studies included in this review. Inter-rater reliability was defined as the agreement between two or more raters on an assessment/score [39]. Intra-rater reliability was defined as the level of agreement of a single observer on multiple assessments/scores [39]. Finally, test–retest reliability is defined as the level of consistency over two or more rounds of testing [39].

2.3 Exclusion Criteria

Studies were excluded if they met any of the following criteria: (1) the activity did not fit the definition of a lifelong activity; (2) insufficient information on validity and/or reliability was reported; (3) the skill was assessed via use of a product measure; (4) the qualitative criteria for measuring the skill were not clearly defined; or (5) articles were not reported in English.

2.4 Assessment of Study Quality

Two authors independently reviewed all included articles for study quality (see Table 1) based on five criteria adapted from a risk-of-bias assessment in a previously published review on sport-related skill outcomes [32]. The five criteria by which articles were assessed included (1) sample size, reported as the number of participants used specifically for establishing the validity and/or reliability of the skill test; (2) participant details, which included age, etc.

### Table 1. Risk of bias

<table>
<thead>
<tr>
<th>Reference</th>
<th>Activity</th>
<th>Sample size</th>
<th>Participant details</th>
<th>Practice session</th>
<th>Stability of conditions</th>
<th>Time between assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toriola et al. [49]</td>
<td>Badminton</td>
<td>116</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>NA</td>
</tr>
<tr>
<td>Wang et al. [54]</td>
<td>Badminton</td>
<td>30</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>NA</td>
</tr>
<tr>
<td>Duchyene et al. [46]</td>
<td>Cycling</td>
<td>93</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
<td>NA</td>
</tr>
<tr>
<td>Macarthur et al. [52]</td>
<td>Cycling</td>
<td>20 (reliability)</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
<td>NA</td>
</tr>
<tr>
<td>Angisi et al. [50]</td>
<td>Dance</td>
<td>6</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>3 months</td>
</tr>
<tr>
<td>Chatfield [47]</td>
<td>Dance</td>
<td>41</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>Immediately</td>
</tr>
<tr>
<td>Krasnow and Chatfield [44]</td>
<td>Dance</td>
<td>20</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Barnett et al. [48]</td>
<td>Golf</td>
<td>43</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>5 days</td>
</tr>
<tr>
<td>Lam and Zhang [43]</td>
<td>Racquetball</td>
<td>131</td>
<td>+</td>
<td>+^*</td>
<td>+</td>
<td>Within 1 week of first test</td>
</tr>
<tr>
<td>Barnett et al. [59]</td>
<td>Resistance training</td>
<td>12</td>
<td>+/-</td>
<td>-</td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td>Lubans et al. [45]</td>
<td>Resistance training</td>
<td>63</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>7 days</td>
</tr>
<tr>
<td>Myer et al. [42]</td>
<td>Resistance training</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Erbbaugh [56]</td>
<td>Swimming</td>
<td>57</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>1 week</td>
</tr>
<tr>
<td>Zetou et al. [55]</td>
<td>Swimming</td>
<td>46</td>
<td>+/-</td>
<td>-</td>
<td>+</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Boxzard et al. [51]</td>
<td>Tennis</td>
<td>28</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Farrow et al. [57]</td>
<td>Tennis</td>
<td>23</td>
<td>+/-</td>
<td>+/-</td>
<td>+</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Mesick [53]</td>
<td>Tennis</td>
<td>60</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

^Not applicable, + indicates fully reported, – indicates not reported, +/- indicates partially reported

^Familiarization session was optional
sex, number of participants, and ability level; (3) whether participants were allowed to practice the tested skills before the official assessment (practice session information was simply reported as having occurred or not); (4) testing environment, including the equipment remaining the same throughout the entire testing process, which was reported as yes or no, or a partial report was given if the stability of conditions can be implied due to study design; (5) reported amount of time between assessments, if applicable. Along with study quality, authors extracted validity and reliability results from each article. As general group associations are determined using correlation coefficients (r) and intraclass correlation coefficient (ICC), values were classified as follows: <0.4 was rated as poor, ≥0.4 to <0.8 was moderate, and ≥0.8 as excellent [39, 40]. As the κ coefficient is a measure of exact agreement between raters, a slightly modified scale was used: >0.01 and ≤0.2 was rated as poor, >0.2 and ≤0.4 was rated as fair, >0.4 and ≤0.6 was moderate, >0.6 and ≤0.8 was good, and >0.8 and ≤1.0 was excellent [41]. If authors could not agree at any point during the data extraction phase, a third author made the final decisions on study quality and validity/reliability extraction.

3 Results

Preliminary search results identified 7508 articles; however, after examining titles and abstracts, 154 full-text articles were retrieved and reviewed for eligibility for inclusion in this review. Reasons for exclusion of search results can be viewed in Fig. 1. After inclusion/exclusion criteria were applied to the full-text articles, 17 met all criteria for inclusion into this review. These 17 articles consisted of eight different lifelong physical activities, including resistance training (three), badminton (two), tennis (three), cycling (two), racquetball (one), swimming (two), golf (one), and dance (three) articles. More specific information related to the skills tested, equipment needed, and the sample used in each study can be viewed in Table 2.

3.1 Risk of Bias

Overall, relative to the study type and design, the sample sizes ranged from small (n = 6) to very large (n = 131). One study only established content validity and did not report a sample size [42]. Only 12 % of studies had a sample size greater than 100, while 47 % of studies involved small sample sizes of 30 participants or fewer. When reporting participants’ details (i.e., sex, age, level of experience, and number of participants), only seven studies adequately reported these details, while the remaining ten were missing at least one criterion. As previously reported by Robertson et al. [32], the ability level of study participants/cohorts is commonly not reported in studies, and this holds true for the current review as this detail went unreported more than any other participant detail (n = 8). Six of the 17 included articles allowed participants to practice the studied skills before the official test was undertaken. However, it should be noted that one study [43] had an optional practice session; thus, we were not able to determine whether all participants had practiced. Nine studies reported keeping testing conditions the same between assessments (i.e., environment and equipment), while the remaining eight studies either made no mention of keeping testing conditions the same or the stability of conditions could not be deduced due to study design.

3.2 Validity

Content validity was the most commonly reported validity for studies in this review. A total of 41 % of studies cited content validity, and all of these studies used some type of expert panel to establish the relevant skills/domains to be
Table 2  Skills tested, equipment used, and participants involved in skill tests

<table>
<thead>
<tr>
<th>Reference</th>
<th>Activity</th>
<th>Skills tested</th>
<th>Equipment</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torisla et al. [49]</td>
<td>Badminton</td>
<td>Badminton overhead serve</td>
<td>Badminton court, racquet, shuttlecock, net, rope</td>
<td>Mixed-sex physical education major college students</td>
</tr>
<tr>
<td>Wang et al. [54]</td>
<td>Badminton</td>
<td>Overhead badminton forehand strike</td>
<td>Badminton racquet, shuttlecock, video camera</td>
<td>Beginner level players aged 16–19 years</td>
</tr>
<tr>
<td>Duchyene et al. [46]</td>
<td>Cycling</td>
<td>Walk with bicycle, mount bicycle and ride, look left and right while riding, ride in straight line, cycle in a circle, cycle one-handed in a circle, slalom, cycling on sloping surface, signal left and right while riding, brake to a controlled stop, dismount bicycle</td>
<td>Asphalt surface, bicycle, cones, boards, traffic signs, ramp, floor markers</td>
<td>Grade 4 primary school children</td>
</tr>
<tr>
<td>Macarthur et al. [52]</td>
<td>Cycling</td>
<td>Riding in a straight line, coming to a complete stop, shoulder checking before a left turn</td>
<td>Chalk, stop sign, pylon</td>
<td>Year 4 primary school children</td>
</tr>
<tr>
<td>Angioni et al. [50]</td>
<td>Dance</td>
<td>Control of movements, spatial skills, accuracy of movements, technique, dynamics, timing, and rhythmical accuracy, performance qualities, overall performance</td>
<td>Video camera</td>
<td>Professional contemporary dancers</td>
</tr>
<tr>
<td>Chatfield [47]</td>
<td>Dance</td>
<td>Skill, space, time, energy, phrasing, and presence</td>
<td>Soundtrack, video camera</td>
<td>Non-dancers, beginners, intermediates, advanced, and professional dancers</td>
</tr>
<tr>
<td>Krasnow and Chatfield [44]</td>
<td>Dance</td>
<td>Full-body involvement, body integration and connectedness, articulation of body segments, and movement skills</td>
<td>Video camera</td>
<td>Low-intermediate to advanced dance class college students</td>
</tr>
<tr>
<td>Barnett et al. [48]</td>
<td>Golf</td>
<td>Golf swing, golf putt</td>
<td>Foam golf ball, golf putter, golf clubs, cone, video camera</td>
<td>Children aged 6–10 years</td>
</tr>
<tr>
<td>Lam and Zhang [43]</td>
<td>Racquetball</td>
<td>Racquetball forehand, racquetball backhand, ceiling slot, wall rally</td>
<td>Standard racquetball court, racquets and racquetballs</td>
<td>Beginner level college students</td>
</tr>
<tr>
<td>Barnett et al. [59]</td>
<td>Resistance training</td>
<td>Body weight squat, push-up, large, suspended row, standing overhead press, front support with chest touch</td>
<td>Suspension bar/straps, anchor point (e.g. door), video camera</td>
<td>Year 7–10 school children</td>
</tr>
<tr>
<td>Lubans et al. [45]</td>
<td>Resistance training</td>
<td>Body weight squat, push-up, large, suspended row, standing overhead press, front support with chest touch</td>
<td>Suspension bar/straps, anchor point (e.g. door), video camera</td>
<td>Year 7–10 school children</td>
</tr>
<tr>
<td>Myer et al. [42]</td>
<td>Resistance training</td>
<td>Back squat</td>
<td>Cylindrical dowel</td>
<td>NA</td>
</tr>
<tr>
<td>Erbaugh [56]</td>
<td>Swimming</td>
<td>Water entry, front locomotion, back locomotion, breathing, kicking, diving, ring pick-up and retrieval</td>
<td>Pool, 6 × 6 platform, 12 × 3/4 bench, water rings, hoops, lane lines</td>
<td>Preschool children</td>
</tr>
<tr>
<td>Zetou et al. [55]</td>
<td>Swimming</td>
<td>Backstroke</td>
<td>Pool, pool basy, video camera</td>
<td>Children aged 10–12 years</td>
</tr>
<tr>
<td>Buszard et al. [51]</td>
<td>Tennis</td>
<td>Tennis forehand</td>
<td>Small, medium and large tennis racquet, standard yellow, low compression green and very low compression red tennis ball, two video cameras</td>
<td>Beginner level children aged 6–8 years</td>
</tr>
<tr>
<td>Farrow et al. [57]</td>
<td>Tennis</td>
<td>Tennis forehand, tennis backhand</td>
<td>Tennis racquet, standard and modified 'red' tennis ball, regular and scaled tennis court with nets, two video cameras</td>
<td>Beginner level primary school children</td>
</tr>
<tr>
<td>Messick [53]</td>
<td>Tennis</td>
<td>Overhead tennis serve</td>
<td>Standard yellow tennis ball, tennis racquet, video camera</td>
<td>Mixed experience players, aged 9–19</td>
</tr>
</tbody>
</table>

NA not applicable
assessed. Two of the studies [43, 44] additionally used a literature review to further justify the inclusion of specific skills to allow for adequate content validity of their test. Construct validity was reported in 24 % of studies. Of the studies reporting construct validity, three different statistical analyses were used. Lubans et al. [45] used a regression model, involving the total score of the resistance skill training battery and sex, and found that 39 % of variance could be explained by a muscular fitness score. Ducheneau et al. [46] established construct validity through factor analysis, which resulted in three factors being extracted from the skills test, including during-cycling skills, walking with the bicycle, and dismounting the bicycle. Discriminative validity was established for a test of dance and golf proficiency [47, 48]. An analysis of variance was used to test for group differences between ability level (i.e., non-dancers, beginners, intermediates, advanced, and professionals) and overall dance test scores. Alternatively, the golf assessment tested for differences in golf skill competency according to age (e.g., 6, 7/8, 9/10 year olds).

Only two studies tested for criterion-related validity. Toriola et al. [49] classified participants as low-skill (displaying less than 50 % of badminton service components) or high-skill (displaying more than 50 % of badminton service components) badminton players. Participants were then scored on a service test (i.e., quantitative test based on where the shuttlecock landed on the serve) while simultaneously being assessed by the judges on the quality of their movement. The results from these two assessments were then correlated, which yielded a low positive association for both low-skill (r = 0.04) and high-skill (r = 0.06) performers. These results indicate that the judges’ process-oriented scoring of participants (i.e., quality of movement) could not sufficiently determine participants’ scores on the overhead serve test (i.e., quantitative score). Similarly, process-oriented ratings on a racquetball skill battery [43] were used to assess the quality of participants’ movements for eight different racquetball skills. This rating was then correlated to individuals’ final standing in a racquetball tournament. This study revealed a higher relationship (r = −0.48) compared with the badminton service test. A rank of one indicates the best player (i.e., high racquetball ability), whereas a score of ten would indicate the tenth best player in the tournament (i.e., less racquetball ability). Therefore, while criterion validity may provide important information in terms of predicting future performance or how a skill test compares to ‘gold standards’, the results of studies included in this review may show that more research should focus on improving and/or establishing criterion validity for use in process-oriented tests. The validity results of included articles are displayed in Table 3. Six tests in this review failed to report any type of validity [50-55].

3.3 Reliability

All but one study [42] included in this review reported at least one type of reliability. Most common was inter-rater reliability (n = 12). This was reported either as the percentage of agreement [53, 54, 56], r coefficient [44, 47, 49, 55, 56], ICC [46, 49-51], or a k coefficient [52]. Intra-rater reliability was reported in 41 % of studies in a similar fashion as inter-rater reliability, with three studies reporting r coefficients [44, 47, 55], three reporting ICCs [43, 48, 50], and one study using percentage of agreement [53]. While most studies showed a high level of inter- and intra-rater agreement, one study [53] had questionable levels of inter-rater agreement (i.e., percentage of agreement below 80 %) for two of the six components assessing the overhead tennis serve.

Test–retest reliability was only reported in four studies [45, 48, 56, 57]. Of those studies reporting test–retest reliability, two studies reported this as an r coefficient [56, 57] and one as an ICC [48]. The fourth study reporting test–retest reliability was unique in that this was demonstrated through rank order repeatability (i.e., ability of participants to remain the same across multiple trials) and change in mean (i.e., change in score between trials of an individual as opposed to group differences and typical error [45, 58]). These statistics were unique to the resistance training battery identified in this review, and the authors of the paper were comparing differences between individuals, unlike other tests that compare group differences. Additionally, coefficient of variation [59] was used in another article assessing the resistance training battery to further show the reliability of the instrument. Two studies reported three different types of reliability statistics [45, 56], while all other studies reported either one or two reliability statistics. Overall, however, levels of reliability were moderate to excellent, with no ICC below 0.60, r below 0.67, and percent agreement below 69 %.

3.4 Test Duration

To the authors’ knowledge, no published guidelines for determining adequate test duration exist. However, test duration has been used as one component of feasibility in a previous sport skill review [32]. Thus, duration to assess a single participant (independent of set-up time) was extracted for this review. Eight of the 17 articles reported time to assess a single participant in a skill test/battery [43,
Table 3 Measurement properties

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sport</th>
<th>Validity</th>
<th>Reliability</th>
<th>Test duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toriola et al. [49]</td>
<td>Badminton</td>
<td>Criterion (concurrent $r = 0.04-0.06$)</td>
<td>Inter-rater (Kendall coefficient of concordance = 0.68, 0.70, 0.78)</td>
<td>NR</td>
</tr>
<tr>
<td>Wang et al. [54]</td>
<td>Badminton</td>
<td>NR</td>
<td>Inter-rater (87.3-94.8 %)</td>
<td>First 5 min of session were recorded</td>
</tr>
<tr>
<td>Ducheyne et al. [46]</td>
<td>Cycling</td>
<td>Construct (factor analysis)</td>
<td>Inter-rater (ICC 0.75-0.98)</td>
<td>NR</td>
</tr>
<tr>
<td>Macarthur et al. [52]</td>
<td>Cycling</td>
<td>NR</td>
<td>Inter-rater ($\kappa = 0.9-1.0$)</td>
<td>45 min</td>
</tr>
<tr>
<td>Angioli et al. [50]</td>
<td>Duance</td>
<td>NR</td>
<td>Intra-rater test-retest (ICC 0.85-0.96)</td>
<td>60 s</td>
</tr>
<tr>
<td>Chatfield [47]</td>
<td>Duance</td>
<td>Content</td>
<td>Inter-rater ($r = 0.95-0.96$)</td>
<td>4 min 3 s</td>
</tr>
<tr>
<td>Krasnow and Chatfield [44]</td>
<td>Duance</td>
<td>Content</td>
<td>Intra-rater ($r = 0.82-0.95$)</td>
<td>NR</td>
</tr>
<tr>
<td>Barnett et al. [48]</td>
<td>Golf</td>
<td>Content</td>
<td>Intra-rater (ICC 0.79)</td>
<td>NR</td>
</tr>
<tr>
<td>Lam and Zhang [43]</td>
<td>Racquetball</td>
<td>Criterion (concurrent $r = -0.48$)</td>
<td>Inter-rater (ICC 0.87)</td>
<td>20-25 min</td>
</tr>
<tr>
<td>Barnett et al. [59]</td>
<td>Resistance training</td>
<td>Content</td>
<td>Inter-rater (ICC 0.67)</td>
<td>8-10 min</td>
</tr>
<tr>
<td>Lubans et al. [45]</td>
<td>Resistance training</td>
<td>Content</td>
<td>Coefficient of variation (4.9 %)</td>
<td></td>
</tr>
<tr>
<td>Myer et al. [42]</td>
<td>Resistance training</td>
<td>Content</td>
<td>Test-retest</td>
<td>8-10 min</td>
</tr>
<tr>
<td>Eribaugh [56]</td>
<td>Swimming</td>
<td>Content</td>
<td>Rank order repeatability (ICC 0.67-0.87)</td>
<td></td>
</tr>
<tr>
<td>Zetou et al. [55]</td>
<td>Swimming</td>
<td>NR</td>
<td>Change in mean ($r = 0.02$ to 0.21)</td>
<td></td>
</tr>
<tr>
<td>Buskard et al. [51]</td>
<td>Tennis</td>
<td>NR</td>
<td>Typical error (range 0.6-1.2; $r = -0.26$ to 0.21)</td>
<td></td>
</tr>
<tr>
<td>Farrow et al. [57]</td>
<td>Tennis</td>
<td>Ecological</td>
<td>Inter-rater (0.81-0.91)</td>
<td>NR</td>
</tr>
<tr>
<td>Messick [53]</td>
<td>Tennis</td>
<td>NR</td>
<td>Test-retest</td>
<td>NR</td>
</tr>
</tbody>
</table>

ANOVA analysis of variance, ICC intraclass correlation coefficient, NR not reported

45, 47, 50, 52, 54, 56, 59). Three tests took 5 min or less to assess a single participant [47, 50, 54]. Additionally, the resistance training skills battery reported 8- to 10-min test durations [45, 59]. The remaining three articles reported a test duration of 20 min or more [43, 52, 56]. The rest of the articles (n = 9) included in this review either made no mention of the time needed to administer the given test, or the time needed was unclear, thus test duration could not be determined.

3.5 Samples and Skills Tested

Information pertaining to skills tested and participant samples used can be found in Table 2. Overall, samples of

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included studies were young, ranging from preschool age to college students, with the exception of two dance studies [47, 50] that included participants aged up to 30 years. Additionally, three of the 17 studies, all of which were dance tests [44, 47, 50], used some elite or professional dancers.

4 Discussion

This review was conducted to assess the methodological properties, validity, reliability, and test duration of process-oriented lifelong physical activity measurement tools, as well as to clearly define the characteristics unique to lifelong physical activities. Although 17 studies were included in this review, only assessments for eight different lifelong physical activities were identified (i.e., resistance training, badminton, tennis, cycling, racquetball, swimming, golf, and dance). All but one study reported some form of reliability, but fewer studies reported the validity of measurement tools. These results may indicate that, while some work has been done on creating valid tests of lifelong physical activities, current tests can still be improved. This review also highlighted the need for assessments of other popular lifelong physical activities, such as yoga, Pilates, tai chi, aerobics, and running.

4.1 Risk of Bias

It should be noted that the majority of the studies failed to describe the participants’ characteristics in sufficient detail, which limits the generalizability of findings. For example, few studies described their sampling frame and participants’ ability levels. While nine studies specifically stated the participants’ skill levels (e.g., beginner, expert), one study [50] used all professional, national, or international level participants, and all five studies used all beginner level participants [43, 47, 51, 54, 57]. By using participants with high ability levels (e.g., professional), the applicability of the content tested for the general or even amateur population may be questionable. For example, competencies in rhythmical accuracy, spatial skills, and accuracy of movements may be too detailed for anyone other than the most elite dancers. Thus, while tests of dance competency exist [44, 47, 50], their suitability for assessing lifelong physical activity competency may be inadequate. In the future, recruiting a more heterogeneous sample with older people (above the age of 20 years) and varied ability levels, may be beneficial, as results may therefore be more applicable to the population as a whole. Thus, the validity and reliability of these lifelong physical activity assessments should hold true for people of all ages. If developed tests are not valid or reliable in older populations, then identifying specific movement skill deficiencies in these populations may be compromised.

4.2 Reliability

As a whole, reliability was better reported than validity. Inter-rater reliability was the most commonly reported type of reliability. Three studies reporting inter-rater reliability had moderate reliability [49, 55, 59], two studies ranged from moderate to excellent levels of reliability [46, 53], and the rest of the studies reporting inter-rater reliability had excellent levels. Intra-rater reliability was also well reported, and levels of intra-rater reliability were classified as excellent for all these studies, except one study that was near excellent levels with an ICC value of 0.79 for a test of golf proficiency [48]. Rank order repeatability showed moderate to excellent levels of reliability for the resistance skill training battery, and acceptable levels of change in mean and typical error were also displayed for this test [45].

Test–retest reliability was only reported in four studies and should be a focus of future studies to see whether results are reliable over time, as opposed to a one-off measurement. If a test is to be considered reliable, the test needs to have adequate stability (i.e., results are similar over time) [39] and sensitivity (i.e., ability to detect small, meaningful differences in scores, such as in the resistance skills training battery) [45, 59, 60]. By addressing these issues, future tests can be administered with greater confidence regardless of time between assessments. While rank order repeatability is an important form of reliability, researchers are encouraged to assess other forms of test–retest reliability. More specifically, change in mean and typical error can be used to determine variability within an individual’s score, which is particularly important when determining the effect of an intervention on movement skill competency.

4.3 Validity

Only ten of the studies included in this review reported validity. Overall, content validity was the most frequently cited type of validity, while criterion validity was largely unreported. Very few process-oriented measures of lifelong physical activities are available; thus, comparing results of one assessment with results of a second assessment for the same activity rarely occurs. Particular attention in future research should be given to ensuring additional forms of validity (e.g., predictive, construct), as opposed to just content validity, are established for any test of movement skill competency. Research is also required to create multiple assessments for a given sport or activity, thereby allowing for more construct and criterion validity of lifelong physical activities to be established. By creating more appropriate tests, researchers and practitioners alike will
possess a range of assessments to test an individual’s competency, which can help to eliminate deficiencies in movement skills or better teach individuals how to correctly perform a skill. It is important to remember that test validity is highly contextual and is not carried across situations, thus it cannot be assumed that a test validated with children will provide similar results for adolescents or adults.

One reason that previous skill tests using process-oriented measures, such as the TGMD-2, have been used with success in the past may be due to the numerous types of validity that have been established in a number of different settings. For example, the content validity of the TGMD-2 was established through the agreement of three experts who judged the appropriateness of the skills included in the battery. Second, criterion validity was shown through the strong correlation of the TGMD-2 to a similar measure of movement ability. Finally, construct validity was established through its ability to test for age differentiation, group differentiation, item validity, subtest correlations (i.e., locomotor and object control subtest), and factor analysis [36].

Researchers are encouraged to assess the predictive validity of lifelong physical activity movement skill tests by comparing results with physical activity behavior. This is important because if lifelong physical activities are able to predict high levels of physical activity, then justification for the inclusion of such activities in the school curriculum, particularly in secondary school, may be warranted. Due to the decline in physical activity that commonly occurs in adolescence [61], it is imperative that young people develop competency in a range of fundamental, specialized, and lifelong physical activity movement skills. Indeed, recent reviews and national guidelines have highlighted the importance of developing movement skill competency to ensure that young people are prepared for a lifetime of physical activity [19, 62–64]. While the relationship between FMS and physical activity during childhood and adolescence has been well documented [4], less evidence is available to support the importance of FMS beyond the adolescent years. It is also well reported that not all individuals will attain proficiency in FMS. As such, these individuals may need an additional set of movement skills in lifelong physical activities that they can learn and may provide another or further opportunity to be physically active. Thus, lifelong physical activities may play a critical role in obtaining higher levels of physical activity into adulthood.

4.4 Test Duration

Just under half of the studies in this review noted a test duration between 1 and 45 min. Longer tests may be acceptable for smaller groups of people, while larger groups may be better served by a quick, efficient test for assessing skill competency. Unfortunately, there is no well-accepted criteria for determining whether a test is too short or too long; thus, researchers need to use their best judgment when creating tests [65]. Given that tests of lifelong physical activities may be targeted in schools, where lack of time in physical education is a known barrier [66], the need for shorter tests may be justified. Test duration may be influenced by other variables such as equipment needed, number of trials tested, and administration duties. While these are all important to consider when determining appropriate test duration, the validity and reliability of a given test should not be compromised. Previously, reviews have noted movement skill tests that take anywhere from 15 to 90 min to complete for a single participant [31, 32]. Around 20 min seems to be the most common amount of time used to assess various FMS, sport, and lifelong movement skills [31, 32]. For example, the TGMD-2 [36] takes about 20 min to administer, and this movement skill assessment is widely used [35, 67, 68]. More research on test duration for skill assessment may be beneficial to see approximately what amount of time balances feasibility with obtaining sufficient information on an individual’s ability.

4.5 Limitations

Limitations of this review are that only eight different lifelong physical activities were identified. More tests of lifelong physical activity competency may exist; however, either validity or reliability of these tests have not been established or they may appear elsewhere, but not in the peer-reviewed literature (e.g., yoga, Pilates). Another limitation is the lack of diverse samples tested. Few tests assessed non-elite and older aged individuals, thus applicability to the general population may be questioned. In addition, test–retest reliability was lacking, as this was only displayed in four studies. Thus, one-time measures of competency seem to be an issue in the assessment of lifelong physical activities.

5 Conclusion

Lifelong physical activity movement skills may be advantageous for individuals to learn due to their individual or small group nature and as an opportunity to broaden their physical activity confidence and competence. Additionally, their need for little structure, decreased contact, varying levels of intensity and competitiveness, along with the ability to perform these activities into old age may allow individuals to be active at any age. A total of 17
studies were considered and reviewed for their methodological properties, validity, reliability, and test duration. Methodological characteristics, such as participants’ details and stability of conditions need to be better reported in future studies. While moderate to excellent levels of intrarater and inter-rater reliability were noted in the majority of tests, few tests of lifelong physical activities reported test-retest reliability. Validity was only reported in ten of the studies; content validity was the most common. Future research should look to establish additional forms of validity and reliability for current tests of lifelong physical activities. Tests of lifelong physical activity included in this review and created in the future should look to establish predictive validity in order to support the notion that competency in lifelong activities does allow for a lifetime of activity.

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References


APPENDIX 1.3: Fundamental Movement Skills: a Seriously Useful Focus

 Fundamental Movement Skills: An Important Focus

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Purpose: Recent international conference presentations have critiqued the promotion of fundamental movement skills (FMS) as a primary pedagogical focus. Presenters have called for a debate about the importance of, and rationale for teaching FMS, and this letter is a response to that call. The authors of this letter are academics who actively engage in FMS research. Method: We have answered a series of contentions about the promotion of FMS using the peer-reviewed literature to support our perspective. Results: We define what we mean by FMS, discuss the context of what skills can be considered fundamental, discuss how the development of these skills is related to broader developmental health contexts, and recommend the use of different pedagogical approaches when teaching FMS. Conclusion: We conclude the promotion of FMS is an important focus in Physical Education (PE) and sport and provide future research questions for investigation.

Keywords: physical activity, motor coordination, motor skill, teaching pedagogy

Recent presentations at international conferences (‘AIESEP World Congress’, February 10–13, Auckland, New Zealand and ‘The International Congress on Children’s Physical Activity and Sport’, 17–18 October, Liege, Belgium) (Almond, 2014; Pot & van Hilvoorde, 2014) have critiqued fundamental movement skills (FMS) as a pedagogical focus. Moreover, a circulating YouTube clip highlights a number of contentions regarding the role of FMS in promoting physical activity in young people: (www.youtube.com/watch?v=LN9pM8UmpEg), Afonso, Coutinho, Araújo, and Pot (2014). Presenters at these conferences have called for a debate about the importance of, and rationale for promoting FMS. In general their criticisms include the following.

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1. FMS are not all fundamental.
2. Each FMS only leads to a limited number of sports and/or activities and therefore skill transfer is limited.
3. Skills are learnt by doing rather than being taught.
4. That a focus on FMS ignores a constraints-based approach.
5. FMS is a ‘skills and drills’ teaching approach.
6. There is little data supporting the association between movement competence and physical activity.

Authors of this letter are academics with PE, kinesiology, or public health backgrounds based in Australia, the United States of America (USA) and Europe, who actively conduct research involving FMS. We respect the viewpoints of the presenters at these sessions for highlighting their perspectives and encouraging divergent thought, as it encourages critical thinking and academic debate. The specific purpose of this paper is to answer the critiques against FMS, based on the best available evidence.

