Australian Journal of Teacher Education

Volume 39 | Issue 1 Article 6

1-2014

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Brendon P. Hyndman
RMIT University

Amanda C. Benson
RMIT University

Amanda Telford
RMIT University

Recommended Citation

Hyndman, B. P., Benson, A. C., & Telford, A. (2014). A Guide for Educators to Move Beyond Conventional School Playgrounds: The RE-AIM Evaluation of the Lunchtime Enjoyment Activity and Play (LEAP) Intervention. *Australian Journal of Teacher Education, 39*(1).
http://dx.doi.org/10.14221/ajte.2014v39n1.2

A Guide for Educators to Move Beyond Conventional School Playgrounds: The RE-AIM Evaluation of the Lunchtime Enjoyment Activity and Play (LEAP) Intervention

Brendon P. Hyndman
Amanda C. Benson
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RMIT University

Abstract: Despite an increase in the provision of effective school-based interventions in recent times, there is an absence of literature for teachers focusing on the translation of promising interventions into real-world practice. The aim of this research was to provide a social-ecological guide for teachers of the external validity of implementing the Lunchtime Enjoyment Activity and Play (LEAP) school playground intervention. This research presents the process evaluation of a school playground intervention using RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) as the theoretical evaluation framework. Data collection consisted of a mixed methods approach for two and a half years including a teacher focus group, direct observations and field notes. The process evaluation confirms the LEAP intervention as cost-effective, sustainable and transferable that is capable of enhancing multiple social-ecological factors within a school playground.

Background

The school environment is recognised to be one of the most important settings to develop students' physical activity (Davison & Lawson, 2006; Ferreira et al., 2007), as students spend a large portion of their day at school. Primary school-aged children are within a 'critical window' to establish physical activity behaviour patterns that can track into adulthood (Telama, 2009). The need for teacher education programs to ensure pre-service teachers are aware of strategies to facilitate childhood physical activity habits is reinforced by physical inactivity (not meeting the physical activity guidelines) accounting for 1.5% to 3.0% of total direct healthcare costs in developed countries (Oldridge, 2008) or an estimated 1.9 million deaths worldwide (Hayman et al., 2007).

A key strategy that teacher education programs should ensure is that pre-service teachers are aware of how to increase physical activity opportunities through non-curricular play during school breaks (Hyndman, Telford, Finch, Ullah, & Benson, 2013a). Primary school students can be engaged in up to 4200 school break periods during primary schooling (3 times per day, 5 days per week, 39 weeks per year, over 7 years) (Stratton, 2000), offering substantial time for students to be physically active. Primary school students aged 5-12 years are estimated to spend at least 30 hours per week attending school and can accumulate up to 35% of their play during school breaks engaged in moderate to vigorous physical activity (MVPA) (Nettlefold et al., 2010). Furthermore, play during break periods has been revealed as the principle source of students' physical activity (Tudor-Locke, Lee, Morgan, Beighle, & Pangrazi, 2006), contributing up to 50% of students' recommended daily physical activity (Tudor-Locke et al., 2006) and has been linked to improvements in classroom behaviour (Ridgers, Stratton, & Fairclough, 2006), cognitive performance (Pellegrini & Bohn, 2005)

and the enhancement of social and physical skills (Pellegrini & Holmes, 2006). With mounting barriers associated with teachers' ability to facilitate physical activity in schools including a crowded curriculum, competing demands on teachers (Jenkinson & Benson, 2010) and students having restricted access to active play opportunities beyond school breaks (Hyndman, Telford, Finch, Ullah, & Benson, 2013b), it is important that teacher education programs inform pre-service teachers of school-based physical activity intervention strategies that do not increase the burden on teachers to facilitate physical activity.

Whilst a well-designed school environment can facilitate opportunities for physical activity during school breaks, many Australian schools have reduced or eliminated play facilities or have crowded play areas (Evans & Pellegrini, 1997). Additionally, some schools administer play policies that act as barriers to the use of play spaces, resulting in decreased opportunity for students to experience active play (Evans & Pellegrini, 1997). A number of school break interventions have successfully attempted to reduce the decline in students' physical activities by introducing equipment and policies that encourage structured physical activities (Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2006; Scruggs, Beveridge, & Watson, 2003; Ridgers, Stratton, Fairclough, & Twisk, 2007) that tend not to engage all students' interests and abilities (Dyment & Bell, 2008). Physical activity participation that is enjoyable and non-competitive is emerging as an important alternative for students who prefer less structured and vigorous intensity physical activities (Dyment, Bell, & Lucas, 2009). Natural environmental features (Dyment & Bell, 2007; Dyment et al., 2009) and movable/recycled materials (Engelen, et al., 2013; Bundy et al., 2009; Bundy et al., 2008) are an emerging alternative to enable teachers to provide diversity of school play activities, develop physical activity participation, playability and appeal to a broader range of students. However, natural environmental features (greening projects) can be quite expensive and can restrict the use of play areas while the greening projects are being implemented (Bundy et al., 2008). A cheaper, more convenient alternative is the implementation of movable/recycled materials within the school environment (Bundy et al., 2011), as students often prefer the flexibility of using movable materials (Francis & Lorenzo, 2006).

Although there has been an increase in effective school physical activity interventions, there is an absence of literature focused on long-term physical activity interventions (Ridgers, et al., 2007) and limited evaluation of the translatability of school-based interventions (Austin, Bell, Caperchione, & Mummery, 2011; Janssen, Toussaint, Van Mechelen, & Verhagen, 2011), especially for teachers. Empowering pre-service and current teachers with the knowledge of how to translate school-based interventions on a wider scale can facilitate the future behavioural shifts necessary to develop preventative health (Austin et al., 2011). The importance of examining the translatability and feasibility of interventions for the setting in which interventions are implemented is critical to positively impact on public health (Collard, Chinapaw, Verhagen, & Van Mechelen, 2010). As teachers are the gate-keepers to informing school playground policies, planning and implementation (Hyndman, Telford, Finch, & Benson, 2012), teacher education programs can train pre-service teachers to play a key role in facilitating such interventions (Janssen et al., 2011).

The RE-AIM framework (reach, efficacy, adoption, implementation & maintenance) was conceptualised to develop a comprehensive, systematic model for examining research translation and dissemination (Austin et al., 2011). The RE-AIM framework evaluates the '<u>r</u>each' to the target population (e.g. response rate of students); the '<u>e</u>fficacy' of the intervention (e.g. efficacy of the intervention for developing students' physical activity, learning and other health outcomes); extent of '<u>a</u>doption' in the target setting (e.g. the school's acceptance of the intervention; '<u>i</u>mplementation' (e.g. barriers/facilitators to students using the materials); and '<u>m</u>aintenance' of the intervention effects (e.g. was the intervention sustained by the school?) (Glasgow, Vogt & Boles, 1999).