It is important firstly to define what we mean by FMS. Confusion in the literature around FMS means terms are often used interchangeably. FMS (also termed fundamental motor skill) are defined as basic learnt movement patterns that do not occur naturally and are suggested to be foundational for more complex physical and sporting activities. They can be classified into three distinct categories: locomotion (involving locomotion of the body e.g., running), object control (manipulative skills e.g., catching a ball) and stability skills such as balancing (Gallahue, Ozmun, & Goodway, 2012). Motor coordination can be described as the capacity to have body segments work together in an organized manner (Turvey, 1990) and might be considered an underlying component of FMS.

Critique 1: FMS Are Not All ‘Fundamental’

The first contention is concerned with how these skills were chosen, as they don’t necessarily include every skill that might be considered fundamental. Different test batteries have emerged around the world, addressing slightly different forms and groups of skills (Cools, Martelaer, Samaey, & Andries, 2009). For each testing battery, the developers and/or users are required to decide how many test items to include (i.e., how many skills) in the context of the specific study aims, time, cost, and participant burden, and what test items are going to best represent the movement skill competence of the child. Therefore, there can be an incongruity between a conceptual definition of what is considered ‘fundamental’ and the actual assessment instrument that measures this concept. Many tests were, on the whole, originally developed to assist with the identification of children with developmental issues. Recent test batteries have emerged with the purpose to classify typically developing children according to different levels of movement competency. That is why it is inappropriate to draw the basic—commonly known—definitions (such as FMS in this case), from what is measured with, or included in, a specific test battery.

Of course it is difficult to determine the most representative skills to target, and we agree that what one person may consider ‘fundamental’ may be different to another person within a different context. Those skills considered FMS have often been tied to the skills that are inherently integrated in common sports, e.g., kicking and running are part of football (soccer). Yet there is also a degree of cultural appropriateness needed for measures, as different sports and physical activities are popular in different countries (e.g., football in England and baseball in the USA). In addition, certain groups (e.g., individuals with disabilities) may not be able to attempt certain movement skills but this doesn’t mean that such skills shouldn’t be classified as fundamental. There will always be individual circumstances that challenge assumptions that are made on a population basis, but this doesn’t preclude the attempt to develop skill batteries that may have relevance for many health behaviors and psycho-social outcomes on a population level. The disparity of skill in some populations (Bardid, Rudd, Lenoir, Polman, & Barnett, 2015; Goodway, Robinson, & Crowe, 2010) further emphasizes the need for assessment that can accurately identify skill deficits and tailor interventions to meet the specific needs of these individuals.

Critique 2: That Each FMS Only Leads to a Limited Number of Sports and/or Physical Activities and Therefore Skill Transfer Is Limited

The second critique is how can we term these skills fundamental when each skill only leads to a limited number of sports and/or activities. ‘Fundamental’ can essentially be commonly defined as forming a necessary base or core. Therefore, this is why sets of skills are proposed; to attempt to cover the most representative or salient skills that, if mastered, will give children the best possible chance to successfully and persistently participate in a range of health-enhancing physical activities. It is suggested that FMS can be subsequently fine-tuned for application in specific sports. For example, advanced mechanisms of throwing or striking transfer to various sports (i.e., cricket, baseball, tennis etc.), whose context can be adapted or varied at different levels across the lifespan (Gallahue et al., 2012; Langendorfer, Roberton, & Snodden, 2011). These points are important and are why we are not concerned with whether FMS competency transfers to nonactive pursuits such as playing chess or flying a Red Bull Plane (Afonso et al., 2014). This is also why test batteries assessing FMS do not directly assess skills needed in daily living such as getting out of bed and rising from a chair, as typically developing children...
will successfully accomplish these activities with little training (i.e., noted for phylogenetic activities). Rather, test batteries focus on skills that require practice and training (i.e., ontogenetic activities) and which promote engagement in a broad range of culturally relevant and socially driven activities.

In general, as the world becomes highly mechanized, sedentary and obeseogenic, developing skills that promote a diverse movement foundation (i.e., functional coordination and control) that allows successful participation in ontogenetically driven activities may be a highly viable tactic to promote/encourage sustained physical activity across the lifespan (Breuer & Wicker, 2009). In this context, FMS are the foundations of later activities frequently taught in PE curricula. Thus, the question is, whether FMS development provides this diverse movement background.

Superficially, it seems reasonable to suggest there would be no direct progression or transfer from developing a highly advanced throwing pattern to activities such as being able to wakeboard, swim, mountain bike or horse ride. However, upon closer inspection, the development of highly advanced throwing (as well as kicking and striking) requires the demonstration of underlying attributes. These attributes could be seen as “fundamental” aspects of coordination and control for many types and forms of movements (i.e., dynamic balance, contralateral coordinative functioning of extremities, perceptual motor integration, development of high angular velocities of multiple joints, optimal relative timing of segmental interactions, optimal inter- and intramuscular coordination and optimal transfer of energy through the kinetic chain), including water skills, mountain biking or horse riding. See Langendorfer, Robertson, and Stoddert (2011) for a more thorough explanation of neuromotor and biomechanical mechanisms of object projection skills. Thus, isolating the skill of throwing, as only a “sports skill” with limited applicability and transfer to other types of movements or neuromuscular-related aspects of physical fitness (Stoddert, Gao, Langendorfer, & Goodway, 2014) promotes a narrow viewpoint of the complexity of these types of movements and a lack of appreciation of the broad applicability of the high levels of functional coordination and control demanded in many FMS. Furthermore, the psychological effects of perceiving oneself as competent, as independent of actual FMS competence, may have a tangible impact on an individual’s desire to engage in other physical activities (Babic et al., 2014; Robinson et al., 2015).

Critique 3: That Skills Are Learnt by Doing Rather Than Being Taught

The third contention is that skills are learnt by doing rather than being taught. We agree that we may acquire rudimentary levels of some FMS through exploration and having opportunities to do so, being engaged, and having appropriate environments with space, equipment and positive reinforcement that allows us to practice and learn (Barnett, Hinkley, Okely, & Salmon, 2013). Yet not every child has access to the conditions that would promote learning at an appropriate rate or has the capacity to learn independently even when the environmental conditions are supportive. Thus, we also benefit from being instructed on how to reach advanced levels of many FMS (just as we also benefit from being taught to read, spell and write). Opportunity to practice, instruction and modeling are important to the development of FMS (McKenzie, Alcaraz, Sallis, & Fausette, 1998). A number of early childhood intervention programs (Goodway & Branta, 2003; Robinson & Goodway, 2009) show that when young children are provided with well-equipped free play time, they do not significantly improve their FMS, and only in the instructed condition are significant improvements in FMS seen. In addition, three recent systematic reviews confirm that interventions improve children’s movement skills beyond what can occur in free-play (Logan, Robinson, Wilson, & Lucas, 2012) or ecological control groups (Ivonen & Sääkslahti, 2013; Logan et al., 2012; Morgan et al., 2013).

Critique 4: That a Focus on FMS Ignores a Constraints-Based Approach

It has been suggested that focusing on FMS within PE ignores a constraints-based approach (Newell, 1986) by considering skills in isolation, and that not taking account of environmental constraints suggests this approach is not ‘authentic’ (Afonso et al., 2014). What is important to keep in mind here though, is that an authentic learning environment is provided when the development of a coordination pattern is promoted via the interaction of the individual, the environment, as well as the specified task that is being promoted (Newell, 1986). Thus, an authentic learning environment is one that is developmentally appropriate, based on the individual’s developmental level, which may necessitate that a new skill (or new variation of a skill) be learnt and practiced in a closed environment (e.g., without the pressures of competition or other external variables), before being able to integrate it in other more advanced movement learning opportunities (Boyce, 1992). Many elementary teachers and intervention studies use a constraints perspective to teach FMS in isolation. For example, the SKIP program developed by Goodway and colleagues (Goodway, Crowe, & Ward, 2005; Brian, Goodway, & Sutherland 2014; Hummeci Akunsoz, & Goodway, 2015), accounts for individual constraints (e.g., lack of ability to track a ball in catching) by manipulating environmental (e.g., equipment, ball size) and task (self-tossed, peer tossed) constraints to account for the individual child’s developmental level. Overall, teaching should take into account the interaction of individual, environmental and task variables and these factors should be synergistically and variably integrated with a variety of movement concepts; thus providing an appropriate application of Newell’s Constraints Theory (1986).
Critique 5: That FMS Is a ‘Skills and Drills’ Teaching Approach

The approach to teaching is pedagogy; being the practice and method of teaching. An underlying critique against the promotion of FMS appears to rest on the ‘misperception’ of FMS as a teaching approach. Teachers generally are required to be highly qualified in the content area of the domain or subject area in which they teach (i.e., high levels of content knowledge [CK]). However, expertise in content alone is inadequate. Effective teachers also possess a high level of pedagogical content knowledge (PCK), that being the skills and knowledge to successfully plan and implement a diversity of pedagogical approaches, which address individual student learning styles and developmental levels (Ayyazo & Ward, 2011; Shulman, 1987). Importantly, the literature suggests that teachers who demonstrate high levels of both CK and PCK achieve better FMS outcomes for their students (R. Cohen, Goodway, & Lidor, 2012). To suggest there is only one way to impart the content serves as a great injustice to not only the students, but also the teaching profession.

FMS is just one content area within international PE curricula (e.g., Standard 1 of the SHAPE America standards incorporates FMS for the lower elementary grades). As such, a variety of evidence-based approaches have been used to teach FMS utilizing a variety of pedagogical approaches. Thus a broad range of both ‘instructional models’ (Gurwitch & Metzler, 2013) as well as teaching strategies (Mosston & Ashworth, 2008) can be implemented when teaching FMS.

FMS can be taught and practiced within a game-like environment, where game play, either structured or unstructured is integrated in the curriculum or practice environment. Launder and Pütz (2013) in their Play Practice Model suggest expertise in skills can be taught within the game context. Others also emphasize that teachers who exhibit a deep understanding of game-centered pedagogy are capable of balancing the teaching of skills/strategies/teaching of skills and tactical thinking (Dudley & Baxter, 2009; Dudley & Baxter, 2013). Simultaneous development of FMS and tactical skill has been demonstrated using such an approach (Miller, Christensen, Eather, Gray, et al., 2015; Miller, Christensen, Eather, Sproule, et al., 2015). This implies that teachers and researchers need to (and can) move from seeing ‘skills teaching’ and ‘tactical instruction’ as distinct elements of PE to a position where the interrelationship existing between skills and tactics is paramount (Dudley & Baxter, 2009). The important point to note when motor skills are taught together within game components is that FMS contribute to development and provide a framework for instruction within integrated models of instruction (especially for nonspecialist PE teachers in primary schools).

Promoting a mastery or high autonomy climate is an approach which aids learning through autonomous motivation, and can be attached to both skills and games based pedagogy. A mastery approach promotes the development of skills in a noncompetitive, nonthreatening learning environment. In this sort of environment all students have an opportunity to succeed, receive instruction and positive reinforcement and are encouraged to improve, which can lead to higher levels of intrinsic motivation, enjoyment and perceived competence (Robinson, Rudisill, & Goodway, 2009; Theoborn, De Knop, & Weiss, 1995; Valenti & Rudisill, 2004). A mastery climate directs control to the learner, who progresses through a planned learning environment which is structured around the dimensions of task, authority, recognition, grouping, evaluation, and time (Ames, 1992). A recent article found a mastery climate approach, focusing on success, optimal challenge, and autonomy led to improvements in FMS (Kalaja, Jaakkola, Liukkonen, & Dugdill, 2012), highlighting the benefits of incorporating these principles into a pedagogical approach. Furthermore, a recent study which used a mastery climate approach to guide the SAAFE (i.e., Supportive, Active, Autonomous, Fair and Enjoyable) teaching principles implemented in the study, demonstrated that improvements in FMS competency mediated the effect of the intervention on physical activity and cardiorespiratory fitness in children (K. E. Cohen, Morgan, Piotnikoff, Barnett, & Lubans, 2015). Thus, how one chooses to promote FMS is a pedagogical matter. FMS in and of itself is clearly not an approach, and it is inappropriate to suggest otherwise.

Critique 6: That There Is Little Data Supporting the Association Between Movement Competence and Physical Activity

A main contention leveled at our research focus is that there is little data supporting the association between FMS and physical activity. We find it interesting that physical activity was the only health-related factor mentioned, as not only do we reject the premise that there is weak evidence that movement skill competency and physical activity are associated, but we also note there is strong evidence supporting associations between FMS and multiple aspects of health-related fitness, including body composition. Systematic reviews have found strong evidence for a positive association between FMS and physical activity and fitness, and an inverse association with body weight status (Cattuzzo et al. 2016). Specifically, Hofelder & Schott (2014) indicated that 12/23 studies found an association between FMS or other forms of motor competence and physical activity. Lubans, Morgan, Cliff, Barnett, & Okely (2010) also noted that of 13 studies that specifically examined FMS, 12 found a positive association with physical activity. Although Cohen and colleagues (2015) have demonstrated an antecedent/consequent relationship between FMS and physical activity, we do acknowledge the need for more appropriately designed experimental studies to demonstrate a cause–effect relationship (Robinson et al., 2015).
Future Research Questions

There are many questions that remain unanswered based on the points argued here. In terms of whether the FMS commonly assessed are really a representative sample of fundamental skills, future researchers could seek to investigate a) what range of skills are important to truly assess the level of movement skill competence that allows us to demonstrate a high and sustained level of capacity to engage in an active lifestyle, and b) are the "typically accepted" FMS universal across cultural contexts? In relation to the transferability of FMS, future research may seek to examine whether some skills demonstrate more global transferability to a wider range of lifetime activities and sports, as well as sustainability for health-enhancing physical activity and fitness. With regard to the teaching of FMS, future research should continue to examine and compare/contrast pedagogical strategies to optimize the learning/development of FMS. Lastly, to extend the field, we should examine whether competence in other types of skills become more important later in life. Lifelong activity skills have been used to describe sports and leisure activities typically performed individually or in small groups with no or limited physical contact, and which can easily be continued into adulthood and old age; such as resistance training and swimming (Hulteen et al., 2015). Future issues worth investigating may include whether traditional FMS also provide a foundation for these lifelong skills and other health-enhancing forms of physical activity.

Fundamental Movement Skills Is a ‘Seriously Useful’ Focus

One final argument presented in the aforementioned ‘critiques’ of FMS is that FMS do not equal physical literacy. While definitions of physical literacy remain a contested topic, we concur with this point. Even the United Nations Educational, Cultural and Scientific Organization (2005) recognizes that developing ‘an autonomous set of skills’ is, but one of four key indicators that need to be addressed to understand literacy-based constructs. Importantly, we see FMS as consisting of one of several components that need to be addressed within the physical literacy construct and one that is most effective, as previously mentioned, when it is integrated with multiple health behaviors and outcomes (Robinson et al., 2015). Being competent in FMS, is associated (and predictive) with not only physical activity (Hoffelder & Schott, 2014; Lubans et al., 2010), but also fitness (Cattuzio et al., 2016; Lubans et al., 2010), healthy weight status (Lubans et al., 2010) and cognitive and academic outcomes (Haapala 2015). Promoting FMS is integral to a holistic view of development. So in our joint quest to optimize psychological and mental health by promoting the development of more physically literate children (and we think we can join forces here), we maintain that the competence component is a seriously useful focus.

References


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APPENDIX 1.4: Interrater reliability assessment using the Test of Gross Motor Development-2

Original research

Interrater reliability assessment using the Test of Gross Motor Development-2

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Abstract

Objectives: The aim was to examine interrater reliability of the object control subtest from the Test of Gross Motor Development-2 by live observation in a school field setting.

Design: Reliability Study - cross sectional.

Methods: Raters were rated on their ability to agree on (1) the raw total for the six object control skills; (2) each skill performance and (3) the skill components. Agreement for the object control subtest and the individual skills was assessed by an intraclass correlation (ICC) and a kappa statistic assessed for skill component agreement.

Results: A total of 37 children (65% girls) aged 4–8 years (M=6.2, SD=0.8) were assessed in six skills by two raters: equating to 222 skill tests. Interrater reliability was excellent for the object control subtest (ICC=0.93), and for individual skills, highest for the dribble (ICC=0.94) followed by strike (ICC=0.85), overhead throw (ICC=0.84), underhand roll (ICC=0.82), kick (ICC=0.80) and the catch (ICC=0.71). The strike and the throw had more components with less agreement.

Conclusions: Even though the overall subscale score and individual skill agreement was good, some skill components had lower agreement, suggesting these may be more problematic to assess. This may mean some skill components need to be specified differently in order to improve component reliability.

1. Introduction

Process oriented movement skill assessments are concerned with how the skill is performed rather than the outcome or product of the skill execution (such as time, distance, accuracy, or number of successful attempts¹). An advantage of process assessments are that they allow identification of specific skill components that may need improving.² It is important these assessments are reliable in order to be able to accurately identify which skill components to improve. When assessing children’s movement skill proficiency for research purposes children are often videoed and then assessment can be completed at a later date by one or more raters. This enables an expert to rate a proportion of the videoed skill tests and in so doing provide a ‘gold standard’ benchmark. However it is not always possible or practical to video children due to differing ethics considerations and the particular resources required. Also, movement skill assessments need to be able to be used in the field, for instance, for physical education teachers to help make decisions about student movement skill ability. Furthermore if assessment criteria are not clear then video assessment will not necessarily resolve these issues.

When assessing children’s skill proficiency in the field using live observation, there is limited data verification, as it is not possible to revisit the skill performance, rather, raters need to be trained to an acceptable standard and then a proportion of assessments are performed by paired raters to check for interrater reliability. Interrater reliability (also termed interrater objectivity), is defined as the consistency or agreement in scores obtained from two or more raters,³,⁴ and is an important aspect of rigour when assessing movement skill proficiency in the field.

The Test of Gross Motor Development-2 (TGMD-2) is the widely used measure of assessing children’s fundamental movement skill competence.² It assesses six locomotor skills and six object control skills. The TGMD-2 is norm-referenced (by gender and population subgroups in the USA) and validated for children aged 3–10 years.⁵ Each skill comprises 3–5 skill components and the TGMD-2 assesses whether each skill component was performed or not performed to determine mastery of the skill. Scores from two trials are summed to obtain a raw score for each skill. The scores for all the skills can then be summed into a total skill score and separate composite object control and locomotor scores.

There are published interrater reliability assessments of the TGMD-2. For example, a recent Brazilian study reported intraclass

correlation coefficients (ICC) of 0.88 for the locomotor subtest and 0.89 for the object control subtest. Similarly, a study of preschool children reported similar results for both subtests (locomotor ICC = 0.92 and object control ICC = 0.90). While some studies have reported the prevalence of individual skill components to identify which components need improvement, no studies have reported the intrarater reliability for the individual skills in the TGMD-2 or for the specific TGMD-2 skill components. It is important to examine the reliability of specific movement skills and the components of those skills to help determine which skills may be more problematic for raters to assess in the field. Object control skills have greater complexity therefore, the purpose of the current study was to determine interrater reliability of each of the TGMD-2 object control skills (i.e. strike, stationary dribble, catch, kick, over-arm throw and underhand roll) and the components of each skill by direct observation of children.

2. Methods

A total of 37 children (55% girls) aged 4–8 years (M = 6.2, SD = 0.8) from three metropolitan elementary schools were assessed by two raters. Assessments were completed in six visits over a two-month period. Parents gave written consent and ethics approval was gained from the University and the relevant school institutional body.

Two researchers experienced in the assessment of children’s movement skills (having previously assessed movement skills through the context of a previous research study or through assessment of children using a validated tool as a physical education teacher, and physical education lecturer) were recruited for the study. Both raters were trained on three separate two-hour occasions by watching videoed children’s skills of child’s performance and rating these against a ‘gold standard’ rating (previously rated by two movement skill raters who had assessed and analysed movement skills in multiple research studies). Accuracy was assessed by comparing observer scores for each skill trial to the expert trainer’s ratings. Video tapes of children performing each skill. Training was considered complete when all observer’s scores for the two trials differed by no more than one unit from the instructor score for each skill (>80% agreement). Once in the field a monitoring process was undertaken in order to achieve the highest reliability possible between the raters. After each visit, reliability results for that day were entered and analysed and any rater disagreements were highlighted to raters by the study coordinator. Discussion between the raters and the coordinator ensured using the training videos to highlight common performance patterns, until raters agreed as to how they would each code that component next time.

Children’s skills were assessed separately by the two raters. The assessment protocol involved providing children with a demonstration of the correct technique before assessment. Children were then asked to perform the skill twice. Each attempt was scored with each component receiving a ‘1’ if correctly executed or a ‘0’ if not. General encouragement was given but no specific verbal feedback about skill performance. The raters were rated on their ability to agree on (1) the raw total for the object control skills (sum of the six skills); (2) each skill performance and (3) the 24 skill components of the six skills.

Data were analysed using SPSS (version 20 for Windows, Chicago, IL, USA). Repeatability was assessed using an ICC (a one way model for consistency for single measures). For the skill components, a kappa statistic was chosen to assess interrater agreement. A kappa statistic ≤0.20 was considered slight; between 0.21 and 0.40 fair, between 0.41 and 0.60 moderate, and 0.61 and above was considered substantial agreement. Percentage agreement was also performed for each skill component.

3. Results

In total, 222 paired assessments were completed. Both raters assessed the full range of skills. Table 1 shows the interrater reliability statistics for the total object control subtest, each skill and each component of each skill. The ICC for the object control subset was excellent overall (0.93) and for all skills (except the catch which showed good reliability (ICC = 0.71). The kappa coefficient was fair (between 0.21 and 0.40) on at least one trial for five of the total 24 skill components. An additional five skill components had moderate kappa coefficients (between 0.41 and 0.60). For the other 14 components over the two trials, the kappa coefficient was substantial (0.61 or above) (Table 1).

4. Discussion

We found excellent agreement for the TGMD-2 object control subtest between raters and for each object control skill, with the exception of the catch which demonstrated good reliability. In another process-oriented movement skill assessment, the ‘Get Skilled Get Active’ (GSGA), the catch was found to have substantial agreement and the highest reliabilities of the assessed object control skills (catch: k = 0.62, kick: k = 0.56, overhead throw: k = 0.45). Interestingly, in the current study the agreement for the kick and throw were excellent (ICC = 0.80 or above) and yet in the study using GSGA, reliability for these skills can be considered better in the moderate range. Perhaps the differences in skill reliability are due to the differences in the movement skill assessments.

When we looked at agreement for specific skill components, we found five of the 24 skill components had ‘fair’ agreement, with a further five having ‘moderate’ agreement suggesting some skill components may be more problematic to assess. The overhead throw and the strike had the most problematic components of all the skills in terms of rater agreement. The first three components of the throw concerning the windup, rotation of hips and shoulders to a point where the nonthrowing side faces the wall and weight transfer had lower agreement. For component 1 (the windup) it was observed there was often a backward movement of the arm initiating wind up, but not a downward movement. The downward movement assumes that the ball starts at chest height, like a baseball pitcher. Children can have a good overall looking throw, but be marked without this component as it does not have a downward movement. Holding them the ball at chest height can avoid this by making the same wind-up initiated by a downward movement.

Component 2 of the overhead throw (concerning rotation) is observed before the forward movement of the hand has begun. Rotation is also observed as the arm moves forward, the ball is released and the follow through enacted. This form of rotation is similar to what is assessed in component 3 of the strike (hip and shoulder rotation during swing) and yet in the overhead throw it is assessed inherently as part of component 4 (follow-through and release diagonally across the body and down towards the non-preferred side). This may provide some explanation for rater disagreement, as each rater may be marking ‘rotation’ at different stages throughout the throw. Perhaps, to avoid the component being misconstrued as the summation of forces throughout the throw, rather than a preparatory position prior to the release of the object, component 2 could be more simply stated as ‘stand side on to target prior to throw’.

Interestingly, a child who flings the ball with a straight armed discus style throw can fulfill most of the specified components for the overhead throw; however, the skill performance is incorrect, and is not even an overhead throw. The issue arises as there is not a component which specifies that the throwing arm must undergo flexion at some point of the overhead throw. It is the flexion at the
<table>
<thead>
<tr>
<th>Performance criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>ICC (LC-4UC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary dribble</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Contacts ball with one hand at about belt level</td>
<td>0.83</td>
<td>0.74</td>
<td>0.80</td>
</tr>
<tr>
<td>2. Pushes ball with fingertips (not a slap)</td>
<td>0.62</td>
<td>0.63</td>
<td>0.80</td>
</tr>
<tr>
<td>3. Ball contacts surface in front of or to the outside of preferred foot</td>
<td>0.94</td>
<td>0.97</td>
<td>0.95</td>
</tr>
<tr>
<td>4. Maintains control of ball for four consecutive bounces without having to move the feet to retrieve it</td>
<td>0.75</td>
<td>0.87</td>
<td>0.95</td>
</tr>
<tr>
<td><strong>All dribble components</strong></td>
<td><strong>0.94</strong></td>
<td><strong>0.95</strong></td>
<td><strong>0.97</strong></td>
</tr>
<tr>
<td>Striking a stationary ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Dominant hand grips but show nondominant hand</td>
<td>0.92</td>
<td>0.91</td>
<td>0.97</td>
</tr>
<tr>
<td>2. Nonpreferred side of body faces the imaginary tosses with feet parallel</td>
<td>0.38†</td>
<td>0.80†</td>
<td>1.00†</td>
</tr>
<tr>
<td>3. Hip and shoulder rotation during swing</td>
<td>0.27</td>
<td>0.32</td>
<td>0.80</td>
</tr>
<tr>
<td>4. Pronounced/clear transfer of body weight to front foot</td>
<td>0.68</td>
<td>0.61</td>
<td>0.81</td>
</tr>
<tr>
<td>5. Bat contacts ball</td>
<td>0.86</td>
<td>0.69</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>All strike components</strong></td>
<td><strong>0.85</strong></td>
<td><strong>0.73</strong></td>
<td><strong>0.82</strong></td>
</tr>
<tr>
<td>Overhand throw</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Windup is initiated with downward movement of hand/arm</td>
<td>0.34</td>
<td>0.39</td>
<td>0.73</td>
</tr>
<tr>
<td>2. Rotates hip and shoulders to a point where the nonthrowing side faces the wall</td>
<td>0.50</td>
<td>0.53</td>
<td>0.78</td>
</tr>
<tr>
<td>3. Weight is transferred by stepping with the foot opposite the throwing hand (not just transferring weight. Foot raised and lands flat on ground)</td>
<td>0.42</td>
<td>0.62</td>
<td>0.81</td>
</tr>
<tr>
<td>4. Follow-through beyond ball release diagonally across the body and down towards the non-throwing side</td>
<td>0.65</td>
<td>0.65</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>All throw components</strong></td>
<td><strong>0.84</strong></td>
<td><strong>0.70</strong></td>
<td><strong>0.81</strong></td>
</tr>
<tr>
<td>Underhand roll</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Preferred hand swings down and back, reaching behind the trunk while chest faces cones</td>
<td>0.84</td>
<td>0.87</td>
<td>0.97</td>
</tr>
<tr>
<td>2. Strides forward with foot opposite the preferred hand towards the cones</td>
<td>0.62</td>
<td>0.72</td>
<td>0.86</td>
</tr>
<tr>
<td>3. Bends knees to lower body</td>
<td>0.72</td>
<td>0.49</td>
<td>0.73</td>
</tr>
<tr>
<td>4. Releases ball close to the floor so ball does not bounce more than 4 inches high</td>
<td>0.59</td>
<td>0.47</td>
<td>0.97</td>
</tr>
<tr>
<td><strong>All roll components</strong></td>
<td><strong>0.82</strong></td>
<td><strong>0.67</strong></td>
<td><strong>0.90</strong></td>
</tr>
<tr>
<td>Kick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Rapid continuous approach to the ball</td>
<td>-</td>
<td>0.97</td>
<td>-</td>
</tr>
<tr>
<td>2. An elongated stride or leap immediately prior to ball contact</td>
<td>0.84</td>
<td>0.86</td>
<td>0.92</td>
</tr>
<tr>
<td>3. Nonstickling foot placed even with or slightly in back of the ball</td>
<td>0.69</td>
<td>0.62</td>
<td>0.80</td>
</tr>
<tr>
<td>4. Kicks ball with instep of preferred foot (shoe-laces) or toe</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>All kick components</strong></td>
<td><strong>0.80</strong></td>
<td><strong>0.54</strong></td>
<td><strong>0.89</strong></td>
</tr>
<tr>
<td>Catch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Preparation phase where hands are in front of the body and elbows are flexed</td>
<td>0.37†</td>
<td>0.54</td>
<td>0.92</td>
</tr>
<tr>
<td>2. Arms extend while reaching for the ball as it arrives</td>
<td>0.42</td>
<td>0.53</td>
<td>0.84</td>
</tr>
<tr>
<td>3. Ball is caught by hands only</td>
<td>0.89</td>
<td>0.81</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>All catch components</strong></td>
<td><strong>0.71</strong></td>
<td><strong>0.54</strong></td>
<td><strong>0.84</strong></td>
</tr>
<tr>
<td>Total object control skills</td>
<td>0.93</td>
<td>0.87</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Note: For the kick component, a.k could not be conducted as one player only scored positively.

† These components scored a lower kappa and possession (or non-possession) of this component was rare. i.e. 5% of the time (or less) raters agreed the child did (or did not) have this component.

elbow which differentiates a throw from a 'fling' or 'sliding'. However, this issue may still arise with other similar instruments. The Victorian classroom manual (another Australian process oriented assessment movement skill battery) specifies the 'windup' component of the throw as 'throwing arm nearly straightened behind the body' which does not alleviate the issue of the 'discus type throw'. GSGA, fares only slightly better, as it specifies this component as 'arm moves down and back'.

It may be that to help raters agreement the components need to be further specified. Raters found it challenging at times in this study to differentiate or indicate the developmental stage that the student is at, by skill component performance. Stoddle suggested that process-oriented instruments do not necessarily take account of developmental stages because by comparing a beginner to expert movements there is not the ability to distinguish between a child with low level skills and one who is more skilled within that particular component. The child may be able to partially achieve sections of, or parts of a component, but not the entire component, making it harder to judge success. This may be due to the components being clustered or grouped into larger movements, rather than the most basic break down of the movement. The strike in this study had high rater agreement (ICC = 0.85), but similar to the throw some problematic components. As in the overall throw, the third component concerning rotation was also challenging in the strike. GSGA provides eight specific components for the strike, in comparison to the five TGMD-2 components. However, these additional components do not further break down the movement, for rotation in GSGA is still specified by one component (marked sequential hip to shoulder rotation during the strike).

A concern with the strike assessment is that a student can theoretically be assessed as being proficient without performing the skill correctly. For example, a student can perform a 'stab' or 'bunt' at the ball, rather than a complete two handed side arm strike, but in doing so can still fulfill all specified TGMD criteria. The two criteria of the TGMD which are subsequently affected are: hip and shoulder rotation during the swing; and pronunciation/clear transfer of body weight to front foot. With a 'stab' or 'bunt', these two criteria are obviously restricted, as it is the follow through of the arms and bat that promote and highlight these movements. However, there can be 'some' rotation and 'some' transfer occurring during the 'stab' hit which causes assessment confusion. Having the additional criteria of bat held behind shoulder prior to the strike (specified
in the Victorian classroom manual), and the follow through component (specified in both the Victorian classroom manual) and in GCSA\cite{11}, would mean the child performing a ‘stab’ would be marked down. An anecdotal observation made by the raters in this study is that often children swing really hard on their first try, and sometimes completely miss the ball, or knock over the stand. On their second attempt, in order to be more accurate they often ‘bunt’ the ball and sacrifice rotation of the hip and shoulder for accuracy.

Additionally, another issue with the strike component 2, concerns the kappa coefficient as a measure to assess reliability. The strike component 2 had high percentage agreement for both trials (86% and 100%) and yet the kappa was in the ‘fair’ category for trial one.\cite{10} This can be explained because non-possession of this component was rare.\cite{13} For instance, in 30/37 cases, raters agreed the child did have the component and in only 2/37 observations raters agreed the child did not have the component. Kappa is affected by the prevalence of what is being observed, so ‘rare’ occurrences can affect the findings.\cite{10} Therefore, low values of kappa in this case may not mean low values of agreement. The results table has the three components marked which may be affected by this ‘paradox’\cite{12}, components where it is either rare for a child to achieve the component, or rare for a child not to achieve the component (as in component 2 of the strike). So the kappas for these components should be interpreted with caution and in consideration with the percentage agreements.

The catch had the lowest agreement of all the skills, and showed lower agreement with the first and second components. The catch component 2 is another occasion (similar to the previous example of strike component 2) where not having the component occurs rarely, and therefore the kappa statistic is perhaps misleading for this skill. The low kappa for kick component 2 is another example of where possessing the component rarely occurs. Trial 2 of the kick produced a strikingly different kappa coefficient to trial one (0.84–0.36). In the first trial, raters agreed the child did not have the component in 32/37 observations, agreed the child did have the component in 4/37 observations, and disagreed for one child observation. In the second trial, raters agreed the child did not have the component in 33/37 observations, agreed in one observation there was the component and there were 3/37 disagreements. Having three disagreements in the second trial completely changed the kappa from a level considered ‘almost perfect’ to ‘fair’.\cite{10}

This example also highlights that the second trial was better than the first trial which brings up the issue of performance over trials. It is suggested that rater agreement is higher on the second trial simply because the raters have had a chance to observe the child for longer and be more familiar with the movement patterns. This is somewhat reflected in the data, with agreement for all the skills on each component higher for the second trial for 12 components, lower in eight and unchanged in four components. This reinforces the idea of instruments having two trials as part of protocol.

5. Conclusion

This study provides valuable information on interrater reliability of the TGMD-2. Whilst the use of video recording would have enabled further confirmation of rater assessment, the study provides useful information on agreement issues in the context of live observation of skill performance which is a typical measurement method. In this sense this study has focused on agreement between rater perception of skill performance and through doing so has highlighted problematic areas of skill component agreement. We highlighted some of the issues involved the application of the TGMD-2 to assess children’s movement skill proficiency and identify barriers in determining and interpreting reliability values. Whilst the TGMD-2 had good overall interrater reliability for object control skills, reliability for some skill components was lower. Therefore practitioners using the TGMD-2, or similar instruments, to assess or improve movement skill in children, should be aware that fusing specific component correction as part of child feedback that some components may be harder to identify than others.

This study also highlights issues in process-oriented movement skill assessment in terms of criteria matching to which is considered a ‘correct’ performance. Future studies using direct observation to assess the FMS proficiency of children should aim to assess interrater objectivity both overall, for each skill tested and for skill components. If some skills are harder to assess, then training for assessing these skills may need to be more extensive or the components involved clarified and discussed until agreement is obtained. While process assessments are useful to identify problem skill components, the challenge is to create a clear scoring and assessment system.

6. Practical Implications

• Overall, interrater reliability for TGMD-2 assessment of object control skills was excellent.

• Some object control skill components, particularly in the overhand throw and strike, are more difficult to assess.

• The overhand throw and strike may be marked as having a masterful performance when performance may be less than masterful.

Acknowledgements
Funding for this study was provided by University internal funds. Author 1 is supported by a National Health and Medical Research Council early career fellowship. The authors are grateful for the support and cooperation of the participating schools and students.

References
11. Get Skilled: Get Active, Department of Education and Training, Sydney, New South Wales, Australia, DIT Product No. 108610040000.
APPENDIX 2: CHAPTER 2/PAPER 2: PHYSICAL EDUCATION TEACHERS’ PERSPECTIVES AND EXPERIENCES WHEN TEACHING FMS TO EARLY ADOLESCENT GIRLS

Appendix 2.1 Ethics Approval

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**Memo**

To: Dr Lisa Barnett  
School of Health and Social Development  

From: Secretary – HEAG-H  
Faculty of Health  

CC: Natalie Lander, A/Prof Amanda Telford, Helen Brown  

Date: 18 December, 2012  

Re: HEAG-H 150_2012: Exploring the assessment processes used by physical educators to identify and monitor fundamental movement skills in year seven girls

Approval has been given for Dr Lisa Barnett, School of Health and Social Development, to undertake this project for a period of 1 year from 18 December, 2012. The current end date for this project is 18 December, 2013.

The approval given by the Deakin University HEAG-H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007). An Annual Project Report Form can be found at [http://www.deakin.edu.au/hmsbs/research/ethics/ethicssubmissionprocess.php](http://www.deakin.edu.au/hmsbs/research/ethics/ethicssubmissionprocess.php) which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s office, Faculty of Health, Burwood campus by Tuesday 19th November, 2013 and when the project is completed.

Good luck with the project!
Appendix 2.2: Study 1 Ethics Modification Approval

Memo

To: Dr Lisa Barnett
School of Health and Social Development

From: Secretary – HEAG-H
Faculty of Health

CC: Helen Brown, A/Prof Amanda Teiford, Natalie Lander

Date: 5 February, 2013

Re: HEAG-H 150, 2012: Exploring the assessment processes used by physical educators to identify and monitor fundamental movement skills in year seven girls.

Approval has been given to Lisa Barnett, of the School of Health and Social Development, to undertake this project with the modifications that were requested on the 4 February, 2013.

Please note that the current end date for this project is 18 December, 2013.

Steven Sawyer
Secretary
HEAG-H

Signature Redacted by Library
Appendix 2.3: PLS and consent

Plain Language Statement
Introduction

Welcome and thank you for taking part in this important research.

My Name is Natalie Lander, I am a Student Researcher from Deakin University. Together, Dr. Lisa Barnett, my Senior Researcher, and I are interested in understanding more about the assessment and instruction processes used by Victorian based Physical Education teachers. Specifically, we are interested in whether Physical Education teachers assess and teach Fundamental Movement Skills (FMS) to Year 7 girls, and if they do, discuss what processes are used.

I thank you for your previous participation in the on-line survey, and I appreciate your interest in further involvement in this study, namely; the upcoming interviews.

In this project, Fundamental Movement Skills (FMS) are defined as common motor activities with specific observable patterns. FMS include: Locomotor skills such as: running, jumping, hopping, and galloping, and; Object control skills such as: throwing, catching, kicking, and striking a ball.

The following is a Plain Language Statement (PLS) in relation to my research, titled "Exploring the assessment processes used by physical educators to identify and monitor fundamental movement skill proficiency levels of Year Seven girls", followed by the consent form. Please read the information provided, and sign and return the consent form, using the email address provided, if you are willing to participate in the research.

With thanks,

Natalie Lander
PhD Candidate
Deakin University
Plain Language Statement

The aim of the research project is to understand more about teachers’ assessment and instructional processes in Fundamental Movement Skill (FMS) education when teaching Year Seven girls. The findings of the study may contribute to the current literature and enhance the effectiveness of instructional strategies used in FMS education. A possible benefit of the research is that it may encourage you to reflect on your own teaching within FMS education. In addition, the study’s findings may be used as the foundation for further research and potential interventions in FMS, and ultimately benefit adolescent girls’ health by enhancing the quality of FMS teaching, which may increase physical activity engagement and in turn, health.

The interview will take approximately 30 minutes of your time to complete. You will be non-identifiable from the interview data. To comply with government requirements all data will be stored securely for a period of a minimum of 6 years after final publication. It will then be destroyed.
I will provide a one page summary of the de-identified results from the broader research and it will be published on the Peak Phys Ed and ACHPER websites. This research is totally funded by Deakin University.

Please be aware that participation in any research project is voluntary. If you no longer wish to take part you are not obliged to. Once you have read this form and agree to participate, please complete the consent over leaf, and we will begin.
The ethical aspects of this research project have been approved by the ethics committee at Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Office of Research Integrity, Level 1, Building EA, Deakin University, Elgar Road, Burwood Victoria, 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research.ethics@deakin.edu.au. Please quote project number: HEAG_1502012.

If you require further information, wish to withdraw your participation, or if you have any problems concerning this project, you can contact either the research supervisor Dr Lisa Barnett, or the student researcher, Natalie Lander.

Student Researcher:
Natalie Lander
Email: nlander@deakin.edu.au
PhD Candidate
School of Health & Social Development
Deakin University, Burwood
TO: Physical Education Teachers

Consent Form

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

Reference Number:

I have read, and I understand the attached Plain Language Statement.

I freely agree to participate in the interviews for this study according to the conditions in the Plain Language Statement.

I understand the interview will be digitally voice recorded.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) .................................................................

Signature .......................................................... Date .........................

Please email this form to:

Student Researcher
Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
Appendix 2.4: On-line Advertisement for initial recruitment of study participants (On-line survey) Posted on ACHPER and PEAK Phys Ed Websites

**RESEARCH BENEFITS**

This research aims to understand more about teachers’ assessment processes when teaching Fundamental Movement Skill (FMS) to girls. The findings of the study may enhance the effectiveness of instructional strategies used in FMS education.

**HOW IT WORKS**

If you are interested in supporting this unique research, please email the Student Researcher, Natalie Lander on: n.lander@deakin.edu.au

I will then send you through the link to the survey. Click on the link and let your research journey begin!

The survey will take less than 10 minutes of your time, but will make a huge contribution to the study!

**Principal Researcher**
Dr Lisa Barnett  
Lisa.barnett@deakin.edu.au  
Deakin Burwood

**Student Researcher**
Natalie Lander  
n.lander@deakin.edu.au  
Deakin Burwood
Appendix 2.5 Interview guide

INTERVIEW GUIDE

Please note: this is a guide only.

Interview direction will be guided by participant responses and will evolve accordingly.

- I noticed from your on-line survey response that you do perceive/do not perceive FMS instruction to be an important inclusion in the Year 7 girls Physical Education curriculum.
  - Tell me a little more about why you do/do not see it as an important inclusion in the PE curriculum.
  - Prompts
    - Importance of FMS education in Year 7
    - Importance of FMS education when teaching girls
- Tell me a little about how your school approaches FMS education with in the year 7 girls PE curriculum?
  - Prompts (if FMS is included)
    - How is it currently taught to the students?
    - What teaching approach is used?
    - Is it taught as its own unit, or is it integrated across other units within the curriculum?
    - How many weeks are allocated to FMS education?
    - Do you perceive the current approach to be effective in the development of FMS proficiency?
    - How do you assess the proficiency levels of your students?
    - Are your PE classes streamlined according to skill level? How students with are low levels of FMS identified, and subsequently, how are their needs addressed to improve their FMS level?
  - Prompts (If FMS is not included)
    - Why do you think FMS has been omitted from the current course?
    - Do you see this as a concern? Why/why not?
    - How do the students develop FMS if it is not instructed within the course?
- The two major barriers of effective FMS instruction and assessment, as indicated by the PE teachers who participated in the online-survey were: no assessment criteria available or provided within the PE curriculum for FMS assessment, and; limited understanding to the best approach to instructing to motivate or engage the girls.
  - As a representative of the PE profession, what are your comments about this?
  - Prompts:
    - Are there any other factors you can share that you believe disrupts or inhibits the quality of FMS instruction? Or prevents you from reaching your FMS learning outcomes for each lesson, and also for the unit?
- In contrast, what do you perceive to be the most important components of an effective FMS program? What factors of a program create a positive learning environment for the year 7 girls?
Prompts – what are some methods you use to create a positive learning environment
Tell me about a lesson or a unit that has shown to be very successful in meeting learning goals – what were some of the key characteristics?

Tell me about your assessment strategies when teaching FMS to your Year 7 students
Prompts:
Do you see assessment as an important component of FMS education and instruction – why/why not?
If you assess…When do you assess your students
If you assess…How do you assess your students
Why do/don’t you assess them
What do you do with the information received via assessment
If you assess…Do you think your assessment strategies are effective? Why/Why not?

Tell me about how you instruct the girls? – What would a typical lesson or even unit look like?

Do you believe you received adequate training in FMS education to prepare you to be able to:
Teach a high quality FMS program?
Enable students FMS to develop?
Teach using diverse approaches?
Assess student FMS proficiency effectively?
Prompts:
If so – what did your training include?
How did it prepare you?
What were the most effective components of your training? What do you see are critical elements of pre service education in terms of preparing you for a teaching degree?
What did you love?
Tell me about the facilitators who were most effective?
If not – what do you think your training was lacking?
How could it be improved?

Tell me about any specific areas of teacher training, whether it be pre service or professional development, that you think should be a priority or focus area, when aiming to improve female junior high FMS proficiency? Why do you see this as important?

What form of professional development would be most effective to meet the needs of the teachers in terms of FMS training?
Prompts:
What format of PD is most effective in terms of enhancing your learning
What are the components of effective PD sessions – tell me about a PD that has been enjoyable/effective
How can the facilitator make the session more engaging or enjoyable
How do you see PD enabling sustainable change and improvement
• You indicated that you were/were not confident in presenting FMS to your students. What factors influence your confidence?
  o Prompts:
    ▪ Do you think that your personal confidence in presenting the FMS has an influence on how you teach and subsequently how the students learn? Why/how

• What do you see as the most important teacher qualities or characteristics, when teaching FMS to year 7 girls?
  o Prompts:
    ▪ How do you think these qualities can developed?

• Would you like to make any further comment, or share anything else in regards to teaching FMS to Year 7 girls?
Appendix 2.6: Reports Posted on ACHPER and Peak Phys Ed Websites

FMS RESEARCH REPORT

Teachers who taught PE to Year 7 Girls were invited to participate in two studies. **Study 1**: An online survey (2013) (Honours Study) and **Study 2**: In depth interviews (2014) (PhD Study)

These studies were conducted by PhD candidate Natalie Lander, and supervised by Dr Lisa Barnett, Professor Phil Morgan, Professor Jo Salmon.

**My Background**

*My name is Natalie Lander, I am a PhD candidate at Deakin University. Prior to this I completed a B. App Sci (PE) and worked for 10 years as a science and physical education teacher in schools in Melbourne, Brisbane and internationally; holding leadership positions including HPE Coordinator, Sport Coordinator, Year Level Coordinator, and Student Welfare coordinator. I subsequently completed my Masters in Sports Science and moved into the tertiary system, where I lectured into the PE degree at RMIT. I am passionate about high quality PE instruction. Instruction that is engaging, exciting and purposeful. My interest is particularly focused on the FMS instructional strategies used by PE teachers at the year 7 level, when teaching girls, as this cohort is particularly concerning in terms of their low FMS proficiency level. I have completed a Bachelor of Health Science (Honours) in this area, and am now into my second study of my PhD, researching the area further.*

**Background to research**

*Fundamental Movement Skills (e.g. catch, throw, bounce, run, jump etc.) are the building blocks for movement, and form the foundation for future physical activity participation. Despite the positive association between FMS competence and physical activity, FMS proficiency is particularly low among adolescent females, especially in object control skills such as the throw, kick and catch. Instruction, practice and feedback are significant factors in the development of FMS. Given the well-established marginalisation of girls FMS, it is imperative that we identify effective strategies to assess and instruct girls in FMS, so the observed gender difference in FMS can be reduced.*
Study 1: Online Survey

Aim:
The purpose of this study was to investigate instruction and assessment of fundamental movement skills (FMSs) by Physical Education (PE) teachers of Year 7 girls.

Who participated?
168 Australian secondary school PE teachers. 75% were female, just over three quarters had a 4 year bachelor degree, years of teaching experience ranged from a first year new graduate to over 25 years. Government (47%), Catholic (24%) and Independent Schools (29%) were represented.

What did the participants do?
PE teachers completed an online survey exploring their level of training in FMS, confidence in instructing FMS and their FMS instructional and assessment procedures.

General Findings:
- Only half (49.6%) had received more than several lectures/tutorials on FMS during their degree.
- Many (69.9%) had undertaken no more than four hours of professional development in FMS since finishing their degree.
- Most (86.9%) did assess the FMS proficiency of their students. However, of those that did, the assessment quality was variable: 43.8% (n = 64) did not assess the quality of the performance, and only just over half (56.2%, n = 82) assessed regularly enough to promote learning.
- Neither years of experience nor confidence level influenced assessment practices used by teachers. However, the more FMS training a teacher had completed, the more likely they were to use the ideal assessment frequency (t = 4.168; p = 0.000) and processes (t = 1.541; p = 0.002).
- Many female adolescents do not reach mastery in FMS, especially girls object control skills. Training in FMS appears to make a difference in teachers’ assessment practices and yet teachers had limited training in FMS. FMS education should be a priority inclusion in pre-service PE teaching programs and professional development.


Study 2: In-depth Interviews

Aim:
To explore teachers’ perspectives and experiences when teaching FMS to early adolescent girls’ FMS.

Who Participated?
25 Australian Physical Education teachers
Teaching experience ranged from one to over 25 years. Catholic, government and independent schools were represented, as were co-educational, all girl, foundation (prep) to Year 12, and Year 7–12 schools.

What did the participants do?
Participants took part in semi-structured individual interviews to investigate their perceptions of: (i) the importance and relevance of teaching FMSs to Year 7 girls, and (ii) the factors influencing effective FMS delivery.

General Findings:
- Year 7 was perceived to be a critical period to instruct FMSs to girls for two main reasons:
  - The low levels of FMS proficiency female students entered secondary PE programs with.
  - Year 7 girls still were still open and receptive to learning FMSs.
- Teachers perceived that several aspects of their own teaching practice influenced the effectiveness of FMS instruction, these included:
  - Instructional Approach: Teachers perceived they were over reliant on teacher-centered or direct teaching approaches, and had a limited understanding of creative student-centered pedagogical strategies when instructing FMS. This resulted in their students being insufficiently, or more importantly, inappropriately motivated to achieve FMS outcomes in PE.
  - Restrictive curriculum and limited curriculum interpretation: Teachers reported that FMSs were often omitted from the Year 7 curriculums set by governing bodies or school departments. Yet, even when FMSs were included in the curriculum, teachers admitted that they were unsure about where, when, and, importantly, how to teach FMSs effectively enough to engage and motivate their students.
  - Lack of meaningful assessment: Assessment of FMSs was rarely conducted, and then only in a summative form. FMS assessment criteria was often omitted on curriculums, and assessment process were more generalised to sport, participation and behaviour rather than skill development.
  - Teacher Training: Enhancing competence in effective teaching practices emerged as a central factor in improving the instruction of FMSs. Many participants articulated a significant disconnect between what was taught in their pre-service teacher education and what was required as practicing PE teachers. The majority of participants indicated that PD seminars tended to lack the quality and depth needed to elicit improvement in their teaching practices.

What teachers can take away?
Effective teaching has been considered the single most powerful influence on student achievement in PE. Teacher who provides student-centered approaches (choice of tasks; encourages leadership, autonomy, and improvisation; included self and peer led assessment; and focuses on assessment for learning) will improve motivation in students, and subsequently student learning.
As teaching styles and teaching practice have been shown to be malleable, the apparent deficits in current teacher effectiveness may be improved with more comprehensive pre-service and in-service teacher training surrounding FMSs, specifically targeting diverse student-led instruction and assessment strategies, creative curriculum interpretation, and assessment “for” learning, both during pre-service and in post-service professional development.
THANK YOU!!!!!

We would sincerely like to thank PEAK Phys Ed. for advertising both studies, and the teachers for your participation in the studies. Without your support we would not be able to investigate these important questions that may impact on adolescent girls’ skills, physical activity and long term health.

Where to from here?
A novel FMS assessment tool (The motor skills obstacle course) is currently being tested in four schools (18 teachers) across Victoria, to determine if it is a feasible assessment tool and a pedagogical instrument to enhance assessment ‘for’ learning in a Year 7 girls Physical Education context. A future intervention focus is a FMS teacher training intervention, focusing on teachers of Junior high school girls, hypothesizing this will have a flow-on effect to subsequent physical activity.

Contact
If you have any questions or comments please contact:
Natalie Lander, PhD Candidate
Faculty of Health
Deakin, Burwood Campus
Email: nlander@deakin.edu.au
APPENDIX 3: PAPER 3: TEACHERS’ PERCEPTIONS OF A FUNDAMENTAL MOVEMENT SKILL ASSESSMENT BATTERY IN A SCHOOL SETTING

Appendix 3.1: HEAG Ethics approval

Memo

To: Dr Lisa Barnett, Prof Jo Salmon, Prof Phil Morgan
   School of Health and Social Development

From: Secretary – HEAG-H
       Faculty of Health

CC: Ms Natalie Lander

Date: 4 December 2014

Re: HEAG-H 190_2014: Improving adolescent girls’ fundamental movement skills via instruction and assessment in Physical Education

Approval has been given for Dr Lisa Barnett, Prof Jo Salmon and Prof Phil Morgan of the School of Health and Social Development, to undertake this project for a period of 2 years from 4 December, 2014 with the following condition. The approval end date is 4 December, 2016.

(i) Please provide approval from DEECD and School Principal’s once received.

The approval given by the Deakin University HEAG-H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007). An Annual Project Report Form can be found at http://www.deakin.edu.au/hmres/research/ethics/ethicssubmissionprocess.php which you will be required to complete in relation to this research. This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s office, Faculty of Health, Burwood campus by Tuesday 17 November, 2015 and when the project is completed.

Good luck with the project!
Appendix 3.2: Study 3 DET Ethics approval

2014_002562

Mrs Natalie Lander
Health and Social Development
Deakin University
211 Burwood Highway
BURWOOD 3125

Dear Mrs Lander

Thank you for your application of 20 November 2014 in which you request permission to conduct research in Victorian government schools and/or early childhood settings titled Improving adolescents' fundamental movement skills via instruction and assessment in Physical Education.

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Training.

2. Separate approval for the research needs to be sought from school principals and/or centre directors. This is to be supported by the Department of Education and Training approved documentation and, if applicable, the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 24 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee, must be submitted to the Department of Education and Training for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or governing body of the early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director or governing body.

5. You acknowledge the support of the Department of Education Training in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reminder will be sent for reports not submitted by the study's indicative completion date.
Appendix 3.3: Study 3 Letter to principals requesting approval to conduct the research in their settings

***

Dear Sir/Madam,

My name is Natalie Lander, I am currently conducting my PhD at Deakin University, under the supervision of Dr. Lisa Barnett, Professor Jo Salmon and Professor Phil Morgan.

(Name of Teacher), a Physical Education teacher employed at your school, previously participated in Study 1 of my PhD, which was a qualitative study using semi-structured interviews, conducted in 2014 (HEAG-H_150 2012). This study explored teachers’ perspectives and experiences with instruction and assessment of early adolescent girls’ fundamental movement skills. Following the interviews, the teachers were asked if they would be interested in further involvement in the study, and (Name of Teacher) indicated interest.

I am writing to you to invite and obtain approval from you, for (Name of Teacher) to continue his/her involvement into Study 2 of my PhD. Study 2 is entitled: “Improving adolescent girls’ fundamental movement skills via instruction and assessment in Physical Education”, which is a feasibility study. The aim of the study is to test the feasibility of the Canadian Agility and Movement Skill Assessment (CAMSA), within a Year 7 (girls) Physical Education context. Specifically, the research will determine whether the ‘CAMSA’, is a feasible method of measuring students’ FMS proficiency, when administered in the early weeks of the Year 7 Physical Education program. And furthermore, whether Physical Education teachers can utilise the students’ FMS proficiency assessment data, generated from the ‘CAMSA’, to plan, develop and deliver FMS instruction to more specifically meet the needs of the students.

The findings of this research may have the potential to improve educational practice of Physical Education teachers, and improve outcomes for students. It has a specific focus on assessment “for” learning, when instructing FMS to Year 7 girls. When administered in the first weeks of Year 7 Physical Education, the tool can be used as a diagnostic measure to identify students’ entry FMS proficiency level. The process based assessment criteria prescribed within assessment protocol of the tool allows for the identification of specific areas of skill deficits, and in turn allows for the development and delivery of specific teaching and learning objectives and activities to remediate these deficits. The criterion also allows for the provision of ongoing, specific feedback on skill performances throughout the learning process. The tool can also be administered at the completion of the FMS unit to identify whether teaching and learning outcomes have been achieved. Thereby, it has the capacity to improve students’ FMS proficiency and expand the physical activity opportunities available to adolescent girls.

I have attached a brochure to this email, which will provide you with an overview of the research, the CAMSA, the requirements of the teachers and the proposed outcomes and benefits to staff and students. If you support the continued research, I will send an email to (Name of Teacher), including the Plain Language Statement and participant consent.

Thank you for your consideration, I look forward to working with you.

Student Researcher
Natalie Lander
nlander@deakin.edu.au
PhD Candidate, School of Health and Social Development, Deakin University, Burwood
Appendix 3.4: Letter of invitation and/or plain language statements to each participant group

Dear Physical Education Teacher,

Thank you very much for your involvement in the previous study entitled “Exploring the assessment processes used by Physical Education teachers to assess FMS proficiency levels of year seven girls”.

I appreciate your interest and willingness to be further involved in the current research, which is entitled “Improving adolescent girls’ fundamental movement skills via instruction and assessment in Physical Education”.

I have attached a brochure to this email, which will provide you with an overview of the research, what is required of you and the proposed benefits to you and your students. Also attached is the consent form for you to sign and either return to me via email, or in hard copy on the day of your training session.

I value your knowledge and experiences and would like to schedule in a time for your first survey and training session in regards to the ‘CAMSA’. If you could provide me with the dates, and times you have available in January 2015, via email, it would be much appreciated. In addition, if your contact details have changed since completing the on line survey, could you also reply to the email with updated contact details.

I look forward to working with you.
Student Researcher
Natalie Lander
nlander@deakin.edu.au
PhD Candidate
School of Health and Social Development
Deakin University, Burwood
Appendix 3.5: Letter to parents/guardians, inviting children to participate in the research

Dear Sir/Madam,

Fundamental movement skills (FMS) are essential movement skills such as the run, hop, catch, throw and kick. They are considered the building blocks of sports and other physical activities, and there is a strong link between FMS competence and increased engagement in physical activity. Regular involvement in physical activity has several well documented physical, social and psychological health benefits. Effective instruction is essential in the development of FMS in children. In order to instruct effectively, the teacher must be able to accurately identify the students’ strengths and weakness, and subsequently plan, develop and deliver a program to address skill deficits and further develop the area of strength. The ‘CAMSA’ offers a dynamic, engaging and fun approach to the assessment of FMS proficiency.

During your child’s regular Physical Education lessons in Term 1, 2015, an alternative method of fundamental movement skill assessment, namely the “CAMSA” will be used by the Physical Education teacher. Your child will participate in the obstacle course assessment within one of her scheduled Physical Education classes in Term 1, 2015. She will receive 2 demonstrations by the teacher, then perform 2 practice trials and 2 scored trials. The teacher will provide directions and prompts to your child throughout each trial.

The obstacle course requires children to run a total distance of 20 meters while completing 7 movement skill tasks. The tasks include 2-footed jumping into and out of 3 hoops on the ground, sliding from side-to-side over 3 metres, catching a ball and then throwing the ball at a wall target 5 metres away, skipping for 5 metres, 1-footed hopping in and out of 6 hoops on the ground, and kicking a soccer ball between 2 cones 5 metres away. Performances will be evaluated by your child’s regular Physical Education teacher, using completion time and criterion-referenced skill evaluations.