No study to our knowledge has provided an insight for the teacher education community (schools, principals, teachers, teacher educators/academics, pre-service teachers)

of the social-ecological levels of influence on students' physical activity and health after a primary school playground intervention during school breaks. The social-ecological model was applied as the theoretical foundation of the study. It emphasises a need for a 'person-environment' fit, implying that there is an association between the intra-personal (individual) level, inter-personal (social) environment level, physical environment level and policy levels of influence within an environment (Salmon & King, 2010). The social-ecological model framework provides a comprehensive approach to designing, implementing and evaluating interventions and can guide the development of long-lasting health and learning outcomes (Salmon & King, 2010). The Lunchtime Enjoyment Activity and Play (LEAP) intervention builds upon a previous pilot (Bundy et al., 2009) to examine the effect of implementing movable/recycled materials on an entire primary school (ages 5 to 12). The primary aim of this mixed methods process evaluation was to evaluate reach, efficacy, adoption, implementation and maintenance of the LEAP intervention.

Methods

Participants

The RE-AIM health promotion framework (Glasgow et al., 1999) was applied to evaluate each level of the LEAP intervention. Applying the RE-AIM framework to evaluate the intervention is important to ensure teachers can replicate the intervention within schools on a wider scale and give consideration to potential facilitators and barriers. An outline of the RE-AIM evaluation of the LEAP intervention is shown in Table 1.

All students aged 5-12-years-old received a plain language statement outlining the research, along with a dual consent form (participant and parental). A total of 123 students from the intervention school (90% response rate) returned signed informed parental consent to participate in the study.

RE-AIM dimension	Method of evaluating each RE-AIM dimension	Measures
Reach (e.g. participation of the target population)	• Response rates of students and teachers to participate in the LEAP intervention.	• Participant/parental consent form return rate compared to total enrolments in each class.
Efficacy (e.g. efficacy of the intervention for students' physical activity, learning & other health outcomes)	• Efficacy of the LEAP intervention for students' participation in physical activity. • Teachers' perceptions of the efficacy of the intervention for students' play and other learning outcomes. • School's/teachers' willingness to allow students access to the movable/recycled materials.	• System of Observing Play and Leisure Activities in Youth (SOPLAY)- (Area level physical activity). • Teacher focus group discussion at the intervention school.
Adoption (e.g. the school's acceptance of the intervention)	• Examining the proportion of students using the materials during school lunchtime. • Teachers' perceptions of the uptake and use of the movable/recycled materials by the students.	• System of Observing Play and Leisure Activities in Youth (SOPLAY)- (Area level physical activity). • Teacher focus group discussion at the intervention school.
Implementation (e.g. facilitators/barriers affecting implementation)	• Teachers' perceptions of the physical environment and policy social-ecological level facilitators and barriers to implementing the intervention materials. • Field notes recording how successfully movable/recycled materials were introduced into the school playground.	• Teacher focus group discussion at the intervention school. • Field note observations of the school playground.
Maintenance (e.g. extent to which the school maintained the LEAP intervention)	• Follow-up phase 1: measurements (8-months after baseline), teacher perceptions (9-months after baseline), Follow-up phase 2: measurements (2 ½-years after baseline).	• Teacher focus group discussion at the intervention school. • System of Observing Play and Leisure Activities in Youth (SOPLAY)- (Area level physical activity) for follow-up phase 1 & 2.

Table 1. How each dimension of the RE-AIM framework was evaluated in the Lunchtime Enjoyment Activity and Play (LEAP) intervention

Nine female teachers and one male principal who taught at the same Catholic primary school took part in the qualitative focus group study prior to a weekly staff meeting nine months after the commencement of the intervention (100% response rate). All nine teachers were included in the yard supervision roster of the intervention playground area throughout the year as per usual school practice. Teachers varied in their ages and years of experience teaching, ranging from 1-31 years of teaching experience. All teachers were invited to participate via a letter and consent form distributed during term four, 2010. Teachers

interested in participating in the study were instructed to complete their consent forms prior to the focus group discussion.

Ethical approval was obtained from both the University of Ballarat Human Research Ethics Committee and the Catholic Diocese of Ballarat. A Catholic Co-educational Primary School in Regional Western Victoria was approached to participate in the study, via emails, phone calls and on-site meetings with the principal. All students participating in the study participated in their regular daily school routines.

The Intervention

The LEAP intervention was developed to guide teacher education programs (pre-service and current teachers) on how to implement a simple, low cost, low burden school playground intervention, implementing movable/recycled materials to encourage students' active play. The intervention builds upon an earlier pilot study that examined teachers' perceptions of risk and the physical activity intensity of a small group of 5-7 year old primary school students (Bundy et al., 2009). Teachers reported benefits of the small, pilot study on students' physical, cognitive and social skills, showing promise for movable/recycled materials to be implemented within a whole primary school environment (all age groups) and further examining the effect on physical activity and health outcomes.

At the intervention school, an information session was provided to staff prior to the LEAP intervention to describe the aim, benefits and organisation of the program. In brief, the LEAP intervention consisted of introducing movable/recycled materials with no fixed purpose on a grass field within a Catholic Primary school on a brand new campus with no fixed playground equipment. The materials were introduced during 2010 from the end of term one to the middle of term two, post-testing was conducted seven weeks after the intervention commenced and additional items were introduced up until 13-weeks after the intervention commenced (Autumn/Winter). The grass field where the LEAP intervention was implemented was 6,094m^2 and there were also hard surfaced play areas external to the grass field measuring 530m^2.

Introduced movable/recycled materials were generally not considered usual school play materials for students. Examples of the movable/recycled materials included milk crates, swimming noodles, buckets, cardboard boxes and tyre tubes. In addition to these materials, different types of play balls, hoops and skipping ropes were also added during the LEAP intervention. Five materials were introduced during the first week and each week thereafter a minimum of two types of material were introduced throughout the LEAP intervention period. Materials were excluded from the school yard or replaced when broken or if teachers had any safety concerns. The LEAP intervention effects were measured at multiple phases over a two and a half year period including baseline (0-weeks); post-test (7-weeks since baseline); follow-up phase one (8-months since baseline: direct observation; 9-months since baseline: qualitative teacher focus group) and follow-up phase two (2 ½-years since baseline; direct observation).

Data Collection

Data collection consisted of different methods to address each RE-AIM dimension (Table 1). Focus group discussions were guided by two investigators and lasted approximately an hour in duration. The focus group discussions explored the adoption and implementation of the LEAP program nine months after baseline measurements. The focus group discussion was held at the intervention school prior to teachers' weekly staff meeting and was audio taped with transcription undertaken at a later time. An interview script using a semi-structured interview format guided the focus group, with all questions structured within the context of a social-ecological framework considering intra-personal, inter-personal, physical environment and policy level factors. Applying a social-ecological framework is important to identify the multiple levels of environmental influence from the LEAP intervention on students' health (Salmon & King, 2010).

All participant data was de-identified and referred to by pseudonym. The data collected from focus group sessions was transcribed and analysed using the NVivo software package (QSR International, Version 9). The content analysis of the transcriptions was based upon the social-ecological model (Salmon & King, 2010) to identify emerging themes relating to the primary school's adoption and implementation of the LEAP intervention. The information provided in the focus groups was used to determine the influences on students' uptake and use of the movable/recycled materials. Final analyses included a review using the NVivo feature of 'nodes most frequently coded' for the focus group, to ensure themes frequently coded were included. The intra-personal and inter-personal level social-ecological themes explored teachers' perceptions of students' adoption of the LEAP intervention materials. Questions relating to the physical environment and policy level social-ecological themes explored the facilitators and barriers to the school implementing the LEAP intervention as intended. Focus groups also provided some insight into the teachers' perceptions of the efficacy and maintenance dimensions of the RE-AIM framework.

The System of Observing Play and Leisure Activities in Youth (SOPLAY) (McKenzie, Marshall, Sallis, & Conway, 2000) was used to evaluate the efficacy, adoption and maintenance dimensions of the RE-AIM framework. SOPLAY was initially used to measure the type and intensity of students' baseline playground activities. After which, SOPLAY was used to determine if the students within the school were still using the movable/recycled materials as intended and engaged in physical activity intensities above or similar to baseline levels. Observation training included familiarisation with the SOPLAY protocol and undertaking practice observations using video examples of playtimes. All school playground defined areas were identified prior to physical activity measurement by determining key areas in which physical activities were taking place and there was visibility of the students' activity level and type. No indoor observations were included in the study. SOPLAY scans were conducted at five minute intervals (5 x scans over 30 minutes).

The SOPLAY is based on observing students' physical activity, in which defined targeted areas are scanned from left to right, and counts are made of the number of students undertaking sedentary behaviour (e.g. sitting and standing), moderate physical activity (MPA; walking, climbing, arm movements) and vigorous physical activity (VPA; skipping, running). There were five defined target areas to record observations within the intervention school. A SOPLAY measurement follow-up phase two (2 ½-years after baseline) assessed whether the intervention had been maintained evaluating the maintenance level of the RE-AIM framework. Weekly onsite visits to record field notes in relation to the students' and school's use of the LEAP intervention materials were also undertaken throughout the first 12-months. Field notes assisted in the evaluation of the adoption and implementation dimensions of the RE-AIM framework.

Results

Reach

Within the intervention school a total cohort of 136 students were available for potential recruitment. The primary school encouraged all students to participate, however if they chose not to, students did not have to participate in the LEAP intervention. During LEAP intervention measurements, 123 students (response rate of 90%) and 10 teachers participated in the study (response rate of 100%).

Efficacy

Objectively Measured Physical Activity

Direct observation of students' school lunchtime activities revealed that the intervention had a positive influence on students' physical activity intensity. The quantity of students within the school playground participating in sedentary behaviour from baseline to post-test significantly decreased by 17.9%, MPA remained consistent (-0.7%) and the quantity of students that were engaged in VPA significantly increased by 18.6% (Figure 1). The increases in physical activity intensity were maintained at eight months and again after two and a half years (see maintenance section).

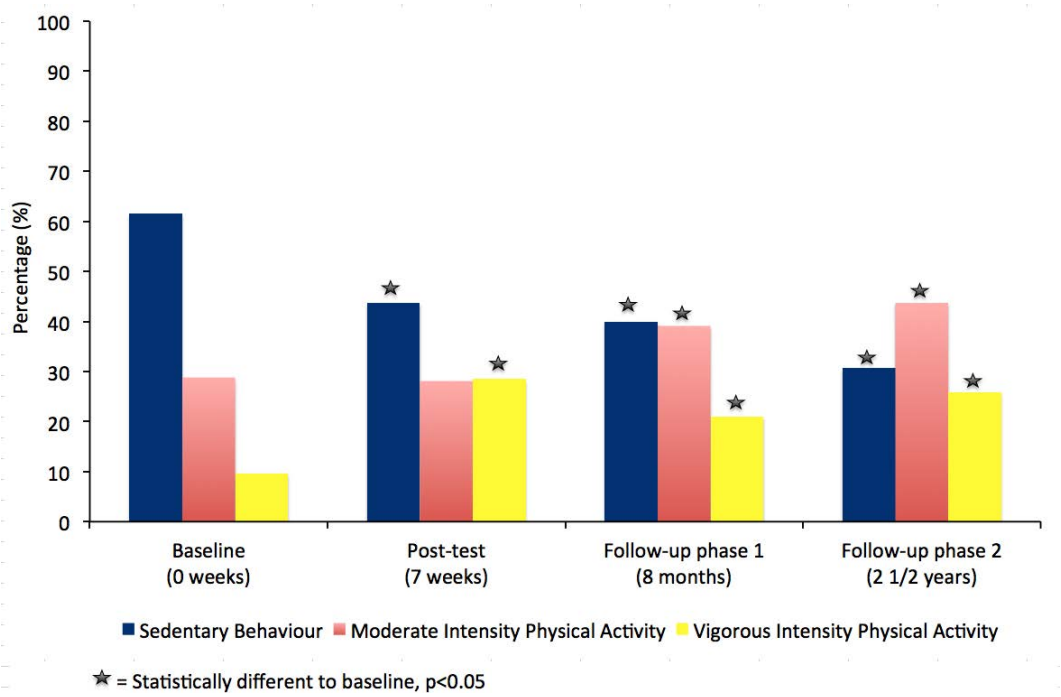

Figure 1. Percentage of students engaged in each physical activity intensity within the school playground

Teachers' Perceptions Of The Efficacy Of The LEAP Intervention

In addition to the direct observation measurements, the focus group discussions with the teachers suggested that there were many benefits for students in relation to play behaviour, *"I think if you were measuring whether play is more powerful or more purposeful you would find a huge impact… a huge increase"*; *"they are really busy aren't they….it's more productive play"*. The importance of the playground intervention for students was

regularly mentioned by the teachers, *"for students in those early years, the intervention is crucial."*

Adoption
School (Organisation) Level Adoption

Before the commencement of the LEAP intervention, investigators conducted a briefing session for teaching staff outlining the program elements including the cost-effective materials in addition to findings from an earlier pilot project applying a similar concept on a smaller scale (Bundy et al., 2009). The intervention was branded via a program name and logo allowing students to identify the LEAP intervention and a section within the school newsletter outlined the details of the intervention. Within the newsletter, the school community was invited to donate movable/recycled materials to the school. This resulted in one family donating milk crates and another donating tractor tyres. Later in the LEAP intervention a local university donated play balls for the students. The rest of the materials were provided by the investigators throughout the intervention.

The high level of student adoption of the LEAP intervention from the outset also provided a catalyst for teachers and the school to adopt the initiative. Intra-personal and inter-personal social-ecological themes from the teacher focus groups and direct observation of the physical environment assisted the evaluation of the participant level 'adoption' dimension of the RE-AIM framework (Table 2).