Please note: This research focuses on the Teacher. Your child’s details and assessment data will NOT be used in the study. The FMS proficiency levels of your child will remain with the Physical Education teacher, and be used for educative purposes within the Physical Education program only. However, if you DO NOT wish for your child to participate in the ‘CAMSA, please complete the attached “Opt- Out” consent form attached and return it to your child’s Physical Education teacher, or the student researcher.

This research is funded by Deakin University, there is no cost to you. The ethical aspects of this research project have been approved by the ethics committee at Deakin University.

If you require further information, or if you have any problems concerning this project, you can contact either the research supervisor Dr Lisa Barnett, or the student researcher, Natalie Lander.

Student Researcher: Natalie Lander
PhD Candidate
School of Health & Social Development
Deakin Burwood
Email: nlander@deakin.edu.au
Appendix 3.6: Consent forms

OPT-OUT CONSENT FORM

TO: Parent/Guardian

Opt-Out Consent Form

Date: 

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

Reference Number:

I hereby wish to WITHDRAW consent for my child to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) ..............................................................

Parent/Guardian’s Name (printed) ......................................................

Parent/Guardian Signature ................................................................. Date ........................

Please return this form to your child’s Physical Education Teacher, or alternatively you can email it to the student researcher:

Student Researcher

Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
TO: Physical Education Teachers

Consent Form

Date:

**Full Project Title:** Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

**Reference Number:**

I have read, and I understand the attached Plain Language Statement.

I freely agree to participate in the surveys and focus group interviews for this study according to the conditions in the Plain Language Statement.

I understand the interview will be digitally voice recorded.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) .................................................................

Signature ........................................................................ Date .................

Please email this form to:

Student Researcher
Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Physical Education Teachers

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

Reference Number:

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) …………………………………………………….

Signature ……………………………………………… Date ……………………

Please e-mail this form to:

Student Researcher Natalie Lander

nlander@deakin.edu.au

School of Health and Social Development

Deakin Burwood
Appendix 3.7: Questionnaires, surveys, and interview schedules

Feasibility Survey- Pre ‘CAMSA’ Intervention

Survey 1: Part A

(Before the CAMSA Training Session)

For all questions below please indicate your level of agreement (please circle) in relation to each statement provided.

1. Fundamental Movement Skills (FMS) is an important component of the Physical Education curriculum for Yr. 7 girls.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

2. I am confident in my ability to teach FMS effectively when teaching Yr. 7 girls.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

3. I am confident in using a diverse range of teaching styles and methods to deliver FMS content.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

4. The assessment of FMS is not important when teaching FMS to Yr. 7 girls.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree
5. I am confident in my ability to assess FMS proficiency of Yr. 7 girls.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

6. I am confident in using a diverse range of assessment strategies to assess FMS proficiency.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

7. Assessing student FMS proficiency at the beginning of the FMS unit or program is the most important time to assess.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

8. Assessing student FMS proficiency throughout the FMS unit or program is the most important time to assess.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

9. Assessing student FMS proficiency at the completion of the FMS unit or program is the most important time to assess.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

10. I do not use the data gathered from FMS assessments to guide my teaching.
    1. Strongly disagree
    2. Disagree
    3. Neither disagree nor agree
    4. Agree
    5. Strongly agree

11. I currently use a predefined set of FMS criteria to assess the students’ FMS proficiency against.
    1. Strongly disagree
    2. Disagree
12. FMS assessment criteria or learning outcomes are prominently featured in the Yr. 7 PE curriculum at my school.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

13. I encounter several challenges when attempting to assess the FMS proficiency of Yr. 7 girls.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

14. The biggest challenge I have when teaching FMS is:

15. The biggest challenge I have when conducting FMS assessment is:

16. I am interested in learning more about FMS assessment.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree
Feasibility Survey- Pre ‘CAMSA’ Intervention

Survey 1: Part B
(After the CAMSA Training Session, before the administration and evaluation of the program)

For all questions below please indicate your level of agreement (please circle) in relation to each statement provided.

Implementation:
1. I will be able to successfully administer the ‘CAMSA’.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

2. I will be able to successfully evaluate the ‘CAMSA’ assessment data.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

3. I will be able to successfully use the assessment data to plan and deliver subsequent FMS teaching and learning.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

Practicality:
4. I will be able to administer and evaluate the ‘CAMSA’ independently, and without any support.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree
**Integration:**

5. The ‘CAMSA’ will fit successfully within my current school PE curriculum and lesson structure.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither disagree nor agree
   - 4. Agree
   - 5. Strongly agree

6. The CAMSA will be a disruption to class/student learning/curriculum.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither disagree nor agree
   - 4. Agree
   - 5. Strongly agree

7. Students will engage well in the ‘CAMSA’.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither disagree nor agree
   - 4. Agree
   - 5. Strongly agree

8. I will modify my lesson content, teaching approach and delivery, according to student needs, following the administration and evaluation of the ‘CAMSA’.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither disagree nor agree
   - 4. Agree
   - 5. Strongly agree

**Expansion:**

9. The ‘CAMSA’ will enhance my FMS delivery.
   - 1. Strongly disagree
   - 2. Disagree
   - 3. Neither disagree nor agree
   - 4. Agree
   - 5. Strongly agree

10. The integration of the ‘CAMSA’ will enhance the FMS proficiency of the students.
    - 1. Strongly disagree
    - 2. Disagree
    - 3. Neither disagree nor agree
    - 4. Agree
    - 5. Strongly agree

**Efficacy:**


11. The ‘CAMS’ could be an ongoing/sustainable measure of FMS in the PE curriculum.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

12. Do you foresee any challenges with the implementation of the ‘CAMS’?

13. What do you foresee the greatest benefits of the ‘CAMS’ will be?
Feasibility Survey 2:
Post ‘CAMSA’ Intervention

For all questions below please indicate your level of agreement (please circle) in relation to each statement provided.

1. I was satisfied with the ‘CAMSA’ training program on the administration and evaluation of the assessment tool.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

Implementation:
2. I successfully administered the ‘CAMSA’.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

3. I successfully evaluated the ‘CAMSA’ assessment data.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

4. I successfully used the assessment data to plan and deliver subsequent FMS teaching and learning.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

Practicality:
5. I did not require additional support to be able to implement the ‘CAMSA’ successfully.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

**Integration:**
6. The ‘CAMSA’ was successfully integrated within my current school PE curriculum and lesson structure.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

7. The ‘CAMSA’ was a disruption to class/student learning/curriculum.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

8. The students were actively engaged in the assessment process.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

**Expansion:**
9. The ‘CAMSA’ enhanced my FMS delivery.
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

10. The ‘CAMSA’ enhanced the FMS proficiency of the students.
    1. Strongly disagree
    2. Disagree
    3. Neither disagree nor agree
    4. Agree
    5. Strongly agree

**Efficacy:**
11. The ‘CAMSA’ could be an ongoing/sustainable measure of FMS in the PE curriculum.
    1. Strongly disagree
    2. Disagree
    3. Neither disagree nor agree
4. Agree
5. Strongly agree

12. I feel more confident in my ability to assess the FMS proficiency of Yr. 7 girls
   1. Strongly disagree
   2. Disagree
   3. Neither disagree nor agree
   4. Agree
   5. Strongly agree

13. The greatest strengths of the ‘CAMSA’ were:
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------

14. The greatest limitations or challenges of the ‘CAMSA’ were:
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------

15. Suggested improvements in regards to the use of the ‘CAMSA’ are:
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
    -----------------------------------------------
Post Intervention:

Focus Group Interview Guide

Please note this is a guide only, and interview content will evolve according to focus group participants’ discussion and elaboration.

- How many classes did you incorporate the tool and the training program content into your lessons and your current curriculum?
  - Prompts:
    - When did you administer the tool?
    - How many times did you administer the tool?
    - When did you integrate content of the training program?
    - How many times did you administer content of the training program?
    - How long did it take to administer the test to your Yr 7 PE class?
    - How long did it take to evaluate the test results of your Yr 7 PE class?

- Tell me about your experiences using the ‘CAMSA’
  - Prompts:
    - Success or failure of administration
    - Success or failure of evaluation
    - Success or failure of using the data as assessment ‘for’ learning
    - Amount, type of resources needed to implement
    - Factors affecting implementation ease or difficulty
    - Efficiency, speed, or quality of implementation
    - Positive/negative effects on students and/or teachers
    - Ability of teachers to carry out all intervention activities
    - Cost (time/equipment/resources/support) analysis

- Tell me about how you integrated the ‘CAMSA’ into your PE program:
  - Prompts:
    - Perceived fit with curriculum and lesson
    - Perceived sustainability
    - Costs or burden to teachers/department/school
    - Fit with departmental and curriculum goals and culture
    - Positive or negative effects on department/class/teacher/student/delivery
    - Disruption to class/student learning/curriculum
    - Challenges
Tell me about the type and level of resources you needed to implement the ‘CAMSA’ successfully?
  - Prompts:
  - Equipment
  - Training Resources
  - Mentoring
  - Administration assistance
  - Evaluation assistance
  - Training sessions
  - Ongoing support

Do you think the ‘CAMSA’ shows promise of being a successful diagnostic assessment tool, and has the potential to guide your FMS delivery?
  - How/why?

What do you see as the benefits or positive effects of the program or process on your teaching and on student learning?

Do you think this is a sustainable process?
  - Prompts
    - How would we best generate sustainable change?
    - What support or resources do you think would enhance the process?
Appendix 3.8: CAMSA Teacher Training Manual

Protocol and Score Sheet
Canadian Agility and Movement Skill Assessment (CAMSA)

Natalie Lander: Deakin University
School of Health and Social Development
Acknowledgements

The CAMSA, was developed as a measure of Motor Competence for the Canadian Assessment of Physical Literacy (CAPL), by the Healthy Active Living and Obesity Group (HALO), 2013.

Health Active Living and Obesity Group
Website: [www.haloresearch.ca](http://www.haloresearch.ca)
401 Smyth Road, Ottawa, ON. K1H8L1
Phone: 6137377600 ext. 4408

The researcher has been granted permission by the authors to use the CAMSA protocol and training materials for the purpose of the research entitled:

“Improving adolescent girls’ fundamental movement skills via assessment and instruction in Physical Education.”

**Principal Researcher:** Dr Lisa Barnett  
**Student Researcher:** Natalie Lander  
**Associate Researcher(s):** Professor Phil Morgan, Professor Jo Salmon

Contact Information

**Natalie Lander**  
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What is the CAMSA?

The CAMSA assesses fundamental movement skills in a dynamic format that simulates active play and requires children to balance speed with technique in order to optimize performance. The obstacle course requires children to run a total distance of 20 meters while completing 7 movement skill tasks. The tasks include: 2-footed jumping into and out of 3 hoops on the ground, sliding from side-to-side over 3 metres, catching a ball and then throwing the ball at a wall target 5 metres away, skipping for 5 metres, 1-footed hopping in and out of 6 hoops on the ground, and kicking a soccer ball between 2 cones 5 metres away (Figure 1). Performances are evaluated using completion time and criterion-referenced skill evaluations (Table 1 and 2). The CAMSA is feasible, valid and reliable (Boyer et al., 2014), therefore, the evaluation of movement skill can obtain valid and reliable skill scores for students aged 6-14 years old. The obstacle course assessment offers an alternative approach to the assessment of children’s motor proficiency that is suitable for population surveillance or the assessment of groups of children in a relatively short period of time.
What is required of you?

1. Training
You will be provided training in the administration and evaluation of the ‘CAMSA’. The training will be facilitated by the researcher, and will be in line with the training regime specified within the Canadian Assessment of Physical Literacy (CAPL) training manual, created by the Healthy Active Living and Obesity Prevention Research Group (2014).

The training will include a 2 hour face to face session highlighting key administration and assessment content in the manual, as well as a practical overview and demonstration of the setup, administration and assessment processes.

You will have the opportunity to practice the setup, administration and assessment within the session and receive feedback and guidance from the facilitator.

You will also be offered the opportunity to receive ongoing support by the candidate, throughout the administration and evaluation process.

2. Administering and evaluating your students using the CAMSA
You are requested to administer the CAMSA to all Year 7 PE students in week 1 of Term 1, 2015, using the prescribed protocol as outlined in this manual.

You are to assess and record the students’ performance on the CAMSA, using the prescribed scoring protocol as outlined in this manual.

3. Use assessment to guide subsequent teaching
You are requested to use the data gathered form the CAMSA assessment to guide your planning and instruction of FMS across Term 1 of your prescribed Year 7 Physical Education curriculum at your school.

4. Measures
You will be invited to take part in two surveys, one observation and one focus group interview to collect data for the feasibility study.

You will be surveyed twice each taking only 5-10 minutes of your time.
Survey 1: will be pre intervention to collect baseline data (Part A: prior to the training, Part B: following the two hour training session).
Survey 2 will be post intervention, to identify the feasibility of the intervention. It will be conducted at the end of term 1, 2015.

You will be observed administering the CAMSA to your class once throughout term 1.

The posttest focus groups interviews will be scheduled in week 1 of Term 2, to provide an opportunity to discuss your perceptions, experiences and recommendations in regards to the CAMSA, in more depth. The interview should take approximately 20-30 minutes to complete.
Examiner positions and roles:

🌟 Examiner 1
- Starts the assessment
- Times the student
- Feeds the catch and places ball for the kick
- Provides clear, accurate and consistent prompts to the child

🌟 Examiner 2 (or IPad position)
- Observes the quality of the students’ performance
- Scores the student’s performance on each of the 7 skills, using checklist provided on next page
Example of CAMSA Score Sheet:

<table>
<thead>
<tr>
<th>Skill and Criteria</th>
<th>Trial 1 Date:</th>
<th>Trial 2 Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 1</td>
<td>Week 1</td>
</tr>
<tr>
<td></td>
<td>Week 5</td>
<td>Week 5</td>
</tr>
<tr>
<td></td>
<td>Week 10</td>
<td>Week 10</td>
</tr>
</tbody>
</table>

**Two Foot Jumping**
- 3 two foot jumps in and out of hoop
- No extra jumps, no touching hoops

**Sliding**
- Body and feet aligned sideways when sliding in one direction
- Body and feet aligned sideways when sliding in opposite direction
- Touch cone with low center of gravity and athletic position

**Catching**
- Catches ball

**Throwing**
- Uses overhand throw to hit target
- Transfers weight and rotates body

**Skipping**
- Correct hop-step pattern
- Alternate arms/leg swing

**One foot hopping**
- Land on one foot in each hoop
- Hops once in each hoop without touching hoop

**Kicking**
- Smooth approach to kick ball – ball hits target
- Elongated stride before impact

**SKILL SCORE**: (range 0-14)

**TIME: Raw Score (in seconds)**

**TIME SCORE**: (range 1-14)

**COMBINED OBSTACLE COURSE SCORE**
(SKILL SCORE AND TIME SCORE: range 1-28)

**SCORING PROTOCOL**
Each Section below is colour coded to match the corresponding section on the example students score sheet, from the previous page.

**SKILL SCORE**

- The quality of the performance is assessed by examiner 2, **OR** video recorded, and subsequently analysed.
- The skill score is the total number of skill criteria that the student performed correctly throughout the obstacle course trial (according to criteria shown below).
- Skill scores can range from 0-14. The better the performance the higher the score.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Criteria</th>
<th>Skill Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-foot jumping</td>
<td>Two feet in and out of blue, orange and purple hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No extra jumps and no touching the hoops</td>
<td>1</td>
</tr>
<tr>
<td>Sliding</td>
<td>Body &amp; feet are aligned sideways sliding in one direction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Body &amp; feet aligned sideways sliding in opposite direction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Touch cone when changing directions after sliding left</td>
<td>1</td>
</tr>
<tr>
<td>Catching</td>
<td>Catches ball (no drop or trap against body)</td>
<td>1</td>
</tr>
<tr>
<td>Throwing</td>
<td>Uses overhand throw to hit target</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Transfers weight and rotates body</td>
<td>1</td>
</tr>
<tr>
<td>Skipping</td>
<td>Correct step-hop foot pattern</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Alternates arms and legs, arms swinging for balance</td>
<td>1</td>
</tr>
<tr>
<td>1-foot hopping</td>
<td>Land on one foot in each hoop</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hops once in each hoop (no touching of hoops)</td>
<td>1</td>
</tr>
<tr>
<td>Kicking</td>
<td>Smooth approach to kick ball between cones</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Elongated stride on last stride before impact</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Skill scored out of a maximum of 14</strong></td>
<td>/14</td>
</tr>
</tbody>
</table>
ASSESSING AND RECORDING TIME

- Time is initially recorded to the nearest 0.1 second by appraiser/examiner #1
- Time is then converted into a point score. Point scores have been divided into 14 categories. The faster the performance, the higher the score.
- Scores range from 1-14.

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;14</td>
<td>14</td>
</tr>
<tr>
<td>14-15</td>
<td>13</td>
</tr>
<tr>
<td>15-16</td>
<td>12</td>
</tr>
<tr>
<td>16-17</td>
<td>11</td>
</tr>
<tr>
<td>17-18</td>
<td>10</td>
</tr>
<tr>
<td>18-19</td>
<td>9</td>
</tr>
<tr>
<td>19-20</td>
<td>8</td>
</tr>
<tr>
<td>20-21</td>
<td>7</td>
</tr>
<tr>
<td>21-22</td>
<td>6</td>
</tr>
<tr>
<td>22-24</td>
<td>5</td>
</tr>
<tr>
<td>24-26</td>
<td>4</td>
</tr>
<tr>
<td>26-28</td>
<td>3</td>
</tr>
<tr>
<td>28-30</td>
<td>2</td>
</tr>
<tr>
<td>≥30</td>
<td>1</td>
</tr>
</tbody>
</table>
The overall CAMSA score is calculated by the skill score (range 0-14) combined with the time score (range 1-14), of the best of the two trials performed, to produce an overall score range of 1-28.

Use the overall score (1-28), against the student’s age, to identify their standard.

<table>
<thead>
<tr>
<th>AGE</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;14</td>
<td>14-18</td>
<td>18-23</td>
<td>23</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;17</td>
<td>17-21</td>
<td>21-24</td>
<td>24</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;19</td>
<td>19-23</td>
<td>23-26</td>
<td>26</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;20</td>
<td>20-24</td>
<td>24-27</td>
<td>27</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;21</td>
<td>21-24</td>
<td>24-27</td>
<td>27</td>
</tr>
</tbody>
</table>
### CAMSA: Example Class List Score Sheet

<table>
<thead>
<tr>
<th>Skill &amp; Criteria</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two Foot Jumping</strong></td>
<td></td>
</tr>
<tr>
<td>3 two foot jumps in and out of hoop</td>
<td></td>
</tr>
<tr>
<td>No extra jumps, no touching hoops</td>
<td></td>
</tr>
<tr>
<td><strong>Sliding</strong></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in one direction</td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in opposite direction</td>
<td></td>
</tr>
<tr>
<td>Touch cone with low centre of gravity and athletic position</td>
<td></td>
</tr>
<tr>
<td><strong>Catching</strong></td>
<td></td>
</tr>
<tr>
<td>Catches ball</td>
<td></td>
</tr>
<tr>
<td><strong>Throwing</strong></td>
<td></td>
</tr>
<tr>
<td>Uses over hand throw to hit target</td>
<td></td>
</tr>
<tr>
<td>Transfers weight and rotates body</td>
<td></td>
</tr>
<tr>
<td><strong>Skipping</strong></td>
<td></td>
</tr>
<tr>
<td>Correct hop-step pattern</td>
<td></td>
</tr>
<tr>
<td>Alternate arms/legs swing</td>
<td></td>
</tr>
<tr>
<td><strong>One Foot Hopping</strong></td>
<td></td>
</tr>
<tr>
<td>Land of one foot in each hoop</td>
<td></td>
</tr>
<tr>
<td>Hops once in each hoop without touching hoop</td>
<td></td>
</tr>
<tr>
<td><strong>Kicking</strong></td>
<td></td>
</tr>
<tr>
<td>Smooth approach to kick ball – ball hits target</td>
<td></td>
</tr>
<tr>
<td>Elongated stride before impact</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE (0-14)**
**TIME/RAW SCORE (in seconds)**
**TIME SCORE (1-14)**
**COMBINED SCORE (1-28) Skill & Time Score**
**STANDARD (beginning, progressing, achieving, excelling)**
<table>
<thead>
<tr>
<th>Teacher Demonstration Actions</th>
<th>Teacher Demonstration Script</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Begin standing stationary in front of the right hand side yellow hoop</td>
<td>&quot;when you are reading to go, I will say ready, set, go&quot;</td>
</tr>
<tr>
<td>2. Complete the 2-foot jumps (right hand side: yellow, blue, red hoops). Run to cone 1 and turn to face assessor #1</td>
<td>&quot;when I say “go” you jump both feet together through the hoops&quot;</td>
</tr>
<tr>
<td>3. Slide sideways to cone 2 and touch the cone. Slide back to cone 1 (remain facing assessor #1)</td>
<td>&quot;the next part is sliding sideways. You should be facing this side so you can see assessor #1. Slide sideways, touch the green cone, then slide back, still facing the same way and touch the other green cone&quot;</td>
</tr>
<tr>
<td>4. Start to run towards the throwing line, catch the ball thrown from assessor #1, and throw at the target at any point before the line.</td>
<td>&quot;after you finish sliding, I will throw the ball to you. Catch it and run up to the line and then throw it at the target before you cross the line&quot;</td>
</tr>
<tr>
<td>5. Run across the line and around cone #2 to reach the outside of cone #3. Skip from cone #3 to cone #4 before running around cone #4 and back to the hoops.</td>
<td>&quot;after you throw you go around the green cone and run outside of the purple cone. When you come to the purple cone you skip all the way to the second purple cone. Do your best athletic skipping. Skip around the purple cone and then run back to the hoops”</td>
</tr>
<tr>
<td>6. After reaching cone #4 and making sure you go around it, you come to the hoops and begin 1-foot hoping in each hoop.</td>
<td>“this time you have to land in all of the hoops in any order, but you have to land on the same foot in each hoop.”</td>
</tr>
<tr>
<td>7. After landing in the last hoop, run to the kicking line and kick the ball towards the target.</td>
<td>“after you land on 1-foot in the last hoop just run to the soccer ball and kick it between the 2 yellow cones. You don’t need to aim for the target on the wall, that is for throwing. Once you kick the ball you are done”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment Actions</th>
<th>Student Assessment Script</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When student is standing in front of the right yellow hoop ready to go</td>
<td>“ready, set, go”</td>
</tr>
<tr>
<td>2. Immediately after saying go</td>
<td>“2-foot jumps”</td>
</tr>
<tr>
<td>3. As third jump is initiated</td>
<td>“slide, touch the cone”</td>
</tr>
<tr>
<td>4. As they approach cone #2</td>
<td>“slide, touch the cone”</td>
</tr>
<tr>
<td>5. As they approach cone #1</td>
<td>“catch the ball”</td>
</tr>
<tr>
<td>6. After assessor has thrown ball</td>
<td>“run up to the line and throw the ball at the target”</td>
</tr>
<tr>
<td>7. Once the child has prepared to throw</td>
<td>“round the cone”</td>
</tr>
<tr>
<td>8. Once the student has gone over the throwing line and is heading for cone #2</td>
<td>“skip”</td>
</tr>
<tr>
<td>9. Once the student is halfway between cone #3 and #4</td>
<td>“round the cone”</td>
</tr>
<tr>
<td>10. When the student is going around cone #4</td>
<td>“1-foot hops in each hoop”</td>
</tr>
<tr>
<td>11. As the final hop is completed</td>
<td>“run and kick the ball between the cones”</td>
</tr>
</tbody>
</table>
Appendix 3.9: Study 3 Teacher Journal

Teacher Journal

Please take 5 minutes to jot down your thoughts and experiences each time you use the CAMSA. Please use the notebook provided to record: when, where and how you used the tool.

Feel free to create a table and fill it out each time you use the tool. An example is provided, however, you can create any headings and/or format you feel is most suitable for your environment.

Example Table of CAMSA use

<table>
<thead>
<tr>
<th>Date</th>
<th>Purpose</th>
<th>Time taken to set up</th>
<th>Time taken to administer</th>
<th>Student response</th>
<th>Ease of evaluation</th>
<th>Time taken to evaluate</th>
<th>Use of Assessment data</th>
<th>Challenges</th>
</tr>
</thead>
</table>

If you choose to document your use in text version, I have provided some suggestions below, again however feel free to record your own thoughts and use of the tool, as you see appropriate.

Suggestion: How many classes did you incorporate the tool and the training program content into your lessons and your current curriculum?

- When did you administer the tool?
- How many times did you administer the tool?
- How long did it take to administer the test to your Yr 7 PE class?
- How long did it take to evaluate the test results of your Yr 7 PE class?

Suggestion: What were your experiences using the ‘CAMSA’
• Success or failure of administration
• Success or failure of evaluation
• Success or failure of using the data as assessment ‘for’ learning
• Amount, type of resources needed to implement
• Factors affecting implementation ease or difficulty
• Positive/negative effects on students and/or teachers
• Ability of teachers to carry out all intervention activities

Suggestions: how did you integrated the ‘CAMSA’ into your PE program

• Perceived fit with curriculum and lesson
• Fit with departmental and curriculum goals and culture
• Positive or negative effects on department/class/teacher/student/delivery
• Disruption to class/student learning/curriculum
• Challenges

Suggestions: What type and level of resources did you need to implement the ‘CAMSA’ successfully?

• Equipment
• Training Resources
• Mentoring
• Administration assistance
• Evaluation assistance
• Training sessions
• Ongoing support

Thank you for your time,

Natalie Lander
APPENDIX 4: PAPER 4: THE RELIABILITY AND VALIDITY OF TWO MOTOR SKILL ASSESSMENTS FOR USE IN A SCHOOL SETTING

Appendix 4.1: HEAG Ethics Approval

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**Memo**

To: Dr Lisa Barnett, Prof Jo Salmon, Prof Phil Morgan  
School of Health and Social Development

From: Secretary – HEAG-H  
Faculty of Health

CC: Ms Natalie Lander

Date: 3 August 2015

Re: HEAG-H 190_2014: Improving adolescent girls’ fundamental movement skills via instruction and assessment in Physical Education

Approval has been given for Dr Lisa Barnett, Prof Jo Salmon and Prof Phil Morgan, of the School of Health and Social Development, to undertake this project with the modifications that were requested on the 3 August, 2015.

Please note that the current end date for this project is 4 December, 2016.

Signature Redacted by Library

Steven Sawyer  
Secretary  
HEAG-H

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Human Ethics Advisory Group, Faculty of Health,  
Melbourne Berwick Campus, 511 Berwick Highway, Berwick, VIC 3126  
Tel 03 9251 7174, email health-ethics@deakin.edu.au www.deakin.edu.au
Appendix 4.2: Letter of Invitation/PLS and Consent (Principal, PE teachers and Parent/Guardians)

Dear Principal,

Thank you for your participation in the feasibility study for the CAMSA that was conducted in your school in early 2015. We found that teachers believed it was a useful test, but also had several suggestions for improvement, which will be utilised to create a teacher training package.

In the proposed study, the student FMS proficiency data, will be assessed using two FMS assessment tools: i) The CAMSA, and ii) The Victorian FMS Classroom Teachers Manual assessment. The assessment data will then be used for the purpose of test re-test, and Interrater reliability.

**Why is this important?**

This study will provide valuable information regarding the reliability of both the CAMSA and The Victorian FMS Teachers Manual assessment. Direct observation FMS assessment tools, are essential to identify, monitor and improve problem skill components both in research and teaching. Therefore, it is essential that a clear scoring and assessment system has been tested for validity and reliability in a school setting, and is accessible to both researchers and teachers, so it can be integrated into teaching practice.

It is important therefore, that these assessments are reliable in order to be able to accurately identify which skill components to target in our teaching and thus improve. When assessing children’s movement skill proficiency for educative and research purposes, children are often videoed and then assessment can be completed at a later date by one or more teachers or raters. Therefore, in addition to the test re-test, the proposed methodology will also include Interrater reliability.

**What is required of your teachers and students?**

The test re-test will be conducted with two classes of Year 7 PE students, and is proposed to occur early Term 4, 2015. The same two tests will be administered to the same group of students, on two separate occasions seven days apart. Both assessments will be administered to the students in one scheduled PE lesson and then the same protocol will be repeated in their next scheduled PE lesson.

Students’ will be divided into groups of six, and will perform the CAMSA twice, and will then rotate through the six skill stations of the Victorian Teachers Manual Assessment, repeating each skill twice. Video cameras will be used to record each consenting student’s FMS performances. One assessor (the student researcher) will perform the test-retest reliability, of the two assessment episodes seven days later.

*Please note: The students would have undergone the additional assessment, using The CAMSA, during their regular PE, conducted by their regular PE teacher, to monitor student progress and evaluate teaching, and report to parent/guardian, as part of their planned PE program. The assessment requirements proposed in this methodology will therefore not present any additional demands on the students, and indeed will reduce the assessment demands of the teacher, as they are now being performed by the research team, in collaboration with the PE teacher.*

If you support the continued research, I would like to arrange a meeting with you to expand on the procedure and provide participant consent. Thank you for your consideration, I look forward to working with you.

Natalie Lander  
nlander@deakin.edu.au  
PhD Candidate: School of Health and Social Development, Deakin University, Burwood
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: The Principal

Consent Form

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education: Reliability of the CAMSA and Victorian FMS Teachers Manual assessment.

Reference Number:

I have read, and I understand the attached Plain Language Statement.

I freely agree to participate in the research project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) ………………………………………………………………………

Signature …………………………………………………. Date ……………………………

Please email this form to:

Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: The Principal

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education: Reliability of the CAMSA and Victorian FMS Teachers Manual assessment.

Reference Number:

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) .................................................................

Signature ................................................................. Date ...................

Please e-mail this form to:

Student Researcher: Natalie Lander

nlander@deakin.edu.au

School of Health and Social Development

Deakin Burwood
TO THE PE TEACHER
YOU ARE INVITED TO
PART IN AN EXCITING RESEARCH PROJECT!