Participant Level Adoption
Intra-Personal Level Of Influence

Intra-personal themes emerging from teachers' perceptions were that students exhibited increased amounts of excitement, engagement, creativity, problem solving and physical activity during their play with the introduced movable/recycled materials (Table 2). Students' excitement for the materials were identified by the teachers and teachers stated that the students were returning to class talking about what they had made, *"Our kids talk about it a lot...they come in and tell us what they made."*

The level of engagement of both genders in using the materials appeared to be a key reason for the school to adopt the LEAP intervention (Table 2), *"… anyone that drives past can see the level of engagement…you hear that…from the community."* Although many of the older boys *"just wanted to play football"* by using the movable/recycled materials for goal posts and boundaries, the intervention was also perceived to have an impact on facilitating greater purpose to girls' activities*,"…they (girls) were lost at the beginning of the year….but when we introduced the materials…they were aware of everything"*; *"all the girls were running to play with things"*; *"girls that might have stayed in the one spot…are now drifting around doing something."* Students' engagement in play was linked to the availability of the many different materials (Table 3) and this was perceived to have produced a sense of purpose in the students' play. The many different materials available were seen to stimulate the students' creative play as they created different structures such as cubbies, boats, rockets and space-ships with the materials (Figure 2).

Figure 2. Images of a structure created by the students with the movable/recycled materials (left) and a girl balancing on a wooden plank (right)

Teachers highlighted the benefits of the LEAP intervention on creative play (Table 2), *"in comparison to more traditional games….imaginative play or planning or designing with the materials….the oral language benefits would have been huge"*; *"developmental play and imaginative play is coming into the classrooms…but this is putting it out to the playgrounds as well"*; *"the imaginative play…that just keeps going."* As the students created the different structures, teachers also reported that there were many physical activity benefits during students' play including lifting and carrying materials, jumping off hay bales and balancing on wooden planks (Table 2). When broom sticks were introduced some of the students were also observed to have been sweeping their play areas and riding the broomsticks around the field.

RE-AIM dimension	Social-ecological component	Theme	Quote
Participant Level Adoption	Intra-personal (Individual)	Excitement/Joy	"you would see the students rushing out to play…just excitement on their faces when the equipment came and the way that they went about it." "the joy on the faces in those first few weeks was terrific and you still see them running out with excitement to play."
		Engagement in Play	"play now has a specific purpose…moving things around is important." "you don't look around and see many students just walking around not knowing what to do…everybody has got something in their hand."
		Creative Play	"they were setting up their rocket or boat." "they used to make a fort…the balls would be like the cannons."
		Physical Activity	"carting and carrying…moving things from one place to another…they are quite able to lift them" "play has increased physical activity…it will have"
		Problem Solving	"having been in many schools, they (students) play with far greater effectiveness…problem solving…more independently and with less adult intervention of any school I've ever seen." "problems are just more easily solved…it's not like there isn't problems arising…but they are easier to sort out and the students manage more often." "you rarely get a comment…they go off and solve it and there are no major issues at all and we don't see any tears."
Participant Level Adoption	Inter-personal (Social)	Social Modelling	"they're watching how others play…so they are learning those skills of play from the students that are really confident."
		Team Work	"they are working like a team…you go to this group, you go to that group…they really had it worked out…I think you can say we see a lot of teamwork." "they make sure they've got a purpose within those little groups."
		Negotiating Skills	"one girl said…I've just traded the washing basket for two more sacs…if they've got excess stuff that they don't need…they've just picked up on those things."
		Social Inclusion	"I've found kids in my room mixed in with kids that they wouldn't normally hang out with." "there's not a distinct or set number that can or can't be involved." "we don't hear much anymore of I don't have anyone to play with or they won't let me play."
		Co-operative Play	"the interaction between year levels has been fantastic… it has just kept going." "nobody says that's our spot…they've all sort of got their spots around the field."
Implementation	Physical Environment	Materials with Positive Effects	"we are seeing them (students) now build cubbies with the tarps and PVC pipe lengths and broom handles and fresh straw bales." "the shells when the students were using them as sleighs…that was enormous…that was really active."
		Materials with Negative Effects	"they (cardboard boxes) got wet and out of nick pretty quickly… I don't think it's practical…the waste." "they don't tend to be able to do much with them (plastic water containers)…they don't seem to be able to stack them and have become less practical."
Implementation	Policy	Safety Policies	"all of the boys picking everything up and beating each other…of course had to be talked about" "if you are jumping off hay bales the maximum was two on top of each other…which was essentially waist height."
		Organisational	"students were allowed to keep their chosen equipment for that week and then after that, it would be dismantled and equipment would be re-issued." "on a Friday we would bring it all in so that then it would physically have to be taken out again."

Table 2. Key social-ecological themes that emerged from the teacher focus groups regarding the LEAP intervention

Teachers believed students developed higher order thinking skills, such as the ability to problem solve within the school playground and that playground issues had decreased since the inception of the LEAP intervention (Table 2). As the LEAP intervention was quite different to conventional playgrounds with fixed structures and structured games many of the teachers made comparisons to these designs when highlighting the benefits of the intervention.

Inter-Personal Level Of Influence

The inter-personal social-ecological component was the most talked about by teachers. Teachers described a range of improvements to students' social skills as a result of the LEAP intervention such as social modelling, teamwork, negotiation, social inclusion and co-operative play (Table 2).

Teachers reported that the groups of students would work together by creating their own imaginary worlds and structures and this would allow students who are less socially confident to observe how others play and participate with others they wouldn't normally play with. Students' co-operative play from the LEAP intervention was a positive, *"the way they interact with each other…it's lovely to listen to"* and across year levels, *"the co-operative play has really increased…they do negotiations…interactions between levels has been fantastic."* As well as co-operative play, teachers believed social inclusion increased, *"we don't hear anymore of I don't have anyone to play with or they won't let me play"*; *"kids in my room have mixed with kids they wouldn't normally hang out with"; "there's not a…set number that can or can't be involved."* The teachers perceived that the playground culture had changed and become more team-oriented (Table 2), *"there is an expectation that students are allowed to join in and there's not much…dispute over that anymore."*

In addition, teachers reported no territorial issues from the LEAP intervention as the students' co-operative play developed. The principal, who had been teaching for 31 years, believed that playground issues were more likely to arise from structured sporting, competitive type activities in the playground. Students' negotiation skills were another higher order thinking skill teachers believed was developed (Table 2). Students had to negotiate in the playground with the exchange of materials and one teacher even talked about students who developed a shop that sells free playground materials. Another teacher highlighted how the complexity of students' play had evolved over the nine month period, from a dragging, pulling and moving phase, to the imaginative, building and negotiation phases. The intra-personal and inter-personal development of the students throughout the school year from the LEAP intervention were major factors in the school's adoption of the intervention program.

Physical Environment levels of influence (Adoption)

Direct observation of school playground areas revealed that the intervention facilitated further lunchtime play opportunities. At baseline, 'no identifiable activity' and 'soccer' were the predominant physical activity types identified (Figure 3). Playing with the movable/recycled materials was the predominant activity students engaged in post-intervention (Figure 4).