DEAKIN UNIVERSITY
School of Health and Social Development
Improving fundamental movement skills (FMS) via assessment and instruction in Physical Education

WHERE IS THE RESEARCH BEING CONDUCTED?
This is a research project being conducted in one Independent Girls School in Melbourne.

WHAT IS THE RESEARCH AIM?
The aim is to provide valuable information regarding the reliability of both the Motor Skill Obstacle Course and The Victorian FMS Teachers Manual assessment.

WHY IS THIS RESEARCH BEING CONDUCTED?
FMS are important for children to learn but they need to be assessed in a reliable and fair manner. This research will determine the most effective method to assess FMS which will inform and improve teaching practice.

WHAT ARE THE BENEFITS OF THE RESEARCH?
This study will provide valuable information regarding the reliability of both the Motor Skill Obstacle Course and The Victorian FMS Teachers Manual assessment. It is important that these assessments are reliable in order to be able to accurately identify students who enter the secondary school with low level FMS proficiency. And subsequently, to improve on the teaching they receive in PE, which will ultimately enhance their FMS proficiency, and the physical activity opportunities available to them.
WHAT WILL YOU RECEIVE?

The research team will collaborate with you, during the assessment protocol, to upskill you in both forms of FMS assessments. You will also be provided accurate FMS proficiency data on each of your students. You can use this information to monitor student and teacher progress, evaluate teaching and program success, and plan and modify subsequent teaching to better meet the needs of the students.

WHAT WILL YOU BE ASKED TO DO?

Assist and collaborate with the Deakin Research Team in regards to the assessment protocol, during two scheduled Year 7 PE lessons.

ASSESSMENT PROTOCOL

Both the Motor Skill Obstacle Course and the Victorian FMS Classroom Teachers Manual assessment will be administered to the students in one of their scheduled PE lessons early in Term 4, 2015. The same protocol will then be repeated 7 days later, in their next scheduled PE lesson. Students' will be divided into groups of six, and will perform the Motor Skill Obstacle Course twice, and will then rotate through the six skill stations of the Victorian Teachers Manual Assessment, repeating each skill twice. Video cameras will be used to tape each consenting student’s FMS performances. The student’s videoed performances, of the initial test (Test 1 of the test re-test) will be analysed separately by the two assessors, to provide a measure of interrater reliability. One assessor (the student researcher) will perform the test-retest reliability, of the two assessment episodes seven days later.

PLEASE NOTE: Following video analysis, the data will be de-identified, that is, all personal details will be removed from the data, and will be replaced by a code. The school, teacher and student details will not be used in any form of reporting associated with this research.
WILL ANYONE ELSE KNOW ABOUT OUR RESULTS?

The information collected through this project will remain strictly confidential. You will be de-identifiable, a code will replace your name in all survey and interview data. To comply with government requirements all data will be stored securely for a period of a minimum of 6 years after final publication. It will then be destroyed. I will provide a one page summary of the de-identified results from the research to you at the completion of the study.

WHO IS FUNDING THE STUDY?

This study is part of a PhD project and is totally funded by Deakin University. The study is being conducted by Natalie Lander, under the supervision of Dr Lisa Barnett, Professor Jo Salmon and Professor Phil Morgan.

HAS THE PROGRAM BEEN APPROVED?

Yes, by the Deakin University Human Ethics Advisory Group - Faculty of Health (HEAG-H)

DO WE HAVE TO TAKE PART?

Please be aware that participation in any research project is voluntary. If you no longer wish to take part you are not obliged to, and have the ability to withdraw at anytime.

WE WANT TO TAKE PART! WHAT DO WE DO NOW?

If you are happy to take part, that’s great. Please email Natalie on nlander@deakin.edu.au and we will schedule in a meeting to discuss the logistics of the program further.
TO: The Physical Education Teacher

Consent Form

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education: Reliability of the CAMSA and Victorian FMS Teachers Manual assessment.

Reference Number:

I have read, and I understand the attached Plain Language Statement brochure.

I freely agree to participate in the research project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) ………………………………………………………………………

Signature ……………………………………………………………… Date ……………………………

Please email this form to:

Student Researcher Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: The Physical Education Teacher

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education: Reliability of the CAMSA and Victorian FMS Teachers Manual assessment.

Reference Number:

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) …………………………………………………….

Signature ……………………………………………………………….

Date ……………………

Please e-mail this form to:

Student Researcher
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
TO: Parent/Guardian

Consent Form

Date: Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education: Reliability of the CAMSA and Victorian FMS Teachers Manual assessment.

Reference Number:

I have read, and I understand the attached information brochure.

I consent for my child to participate in the above research project, according to the conditions provided in the information letter.

I agree for my child to be video recorded when performing a series of fundamental movement skills (e.g., throw, catch, kick, dodge, jump, run).

The researcher has agreed not to reveal my child’s identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) …………………………………………………….

Parent/Guardian’s Name (printed)……………………………………………

Parent/Guardian Signature ……………………………………………………………….

Date …………………

Please return this form to your child’s Physical Education Teacher, or alternatively you can email it to the student researcher:

Student Researcher

Natalie Lander

nlander@deakin.edu.au

School of Health and Social Development

Deakin Burwood
I WANT MY CHILD TO PARTICIPATE!

WHAT DO I DO NOW?
If you would like your child to take part, that’s great. Please complete and return the attached consent form to your child’s PE teacher, or email directly to Natalie Lander, nlander@deakin.edu.au

DOES MY CHILD HAVE TO TAKE PART?
Please be aware that participation in any research project is voluntary. If your child no longer wish to take part you are not obliged to and can withdraw at any time.

CONTACT US
Phone: (03) 92446258
Email: nlander@deakin.edu.au
Address: School of Health and Social Development, Deakin University, Burwood Hwy, Burwood, VIC, 3125

DEAKIN UNIVERSITY
Your child is invited to participate in an exciting research project being conducted in Girls Secondary Schools across Melbourne.

DEAKIN UNIVERSITY
Please feel free to contact Natalie Lander With any questions or queries
nlander@deakin.edu.au
Proficiency in skill has strong links to healthy weight status.

WHAT IS REQUIRED OF YOUR CHILD?

During your child’s regular Physical Education lessons in Term 4, 2015, a fun and exciting method of fundamental movement skill assessment will be used by the Physical Education teacher, within the scheduled Physical Education classes.

The assessment is an obstacle course and requires children to run a total distance of 20 meters while completing 7 movement skill tasks.

Performances will be evaluated by the research team in collaboration with your child’s regular Physical Education teacher. The Physical Education teacher will use the results of the assessment to motor progress and help lesson planning and delivery in PE, to better meet the individual needs of each student. The research team will use the data for the purpose of ascertaining a measure of reliability of the CAMSA.

ANYTHING ELSE REQUIRED OF YOUR CHILD?

Your child’s FMS proficiency will be tested twice by the Deakin research team. The first assessment will occur within the first two weeks of Term 4, the second about 1 week later. To do this, the researcher will video record each student as they perform a range of skills (e.g. throw, catch, kick, dodge, jump, and run). Each video performance will analysed by the research team, to ascertain a measure of reliability for this type of FMS assessment.

PLEASE NOTE: Following video analysis, the data will be de-identified, that is, all personal details will be removed from the data, and will be replaced by a code. The school, teacher and student details will not be used in any form of reporting associated with this research.

WHO IS FUNDING THE STUDY?

This research is funded by Deakin University, there is no cost to you.

HAS THE PROGRAM BEEN APPROVED?

The ethical aspects of this research project have been approved by the ethics committee at Deakin University.

If you would like to receive a one page summary of the de-identified results from the research, at the completion of the study, please email Natalie Lander: nlander@deakin.edu.au.

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Office of Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125,

WHAT ARE THE BENEFITS OF THE RESEARCH?

This study will provide valuable information regarding the reliability of both the CAMSA and The Victorian FMS Teachers Manual assessment. It is important that these assessments are reliable in order to be able to accurately identify students who enter the secondary school with low level FMS proficiency. And subsequently, to improve on the teaching they receive in PE, which will ultimately enhance their FMS proficiency, and the physical activity opportunities available to them.
APPENDIX 4.3: TEST RETEST RELIABILITY CAMSA SCORE SHEETS

<table>
<thead>
<tr>
<th>Skill and Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two Foot Jumping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 two foot jumps in and out of hoop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No extra jumps, no touching hoops</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sliding</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in one direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in opposite direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touch cone with low center of gravity and athletic position</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Catching</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catches ball</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Throwing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses over hand throw to hit target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfers weight and rotates body</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Skipping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct hop-step pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternate arms/leg swing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>One foot hopping</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land on one foot in each hoop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hops once in each hoop without touching hoop</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Kicking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smooth approach to kick ball – ball hits target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elongated stride before impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SKILL SCORE: (range 0-14)**

**TIME: Raw Score (in seconds)**

**TIME SCORE: (range 1-14)**

**COMBINED OBSTACLE COURSE SCORE**
*(SKILL SCORE AND TIME SCORE: range 1-28)*
APPENDIX 4.3: TEST RETEST RELIABILITY VIC FMS SCORE SHEETS

<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Catch</td>
<td>1. Eyes are focused on the ball throughout the catch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Preparatory position with elbows bent and hands in front of body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Hands move to meet the ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Hands and fingers positioned correctly to catch the ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Catch and control the ball with hands only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skill Score:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Kick</td>
<td>1. Eyes are focused on the ball throughout the kick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Step forward with non-kicking foot placed near the ball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Bend knee of kicking leg during the backswing for the kick</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Hip extension and knee flexion of at least 90° during preliminary kicking movement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Contact ball with top of foot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Forward and sideward swing of arm opposite kicking leg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Kicking leg follows through towards the target after ball contact</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skill Score:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### LOCOMOTOR SUBSET

<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vertical Jump</td>
<td>1. Eyes focused forwards or upwards throughout the jump</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Crouch with knees and arms bent behind body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Forceful up thrust of arms as legs straighten to take off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Contact ground with front part of feet and bend knees to absorb force of landing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Balanced landing with no more than one step in any direction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Leap</td>
<td>1. Forward movement sustained throughout the leap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Eyes focused forward throughout the leap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Take off from one foot and land on the opposite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. During flight legs are straightened with the arms held in opposition to legs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Controlled landing without losing balance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Skill Score:

Object Control Subset Score:
<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Dodge</td>
<td>1. Eyes focused in direction of travel throughout the dodge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Change direction by pushing off outside foot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Body lowered during change of direction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Change of direction occurs in one step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Dodge repeated from right to left, left to right etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Skill Score:

Locomotor Subset Score:

Overall Skill Score:
APPENDIX 5: PAPER 5: IMPROVING EARLY-ADOLESCENT GIRLS’ FUNDAMENTAL MOVEMENT SKILL: A PILOT CLUSTERED RANDOMIZED CONTROLLED TRIAL

Appendix 5.1: HEAG Ethics Approval

Memo

To: Dr Lisa Barnett
School of Health and Social Development

From: Secretary – HEAG-H
Faculty of Health

CC: Natalie Lando, Professor Jo Salmon, Professor Phil Morgan

Date: 20 July 2015

Re: HEAG H 96_2015: Improving adolescent girls fundamental movement skill proficiency via assessment and instruction in physical education

Approval has been given for Dr Lisa Barnett, School of Health and Social Development, to undertake this project for a period of 1 year from 20 July, 2015. The current end date for this project is 20 July, 2016.

The approval given by the Deakin University HEAG-H is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Secretary immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion
- Modifications that have been requested by other Human Research Ethics Committees

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

An Annual Project Report Form can be found at:

This should be completed and returned to the Administrative Officer to the HEAG-H, Pro-Vice Chancellor’s office, Faculty of Health, Burwood campus by Tuesday 17th November, 2015 and when the project is completed. HEAG-H may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

Good luck with the project!
Appendix 5.2: Catholic Education Office Ethics Approval

GE15/0009
10 July 2015

Mrs Nettie Lander,
Deakin University, Burwood Highway,
Burwood. VIC 3125

Dear Mrs Lander,

I am writing with regard to your research application received on 29th June 2015 concerning your forthcoming project titled, Improving adolescent girls’ fundamental movement skill (FMS) proficiency via assessment and instruction in physical education. You have asked approval to approach Catholic schools in the Archdiocese of Melbourne, as you wish to involve teachers and students.

I am pleased to advise that your research proposal is approved in principle subject to the eight standard conditions outlined below.

1. The decision as to whether or not research can proceed in a school rests with the school’s principal, so you will need to obtain approval directly from the principal of the school that you wish to involve. You should provide the principal with an outline of your research proposal and indicate what will be asked of the school. A copy of this letter of approval, and a copy of notification of approval from the organisation/University’s Ethics Committee, should also be provided.

2. A copy of the approval notification from your institution’s Ethics Committee must be forwarded to this Office, together with any modifications to your research protocol requested by the Committee. You may not start any research in Catholic Schools until this step has been completed.

3. A Working with Children (WWC) check – or registration with the Victorian Institute of Teaching (VIT) – is necessary for all researchers visiting schools. Appropriate documentation must be shown to the principal before starting the research in the school.

4. No student is to participate in the research study unless she is willing to do so and informed consent is given in writing by a parent/guardian.

1 of 2

James Geold House, 228 Victoria Parade, East Melbourne VIC 3002 Tel: (+61 3) 9616 6328 Fax: (+61 3) 9415 9225
Correspondence: PO Box 3, East Melbourne VIC 3002 Email: director@cemelb.catholic.edu.au www.cemelb.catholic.edu.au
ABN 61 136 448 204

374
Appendix 5.3: DET Ethics Approval

Mrs. Natalie Lander
Faculty of Health, School of Health and Social Development
Deakin University
771 Burwood Highway
BURWOOD 3125

Dear Mrs. Lander,

Thank you for your application of 20 June 2015 in which you request permission to conduct research in Victorian government schools titled improving adolescent girls fundamental movement skill (FMS) proficiency via assessment and instruction in physical education (PE).

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Training.

2. Separate approval for the research needs to be sought from school principals. This is to be supported by the Department of Education and Training approved documentation and, if applicable, the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 12 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee must be submitted to the Department of Education and Training for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or governing body of the early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director or governing body.

5. You acknowledge the support of the Department of Education and Training in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reinforcer will be sent for reports not submitted by the study’s indicative completion date.

2016_002798

Department of Education & Training
Strategic & Review Group

2 Treasury Place
Docklands, Melbourne, Victoria 3008
Telephone: 1800 180 000
Fax: 1800 004 080
CFO Box 4397
Melbourne, Victoria 3001
Appendix 5.4: PLS and Consent

Letter to principals or directors requesting approval to conduct the research in their school

Dear Sir/Madam,

My name is Natalie Lander, I am currently conducting my PhD at Deakin University, under the supervision of Dr. Lisa Barnett, Professor Jo Salmon and Professor Phil Morgan. I have completed 2 of the 3 proposed studies in my PhD, and I am writing to invite your school to participate in my final study. My research focus is the teaching of fundamental movement skills (FMS), with the intention of improving teaching methods and students outcomes.

FMS are basic skills ideally learnt in childhood, and include locomotor skills such as running, hopping and jumping, and object control skills such as catching, kicking and throwing. There is a strong positive relationship between skill proficiency and; cognition, fitness and physical activity, and healthy weight status. Despite the clear correlation between skill competence and health, a large proportion of students are under-skilled. Primary school PE should provide the ideal environment to develop FMS. The reality is however, many girls enter high school under skilled. Yet on entry to high school, these skills are rarely screened for, nor are they taught in a targeted or individualized manner.

In 2014 I conducted interviews with 25 specialist PE teachers investigating their perceptions and experiences when teaching FMS to Year 7 girls. Two major findings arose – firstly, the teachers perceived this to be an important time to teach and assess FMS. Secondly, many of the teachers felt unequipped to teach or assess in a manner which motivated the students to learn. In early 2015 I investigated the feasibility of a novel and exciting motor skill assessment tool (i.e., the CAMSA) in 4 Schools across Victoria. I found that although teachers perceived it to be a feasible test, they had several recommendations in regards to how they could integrate the assessment data gleaned from the obstacle course into better teacher practice, and perceived more comprehensive training in how to integrate assessment ‘for’ learning would have been beneficial. The aim of the current study is to provide the teachers with training in student centred pedagogy, as well as the motor skill assessment, to improve the teachers’ assessment and instruction of, and ultimately the Year 7 students’ FMS proficiency.

Benefits to your teachers and the students?

The student assessment data generated from the motor skill assessment tool is valid and reliable. The assessment tool is an obstacle course format that provides an engaging, dynamic, authentic and fun approach to the assessment of student’s motor proficiency. It is suitable for the assessment of large groups of students in a relatively short period of time, which will allow teachers to obtain important information regarding the level of FMS proficiency of the students. The combined method of using a valid and reliable assessment, coupled with student-centered learning (SAAFE teaching principles), has the capacity to improve students’ FMS proficiency and expand the physical activity opportunities available them.

When is it?

Teacher Training: Term 4, 2015
Program implementation: Term 1, 2016

What will your teachers receive?

Training: Teachers will receive a 2 hour teacher training program. The teacher training will be facilitated by the researcher, and conducted in your school environment. Teachers will receive an overview of the background and importance of FMS, the administration and evaluation protocol of the CAMSA, and in-service in the SAAFE teaching principles. Teachers will be provided a hard copy of the training manual and SAAFE principles,
score sheets, lesson framework templates, practical demonstrations, and will have the opportunity to demonstrate, administer and evaluate the CAMSA and receive feedback and guidance on their performance.

**Certificate of Participation and Certificate of Facilitation:** Your teachers will be awarded a certificate of participation for attendance in the professional development. And a certificate of facilitation for the implementation of the program. In addition, your school will be awarded a framed certificate for your participation in the Deakin University research project.

What will be required of your teachers?

**Questionnaire:** Teachers’ experiences, perceptions and approaches, to PE and FMS will be asked about, via a brief questionnaire, which will take approximately 5-10 minutes of their time.

**Administration of CAMSA and the SAFFE Teaching Principles into your PE program:** Teachers will administer the obstacle course to all of your Year 7 Physical Education students, evaluate the assessment data and subsequently teach the prescribed FMS curriculum, using the results of the MSOC and the SAAFE teaching principles to guide your delivery. The MSOC takes about 20 minutes to administer to a class of 20 students.

**Focus group interview:** Teachers will be involved in brief focus group interviews, 6 months post intervention, to investigate the maintenance effects of the program.

What will your students receive?

The students will have their entry level motor skill assessed in a fun and engaging manner. They will then receive teaching that is student-centred and more accurately targets their learning needs, which will ultimately improve their movement skill proficiency, and subsequently have positive implications for their health.

What will be required of your students?

The students will take part in their regular PE classes and curriculum. In addition they will have their skill level objectively measured, via video, by the lead researcher, once at the beginning of the Term 1, and once in Term 2.

What are the details of the CAMSA?

The obstacle course assesses fundamental movement skills in an authentic and dynamic format that simulates active play. It requires children to run a total distance of 20 meters while completing 7 movement skill tasks. The obstacle is part of the Canadian Assessment of Physical Literacy, and has been tested for validity and reliability for the age group.

What are the details of the SAAFE Teaching Principles?

The SAAFE teaching principles is a framework for teacher training, which has had significant success within school-based interventions in recent years. Teacher training using the SAAFE teaching principles is broadly framed by Self-Determination Theory (SDT) and Competence Motivation Theory (CMT), and are implemented to ensure that students’ basic psychological needs are satisfied, and subsequently are optimally motivated to learn.

I would like to arrange a meeting with you to expand on the procedure and provide participant consent. I will contact your school via phone in the next fortnight as a follow up to this letter. Thank you for your consideration, I look forward to working with you.

Natalie Lander

nlander@deakin.edu.au

PhD Candidate: School of Health and Social Development, Deakin University, Burwood
Dear Physical Education Teacher,

I appreciate your interest and willingness to be involved in this important research, which is entitled “Improving adolescent girls’ fundamental movement skills via instruction and assessment in Physical Education”.

I have attached a brochure to this email, which provides you with an overview of the research, what is required of you and the students, and the proposed benefits of the research. Also attached is the consent form for you to sign and either return to me via email, or in hard copy on the day of your training session.

I value your knowledge and experiences and would like to schedule in a time for your first questionnaire, and training session in regards to the ‘CAMSA’ and SAAFE teaching principles. If you could provide me with the dates, and times you have available in Term 4, 2015, via email, it would be much appreciated.

I look forward to working with you.

Student Researcher
Natalie Lander
nlander@deakin.edu.au
PhD Candidate
School of Health and Social Development
Deakin University, Burwood
# PLAIN LANGUAGE STATEMENT AND CONSENT FORM

**TO:** Physical Education Teachers

## Consent Form

**Date:**

**Full Project Title:** Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

**Reference Number:**

I have read, and I understand the attached Plain Language Statement.

I freely agree to participate in the research project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) ……………………………………………………………………

Signature ……………………………………………………… Date ………………………

Please email this form to:

<table>
<thead>
<tr>
<th>Student Researcher</th>
<th>Natalie Lander</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><a href="mailto:nlander@deakin.edu.au">nlander@deakin.edu.au</a></td>
</tr>
<tr>
<td>School of Health and Social Development</td>
<td></td>
</tr>
<tr>
<td>Deakin Burwood</td>
<td></td>
</tr>
</tbody>
</table>
PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: Physical Education Teachers

Withdrawal of Consent Form

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

Reference Number:

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University.

Participant’s Name (printed) ………………………………………………………………..

Signature ……………………………………………………………….. Date ……………………

Please e-mail this form to:

Student Researcher: Natalie Lander

nlander@deakin.edu.au

School of Health and Social Development
Deakin Burwood
Letter to parents/guardians, inviting children to participate in the research

CONSENT FORM

TO: Parent/Guardian

Date: Full Project Title: Improving FMS proficiency of early adolescent girls via instruction and assessment in Physical Education

Reference Number:

I have read, and I understand the attached information letter.

I consent for my child to participate in the above research project, according to the conditions provided in the information letter.

I agree for my child to be video recorded when performing six fundamental movement skills (throw, catch, kick, dodge, jump, and run).

The researcher has agreed not to reveal my child’s identity and personal details, including where information about this project is published, or presented in any public form.

Participant’s Name (printed) ……………………………………………………. Participants Date of Birth …………………

Parent/Guardian’s Name (printed)…………………………………………

Cultural Background: ……………………………………………

Primary Language Spoke at Home: ………………………………………...

Parents Level of Education (Please circle): Year 10/VCE or equivalent/Tertiary

Parent Occupation………………………………………..

Parent/Guardian Signature ……………………………………………………………… Date …………………

Please return this form to your child’s Physical Education Teacher, or alternatively you can email it to the student researcher:

Student Researcher Natalie Lander
nlander@deakin.edu.au
School of Health and Social Development
Deakin Burwood
YOU ARE INVITED TO
TAKE
YOU ARE INVITED TO
PART IN AN EXCITING
RESEARCH PROJECT!

DEAKIN UNIVERSITY
School of Health and
Social Development

Improving fundamental
movement skills (FMS)
via assessment and
instruction in Physical
Education

Contact Information
Natalie Lander
School of Health & Social
Development
Faculty of Health
Deakin University, 221
Burwood Hwy
Burwood, Vic 3125
Email: nlander@deakin.edu.au

WHERE IS THE RESEARCH BEING CONDUCTED?
This is a research project being conducted in one Independent Girls School in Melbourne.

WHAT IS THE RESEARCH AIM?
The aim is to provide valuable information regarding the reliability of both the Motor Skill Obstacle Course and The Victorian FMS Teachers Manual assessment.

WHY IS THIS RESEARCH BEING CONDUCTED?
Direct observation FMS assessment tools, are essential to identify, monitor and improve problem skill components both in research and teaching. Therefore, it is essential that a clear scoring and assessment system has been tested for validity and reliability is accessible to both researchers and teachers, to it can be integrated into research and teaching practice.

WHAT ARE THE BENEFITS OF THE RESEARCH?
The combined method of using a valid and reliable assessment tool, coupled with student-centered learning, has the capacity to more effectively identify students who enter the secondary Physical Education system with low level FMS proficiency, and improve educational practice of PE teachers when instructing FMS to Year 7 girls. Thereby, improving student FMS proficiency and the physical activity opportunities available to them.
WHAT WILL YOU RECEIVE?

The research team will collaborate with you, during the assessment protocol, to upskill you in both forms of FMS assessments. You will also be provided accurate FMS proficiency data on each of your students. You can use this information to monitor student and teacher progress, evaluate teaching and program success, and plan and modify subsequent teaching to better meet the needs of the students.

WHAT WILL YOU BE ASKED TO DO?

Assist and collaborate with the Deakin Research Team in regards to the assessment protocol.

ASSESSMENT PROTOCOL

Both the CAMSA and the Victorian FMS Classroom Teachers Manual assessment will be administered to the students in one of their scheduled PE lessons early in Term 4, 2015. The same protocol will then be repeated 7 days later, in their next scheduled PE lesson. Students’ will be divided into groups of six, and will perform the CAMSA twice, and will then rotate through the six skill stations of the Victorian Teachers Manual Assessment, repeating each skill twice. Video cameras will be used to tape each consenting student’s FMS performances. The student’s videoed performances, of the initial test (Test 1 of the test re-test) will be analysed separately by the two assessors, to provide a measure of interrater reliability. One assessor (the student researcher) will perform the test-retest reliability, of the two assessment episodes seven days later.

PLEASE NOTE: Following video analysis, the data will be de-identified, that is, all personal details will be removed from the data, and will be replaced by a code. The school, teacher and student details will not be used in any form of reporting associated with this research.
WILL ANYONE ELSE KNOW ABOUT OUR RESULTS?
The information collected through this project will remain strictly confidential. You will be de-identifiable, a code will replace your name in all survey and interview data. To comply with government requirements all data will be stored securely for a period of a minimum of 6 years after final publication. It will then be destroyed. I will provide a one page summary of the de-identified results from the research to you at the completion of the study.

WHO IS FUNDING THE STUDY?
This study is part of a PhD project and is totally funded by Deakin University. The study is being conducted by Natalie Lander, under the supervision of Dr Lisa Barnett, Professor Jo Salmon and Professor Phil Morgan.

HAS THE PROGRAM BEEN APPROVED?
Yes, by the Deakin University Human Ethics Advisory Group-Faculty of Health (HEAG-H) and the Victorian Catholic Education Office (CEO).

DO WE HAVE TO TAKE PART?
Please be aware that participation in any research project is voluntary. If you no longer wish to take part you are not obliged to, and have the ability to withdraw at anytime.

WE WANT TO TAKE PART! WHAT DO WE DO NOW?
If you are happy to take part, that’s great. Please email Natalie on nlander@deakin.edu.au and we will schedule in a meeting to discuss the logistics of the program further.
Proficiency in skill has strong links to fitness.

WHY IS THIS RESEARCH BEING CONDUCTED?

Competence in fundamental movement skill (FMS), e.g. catch, throw, bounce, run, jump etc. has strong links to an individual’s cognition, fitness, weight status and physical activity. However, FMS proficiency is particularly low among many Australian girls.

Instruction, practice and feedback are essential to the development of FMS. Therefore, it is important that we identify effective ways to assess and instruct FMS, so skill weaknesses can be identified, addressed and improved.

I WANT MY CHILD TO PARTICIPATE!

WHAT DO I DO NOW?

If you would like your child to take part, that’s great. Please complete and return the attached consent form to your child’s PE teacher, or email directly to Natalie Lander, nlander@deakin.edu.au

DOES MY CHILD HAVE TO TAKE PART?

Please be aware that participation in any research project is voluntary. If your child no longer wish to take part you are not obliged to and can withdraw at any time.

CONTACT US

Phone: (03) 92446258
Email: nlander@deakin.edu.au
Address: School of Health and Social Development, Deakin University, Burwood Hwy, Burwood, VIC, 3125

DEAKIN UNIVERSITY

Your child is invited to participate in an exciting research project being conducted in Girls Secondary Schools across Melbourne.
WHAT IS REQUIRED OF YOUR CHILD?

During your child’s regular Physical Education lessons in Term 1, 2016, a fun and exciting method of fundamental movement skill assessment will be used by the Physical Education teacher, within the scheduled Physical Education classes.

The assessment is an obstacle course and requires children to run a total distance of 20 meters while completing 7 movement skill tasks.

Performances will be evaluated by your child’s regular Physical Education teacher. The Physical Education teacher will then use the results of the obstacle course to help lesson planning and delivery in PE, to better meet the individual needs of each student.

ANYTHING ELSE REQUIRED OF YOUR CHILD?

Your child’s FMS proficiency will be tested twice by the Deakin research team. The first assessment will occur within the first two weeks of Term 1, the second about 10 weeks later. To do this, the researcher will video record each student as they perform six skills (throw, catch, kick, dodge, jump, and run). Each video performance will be analysed by the research team.

PLEASE NOTE: Following video analysis, the data will be de-identified, that is, all personal details will be removed from the data, and will be replaced by a code. The school, teacher and student details will not be used in any form of reporting associated with this research.

Your child will also complete a brief survey which looks at their thoughts and feelings around physical activity.

WHO IS FUNDING THE STUDY?

This research is funded by Deakin University, there is no cost to you.

HAS THE PROGRAM BEEN APPROVED?

The ethical aspects of this research project have been approved by the ethics committee at Deakin University and the Catholic Education Office (CEO).

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Office of Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, research-ethics@deakin.edu.au Please quote project number HEAG-H 96/2015.

WHAT ARE THE BENEFITS OF THE RESEARCH?