Implementation

There were a number of facilitators and barriers reported by the teachers which schools need to be aware of when implementing the LEAP intervention program on a wider scale in the future. The facilitators and barriers to implementing the intervention are categorised into physical environment and policy levels of influence.

Physical Environment level of influence (Implementation)

The impact of the introduced materials were categorised as having a positive or negative effect on the students' play. The main materials that were suggested by teachers to have the most positive impact on the students' play included tarpolines (plastic sheets), empty plastic sand shells, piping, milk crates, tyre tubes and the hay bales (Table 2). The milk crates were reported to be the most popular and useful material with teachers mentioning students could most easily build structures and the crates were light weight and therefore could be transported around the field quite easily (Figure 4). The milk crates were often combined with pipes when students were creating structures.

Figure 4. Images of students using the milk crates for building and construction

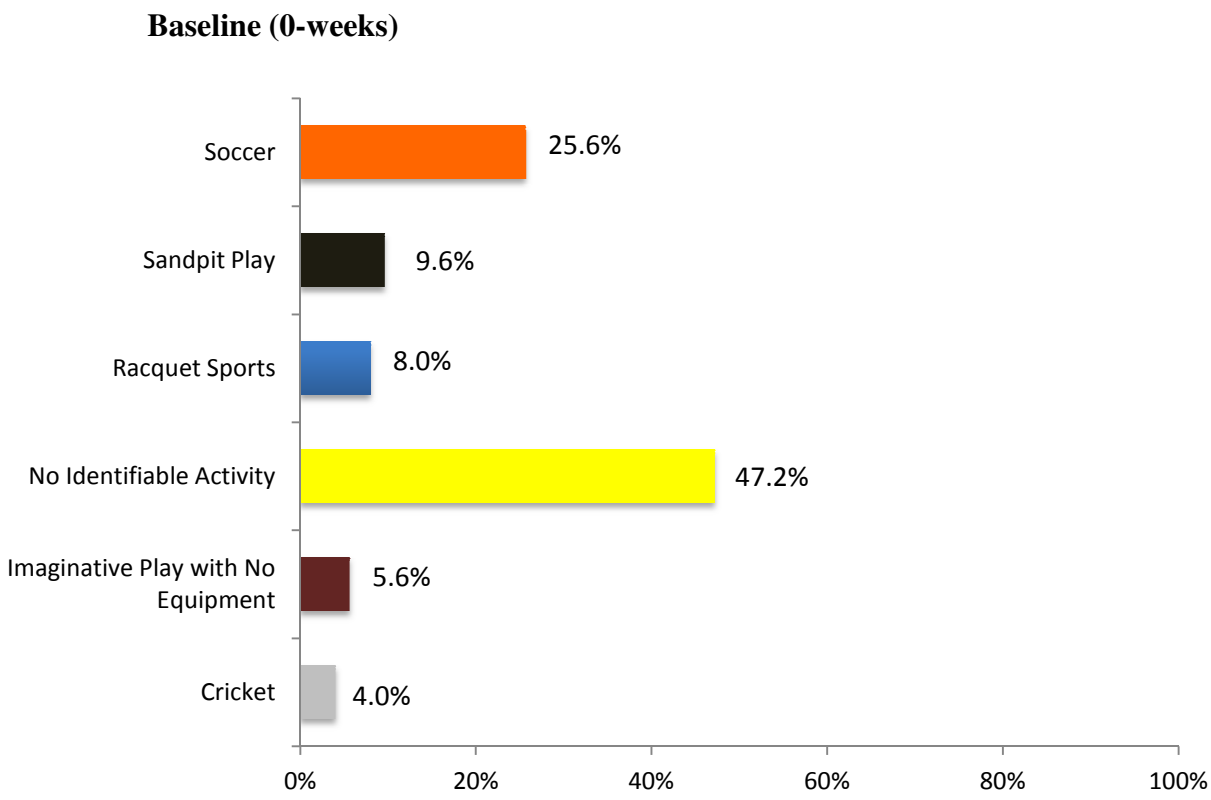

Figure 3. The proportion of predominant activity types measured by SOPLAY within each specified target area at baseline

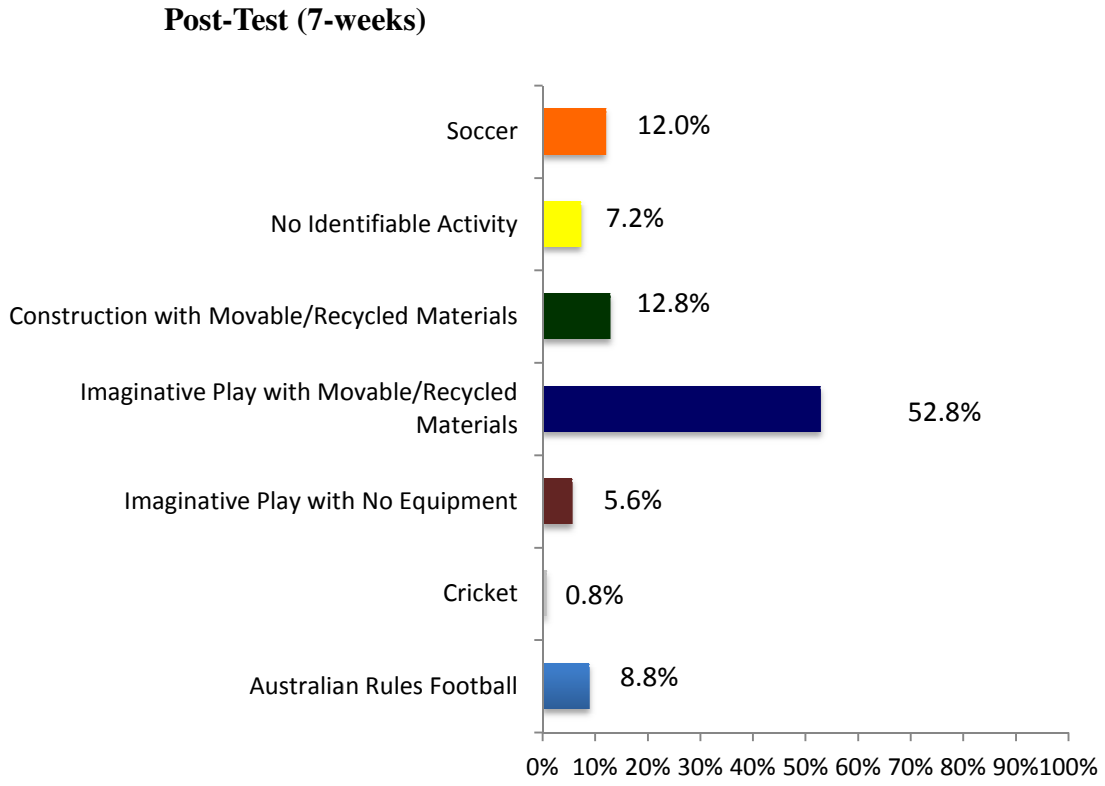

Figure 4. The proportion of predominant activity types measured by SOPLAY within each specified target area at post-test (7-weeks)

Hay bales were also popular with the students and were seen by the teachers as a useful material for students to jump off and over to promote physical activity, build structures with and one teacher even reported students using a hay bale to slide over moving water containers like a conveyor belt (Figure 5).


Figure 5. Images of students engaging in play with the hay bales

The plastic sand shells were reported by the principal to have dramatically increased students' physical activity levels as they used their initiative to create a sand-shell sleigh (Figure 6; Table 2 & 3).


Figure 6. Images of students using plastic sand shells as a sleigh during the post-test

The play balls introduced later in the LEAP intervention were also effective for building, rather than games (Table 2). The variety of tyres introduced were seen as effective, *"the tyres are something the kids really love."* Moreover, tarpolines (plastic sheets) were unanimously reported to be used as roof tops and walls when students created their cubby houses.

As one of the teachers noted, *"it's about letting kids teach us how to play"* and the journey of students' play from the LEAP intervention highlighted that *"students became a lot more complex in what they did…it was a real journey…there was…dragging, pulling and moving…then came the building phase…then came the dramatic phase…but all of those remain there."* Stations of materials were spread out around the grass field, *"they've all got their spots around the field."* Within each of the stations around the field students would be creating things (Table 2), *"we are now seeing them build cubbies" and "they want you to come and look at all the things…buy things from the shop they've made."*

There were a number of materials described by the teachers as barriers to children's play. The twine (from hay bales) was noted as an issue, *"was a bit annoying…trying to undo knots and things."* Cardboard boxes were also seen as a potential problem, losing shape within a cooler, wetter climate (Table 2). The cardboard boxes were suggested to be more beneficial in a warmer climate, *"If it was implemented in Queensland (warmer climate) I think it would be fine."* Another material that was seen to have little use were plastic bottles

(Table 2). The size of the tractor tyres was a safety concern for the school and it was enforced that, *"tractor tyres shouldn't be for anything other than walking on, climbing on, balancing and playing on"*. The weather was also seen as a major barrier to packing up the LEAP intervention materials, *"It's beautiful when kids are playing… it's not so good when it's raining and there's stuff all over your yard"; "rain's a big issue."*

Movable/recycled materials	**Activities students engaged when using the movable/recycled materials**
All materials	Obstacle course, imaginary play, building
Bike tyres	Rolling, stacking
Broom sticks	Riding, sweeping activity stations
Buckets	Filling with materials, driving cars
Cardboard boxes	Hiding, clothing, sliding, stacking
Hay bales	Jumping, landings, building, cubby houses
Hoola hoops	Rolling, hoola hooping around waist
Mats	Sleigh seat, hay bale cover
Milk crates	Building houses, space ships, cars, castles, rockets, tunnels & boats, climbing, jumping, soccer goals
Netting	Dresses, capes, house roofs. sails
Plastic cones	Activity station borders, hats, goals
Plastic cylinders	Telescopes, rockets, cannons
Plastic sand shells	Sleigh running (toboganning), sand play, walls
Plastic walls	Cubby house roofing/walls, climbing
Play balls	Cannon balls, rolling, groceries
Swimming kick boards	Sleigh seat, dragging, building
Swimming noodles	Riding horses, fencing, tug of war
Tarpolines	Cubby house roofing/walls, sails
Tyre tubes	Jumping, stacking, rolling
Vacuum tubes	Instruments, phone call centre
Wooden planks	Balancing beams, house walls

Table 3. Field note examples of how the movable/recycled materials were used by the students to engage in various unstructured play activities

Policy/organisational levels of influence

There were a number of facilitators to the success of the intervention, including a senior teacher that thoroughly supported the LEAP intervention throughout; reported as essential in previous intervention studies (Austin et al., 2011; Jenkinson, Naughton & Benson, 2012). When using movable/recycled materials, an obvious consideration for the teachers from the outset of the LEAP intervention was safety. Therefore, two of the policies that teachers unanimously introduced was the rule of not striking anyone and not stacking or jumping off materials above waist height, *"if you are jumping off hay bales the maximum was two on top of each other."* In addition, with so many materials introduced over a 13 week period, the teachers suggested that the packing up (organisational factor) of the materials had to be talked about. Teachers decided that leaving the materials out for the entire week, packing everything up on the Friday and re-administering the equipment to the students the following week was the most feasible option. Having a rule that allowed students to have certain equipment for the entire week and then distributed to others the following week was determined by teachers to ensure all students would have equal opportunity to use the different materials (Table 2). Despite students' engagement with the many materials a

teacher cautioned about surplus equipment, *"… you can over-provide as well…you have to be careful not to have too many things."* Therefore, beyond the initial intervention of 13-weeks the only materials introduced by the school were cubby houses, goal posts, milk crates, plastic cups/plates and the replacement of hay bales.

Maintenance

The focus group discussion conducted with the teachers nine months after the introduction of the LEAP intervention provided some insight into the maintenance dimension of the RE-AIM framework. Teachers were very supportive of the LEAP intervention during the focus group discussion quoting at nine months after baseline, *"I think the LEAP intervention worked really well, I'd like to see it stay"*; *"you still see them running out to play."* A teacher also expanded on this by making a suggestion for the maintenance of such an intervention, *"the LEAP intervention has brought an enormous richness to the play…you can see continuing on for a very long time…I think you need to be open to continuously introducing new equipment as you go."* Whilst comparisons were regularly made between conventional playgrounds and the LEAP intervention program, teachers suggested the concept could be feasibly transferred to other schools, *"I think the LEAP intervention is hugely beneficial… I don't think it has to be this playground or a conventional playground…I think it can go hand in hand to cater for all students"*; *"I'm absolutely convinced that you could implement this into any school."* Consequently, the LEAP intervention was independently maintained by the school beyond the initial 13 week intervention period.