The combined method of using a fun and reliable assessment tool, coupled with a teaching approach that is motivating and meaningful, has the potential to not only identify students who enter the secondary school with low level FMS proficiency, but also improve the teaching they receive in PE, which will ultimately enhance their FMS proficiency, and the physical activity opportunities available to them.
Protocol and Score Sheet
Canadian Agility and Movement Skill Assessment (CAMSA)

Natalie Lander: Deakin University
School of Health and Social Development
Examiner positions and roles:

**Examiner 1**
- Starts the assessment
- Times the student
- Feeds the catch and places ball for the kick
- Provides clear, accurate and consistent prompts to the child

**Examiner 2 (or IPad position)**
- Observes the quality of the students’ performance
- Scores the student’s performance on each of the 7 skills, using checklist provided on next page
### Example of CAMSA Score Sheet:

**Student Name:** __________________________

**Class:** ________________________________

<table>
<thead>
<tr>
<th>Skill and Criteria</th>
<th>Trial 1 Date:</th>
<th>Trial 2 Date:</th>
<th>Trial 1 Date:</th>
<th>Trial 2 Date:</th>
<th>Trial 1 Date:</th>
<th>Trial 2 Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Foot Jumping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 two foot jumps in and out of hoop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No extra jumps, no touching hoops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sliding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in one direction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in opposite direction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touch cone with low center of gravity and athletic position</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catching</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catches ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throwing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses over hand throw to hit target</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfers weight and rotates body</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skipping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct hop-step pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternate arms/leg swing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One foot hopping</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land on one foot in each hoop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hops once in each hoop without touching hoop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kicking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smooth approach to kick ball – ball hits target</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elongated stride before impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SKILL SCORE:** (range 0-14)

**TIME:** Raw Score (in seconds)

**TIME SCORE:** (range 1-14)

**COMBINED OBSTACLE COURSE SCORE**

(SKILL SCORE AND TIME SCORE: range 1-28)

---

**SCORING PROTOCOL**
Each Section below is colour coded to match the corresponding section on the example students score sheet, from the previous page.

**SKILL SCORE**

- The quality of the performance is assessed by examiner 2, OR video recorded, and subsequently analysed.
- The skill score is the total number of skill criteria that the student performed correctly throughout the obstacle course trial (according to criteria shown below).
- Skill scores can range from 0-14. The better the performance the higher the score.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Criteria</th>
<th>Skill Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-foot jumping</td>
<td>Two feet in and out of blue, orange and purple hoops</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No extra jumps and no touching the hoops</td>
<td>1</td>
</tr>
<tr>
<td>Sliding</td>
<td>Body &amp; feet are aligned sideways sliding in one direction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Body &amp; feet aligned sideways sliding in opposite direction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Touch cone when changing directions after sliding left</td>
<td>1</td>
</tr>
<tr>
<td>Catching</td>
<td>Catches ball (no drop or trap against body)</td>
<td>1</td>
</tr>
<tr>
<td>Throwing</td>
<td>Uses overhand throw to hit target</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Transfers weight and rotates body</td>
<td>1</td>
</tr>
<tr>
<td>Skipping</td>
<td>Correct step-hop foot pattern</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Alternates arms and legs, arms swinging for balance</td>
<td>1</td>
</tr>
<tr>
<td>1-foot hopping</td>
<td>Land on one foot in each hoop</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hops once in each hoop (no touching of hoops)</td>
<td>1</td>
</tr>
<tr>
<td>Kicking</td>
<td>Smooth approach to kick ball between cones</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Elongated stride on last stride before impact</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Skill scored out of a maximum of 14</strong></td>
<td>/14</td>
</tr>
</tbody>
</table>
ASSESSING AND RECORDING TIME

• Time is initially recorded to the nearest 0.1 second by appraiser/examiner #1
• Time is then converted into a point score. Point scores have been divided into 14 categories. The faster the performance, the higher the score.
• Scores range from 1-14.

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;14</td>
<td>14</td>
</tr>
<tr>
<td>14-15</td>
<td>13</td>
</tr>
<tr>
<td>15-16</td>
<td>12</td>
</tr>
<tr>
<td>16-17</td>
<td>11</td>
</tr>
<tr>
<td>17-18</td>
<td>10</td>
</tr>
<tr>
<td>18-19</td>
<td>9</td>
</tr>
<tr>
<td>19-20</td>
<td>8</td>
</tr>
<tr>
<td>20-21</td>
<td>7</td>
</tr>
<tr>
<td>21-22</td>
<td>6</td>
</tr>
<tr>
<td>22-24</td>
<td>5</td>
</tr>
<tr>
<td>24-26</td>
<td>4</td>
</tr>
<tr>
<td>26-28</td>
<td>3</td>
</tr>
<tr>
<td>28-30</td>
<td>2</td>
</tr>
<tr>
<td>≥30</td>
<td>1</td>
</tr>
</tbody>
</table>
The overall CAMSA score is calculated by the skill score (range 0-14) combined with the time score (range 1-14), of the best of the two trials performed, to produce an overall score range of 1-28.

Use the overall score (1-28), against the student’s age, to identify their standard.

<table>
<thead>
<tr>
<th>AGE</th>
<th>Beginning</th>
<th>Progressing</th>
<th>Achieving</th>
<th>Excelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years</td>
<td>&lt;14</td>
<td>14-18</td>
<td>18-23</td>
<td>23</td>
</tr>
<tr>
<td>9 years</td>
<td>&lt;17</td>
<td>17-21</td>
<td>21-24</td>
<td>24</td>
</tr>
<tr>
<td>10 years</td>
<td>&lt;19</td>
<td>19-23</td>
<td>23-26</td>
<td>26</td>
</tr>
<tr>
<td>11 years</td>
<td>&lt;20</td>
<td>20-24</td>
<td>24-27</td>
<td>27</td>
</tr>
<tr>
<td>12 years</td>
<td>&lt;21</td>
<td>21-24</td>
<td>24-27</td>
<td>27</td>
</tr>
</tbody>
</table>
# CAMSA: Example Class List Score Sheet

<table>
<thead>
<tr>
<th>Skill &amp; Criteria</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two Foot Jumping</strong></td>
<td></td>
</tr>
<tr>
<td>3 two foot jumps in and out of hoop</td>
<td></td>
</tr>
<tr>
<td>No extra jumps, no touching hoops</td>
<td></td>
</tr>
<tr>
<td><strong>Sliding</strong></td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in one direction</td>
<td></td>
</tr>
<tr>
<td>Body and feet aligned sideways when sliding in opposite direction</td>
<td></td>
</tr>
<tr>
<td>Touch cone with low centre of gravity and athletic position</td>
<td></td>
</tr>
<tr>
<td><strong>Catching</strong></td>
<td></td>
</tr>
<tr>
<td>Catches ball</td>
<td></td>
</tr>
<tr>
<td><strong>Throwing</strong></td>
<td></td>
</tr>
<tr>
<td>Uses over hand throw to hit target</td>
<td></td>
</tr>
<tr>
<td>Transfers weight and rotates body</td>
<td></td>
</tr>
<tr>
<td><strong>Skipping</strong></td>
<td></td>
</tr>
<tr>
<td>Correct hop-step pattern</td>
<td></td>
</tr>
<tr>
<td>Alternate arms/legs swing</td>
<td></td>
</tr>
<tr>
<td><strong>One Foot Hopping</strong></td>
<td></td>
</tr>
<tr>
<td>Land of one foot in each hoop</td>
<td></td>
</tr>
<tr>
<td>Hops once in each hoop without touching hoop</td>
<td></td>
</tr>
<tr>
<td><strong>Kicking</strong></td>
<td></td>
</tr>
<tr>
<td>Smooth approach to kick ball – ball hits target</td>
<td></td>
</tr>
<tr>
<td>Elongated stride before impact</td>
<td></td>
</tr>
</tbody>
</table>

| TOTAL SCORE (0-14)        | |
| TIME/RAW SCORE (in seconds) | |
| TIME SCORE (1-14)         | |
| COMBINED SCORE (1-28) Skill & Time Score | |
| STANDARD (beginning, progressing, achieving, excelling) | |
SAAFE Teaching Principles
SAAFE teaching principles defined

The SAAFE (Supportive, Active, Autonomous, Fair and Enjoyable) teaching principles (Lubans et al 2012) is a framework for teacher training, which has had significant success within school-based interventions in recent years. Teacher training using the SAAFE teaching principles is broadly framed by Self-Determination Theory (SDT) (Deci, 1985) and Competence Motivation Theory (CMT) (Harter, 1985), and are implemented to ensure that students’ basic psychological needs are satisfied, and subsequently are optimally motivated to learn. The SAAFE teaching principles framework provides descriptor for each principal and step by step procedures to take when teaching to enhance student motivation. Including motivation as a key training component, as demonstrated by the SAAFE teaching principals, can help teachers view themselves as important change agents, who can positively impact the health and wellbeing of their students for years to come.

<table>
<thead>
<tr>
<th>SUPPORTIVE</th>
<th>ACTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A supportive environment by both teachers and students</td>
<td>High level of movement and active learning time (ALT)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENJOYABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyable experiences</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUTONOMOUS</th>
<th>FAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements of choice and opportunities for graded tasks</td>
<td>All students have an opportunity to experience success</td>
</tr>
</tbody>
</table>

Modified Versions of SAAFE Teaching Principles (Lubans et al., 2012)
SAAFE teaching principles suggested tasks

**SUPPORTIVE**
- Recognise all students
- Feedback
- Manage inappropriate behaviour
- Positive interactions

**ACTIVE**
- Small sided games
- Plentiful equipment
- Monitor in-class PA
- Circuits / tabloids

**AUTONOMOUS**
- Multiple challenge tasks
- Students modify
- Leadership
- Student self-appraisal

**FAIR**
- Equitable contests
- Modify tasks
- Evenly match students
- Reward effort

**ENJOYABLE**
- Variety
- Engaging
- Avoid repetitive activity
- Success based
- Do not use exercise as punishment

Modified Versions of SAAFE Teaching Principles (Lubans et al., 2012)
<table>
<thead>
<tr>
<th>SAAFE teaching principles teacher checklist</th>
<th>Week 1</th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td><strong>SUPPORTIVE</strong></td>
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<td>Teacher provides individual skill specific feedback</td>
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<td>Teacher provides feedback on student effort and involvement</td>
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<td>Teacher promotes positive interactions between students</td>
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<td><strong>ACTIVE</strong></td>
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<tr>
<td>Activities involve small-sided games or tabloids and children spend minimal time waiting for a turn</td>
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<tr>
<td>Teacher monitors students’ activity levels (visually or using pedometers)</td>
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<tr>
<td>Equipment is plentiful and developmentally appropriate</td>
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<td>Transitions between activities are efficient</td>
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<tr>
<td><strong>AUTONOMOUS</strong></td>
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<td>Some activities incorporate multiple challenge levels</td>
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<td>Students are given choices about the tasks and activities</td>
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<td>Students are involved in the set-up and running of activities</td>
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<tr>
<td><strong>FAIR</strong></td>
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<tr>
<td>Teacher ensures that students are evenly matched in activities</td>
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<td>Teacher acknowledges and rewards good sportsmanship</td>
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<td>If necessary, teacher modifies activities to maximise opportunities for success</td>
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<tr>
<td><strong>ENJOYABLE</strong></td>
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<tr>
<td>Lesson starts with an enjoyable activity and concludes with an enjoyable experience</td>
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<tr>
<td>Activities are meaningful and not repetitive</td>
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<tr>
<td>Lessons involve a wide range of activities</td>
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</tbody>
</table>
Suggestions for lesson planning: ‘Supportive’

Ensure you provide appropriate and timely feedback that describes the student’s own skill development and does not draw comparisons between children. Ideally all students will be able to achieve success in a given activity.

You can “support” each student by modifying the same activity (i.e., making it easier or harder) to suit their specific needs. This can be done by changing:

1. THE TASK 2. THE EQUIPMENT 3. THE GROUP

1. THE TASK

- Task
- Teaching cues e.g. foot markings, physical guidance, verbal cues;
- Rules of the activity e.g. allowing the ball to bounce once in game of volleyball
- Number of trials e.g. 5, 10, or 15 successful catches in a row
- Demand of the task e.g. with/without defenders
- Technique the child uses to achieve the task
- Level of competition within the task
- Number of players involved e.g. tag games are harder with fewer players
- Length of time e.g. do 5 successful bounce-and catches in 5 seconds, 10 seconds;
- Area in which a task can be performed e.g. ball games are harder in a smaller area
- Distance e.g. the distance from a target or the distance to run
- Pathway of the movement e.g. run in a straight, curved, or zig-zag line
- Direction of movement e.g. moving forward, backward, sideward, diagonally
- Number of trials e.g. 5, 10, or 15 successful catches in a row
2. THE EQUIPMENT

- **Size of the target**
  - for example, making the target bigger or smaller, wider or narrower, more or less targets;

- **Height of the equipment**
  - for example, varying the walking along a line on the ground or a beam, varying the height of a goal post, varying the height of a target

- **Size of the equipment**
  - for example, making the ball or bat larger or smaller

- **Number of pieces of equipment**
  - for example, four or ten pins to bowl toward;
Peer teaching; cooperative learning; partner tasks; mentoring; peer assessment

Skill 'needs' specific, independent learning task

work in learning level groups - for example, skill level, rate of learning, learning style

Student Roles; instructor, teacher, coach, umpire, manager etc
Suggestions for lesson planning: *Active*

It is important that you develop strategies to maximise the participation of all children and, therefore, optimise their learning.

- **Active participation**
  - Keep the session flowing and uninterrupted. Minimise waiting times, use small groups and have few interruptions.
  - Ensure sufficient quantities of equipment are available. For example, one ball per child, one bat per two children.
  - Include less talk and more action. Keep teacher talk brief and explicit. Children cannot sit still and listen for long periods of time, nor absorb and respond to lengthy instructions.
  - Avoid low activity where a few children are moving and the rest are watching.
  - Ensure children understand rules and routines.
  - Keep the number of rules to a minimum.
  - Avoid elimination games. ‘Getting out games’ often mean that less able children spend a lot of time sitting and watching others having fun. It reinforces their own incompetence.
Suggestions for lesson planning: “autonomous”

Try to facilitate student ownership of their own learning where possible. Using strategies listed earlier under ‘Supportive’, provide choice (i.e., variations of: task, equipment, grouping), and allow students to select.

- Arrangement of the equipment to enable choice
- Size of the target - for example, making the target bigger or smaller, wider or narrower, more or less targets;
- Distance - for example, the distance from a target or the distance to run;
- Length of time to complete the task - for example, do 5 successful bounce-and-catches in 5 seconds, 10 seconds;
- Complexity of task e.g. with/without defender;
- Choice of activity or graded tasks within activities.
Suggestions for lesson planning: “fair”

Avoid activities that involve winning more than learning.

Encourage teaching/learning equity: in time, attention, equipment, feedback, learning, and enjoyment.

Avoid elimination games. ‘Getting out games’ often mean that less able children spend a lot of time sitting and watching others having fun. It reinforces their own incompetence.

Take care when choosing children to demonstrate a skill. Some children may be embarrassed and discouraged when singled out to perform in front of other people, whether they are competent or incompetent.

Ensure all children have positive experiences with at least an 80% success rate.
Suggestions for lesson planning: “enjoyable”

Ensure there is an emphasis on fun. This means including more activities in PE which make children “feel good” and which develop skills and physical competencies that contribute to lifelong habits. One of the big challenges of education is how to engage students who all have different learning styles. This is the essence of the fun theory – identifying methods that fascinate, engage and challenge students, and using those methods to educate.
PUTTING IT ALL TOGETHER
Overview of the program and
Lesson Plans and activity ideas
Program Timeline: Term 1 2016

- **Week 1**
  - First PE lesson
  - Baseline Testing conducted by research Team
  - Analyze assessment data and identify strengths and weaknesses
  - Share the information with students

- **Plan appropriate learning activities and experiences and integrate them into prescribed curriculum**

- **Week 5**
  - Reassess (using CAMSA) students' FMS proficiency to monitor progress
  - Involve the students.
  - Evaluate curriculum program versus student need.
  - Plan and modify learning activities and experiences

- **Week 10**
  - Reassess students (using CAMSA) to evaluate student and teacher progress.
  - Share the information

- **Week 1**
  - Administer the CAMSA to all Year 7 Students
  - Choose focus skill/s or skill criteria and identify learning outcomes

- **Week 1-5**
  - Implement lessons using SAAFE teaching principles

- **Week 6-10**
  - Implement lessons using SAAFE teaching principles

- **Week 12**
  - Post Intervention Testing Conducted by Research Team

- **Analyze assessment data and identify strengths and weaknesses**

- **Evaluate curriculum program versus student need.**

- **Plan and modify learning activities and experiences**
Assessment ‘for’ learning

**Assessment:**
- CAMSA
  - Video based self-assessment; peer-assessment; teacher-directed infield assessment; teacher guided video analysis; progress photos; task cards

**Fundamental Movement Skills**
- **Object control:** catch, throw, kick, strike, bounce, roll
- **Locomotor:** run, jump, hop, skip
- **Stability:** balance, roll, twist, turn

**Sharing Information**
- Student feedback; family talks; homework task cards; student activity/skill diary; parents in class; portfolio; class list/records; progress reports; peer feedback; class presentations; newsletters; staffroom chats/presentation; student/teacher conference

**Learning Experiences**
- Peer teaching; game-sense; SEPEP; TGFU; skills practice; circuits; obstacle courses; athletics; dance; sports; modified games; performance task cards; cooperative games; aerobics; invasion games; grid games; minor games; gymnastics; fitness circuits.
Lesson Plan Ideas
FMS Focus – Catch and overhand throw

Catch

<table>
<thead>
<tr>
<th>Components</th>
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<tbody>
<tr>
<td>1. Eyes are Focused on the ball throughout the catch</td>
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<tr>
<td>2. Preparatory position with elbows bent and hands in front of body</td>
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<tr>
<td>3. Hands move to meet the ball</td>
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<tr>
<td>4. Hands and fingers positioned correctly to catch the ball</td>
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<tr>
<td>5. Catch and control ball with hands only</td>
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<tr>
<td>6. Elbows bend to absorb the force</td>
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</table>

Common Problems                                                                 | Teaching Cues                  |
Taking the eyes off the object or turning the body away from the object      | Watch the object move into your hands |
Keeping the fingers too rigid and straight in the direction of the object    | Cup your hands. Relax your hands |
Failure to give with the catch                                              | Bend elbows to absorb the force of the object. |
Failure to adjust hands and move to the object according to its trajectory and height | Point your fingers up for a high ball. Point your fingers down for a low ball. |
Inability to move body parts into the best position to catch                | Move to the ball.               |

Source: Victorian Department of Education (1996)
## Overhand Throw

<table>
<thead>
<tr>
<th><strong>Components</strong></th>
<th>![Illustration of overhand throw]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Eyes are focused on the target throughout the throw</td>
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<tr>
<td>2. Stand side on to target</td>
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<td>3. Throwing arm nearly straightened behind the body</td>
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<tr>
<td>4. Step towards the target with the foot opposite throwing arm during the throw</td>
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<tr>
<td>5. Marked sequential hip to shoulder rotation during the throw</td>
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<tr>
<td>6. Throwing arm follows through, down and across the body</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Common Problems</strong></th>
<th><strong>Teaching Cues</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward movement of the foot the same side as the throwing arm</td>
<td>Step forward and with the same foot as you are point to the target with throw. Step forward with your front foot.</td>
</tr>
<tr>
<td>Inability to release ball at the right trajectory</td>
<td>Release at shoulder height</td>
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<tr>
<td>Not standing side on</td>
<td>Look at your target. Point to the target (with your non-throwing arm). Stand side-on.</td>
</tr>
<tr>
<td>Failure to rotate hips as throwing arm is brought forwards</td>
<td>Follow through, down and across your body with your throwing arm. Slap your hip on follow through</td>
</tr>
<tr>
<td>Throwing arm does not fully extend</td>
<td>Swing your arm down and back as you prepare to throw Reach behind you with the ball</td>
</tr>
<tr>
<td>Non-throwing arm remains by side Inhibited backswing</td>
<td>Step, throw and follow-through down and hard across your body.</td>
</tr>
</tbody>
</table>

*Source: Victorian Department of Education (1996)*
Catch and Throw: Example Lesson Plan

**NB:** I encourage you to integrate the suggestions provided and in practiced within our practical sessions into these lesson plans.

The use of circuits, tabloids, grid games with varying levels of complexity, as demonstrated in our sessions, is highly encouraged.

This lesson can be divided into 2 smaller more focused lessons.

**WARM UP**

**Incremental ball tag using a variety of locomotion (Domino Tag)**

**Equipment** – 1 Tennis Ball per person

Tagger starts with ball in hand – remaining class members power walk in assigned area. As they get tagged with the ball they retrieve one ball from equipment area and resume game as an additional tagger. Game continues until all students have a ball. You can perform game in reverse to put equipment away.

- Modify the form of locomotion to increase the pace or focus of the game, e.g., skip, hop, jump, run (supportive, active, fair, and enjoyable).
- Divide class into smaller groups, smaller space, more taggers etc

**SKILL DEVELOPMENT/BODY**

Progress through the following phases to highlight specific components. Integrate peer teaching, peer feedback, and allow individuals, partners or groups to work independently, and progress at varying rates according to their skill level (supportive, active, autonomous, fair, and enjoyable).

1. **Catch: Individual skill development**
   - Ball control Skills:
     - Allow students to choose whether they want to focus on:
       - 10 attempts per student
       - Specified time per student
       - Focus on improving quality of performance
         - Around ankles, knees, waist, head, figure 8, ball strides (add challenges/competitions for those students who need it, allow for basic performance for those students who need it – promote success and mastery for **ALL**)
         - Toss and catch, toss clap and catch, toss and catch behind back

2. **Catch: Partner ball skills**
   One ball between 2 students. Students stand about 2 meters apart facing each other. Throw the ball underarm to specific locations, with the focus on correct hand and body position for the catch.
   - Allow students to choose whether they want to focus on:
     - 10 successful attempts per student
     - Specified time per student – increase decrease time limit according to skill level
     - Focus on improving quality of performance for positions listed below
       - Foot to foot
       - Knee to knee
       - Hip to hip
       - Ear to ear
       - Sky to sky
3. **Catch: Reflex challenge**
One ball between 2 students – allow students to choose whether they want to focus on 10 attempts per student or specified time per student or focus on improving quality of performance. Alternate feeder and receiver. Encourage peer feedback - the feeder can also be a feedback provider, focusing on specific teaching cues, and positive reinforcement. Encourage student ownership. Question students about the key points of the catch and allow them to develop creative/funny teaching cues. Be clever with partnering to ensure a supportive and fair environment

   a) Unsighted catch – partners stand one behind the other, facing the same direction. Student at the back has the ball. She throws it high in the sky, and calls up with the ball arm’s length above the receiver. The receiver needs to sight and track the ball quickly to make the catch. Highlight the need to watch ball into the hands, extend hand up towards the flight of the ball etc

   b) Hip drop drill – partners face each other 1 meter apart. Feeder holds the ball at hip height. Receiver stands at ready with hands on head. Feeder drops ball and receiver aims to catch it before it hits the ground.

   c) Hands on hands drill – partners face each other 1 meter apart. Feeder holds 2 balls (one in each hand) facing the ground, at shoulder height. Receiver places the backs of his hands on the backs of the feeders hand. Feeder drops both balls and receiver tries to catch them before they hit the ground.

4. **Catch: Team catch challenge**
   - In groups of 6 –8 students’ line up facing each other about 2 meters apart.
   - One ball starts with the student at head of one line.
   - Ball is thrown diagonally (underhand throw) down the group.
   - Soon as the student makes the throw they run around the outside of the group to take up position at the head of the opposite end/side.
   - The whole group progressively moves from one end of the assigned area to the other.
   - Groups compete against each other to get to the other end first.
   - Modify height of throw to refine different elements of the catch

   Question: Ask students to discuss and collaborate to come up with the most effect method – encourage students to identify strengths and weakness of the TEAM/GROUP and work with them to improve performance

5. **Throwing technique drill**
One ball between 2 students, about 15 meters apart. Progress through the following phases to highlight specific components. Integrate peer teaching, peer feedback, and allow individuals and partners to work independently and progress at varying rates according to their skill level. Encourage non-throwing student to provide skill specific feedback (PEER FEEDBACK) on their partners throw, using established teaching cues and positive reinforcement. Again be clever with partnering to ensure a fair and supportive environment.

   1. **Stationary Throw**
      a. Throw from one knee – highlight sequential trunk rotation
      b. Side on - use “T” stance as teaching cue
      c. Exaggerated follow through - continue forward momentum with a fluent stepping forward action after throw. Slap opposite hip pocket after ball release
      d. Extension throw – students take one step back following a successful throw and catch. As the throw gets extended more faults will appear making it easier to address them.
      e. Rapid fire – over a distance. Add an element of competition to the task, adding a time limit to achieve maximal throw and catch effort.
2. Dynamic Throw
Provide a time challenge to this drill for those student who need the challenge. For these students - allow students to perform as many repetitions as they can in the set time limit. Repeat and encourage partnerships to better their own score. For those who need to focus on process – set a quality related goal for them. Allow students to set their own distance according to their skill level. Try not to highlight comparison among other groups (supportive, active, autonomous, fair, and enjoyable).

- One partner feeds a ground ball, other approaches with speed fields the ball in a fingers down position, then moves into a dynamic throwing position and returns ball with pace.

3. Multi-direction throw
   a. Grid work. Set up a box/square with cones 10m between each. Feeder stands at one corner, and feeds a fly ball, groundball or chest throw to receiver, who must receive the ball at a different point of the grid for each catch and throw back to the receiver. Can modify by getting both students active.
   b. Use this grid format to change challenge level/complexity for differing student needs. As in our practical session you can:
      1. Use cones for stationary throw catch – focus on technique and process of throw and catch
      2. Use cones as point of reference for one student to lead to and receive ball from stationary feeder
      3. Add in two moving participants – both leading a receiving ball at different points. Add challenge to this as you see fit – lots of options e.g. time, number, distance
      4. Add in a defender
      5. 2V2 in grid
      6. Join grids together 4V4, 8V8
      7. Use grid idea and build a minor game using full court

MODIFIED GAMES
(supportive, active, fair, enjoyable)

- **Tunnel ball Tee Ball** (reduce diameter of playing area to suit throwing and catching ability, encourage all students to take turns on the cones)

- **Over run, overtake** (again ensure distance between bases/cones suits player ability, ensure a variety of student play on the bases for equal practice time)

- **Progressive speedball** (Start with the rule that ball has to have 2 bounces between passes to highlights finger position to the ground and moving body into position, move to underarm passes below shoulder height, and progress to over arm passes above head height)

- **End ball** (variety of balls – start with large soft playground ball, move to netball, soft lacrosse, tennis and finally use a super ball as a challenge)
Lesson Plan ideas
FMS Focus – bounce, Kick, Strike

**The Ball Bounce**

<table>
<thead>
<tr>
<th>Components</th>
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<tbody>
<tr>
<td>1. Eyes focused forward throughout the bounce</td>
<td><img src="image1.png" alt="Image of three people bouncing a ball" /></td>
</tr>
<tr>
<td>2. Contact the ball with the fingers of one hand at about hip height</td>
<td><img src="image2.png" alt="Image of three people bouncing a ball" /></td>
</tr>
<tr>
<td>3. Wrist and elbows bend then straighten to push the ball</td>
<td><img src="image3.png" alt="Image of three people bouncing a ball" /></td>
</tr>
<tr>
<td>4. Hips and knees slightly flexed during the bounce</td>
<td><img src="image4.png" alt="Image of three people bouncing a ball" /></td>
</tr>
<tr>
<td>5. Ball bounces in front of and to the side of the body</td>
<td><img src="image5.png" alt="Image of three people bouncing a ball" /></td>
</tr>
</tbody>
</table>

**Common Problems**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Looking down at the ball</td>
<td>Eyes forward</td>
</tr>
<tr>
<td>Slap ball rather than use finger tips</td>
<td>Spider fingers/tiger paws</td>
</tr>
<tr>
<td>Ball is bounced too high</td>
<td>Bounce at belt</td>
</tr>
<tr>
<td>Ball is bounced away from body</td>
<td>Bend with the ball, keep it close to feet</td>
</tr>
</tbody>
</table>

**The Kick**

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<thead>
<tr>
<th>Components</th>
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</thead>
<tbody>
<tr>
<td>1. Eyes are focused on the ball throughout the kick</td>
<td><img src="image6.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>2. Step forward with non-kicking foot placed near the ball</td>
<td><img src="image7.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>3. Bend knee of kicking leg during the backswing for the kick</td>
<td><img src="image8.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>4. Hip extension and knee flexion of at least 90º during preliminary</td>
<td><img src="image9.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>5. Contact the ball with the top of the foot</td>
<td><img src="image10.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>6. Forward and sideward swing of arm opposite kicking leg</td>
<td><img src="image11.png" alt="Image of three people kicking a ball" /></td>
</tr>
<tr>
<td>7. Kicking leg follows through towards the target after ball contact</td>
<td><img src="image12.png" alt="Image of three people kicking a ball" /></td>
</tr>
</tbody>
</table>

**Common Errors**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>looking at target area rather than the ball</td>
<td>Keep your eyes on the ball.</td>
</tr>
<tr>
<td>Non-kicking foot is placed behind or in front of the ball</td>
<td>Place your foot beside the ball before you kick.</td>
</tr>
<tr>
<td>poking or pushing at the ball rather than kicking through it</td>
<td>Follow through forward and up with your kicking foot after you</td>
</tr>
<tr>
<td>(results in no follow-through or straight legged kick)</td>
<td>have kicked the ball.</td>
</tr>
<tr>
<td>Arm opposite kicking leg is kept beside body during preparation</td>
<td>Swing the arm opposite to your kicking leg.</td>
</tr>
<tr>
<td>Run up is slow or disjointed</td>
<td>Run hard and kick the ball hard.</td>
</tr>
</tbody>
</table>
The Two Handed Strike

### Components

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Eyes are focused on the ball throughout the strike</td>
</tr>
<tr>
<td>2.</td>
<td>Preferred hand grips bat above non-preferred hand</td>
</tr>
<tr>
<td>3.</td>
<td>Stand side-on to the target</td>
</tr>
<tr>
<td>4.</td>
<td>Bat held behind shoulder prior to the strike</td>
</tr>
<tr>
<td>5.</td>
<td>Step towards target with foot opposite preferred hand during the strike</td>
</tr>
<tr>
<td>6.</td>
<td>Marked sequential hip to shoulder rotation during the strike</td>
</tr>
<tr>
<td>7.</td>
<td>Ball contact made opposite front foot with straight arms</td>
</tr>
<tr>
<td>8.</td>
<td>Follow through with bat around body</td>
</tr>
</tbody>
</table>

### Common Errors

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>looking at the target area rather than the ball</td>
</tr>
<tr>
<td>2.</td>
<td>having an open stance with feet more front on to target area</td>
</tr>
<tr>
<td>3.</td>
<td>hands are not next to each other on the bat</td>
</tr>
<tr>
<td>4.</td>
<td>hands wrong way round on the bat</td>
</tr>
<tr>
<td>5.</td>
<td>front foot doesn’t step towards target area during propulsion</td>
</tr>
<tr>
<td>6.</td>
<td>bat does not swing horizontally through ball (“swatting” action used)</td>
</tr>
<tr>
<td>7.</td>
<td>no weight transferred onto front foot during forward swing</td>
</tr>
<tr>
<td>8.</td>
<td>No follow throw</td>
</tr>
</tbody>
</table>

### Teaching Cues

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Watch the ball onto your bat</td>
</tr>
<tr>
<td>2.</td>
<td>Point your non-dominant (non-throwing) shoulder towards the pitcher</td>
</tr>
<tr>
<td>3.</td>
<td>Face the home plate</td>
</tr>
<tr>
<td>4.</td>
<td>Hands close together on bat</td>
</tr>
<tr>
<td>5.</td>
<td>Dominant hand on top</td>
</tr>
<tr>
<td>6.</td>
<td>Step towards the pitcher</td>
</tr>
<tr>
<td>7.</td>
<td>Swig bat from back shoulder to front shoulder</td>
</tr>
<tr>
<td>8.</td>
<td>Push off back foot and step forward (towards the pitcher) with front foot</td>
</tr>
<tr>
<td>9.</td>
<td>Wrap your bat around your back on follow through</td>
</tr>
</tbody>
</table>

*Source: Department of Education (1996)*
Bounce, Kick and Strike:
Example Lesson Overview

NB: This lesson can be divided into 3 smaller more skill specific or focused lessons

**WARM UP**
Get your move on

*Purpose of Activity:* To improve cardiovascular endurance, running efficiency and technique, as well as introduce familiarity with a range of balls for the object skill development session (range of basketballs, soccer balls, tennis balls).

*Materials Needed:* 4 large wheely bins/buckets, 3 sets of team bibs, class sets of soccer balls, basketballs, and tennis balls.

*Description of Idea*

Divide your class into 4 equal teams. Give 3 teams different color bibs and the other is just the color of their PE uniform. Each team has a wheely bin/bucket that is marked with their team’s name on it. The buckets remain stationary on the gym floor. On the teacher’s command or whistle, all students run, jog, or walk down to the other end of the gym and pick up one ball and hustle it back as quick as they can to the other side of the gym where the buckets are. They drop their ball in any teams bucket except their own. The team with the fewest amount of balls at the end of the time are the winners.

Once they drop their ball off in a bucket go after another. The faster they run, the more they help they are to their team. Students will be running at all different speeds and levels. They must use strategy as well to recognize what team is ahead and then try to fill their bucket. Play some fast moving music during this activity, or even participate with the students. Laugh, and have fun (supportive, active, fair, and enjoyable).

**SKILL DEVELOPMENT/BODY**
(supportive, active, autonomous, fair, enjoyable).

Progress through the following phases to highlight specific components. Allow individuals partners and groups to work independently and progress at varying rates according to their skill level. Suggestion: set activities up in a tabloid or circuit format (one tabloid set up per skill), or develop and provide task cards for students to work through skill development activities independently/autonomously

1. **Ball Bounce Skill Development/Activity Progressions**
   - Individual ball Skills (each students has a ball):
     - Start in triple threat position (feet shoulder width apart, one foot slightly ahead of the other, knees bent)
     - Dribble dominant hand/dribble non dominant hand, dribble moving forward/backward/diagonal.
     - Dribble stand, knee, sit, back and up
     - Kill drill
o Figure 8 dribble
o Scissor dribble /crossover dribble – introduce change of direction whilst on the move using these skills

- Groups of 4
  o Zig zag drill
  o Dribble at speed
  o Follow the leader
  o 2 v 2 grid game (first to 5 passes)

- Small sided
  o Dribble a rama: suggestion- do not eliminate, students who get knocked out should be asked to perform a series of ball handling drills then reintroduced into game.

2. Soccer Kick Development/ Activity Progressions

- Individual Ball Handling
  o Foot change
  o Juggling – knee, instep of foot, combination

- In pairs
  o close toss to instep
  o continuous tennis taps
  o pass trap, kick
  o Pass between the cones

- Groups of 4
  o Grid work – 2 V 2; suggestion- introduce different concepts according to skill level. e.g., low level skill- perform static passes to varying corners of a grid/square, no defense. Intermediate skill- introduce dynamic passes to varying corners of a grid/square, no defense. Advanced- 2V2 within grid/square.

3. Striking Skill Development/ Activity Progressions

- Groups of 4/5
  o Balloon bat it up (count how many times or how long you can keep the ball up off the ground using hand – introduce some teaching cues for the strike. Add in some other elements to increase fun – complete a full turn once tapped ball, touch ground, tap under legs etc.
  o Bat tennis bat and ball bat it up – same concepts as above but introduce small bat and ball.

- Relays
  o Small bat relays – carry ball stationary on bat, bat ball up, bat ball up alternating sides of bat ball is hit with, bat ball up as many times (very low ball height), bat ball up as few time (very high ball height)
  o Minkey hockey relays

- 4 stations progressions
  o This requires a large amount of space. Ensure students are batting into/towards a ‘safe’ direction. Use “soft” rubber balls for safety reasons).
  o 4 students per group, 1 batter, 1 feeder, 2 fielders.
  o Suggestion: again provide variations at each station to cater for skill diversity. Allow students to select level or complexity of task.
  o Encourage peer teaching/feedback highlighting skill component and technique.
    ▪  **Tee ball**: Five fast bats off a stationary Softball Tee
- **Toss bat**: Five fast bats from a Toss bat position-feeder tosses ball up to batter who hits a line drive out to two fielders.
- **Cricket cones** (playing a straight drive out to designated area off a soft rubber cone)
- **Cricket drop** – as with toss bat – feeder drops ball in front of batter for her to play a straight drive out to two fielders.

**MODIFIED GAME**

(supportive, active, fair, enjoyable)

**Pin Soccer**

*Purpose of Activity:* To practice soccer skills and game strategies in an active game setting.

*Prerequisites:* Knowledge of soccer rules and guidelines. Kicking, passing, and goalkeeping skills should have been practiced.

*Materials Needed:* 12 cones, 4 different colored bids, 2-4 soccer balls (can be high density foam balls if you wish for safety purposes), 12 pins or something else that can be used to keep score.

*Description of Idea*

This activity is a variation of the activity called 4 goal soccer. It should only be played after you have taught and had the students practice soccer skills.

For this activity you will need a fairly large playing field in the shape of a square. Place four different goals at the four different sides of the square. Class is divided into 4 different teams with each team trying to defend their own goal. You can have more teams if you wish by making two fields. You can play this with one ball or you can add another ball if you wish depending on your classes skill level.

It is played like regular soccer however there are 4 goals. Each team begins the game with 3 pins behind their goal. If team 1 scores a goal on team 2 then team 1 takes a pin and places behind their goal. If a team runs out of pins than their goal is closed. That team can bring their goalie out and try to score a goal and get a pin back.

Feel free to switch teams and start again when you see fit. Go over strategies for moving the ball to open spaces and reminding students to move to open spaces.
Lesson Plan ideas
FMS Focus: Vertical Jump, Leap and The Dodge,

The Vertical Jump

<table>
<thead>
<tr>
<th>Components</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Eyes focused forwards or upwards throughout the jump</td>
<td></td>
</tr>
<tr>
<td>2. Crouch with knees bent and arms behind body</td>
<td></td>
</tr>
<tr>
<td>3. Forceful upward thrust of arms as legs straighten to take off</td>
<td></td>
</tr>
<tr>
<td>4. Contact ground with front part of feet and bend knees to absorb force of landing</td>
<td></td>
</tr>
<tr>
<td>5. Balanced landing with no more than one step in any direction</td>
<td></td>
</tr>
</tbody>
</table>

Common Errors                                                                 | Teaching Points |
| looking down at the ground or feet                                        | Look up         |
| keeping arms by their side or out in front of the body during the preparatory crouch | Swing arms behind you as you bend your knees |
| feet not leaving the ground or not landing simultaneously                  | Take off and land on two feet |
| needing several steps to correct balance on landing                        | Bend you knees on landing |

The Leap

<table>
<thead>
<tr>
<th>Components</th>
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</thead>
<tbody>
<tr>
<td>1. Forward movement sustained throughout the leap</td>
<td></td>
</tr>
<tr>
<td>2. Eyes focused forward throughout the leap</td>
<td></td>
</tr>
<tr>
<td>3. Take off from one foot and land on the opposite foot</td>
<td></td>
</tr>
<tr>
<td>4. During flight legs are straightened with the arms held in opposition to legs</td>
<td></td>
</tr>
<tr>
<td>5. Controlled landing without losing balance</td>
<td></td>
</tr>
</tbody>
</table>

Common Errors                                                                 | Teaching Cues |
| • looking down at the ground or feet                                       | Look forward   |
| • insufficient knee bend in take-off leg (resulting in lack of propulsion or forward and upward elevation) | Push off hard with take-off leg |
| taking off and landing on the same foot (hops)                            | Land on opposite foot to your take off foot |
| short flight stage (or no period where both feet are off the ground)      | Try to stay in the air as long as you can |
| arm opposite the lead leg does not reach forward during flight            | Reach forward with opposite arm to lead leg |
| Landing on two feet                                                        | Land on opposite foot to your take off foot |

The Dodge

Components
1. Eyes focused in direction of travel throughout the dodge
2. Change direction by pushing off outside foot
3. Body lowered during change of direction
4. Change of direction occurs in one step
5. Dodge repeated from right to left, left to right, and so on

<table>
<thead>
<tr>
<th>Common Errors</th>
<th>Teaching Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>looking down at the ground or in the direction of travel</td>
<td>Look straight ahead</td>
</tr>
<tr>
<td>little or no knee bend or push off outside foot during change of</td>
<td>Get your body low and push off your outside foot</td>
</tr>
<tr>
<td>direction</td>
<td></td>
</tr>
<tr>
<td>inability to perform the dodge on both sides of the body</td>
<td>Stay low, and push off outside foot</td>
</tr>
<tr>
<td>change of direction is slow and requires numerous small steps</td>
<td>Stay low, and push off outside foot with one large step/push</td>
</tr>
</tbody>
</table>

*Source: Department of Education (1996)*
Jump, Leap and Dodge &
Review of the throw, catch, run, kick and strike: Example Lesson Plan
NB: This lesson can be divided into 3 smaller more skill specific or focused lessons

WARM UP
(supportive, active, autonomous, fair, enjoyable)

1. Circle Partner circuit
   a. Two circles of students (inner and outer circle) each student of the inner circle selects one activity eg: lunges, squats, sit ups, vertical jumps, etc
   b. Students of the outer circle jog one lap and then perform the activity of the person in front of them for 30 secs
   c. Outer circle then repeats the lap however moves one place to their right on completion, they then perform the new activity for 30 sec
   d. Student on the inner circle are to provide brief instructions, motivation and feedback to the student performing the activities
   e. After 4 min the roles are reversed

2. Jockeys and horses (FMS – Run dodge, leap, jump)
   a. Remain in inner and outer circle to perform actions instructed by teacher, including jockeys up, jockeys under, jockeys change, jockeys around etc, last pair back performs selected activity eg star jumps, pushups for one circle of game then returns to activity.

3. Throw and catch tiggy (FMS – run, dodge, throw, catch, bounce)
   a. Three taggers, one with green bean bag, one yellow, one red (green =1, yellow =2, red=3)
   b. Remaining students jog around designated area, each student has a ball.
   c. The taggers are to under arm throw the bean bag at the students below knee level. If hit the students are to perform the appropriate number of designated skills. eg, if hit with the red bean bag they are to perform 3 high throws and catches before returning to the game.
   d. Skills and taggers change after 2 minutes

4. Bean Bag Scramble (FMS focus-run, dodge, throw, catch)
   a. Divided into 4 groups.
   b. First game focus on run and dodge, with rule to pick up and drop bean bag
   c. Second round progress to a thrower and catcher from each group to collect and deliver each bean bag.

5. Cross the river (FMS focus- Leap and jump)
   a. Relay style activity
   b. Moving (in same groups as bean bag scramble), from one end of the basketball court to the other.
c. Two hoops per group, have to manipulate group member in one hoop at a time to “cross the river”

**SKILL DEVELOPMENT/BODY**

1. **Skipping mini session (FMS focus – leap, hop, and jump).**

   Introduce individual skills as listed below. Encourage students to develop a progressively more challenging skipping routine. Can work individually, in partners of in small groups. Can introduce different length ropes to encourage diversity/creativity. Introduce music to routines. (supportive, active, autonomous, fair, enjoyable)

   - Two feet jump with rebound
   - Skip alternating feet
   - Skip feet close/feet wide
   - Moving skip – changing forms of locomotion
   - Skip high knee
   - Skip cross over feet
   - Skip backwards
   - Skip – double arm turn

2. **Jumping/running tabloid**

   - (4 students per station, 7 stations with varying complexity at each station, vary time/ repetition requirements according to student needs and levels. Encourage peer teaching and feedback following each performance, again question students as to the key teaching points)
     - i. Low hurdle bounds
     - ii. Ladder work (stutter step, 1 per rung, side step, high knees, heel flicks)
     - iii. 20 m run through: high knees, heel flicks, bounding, speed start
     - iv. 40 m technique runs: ¼ pace, ½ pace, ¾ pace. Sandwich runs
     - v. Partner chase activities
     - vi. Hoop hop
     - vii. Low box jump circuit

3. **Combined skill Activities**

   a) **Ball Chase (throw catch)**

   - Back to inner and outer circle formation.
   - Inside partner with ball
   - Inside partner feeds a chest pass to partner who catches and returns it to partner before performing a lap and then moving on to next partner
   - Passes become progressively more challenging, eg one hand, low, high, reflex etc
   - Swap roles.
   - Change so inside partner becomes dynamic – set challenges such as 5 throws and catches to 5 different students from outside circle. Introduce special awareness, call of names, passing to a lead etc.

   b) **Catch me if you can (Throw, catch, run dodge)**

   - Students from inner circle join outer circle, in an alternating fashion.
- A leader from each group remains in the centre of the circle with a ball each
- First round is a race, between the two groups to perform a full round of throws and catches.
- Round two is dynamic throws and catches with the passes being replaced by the receiver of the outside group each throw. Modify throwing and catching techniques

c). Soccer circle work (FMS – kick, run, dodge)

- Students return to inner and outer circle formations and complete a modified version of kanga soccer, focusing on passing and trapping with alternate feet
- Increase complexity by increasing amount of passes to be performed at each partner.
- Modify by including ball carrying skills between partners

d). Modified poison ball – circular structure, soccer variation (using foam balls)

MODIFIED GAMES

1. Modified zone cricket – with the inclusion of a roll, a throw, batting of a cone with cricket bat and batting off a tee with foam softball bat. (FMS – throw, catch, run, kick, strike, roll)
   a. Teams divided into batting and fielding
   b. Batting team, one at a time have to perform 5 skills with 5 balls preset up
      i. Roll the ball
      ii. Throw the ball
      iii. Kick the ball
      iv. Cricket straight drive
      v. Softball hit off ate
   c. They then choose to run to either to the 1 point cone, 5 point cone, or 10 point cone and back
   d. The fielders field each ball and set them up in their starting positions
   e. If the runner is back before all the balls they score the allocated runs, if the balls are set up before the batter returns, so runs/points are scored
Additional FMS FOCUSED MODIFIED GAME ideas

NB: Please play with purpose. As demonstrated in our practical sessions - Create teachable moments to pause and focus on skill development. Remember remediate in private, praise in public.

Thread the Needle

Purpose: Refine individual ball handling skills and concepts of passing into space, and for accuracy.
FMS: kick, run, dodge.
Prerequisites: Students should have the basic fundamentals of dribbling and passing before attempting this activity.
Materials Needed: One soccer ball per/offensive partners. 20+ cones (2/goal with 5+ goals on each side of the gym)
Description of Idea
Before class, have several pairs of cones set-up around the gym about 5 feet apart. These will be the goals.
Split the class into four teams and have each student pick a partner (be wary of this, maybe better to assign partners according to skill level and class dynamics). Then split the class into two separate games, two teams on one side of the gym and the other two on the other side.
Decide which teams are the defenders and which are the offenders. The students who are the offenders must dribble up to the cones and pass, through the cones, to their partner on the other side. The defenders must prevent the offenders from scoring by stealing the ball.
If the ball does get stolen, the defending pair become the offenders and vice versa. For every pass that is successfully passed through the cones to their partners, is a point. After they have passed through the cone to their partner, they must then dribble to another set of cones.
After a few minutes have the teams switch roles to allow everyone to have a turn in being the defender and offender.

Wacky Tacky Ball

Purpose of Activity: This activity is to engage a large number of students with constant movement as well as foster teamwork.
FMS: throw catch, run dodge, leap, jump.
Materials Needed: 6 basketball goals, 8 light airy balls (e.g "gator" balls)
Description of Idea
The objective is to get the ball to your offensive team so they can score and to prevent the opponent from scoring.
Divide the class into 6 equal teams. From there you should have them decide who is on offense and who is on defense. Try to make them as even as possible.
To start the game, place the balls in the middle of the court on the floor, with all team members on their own baseline. On the whistle, students will move to the balls to get one to give to their offensive team. Students are allowed to only get one ball or balls may be tossed in a scattered fashion to the baskets. Students are only allowed to pass or throw the ball to their teammates. No dribbling or walking with the ball is permitted. They may use any ball that comes into their court but they must stay on their designated court. There is no out of bounds.
After a basket is made, the defense immediately takes the ball and throws it to another defensive player in an effort to get in the direction of their offensive team members or directly to an offensive teammate. They are not allowed to shoot half or full court shots. They are not allowed to kick the balls. It is possible to have more than ball in their possession at a time. Defensive players are only allowed to play defensive on their opposing team as the court areas overlap each other. Each basket is worth 1 point and the offensive team is to keep track of their score.
After a designated period of time, rotate one team from each basket in a clockwise direction. And go again.

Cone-Handball

Purpose of Activity: To practice: (a) passing/catching and throwing, (b) individual defensive (marking) and offensive (getting free) in a game-like situation.
FMS: catch, throw, run, jump, dodge, leap
Prerequisites: Previous practice with "over-head" passing/throwing and catching has taken place.
Materials Needed: 1 handball or substitute ball for each game played, cones, colour bibs

Description of Idea
Two teams of equal numbers of students (4-7) compete to score as many points as they can within a set time by knocking down cones (4-6) placed in their opponents’ respective goal areas.
The goal areas are off limits for both attackers and defenders except for throw-ins. All shots at the cones and defensive actions such as steals, interceptions and blocks must take place outside the goal areas.
The game starts with team captains trying to win first possession during a jump ball in the middle of the field. The game is played according to the no-body contact rule. Players are allowed dribbling, passing, catching, holding the ball for three (3) seconds and making three (3) steps with a ball. Kicking, double dribble and traveling create a turnover situation from the spot where it was committed. A free-throw is a simple pass made by one player to another to restart the game.
All shots on cones should be made with one hand, preferably using overhand technique. A point is scored when the cone gets knocked down by the throw’s impact. After each point, the team that was scored upon restarts the game with a throw-in executed by the team’s captain from within the goal area.
A penalty shot is awarded and taken by the designated player from the line marking the goal area in two situations: (a) when a defender enters his/her goal area for the intentional purpose of keeping the opponents from scoring, and (b) when a defender fouls an offensive player who attempts to take a shot from the goal area line.
If the ball goes out of bounds, the game is restarted by a player from the opposite team with a throw-in made from the sideline where the ball left the field.

Rebound Ball
Purpose of Activity: The students will practice throwing and catching while learning about rebound angles.
FMS: throw, catch, jump
Prerequisites: The students need to be able to throw and catch in order to play.
Materials Needed: For each game that you set up you will need 2 rebounders, 1 net and 1 ball.
Description of Idea
There are 2 teams. 2 to 4 players per team. Set up as many games as necessary to keep the teams small. This will maximize participation level for all students. One team stands on each side of the net. Each team has a rebounder on their side of the net. The team with the ball throws it against their own rebounder so that the ball hits it and then travels over the net. Once the ball goes over the net the receiving team attempts to catch the ball. If they don’t catch the ball, the throwing team gets one (1) point. If they do catch the ball they immediately throw the ball against their rebounder so it goes over the net.
The throwers are trying to throw it at angles so the ball travels to open spaces on the court. This makes it more challenging for the opponents to catch the ball.

Throwing for Distance/Accuracy
Purpose of Activity: To have students practice throwing for distance and for accuracy.
FMS: Throw
Materials Needed: Various throwing objects like tennis balls, foxtails, footballs, softer foam balls, etc., markers (cones), tape measure.
Description of Idea
1. Students get in pairs. Each pair chooses a ball of their choice.
2. Students warm up by playing catch.
3. Now bring them in for a discussion about the importance of accuracy when throwing. Have them give you some examples of situations in sports where it is important to have accurate throws. Discuss and demonstrate how the body would look if you wanted to throw a ball very accurately when your target is very close. Your body parts are compact and your body has very little movement. It looks like you are aiming and throwing a dart.
4. Give them time to go with their partner and practice short, accurate throws. They should stand about 10-20 feet from their partner and throw at their partner's chest area. You can make this a game by assigning points for accuracy (Chest area = 2 points, Any other body area = 1 point).

5. Now bring them in for a discussion about the importance of distance when throwing. Have them give you some examples of situations in sports where it is important to have far throws. Discuss and demonstrate how the body would look if you wanted to throw a ball very far. Your body parts are extended. Your body has a lot of movement. You look like an outfielder in baseball who is throwing the ball to home plate.

6. Give them time to go with their partner and practice their distance throws. They should stand 50-100 feet from their partner. You can make it a game by placing markers at 10 foot increments starting at 50 feet and ending at 100 feet. 1 point if the ball passes the 50 foot marker, 2 for 60 feet, etc.

7. Bring them in for a final discussion about the importance of accuracy and distance. Have them give you some examples of situations in sports where it is important to have far, accurate throws. Discuss and demonstrate how to combine the concepts from each type of throw in order to maximize accuracy and distance.

8. Give them time to practice this by setting up real sports situations (Outfielders throwing to home plate, Quarterbacks throwing to receivers, etc.).

9. Add in element of competition where appropriate, e.g., as many throw/catches in 1 minute, complete 10 throws to chest/above head/low; extension throw each accurate throw catch take a step back)

**Soccer Tennis**

**Purpose of Activity:** Volleying a soccer ball in a dynamic environment.

**FMS:** kick, throw

**Prerequisites:** Ways/Skills to juggle a soccer ball. Surfaces that are easier to use and how to do so. How to rotate and score in volleyball.

**Materials Needed:** Soccer or playground balls and tennis courts

**Description of Idea**

Group students into teams of 3-6 depending on the size of the court. If you divide each tennis court into two courts, teams of 4 work well.

The game starts when a player puts the ball in play by either:

- punt - from baseline or service box
- throw-in - soccer style from baseline or service box

The ball must land in the opposing court on the first bounce. This is where the teacher begins to have a lot of options. The teacher can decide that the ball cannot bounce at all, can have 1, 2 or 3 bounces between each hit, or can have a total of 3 bounces on one side. Also, the teacher has the option of putting a limit on the number of times a ball can be hit on one side.

**Rules that are helpful:**

1. The same person cannot hit the ball twice in a row.
2. If the teacher chooses to use multiple bounces between hits, the maximum to use is usually three because the ball starts to roll.
3. If the ball is bouncing have the team call out the number of bounces so there is no confusion or accusations of more bounces.
4. The serving rotation can be used like that in volleyball. You can also allow for serves by providing two chances, but it makes the game move slower.
5. Scoring follows volleyball rules.
6. Time to play can be a time limit (which is easier because everyone ends at the same time) or to a point total.

**Variations:**

Use a gator ball, wiffle ball, or other balls of differing shape, size and weight.

Give skilled players the option of playing with a volleyball net.

Have students make up their own rules regarding the number of bounces.

**Skipping routine**

**Purpose of activity:** Improve locomotor skills of jumping, skipping hopping whilst participating in skipping routines
Prerequisites: basic knowledge of skipping technique
Material: 1 skipping rope per student
Description: start with basic skipping technique emphasizing correct jumping position and hand position. Vary locomotor from jump, hop, gallop, ship, walk, run whilst skipping. Increase complexity via introducing double jumps, cross overs, backwards skipping, movement whilst skipping, change of directions. Combine movements to form basic routines. Allow students to work individually, in partners and in small groups to develop routines.

EGGercise
Purpose of Activity: The purpose of this activity is to promote increased fitness, body tension and core strength, and effective teamwork.
Prerequisites: Demonstrate the three proper ways to utilize a scooter (kneeling, sitting, or laying) and NEVER stand on top. Because scooters will be used be sure that students know to “park their ride” (flip the scooter over with wheels up) whenever it is not being ridden. Student must have a knowledge base of a variety of fitness activities such as push ups, sit ups, jumping jacks, half jacks, heel raises, body weight squats, lunges etc. Whatever your EGGercise tags are, be sure that your students can identify what that exercise is.
Materials Needed:
Scooters (# depends on # of students and # of teams - aim for 1 scooter for every 2-3 students)
A large bucket
Plastic Easter eggs with "EGGercise tags" on the inside of the them
Easter baskets or smaller collection buckets
MUSIC!
Description of Idea
Students will be divided into teams around the gym (team sizes depend on number of students in your class), each team should have 1 scooter for every 2-3 students on the team. In the center of the gym place a large (5 gallon) bucket filled with plastic eggs. Inside the eggs there should be "EGGercise tags" such as "do 5 push ups" "10 jumping jacks" "give your coach a high five" etc (BE CREATIVE!). Around the center circle place a basket or smaller bucket for each team to place their eggs into once they have completed the exercise. One student should start on the scooter and "scoot" in an appropriate way to the center circle, "park their ride" (turn scooter with wheels face up) outside the center circle, select an egg from the bucket, open it, perform the exercise that is inside, place the completed egg in team basket and then return to team to allow for a second student to repeat the process. This continues until one team has filled the basket or you as the teacher decide that time has been reached.
Variations:
You could decide to place baskets at each teams starting point and each person to scoot to the center would have to bring the egg back to the team, everyone perform the exercise before placing it into the team basket.

Push Up Routine
Purpose of Activity: Push-ups are one component of most fitness tests and the only way to improve scores is to use activities to improve upper body strength. The purpose of this activity is for students to improve upper body strength (push-ups). Can be used as part of a strength warm-up or as a fitness station.
Prerequisites: The students should be able to hold a push-up position for at least 30 seconds.
Suggested Grade Level: 5-12
Materials Needed: If used as a station, a print out of the directions is helpful.
Description of Idea
Students work with one partner. Explain and demonstrate some movements students can do from a push-up position synchronized with a partner. With two people facing one another in push-up position, demonstrate:
- Shake hands (right hand)
- Shake hands (left hand)
- High five (right hand)
- High five (left hand)
- Pat the floor with right hand
- Pat the floor with left hand
- Lift right foot
- Lift left foot
Let them practice some of these and encourage them to create their own movements. Have students make a routine with their partners. The movements should be synchronized and they must remain in a push-up position.

You may want to make an acceptable timetable, so students know how long the routine should last. When students have had time to prepare their routine, have them perform it for the class.

Variations:
Use groups of 3 or 4 to create different routines.
Have students do this as part of their warm-up.
Offer props such as small balls (tennis sized foam balls for example) to use as part of the routine.

Race for Space

Purpose of Activity: The purpose of this activity is to focus on the teamwork of each pair through the integration of key concepts such as: getting into open space, anticipating, communication, developing strategies, etc. This game can be modified in many ways to accommodate almost any field/court sport that involves passing on the ground.

The example provided is using minkey/indoor hockey sticks.

Prerequisites: Very little previous experience is needed for this activity because it is an effective way to work on concepts that apply to multiple sports.

Materials Needed: 20-24 minkey hockey sticks, 20 tennis/foam balls, 4-6 colored bibs and 20 cones

Description of Idea
The activity can run for upwards of 30-40 minutes.

Prior to class:
Set up goals around the gym floor. Goals can be small heavy cones (so that they don’t move) paired up about 3 feet apart. These cones should be evenly distributed throughout the gym.
The activity will be played in one minute rounds. Each successive round will build upon the previous one. To start the game each student will pair off with a classmate. Each student will get a stick and each pair will take one ball.

To start the game each pair should find an area of the gym that is open.