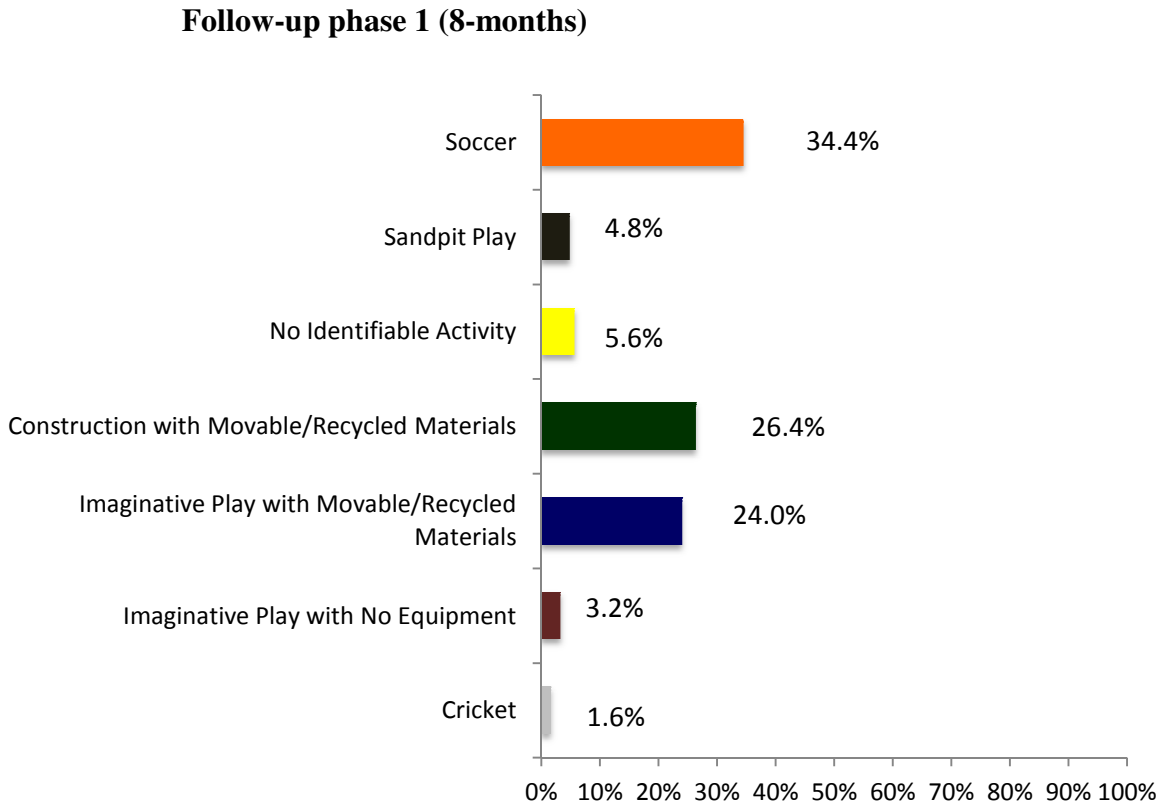

Figure 7. The proportion of predominant activity types measured by SOPLAY within each specified target area at the 8-month follow-up phase 1

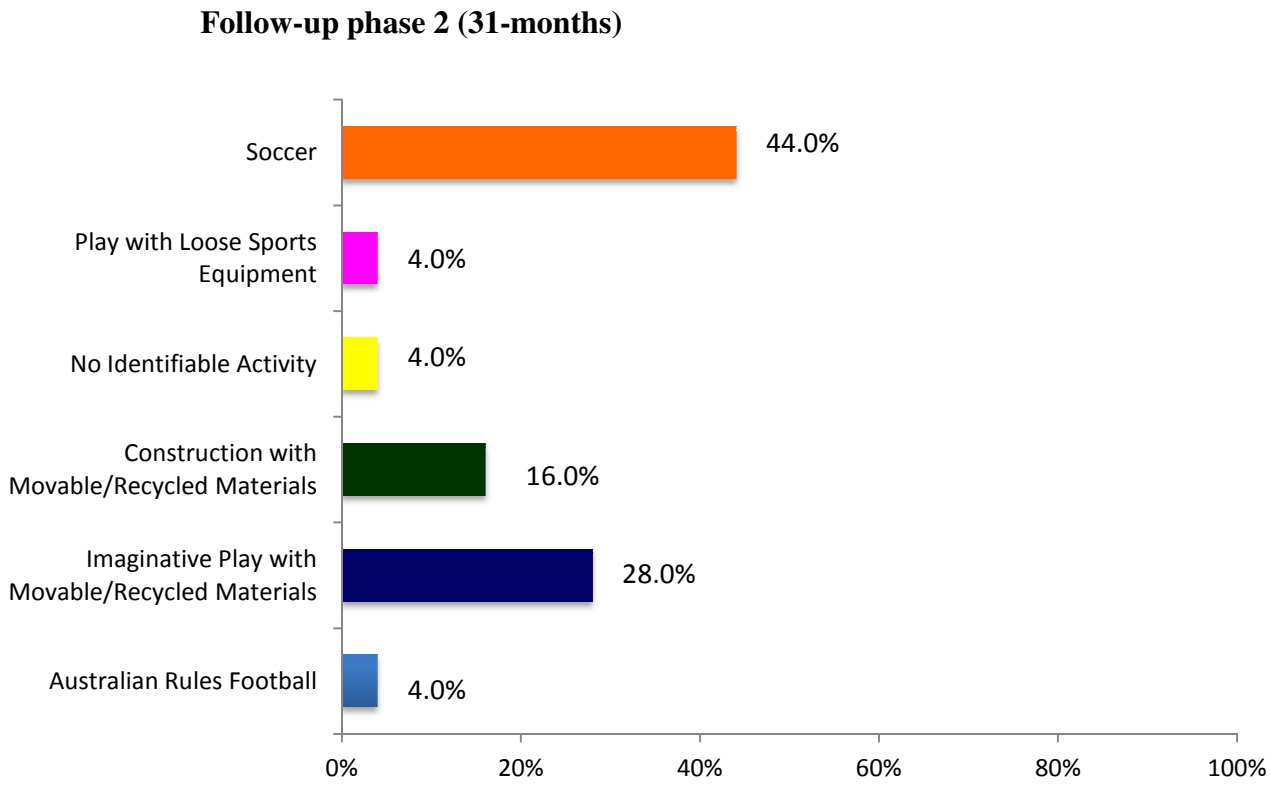

Figure 8. The proportion of predominant activity types measured by SOPLAY within each specified target area at the 2 ½-year follow-up phase 2

The LEAP intervention was associated with an increase in the intensity of physical activity which was maintained for two and a half years. Similar to the seven week post-test (see efficacy section), students' sedentary behaviour was 21.5% significantly lower at the 8 month follow-up and 31% significantly lower at the 2 ½ year follow-up compared to baseline (Figure 1). The proportion of students' participating in MPA (10.3% (8-months) and 14.9% (2 ½-years)) and VPA (11.2% (8-months) and 16.1% (2 ½-years)) was significantly higher than baseline (Figure 1). Students' play with the movable/recycled materials was maintained at eight months (Figure 7) and two and half years after baseline (Figure 8). Observation scans during the eight month follow-up also revealed that within 50.4% (26% construction & 24.4% imaginative play with the materials) and 44% of specified playground areas during the 2 ½-year follow-up (28% imaginative play & 16% construction with the materials) students were still engaged in play using the movable/recycled materials (Figure 7 & 8).