Partner Scoring
- each round should last 60 seconds
- to score a point the partners must pass the ball between the “goals” from one partner to the other to earn a point
- after scoring you must go to a different goal before returning
- a few rounds should be done to reinforce the rules (use teachable moments between rounds)

Round 1
Add two defenders each wearing a bib. These defenders attempt to stop the pairs from scoring. These defenders should be split and/restricted to areas, so that one defender watches half of your field and the other defender is on the opposite side.

Round 2
The two defenders can roam freely from side to side of the gym.

Round 3
Add two additional defenders (for a total of 4) each wearing a bib. These defenders attempt to stop the pairs from scoring. These defenders should be able to roam freely within the playing space.

Round 4
Each student should have their own stick and ball. There should be roughly 4-6 defenders. As before (1 minute rounds), the students should see how many goals they can score by dribbling their ball through the cones.

Variations:
1. Students who have difficulty tracking moving objects or manipulating the stick can be given a larger ball that will roll slower and be easier to control.
2. Additional rounds of practice can be added before defenders are introduced.
3. Goals can be increased in size.
4. By facilitating discussion within the class, we can help our students come up with effective strategies for success.

For example: being between the ball and the defender, using goals that are away from the center of the gym, etc.
Tap Ball

**Purpose of Activity:** The purpose of this activity is for students to reinforce their skills of basketball, soccer, and football. This activity involves the shooting of soccer, passing of the football, and the concept of dribbling in basketball.

**FMS:** bounce, kick, throw, catch, run, dodge, jump, leap

**Prerequisites:** Skills of throwing, shooting, catching, and kicking should have already been taught.

**Materials Needed:** 1 foam ball, 2 lacrosse nets

**Description of Idea**

This game is set up with 2 teams on a field. The number of students vary depending on the class size. I like to keep the teams to 5 and no more than 6 students. The game begins with a jump ball, like in basketball. After that, the student may run with the ball, however, if they choose to run they have to tap the ball up and down in their hand as they run. It is called a travel if the player runs with the ball, just like in basketball. A safety shooting line should be used in the shooting area.

**Rules:**
- The opposing players may steal the ball.
- Students may also use their feet and kick the ball as well.
- Students may pass the ball by throwing.
- Students may not pick up the ball off the ground. (It can be picked up by grabbing it between their legs and jumping up and catching it or kicked off a wall or person and be caught.)
- Students must make at least 3 passes before scoring a goal
- The goalie on each team may use their hands to pick the ball up within the designated area (I usually set up cones about 10 feet from the goal)
- 1 point is awarded for a throw into the goal
- 1 point is awarded for a kick into the goal
- 2 points are awarded for a drop kick by taking the ball from your hands and placing it down and kicking it in the goal

Small-sided Soccer Skill Baseball

**Purpose of Activity:** To engage the students in a lead up game that emphasizes practicing all of the basic soccer skills (e.g., correct punting, dribbling, trapping and passing.)

**FMS:** kick, run, dodge

**Prerequisites:** This is a lead up game to play that emphasizes many of the skills involved in the game of soccer so previous practice and instruction for the skills of punting, dribbling, trapping and passing a soccer ball is essential.

**Materials Needed:** 4 hula hoops and 5 soccer balls for each diamond.

**Description of Idea**

Set up several diamonds so there are small groups of students at each diamond. The object is to dribble the soccer ball around the bases of a makeshift baseball diamond with each new kicker from the home team progressing as many bases as possible without being caught out, until they eventually score at home. The bases are replaced with hula hoops. The fielding team assumes regular softball positions.

The "batter" (e.g. punter or kicker) begins with 2 balls in front of her at home plate. She can either choose to punt the ball or kick it off of the ground. Make sure to have plenty of choices for types of balls for students to kick. This is important as you want to make them comfortable. After kicking or punting, she heads to 1st base dribbling the SECOND ball. Meanwhile, the fielding team traps the ball with their feet to gain control and passes it (with their feet) to the nearest base where a player is approaching. Whichever player (the fielder or the dribbler) stops her ball inside the hula hoop first determines whether the dribbler is out or safe. If she is safe she stays on her base for the next kicker at home to kick or punt. The ball being played by the fielding team is returned to home plate after each play is completed for the next kicker to punt.

A second ball is again placed at home plate when he punts so he can dribble it to first base after he kicks or punts. This is why 5 balls are needed in case the bases are loaded (3 balls) plus the 2 needed at home for each new kicker/punter (2 balls). No fielder can block the base path or entrance into the hula hoop.
I have them kick through the home team kicking order rather than switching at three outs, so everyone gets a chance to punt.
Variations:
Make the infielders have to make 5 passes (or have it touch everyone on the fielding team) to teammates first before going to the hula hoop base.

**Ultimate Sponge Ball**

**Purpose of Activity:** To teach students how fitness can be fun and beneficial while involved in a team game. Additionally, this is a great game to teach students how to move into open spaces to receive passes from teammates.

**FMS:** run, dodge, throw, catch, jump, leap

**Prerequisites:** Students must be able to throw and catch a soft sponge ball, have a basic understanding of person-to-person defense, and have practice with proper field spacing.

**Materials Needed:** 1 solid sponge type nerf ball (about 22” round) for each team (4 - 8 members per team); colour bibs to differentiate between two teams; A field or fields (basketball courts can be used for indoors) (cones can be used to divide a football/soccer field into 3 separate fields); Whistle to stop and start games; Stop Watch to take EHR’s (Exercise Heart Rates)

**Description of Idea**
Divide your class up into equal teams of 4 - 8 players (6 per team typically works well for me). Each field has 2 sidelines and 2 goal lines. Each team starts at their own goal line with one of the teams in control of the sponge ball. On the whistle, each team moves onto the field. The team in control of the ball must move the ball down field by passing it to each other, however, the student that catches or has control of the ball cannot run. They may only pivot.

All other offensive players should be trying to shake their defensive player and get open for a pass. They can move anywhere on the field as long as they stay in-bounds. The objective of the game is to move the ball all the way down the field and make a successful pass to a teammate who is behind their opponents goal line. When this occurs a point is scored, the ball is dropped, and the opposite team picks up the ball and prepares to do the same. The game never stops and is played continuously, unless the teacher stops the game to rotate teams or take Heart Rates.

**RULES:**
Defensive team must play person-to-person defense.
Defensive team must stay at least 2 arm lengths away from player with the ball.
Defensive team may NOT grab ball from offensive player when they are in control of the ball.
Offensive team loses possession of the ball through an uncompleted pass or a pass that is knocked down by a defensive player.
The ground and the sidelines are dead and constitutes an automatic turnover to the other team where the infraction occurred.
Any steps which occur after an offensive player catches a pass should also constitute a turnover (However, you may have to be flexible here). Offensive players CANNOT run with the ball.
Questions What made for a successful game?
What FMS need to be mastered? What components of the skill are the most important?
Was it better to use long passes, short passes, a combination of both?
What happened if some students did not get open for a pass?
How important was spacing your teammates when you’re in control of the ball.

**Window Soccer**

**Purpose of Activity:** Students practice moving to open space and passing a soccer ball to open players.

**FMS:** kick, run, dodge

**Prerequisites:** Soccer dribbling and passing to a moving target.

**Materials Needed:** Soccer ball and two large cones for each group.

**Organization:** Groups of 4 or 6 (two teams of 2 or 3)
**Description of Idea**

Two cones are set up for the goal [window]. The distance the cones are apart is up to the instructor and the tighter the cones the less the scoring. There are no out of bounds except for obvious unsafe areas. One team scores through the cones one way [ie. north] while the other team scores through the other [ie.south]. The teams must only be able to score from their own direction. Anyone can block the shot, but noone can use their hands. The play does not stop when a goal is scored and the team can immediately score after the ball goes through the goal.

Goals can only be scored from the knees down. The goals can be scored fast when everyone is around the goal kicking the ball in. All soccer rules are reinforced including free kicks.

**Variations:**
- Make the "window" larger or smaller.
- Use uneven teams, i.e. 2 vs. 3.
- Add a safety circle around the "window" where no players are allowed to go.
- Add a "3 step then pass" rule.
- Require both groups to play a zone defense when they don't have the ball.

**Assessment Ideas:**
- Students are successful when they pass the ball around instead of dribbling.
- Have students count how many successful passes they make before a shot on goal.
- All team members pass two times before a shot on goal while you are watching.
Appendix 5.10: Study 5 Teacher Questionnaires
TEACHER QUESTIONNAIRE 1
TEACHING AND ASSESSING
FUNDAMENTAL MOVEMENT SKILL:
EXPERIENCES, FEELINGS AND
PRACTICES OF THE TEACHER

Instructions:

- The results from this questionnaire will help us identify the type and amount of support teachers need to deliver quality FMS programs in Year 7 PE.
- As such, please answer all questions honestly. The information that is provided will be confidential to the researchers. Once the information is entered on the data file, all questionnaires will be destroyed and no person or school will be identifiable in the data files or published report.

BACKGROUND INFORMATION

1. Gender: Male Female (please circle)
2. Age: ______________
3. Years of teaching experience: __________
4. What Year level(s) are you currently teaching? ______________
5. If your school utilizes external agencies (such as development officers, YMCA, sporting organisations, specialist coaches etc.), please list/describe their levels of involvement and specific activities taught:

________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

433
1. Directions: Please indicate the degree to which you AGREE or DISAGREE with the following statements concerning your feelings about FMS.

1. Strongly Disagree  4. Agree slightly
2. Disagree            5. Agree
3. Disagree slightly   6. Strongly Agree

<table>
<thead>
<tr>
<th>Statement</th>
<th>Scale</th>
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<tr>
<td>a. I think FMS development is important for students future participation in sport and physical activity</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>b. I think low competence in FMS prevents successful participation in sport and physical activity</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>c. I would like to teach FMS regularly</td>
<td>1 2 3 4 5 6</td>
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<tr>
<td>d. I enjoy teaching FMS</td>
<td>1 2 3 4 5 6</td>
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<td>e. I am generally enthusiastic about teaching FMS</td>
<td>1 2 3 4 5 6</td>
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<td>f. FMS is an important component in the PE curriculum</td>
<td>1 2 3 4 5 6</td>
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<td>g. I have fun teaching FMS</td>
<td>1 2 3 4 5 6</td>
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TEACHING PERCEPTIONS ABOUT PE AND FMS

1. Directions: Please indicate the degree to which you AGREE or DISAGREE with the following statements concerning various strands within the 7-10 PE Curriculum.

1. Strongly Disagree 4. Agree slightly
2. Disagree 5. Agree
3. Disagree slightly 6. Strongly Agree

- I FEEL CONFIDENT TEACHING: (circle appropriate category)

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2. For each aspect of teaching listed in the table below, indicate how YOU perceive YOUR LEVEL OF COMPETENCE IN RELATION TO FMS:

1. Very incompetent 4. Somewhat competent
2. Incompetent 5. Competent
3. A little incompetent 6. Extremely competent

(circle appropriate category)

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ADEQUACY OF YOUR PE TRAINING

1. Please rate the quality of your teacher training as it relates to the following content:

1. Very poor  4. Average  
2. Poor       5. Good       
3. Fair       6. Excellent

(circle appropriate category)

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2. “My PE teacher training prepared me to teach PE effectively” (please circle)

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<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
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3. “My PE teacher training prepared me to teach FMS effectively” (please circle)

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PERCEPTIONS OF YOUR PE TEACHING EXPERIENCES

1. How do you currently rate your level of commitment to teaching FMS? (please circle)
   - Very Low
   - Low
   - Somewhat low
   - Somewhat high
   - High
   - Very high

2. When you have taught PE lessons (in the last 12 months or so), please indicate how often you class participated in the following activities: (please circle appropriate number for each)
   - 1. Never
   - 2. Now and then
   - 3. Sometimes
   - 4. Quite often
   - 5. Often
   - 6. Always

<table>
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</table>

3. How successful do you think your PE programs have been in achieving YEAR 7 STUDENT OUTCOMES for the following PE strands (think about PE lessons taught in the last 12 months)?
   - 1. Very unsuccessful
   - 2. Unsuccessful
   - 3. Somewhat unsuccessful
   - 4. Somewhat successful
   - 5. Successful
   - 6. Very successful

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<th>Activity</th>
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</tbody>
</table>
4. How successful do you feel your PE programs have been in achieving the following SPECIFIC YEAR 7 STUDENT OUTCOMES (think about PE lessons taught in the last 12 months)?

1. Very unsuccessful 4. Somewhat successful
2. Unsuccessful 5. Successful

<table>
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<tr>
<th>Outcome</th>
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<td>Improved level of physical activity</td>
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<td>Improved sports skills</td>
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<td>Improved fundamental movement skills</td>
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<td>Greater participation in various physical activities</td>
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<tr>
<td>Increased enjoyment of PE activities</td>
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<tr>
<td>Improved knowledge of sports rules and tactics</td>
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<tr>
<td>Increased levels of fitness</td>
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<tr>
<td>Improved attitudes towards physical activity</td>
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<tr>
<td>Developed knowledge, skills and attitudes to lead to healthy and active lifestyles</td>
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</table>
CURRENT PE TEACHING PROGRAM

1. On average, how many minutes of PE would you teach your Year 7 PE class?

_____________________

2. Please indicate the degree to which you AGREE or DISAGREE with the following statements with reference to your FMS program within PE

| 1. Strongly Disagree | 4. Agree slightly |
| 2. Disagree          | 5. Agree          |
| 3. Disagree slightly | 6. Strongly Agree |

<table>
<thead>
<tr>
<th>PE Planning</th>
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</thead>
<tbody>
<tr>
<td>a. The school has a formal planning team that meets routinely to monitor and initiate programs to promote PE in the school</td>
</tr>
<tr>
<td>b. Teaching programs are developed from an overall PE policy</td>
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<tr>
<td>c. The school policy clearly outlines allocation of curriculum time to PE</td>
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<tr>
<td>d. Parents are involved in the planning process</td>
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<tr>
<td>e. Students needs are considered when planning for PE</td>
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<tr>
<td>f. A school level scope and sequence overview guides planning in PE</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FMS Programming within PE</th>
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</thead>
<tbody>
<tr>
<td>a. A school/year plan for FMS is developed so syllabus outcomes and content can be mapped by each stage</td>
</tr>
<tr>
<td>b. FMS programs cater for the diversity of student learning needs</td>
</tr>
<tr>
<td>c. Previous FMS outcomes achieved by students are considered when implementing lessons</td>
</tr>
<tr>
<td>d. Learning experiences selected in FMS programs engage student interest and provide appropriate challenge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FMS Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. A range of assessment strategies are used to assess student FMS learning in PE</td>
</tr>
<tr>
<td>b. Indicators are used to make judgements about student achievement of outcomes</td>
</tr>
<tr>
<td>c. The assessment process is based on syllabus outcomes and reflect syllabus content</td>
</tr>
<tr>
<td>d. Judgements are regularly made about what students know and can do in relation to FMS syllabus outcomes</td>
</tr>
</tbody>
</table>

| FMS Reporting |
a. Students FMS achievement outcomes are reported and communicated to the relevant audience

b. Parents/caregivers are given feedback regarding what their child knows and what skills they have gained

FMS Evaluation

| a. Evaluation of FMS programs in PE is ongoing | 1 2 3 4 5 6 |
| b. Evaluation of FMS programs in PE is comprehensive | 1 2 3 4 5 6 |
| c. FMS programs in PE are modified and improved as a result of evaluation | 1 2 3 4 5 6 |

FACTORS INFLUENCING THE DELIVERY OF FMS IN PE

1. Please indicate the DEGREE to which the following FACTORS ACT AS BARRIERS OR INHIBIT THE DELIVERY OF FMS IN YOUR PE PROGRAM:

1 = No barrier or does not inhibit
4 = moderate barrier
6 = A major barrier or strongly inhibits

| Inadequate training in FMS | 1 2 3 4 5 6 |
| Class size too big | 1 2 3 4 5 6 |
| Low levels of FMS teaching confidence | 1 2 3 4 5 6 |
| Poor level of staff support provided | 1 2 3 4 5 6 |
| Inadequate facilities or equipment | 1 2 3 4 5 6 |
| Poor personal experience in learning FMS | 1 2 3 4 5 6 |
| Low levels of personal interest and enthusiasm in teaching FMS | 1 2 3 4 5 6 |
| Negative parental attitudes towards learning/teaching FMS | 1 2 3 4 5 6 |
| Negative student attitudes towards learning FMS | 1 2 3 4 5 6 |
| Litigation concerns | 1 2 3 4 5 6 |
| Demands to teach other strands/units in PE | 1 2 3 4 5 6 |
| Lack of money budgeted to programs | 1 2 3 4 5 6 |
| Other: (please list); | 1 2 3 4 5 6 |

- Is there anything else you would like to add to help our understanding of your experiences when teaching or assessing FMS?
THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE. YOUR COOPERATION IS GREATLY APPRECIATED.
TEACHER QUESTIONNAIRE 2
TEACHING AND ASSESSING FMS: EXPERIENCES, FEELINGS AND PRACTICES OF THE TEACHER”

Instructions:
• The results from this questionnaire will help us identify the type and amount of support teachers need to deliver quality FMS programs in Year 7 PE.
• As such, please answer all questions honesty. The information that is provided will be confidential to the researchers. Once the information is entered on the data file, all questionnaires will be destroyed and no person or school will be identifiable in the data files or published report.

SATISFACTION OF TRAINING AND PROGRAM
Please indicate the degree to which you were satisfied/unsatisfied with the following statements concerning the training provided, by circling the appropriate response.

How satisfied were you in regards to the training provided in the 4 hour work shop?
1. Very Satisfied
2. Satisfied
3. Neither satisfied or unsatisfied
4. Unsatisfied
5. Very unsatisfied

How satisfied were you with the resources provided?
1. Very Satisfied
2. Satisfied
3. Neither satisfied or unsatisfied
4. Unsatisfied
5. Very unsatisfied

How satisfied were you with the support provided to you throughout the intervention?
1. Very Satisfied
2. Satisfied
3. Neither satisfied or unsatisfied
4. Unsatisfied
5. Very unsatisfied

How satisfied were you with the student program and outcomes across the program?
1. Very Satisfied
2. Satisfied
3. Neither satisfied or unsatisfied
4. Unsatisfied
5. Very unsatisfied
3. Neither satisfied or unsatisfied
FEELINGS ABOUT FMS AND FMS TEACHING

1. Please indicate the degree to which you AGREE or DISAGREE with the following statements concerning your feelings about FMS.

1. Strongly Disagree 4. Agree slightly
2. Disagree 5. Agree
3. Disagree slightly 6. Strongly Agree

<table>
<thead>
<tr>
<th>Statement</th>
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<tbody>
<tr>
<td>a. I would like to teach FMS regularly</td>
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<td>b. I enjoy teaching FMS</td>
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<tr>
<td>c. I am generally enthusiastic about teaching FMS</td>
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<td>d. FMS is an important component in the PE curriculum</td>
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<td>e. I have fun teaching FMS</td>
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</table>
TEACHING PERCEPTIONS ABOUT PE AND FMS

1. Directions: Please indicate the degree to which you AGREE or DISAGREE with the following statements concerning various strands within the 7-10 PE Curriculum.

1. Strongly Disagree  4. Agree slightly
2. Disagree  5. Agree
3. Disagree slightly  6. Strongly Agree

- I FEEL CONFIDENT TEACHING: (circle appropriate category)

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2. For each aspect of teaching listed in the table below, indicate how YOU perceive YOUR LEVEL OF COMPETENCE IN RELATION TO FMS:

1. Very incompetent  4. Somewhat competent
2. Incompetent  5. Competent
3. A little incompetent  6. Extremely competent

(circle appropriate category)

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<th>Activity</th>
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<tr>
<td>Lesson planning for FMS</td>
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<td>Programming for FMS</td>
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<td>Subject matter knowledge in relation to FMS</td>
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<tr>
<td>Implementing teaching and learning strategies in FMS</td>
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<tr>
<td>Assessing student learning in FMS</td>
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<td>Reporting on student outcomes in FMS</td>
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<tr>
<td>Identifying individual differences in FMS</td>
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<td>Managing the class when teaching FMS</td>
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<tr>
<td>Ability to evaluate your FMS teaching</td>
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ADEQUACY OF YOUR PE TRAINING

1. Please rate the quality of your teacher training as it relates to the following content:

1. Very poor  
2. Poor  
3. Fair  
4. Average  
5. Good  
6. Excellent  

(circle appropriate category)

| Modified Games | 1 | 2 | 3 | 4 | 5 | 6 |
| Gymnastics     | 1 | 2 | 3 | 4 | 5 | 6 |
| Sports         | 1 | 2 | 3 | 4 | 5 | 6 |
| FMS            | 1 | 2 | 3 | 4 | 5 | 6 |
| Dance          | 1 | 2 | 3 | 4 | 5 | 6 |
| Aquatics       | 1 | 2 | 3 | 4 | 5 | 6 |
| Health-related fitness | 1 | 2 | 3 | 4 | 5 | 6 |
| Human development | 1 | 2 | 3 | 4 | 5 | 6 |
| Athletics      | 1 | 2 | 3 | 4 | 5 | 6 |

2. “My PE teacher training prepared me to teach PE effectively” (please circle)

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

3. “My PE teacher training prepared me to teach FMS effectively” (please circle)

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
PERCEPTIONS OF YOUR PE TEACHING EXPERIENCES

1. How do you currently rate your level of commitment to teaching FMS? (please circle)

Very Low  Low  Somewhat low  Somewhat high  High  Very high

2. When you have taught PE lessons (in the last term or so), please indicate how often you class participated in the following activities: (please circle appropriate number for each)

1. Never  4. Quite often
2. Now and then  5. Often
3. Sometimes  6. Always

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<th>Activity</th>
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</table>

3. How successful do you think your PE programs have been in achieving STUDENT OUTCOMES for the following PE strands (think about PE lessons taught in the last term)?

1. Very unsuccessful  4. Somewhat successful
2. Unsuccessful       5. Successful

<table>
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<tr>
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</tbody>
</table>
4. How successful do you feel your PE programs have been in achieving the following SPECIFIC STUDENT OUTCOMES (think about PE lessons taught in the term)?

1. Very unsuccessful  
2. Unsuccessful  
3. Somewhat unsuccessful  
4. Somewhat successful  
5. Successful  
6. Very successful

<table>
<thead>
<tr>
<th>SPECIFIC STUDENT OUTCOMES</th>
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<tr>
<td>Improved self esteem</td>
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<tr>
<td>Improved fundamental movement skills</td>
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<tr>
<td>Greater participation in various physical activities</td>
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<tr>
<td>Increased enjoyment of PE activities</td>
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<tr>
<td>Improved knowledge of sports rules and tactics</td>
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<tr>
<td>Increased levels of fitness</td>
<td></td>
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<tr>
<td>Improved attitudes towards physical activity</td>
<td></td>
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<tr>
<td>Developed knowledge, skills and attitudes to lead to healthy and active lifestyles</td>
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</tr>
</tbody>
</table>
1. Please indicate the degree to which you AGREE or DISAGREE with the following statements with reference to your FMS program within PE


### PE Planning

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The school has a formal planning team that meets routinely to monitor and initiate programs to promote PE in the school</td>
<td></td>
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</tr>
<tr>
<td>b. Teaching programs are developed from an overall PE policy</td>
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<tr>
<td>c. The school policy clearly outlines allocation of curriculum time to PE</td>
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<tr>
<td>d. Parents are involved in the planning process</td>
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<tr>
<td>e. Students needs are considered when planning for PE</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>f. A school level scope and sequence overview guides planning in PE</td>
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</tr>
</tbody>
</table>

### FMS Programming within PE

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. A school/year plan for FMS is developed so syllabus outcomes and content can be mapped by each stage</td>
<td></td>
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</tr>
<tr>
<td>b. FMS programs cater for the diversity of student learning needs</td>
<td></td>
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<tr>
<td>c. Previous outcomes achieved by students are considered when implementing lessons</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>d. Learning experiences selected in FMS programs engage student interest and provide appropriate challenge</td>
<td></td>
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</tr>
</tbody>
</table>

### FMS Assessment

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. A range of assessment strategies are used to assess student FMS learning in PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Indicators are used to make judgements about student achievement of outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. The assessment process is based on syllabus outcomes and reflect syllabus content</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>d. Judgements are regularly made about what students know and can do in relation to FMS syllabus outcomes</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### FMS Reporting
a. Students FMS achievement outcomes are reported and communicated to the relevant audience

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
</table>

b. Parents/caregivers are given feedback regarding what their child knows and what skills they have gained

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
</table>

### FMS Evaluation

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

a. Evaluation of FMS programs in PE is ongoing

b. Evaluation of FMS programs in PE is comprehensive

c. FMS programs in PE are modified and improved as a results of evaluation

### FACTORS INFLUENCING THE DELIVERY OF FMS IN PE

1. Please indicate the DEGREE to which the following FACTORS ACT AS BARRIERS OR INHIBIT THE DELIVERY OF FMS IN YOUR PE PROGRAM:

1 = No barrier or does not inhibit  4 = moderate barrier  6 = A major barrier or strongly inhibits

<table>
<thead>
<tr>
<th>Inadequate training in FMS</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class size too big</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Low levels of FMS teaching confidence</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Poor level of staff support provided</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Inadequate facilities or equipment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Poor personal experience in learning FMS</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Low levels of personal interest and enthusiasm in teaching FMS</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Negative parental attitudes towards learning/teaching FMS</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Negative student attitudes towards learning FMS</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Litigation concerns</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Demands to teach other strands/units in PE</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Lack of money budgeted to programs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Other: (please list);</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

- Is there anything else you would like to add to help our understanding of your experiences when teaching FMS?
THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE. YOUR COOPERATION IS GREATLY APPRECIATED.
### Appendix 5.11: Study 5 Student Skill Assessment Victorian Fundamental Motor Skills Assessment

<table>
<thead>
<tr>
<th>Student Name:</th>
<th>Student ID:</th>
<th>School:</th>
<th>Date of Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preferred hand:</td>
<td>Preferred Foot:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### OBJECT CONTROL SUBSET

<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
</tr>
</thead>
</table>
| 1. Catch                   | 1. Eyes are focused on the ball throughout the catch  
2. Preparatory position with elbows bent and hands in front of body  
3. Hands move to meet the ball  
4. Hands and fingers positioned correctly to catch the ball  
5. Catch and control the ball with hands only |
| 2. Kick                    | 1. Eyes are focused on the ball throughout the kick  
2. Step forward with non-kicking foot placed near the ball  
3. Bend knee of kicking leg during the backswing for the kick  
4. Hip extension and knee flexion of at least 90° during preliminary kicking movement  
5. Contact ball with top of foot  
6. Forward and sideward swing of arm opposite kicking leg  
7. Kicking leg follows through towards the target after ball contact |
| 3. Overhand Throw          | 1. Eyes are focused on the target throughout the throw  
2. Stand side-on to the target  
3. Throwing arm nearly straightened behind the body  
4. Step towards the target with foot opposite throwing arm during the throw |

Skill Score:
5. Marked sequential hip to shoulder rotation during the throw

6. Throwing arm follows through and down across the body

**LOCOMOTOR SUBSET**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Performance Criteria</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Score</th>
</tr>
</thead>
</table>
| 1. Vertical Jump | 1. Eyes focused forwards or upwards throughout the jump  
2. Crouch with knees and arms bent behind body  
3. Forceful up thrust of arms as legs straighten to take off  
4. Contact ground with front part of feet and bend knees to absorb force of landing  
5. Balanced landing with no more than one step in any direction |         |         |       |
| 2. Leap     | 1. Forward movement sustained throughout the leap  
2. Eyes focused forward throughout the leap  
3. Take off from one foot and land on the opposite  
4. During flight legs are straightened with the arms held in opposition to legs  
5. Controlled landing without losing balance |         |         |       |
| 3. Dodge    | 1. Eyes focused in direction of travel throughout the dodge  
2. Change direction by pushing off outside foot  
3. Body lowered during change of direction  
4. Change of direction occurs in one step |         |         |       |
<table>
<thead>
<tr>
<th>Skill Score:</th>
<th>Overall Skill Score:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotor Subset Score:</td>
<td></td>
</tr>
</tbody>
</table>

5. Dodge repeated from right to left, left to right etc.
### Appendix 5.9: Study 5 Adherence to SAAFE teaching principles

<table>
<thead>
<tr>
<th>Adherence to SAAFE teaching principles (circle and provide comments)</th>
<th>(1 = Not at all to 5 = Very true)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPORTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>iv) Teacher provides individual skill specific feedback</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>v) Teacher provides feedback on student effort and involvement</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>vi) Teacher promotes positive interactions between students</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>ACTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>iv) Activities involve small-sided games or tabloids and children spend minimal time waiting for a turn</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>v) Equipment is plentiful and developmentally appropriate</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>vi) Transitions between activities are efficient</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>AUTONOMOUS</strong></td>
<td></td>
</tr>
<tr>
<td>iv) Some activities incorporate multiple challenge levels</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>v) Students are given choices about the tasks and activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>vi) Students are involved in the set-up, decision-making or running of activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>FAIR</strong></td>
<td></td>
</tr>
<tr>
<td>iv) Teacher ensures that students are evenly matched in activities</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>v) Teacher acknowledges and rewards good sportsmanship</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>vi) If necessary, teacher modifies activities to maximise opportunities for success</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td><strong>ENJOYABLE</strong></td>
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</tr>
<tr>
<td>iv) Lesson starts with an enjoyable activity and concludes with an enjoyable experience</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>v) Activities are meaningful and not repetitive</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>vi) Lessons involve a wide range of appropriate activities (based on the lesson focus)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td>General comments:</td>
<td></td>
</tr>
</tbody>
</table>
This is to certify that

**NATALIE LANDER**

has successfully completed the compulsory Research Integrity online training.

**Research Integrity – Deakin University**

research-integrity@deakin.edu.au

Date: 27/9/2016

Authentication number: 212094784v3