'Sustainable' materials still present during 2 ½ year follow-up phase 2	Materials not present during 2 ½ year follow-up phase 2	**Additional materials introduced by the intervention school between follow-up phase 1 (8-months) & follow-up phase 2 (2 ½-years)**
Bicycle tyres	Netting	Man-made cubby houses (fixed structure)
Wooden planks	Hoops	Australian Rules Football goal posts (fixed structure)
Milk crates	Exercise mats	Plastic cups (movable/recycled material)
Hay bales	Tennis balls	Plastic plates (movable/recycled material)
Water containers	Plastic buckets	Replacement hay bales
Plastic cylinders	Cardboard boxes	Replacement milk crates
Pipes	Baskets (plastic & wooden)	
Plastic sheets	Frisbees	
Motorcycle tyres		
Plastic walls		
Foam mats		
Plastic cones		
Tractor tyres		
Rope		
Broom sticks		
Plastic walls		
Hessian sacks		
Play balls		
Skipping ropes		
Tyre tubes		
Swimming kick boards		
Plastic sand shells		
Swimming noodles		

Table 4. Overview of the sustainable and unsustainable movable/recycled materials identified during intervention phases

Consultation with teaching staff after two and a half years identified that the policy relating to the distribution of materials to students at the beginning of the school week and then packing the materials up at the end of the week was still being maintained. An audit of the sustainability of the movable/recycled materials (Table 4) highlights that 23 of the 31 types of materials introduced (74%) still existed within the school playground after two and a half years.

Field notes collected at the 2 ½ year follow-up suggest students would use the movable/recycled materials to play around the 'man made' cubby houses that were introduced after the 8-month follow-up, around the trees and bushes or create a structure to play around along the fence line of the field (Figure 8).

Figure 8. Images of structures students would use the movable/recycled materials to play around

Students engaged with the movable/recycled materials around the outside of the field, whilst students participated in games of soccer in the centre of the field. Additionally, if students preferred to establish their own soccer game, milk crates were often utilised as soccer goals. Students would build and construct materials at the beginning of the school week such as 'cubby houses', 'shops' and 'space ships' and then for the remainder of the week participate in imaginative play (e.g. fantasy, role, escapist, dramatic play) around the station of constructed materials (Figure 9). The original supervision arrangements of one teacher on the grass field and one teacher on the hard surfaced area were still maintained after two and a half years.

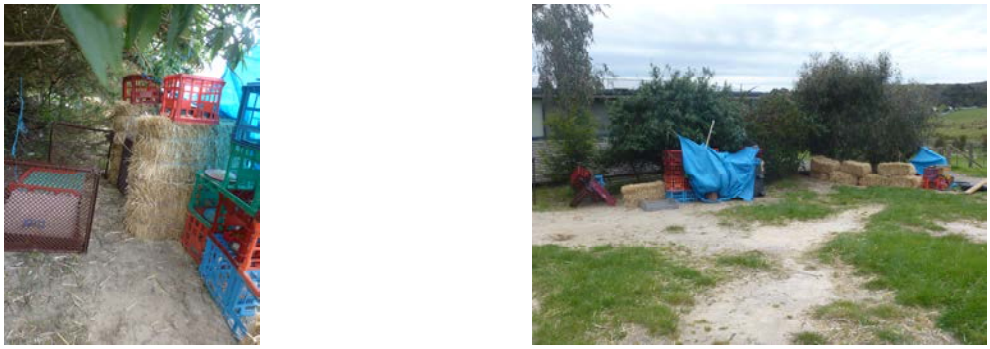

Figure 9. Images of an example of a shop constructed by the students with the movable/recycled materials

Discussion

The aim of this mixed methods process evaluation was to evaluate the reach, efficacy, adoption, implementation and maintenance (RE-AIM) of the LEAP intervention. The use of movable/recycled materials are an innovative option for educators to implement within their schools as well as for teacher education programs to guide pre-service teachers, as research indicates that conventional school play grounds have limitations affecting the engagement of students not interested or physically able to participate in vigorous intensity and more structured activities (e.g. soccer, basketball) (Dyment & Bell, 2007).

The 'reach' of the LEAP intervention program within the targeted Catholic Primary School was high with a 90% response rate of students during participant recruitment and 100% of teachers (n=9) participating in the focus group evaluation. The high response rate could be due to the school being recently built and the options provided by the LEAP intervention stimulated interest from the teachers and motivation for the students to participate.

The 'efficacy' of the introduction of movable/recycled materials was illustrated by the increase in the proportion of students engaging in higher intensity physical activity after the intervention was introduced. Consistent with physical activity intensity increases from the

LEAP intervention, a previous 13-week movable/recycled materials intervention (n=12 schools) also demonstrated significant increases in 5-7 year old students' MVPA during school breaks (Engelen, et al., 2013). Teachers in the present study reported that the intervention was essential for the students and had a positive impact on their productivity and purpose during play activities.

In relation to the RE-AIM framework 'adoption' dimension, teachers were receptive to the LEAP intervention because the intervention was offered to the school as a complete package including implementation, support and evaluation. Although the school community did donate some materials (milk crates, tractor tyres) after an advertisement in the school newsletter, the low donation of movable/recycled materials from the school community could demonstrate that schools are busy places with a major goal of 'classroom' learning (Wamp, 2009). Interest to adopt the LEAP intervention from the principal resulted in a briefing session outlining potential benefits of the intervention and the subsequent research. The briefing session was seen as highly important for the adoption (or buy-in) of teachers (Ginexi & Hilton, 2006). The intra-personal (individual level), inter-personal (social level) and physical environment development and adoption by the students from the outset of the LEAP intervention was seen as a key factor in the teachers' and school's adoption of the intervention and on-going maintenance.

Reflecting previous studies of 5-7 year olds (Engelen et al., 2013; Bundy et al., 2009; Bundy et al., 2008), teachers highlighted many intra-personal developmental benefits in primary school students of all ages that included students' engagement in play, excitement, creativity, problem solving and physical activity. The level of students' engagement was seen to reflect positively within the wider school community with teachers stating that many parents highlighted how engaged the students were with the materials. As students appeared engaged and excited to be moving the materials to different locations, this may have developed a greater sense of ownership and place for the students within the playground (Armitage, 2005). Consistent with previous research (Bundy et al., 2009), students' engagement in resistance type physical activities of pushing, lifting and dragging materials around the field were perceived to have increased since the introduction of the movable/recycled materials. Although, muscular resistance is an area of physical activity that was not objectively measured, multiple domains of physical activity were accounted for in the development of the LEAP intervention (Dollman et al., 2009). The present study has the potential to inform teacher education programs and training teachers that fixed structures, structured games and sports equipment aren't the only method to develop students' physical and motor activities during school breaks (Malone & Tranter, 2003).

An interesting finding identified by the teachers was the level of adoption from girls within the study. Many studies of school breaks have identified the challenges to engage girls in adequate physical activity (Ridgers, Salmon, Parrish, Stanley, & Okely, 2012). The findings from the present study may highlight an effective strategy teachers could use to engage girls in physical activity at an early age may assist with the prevention of transitional declines of physical activity into secondary school reported (Pate et al., 2007). Playing with 'unfixed equipment' has previously been associated with girls' activity within the school playground and providing further play options with unfixed equipment may encourage girls' physical activity participation (Roberts, Fairclough, Ridgers, & Porteous, 2012). As it has been reported that girls prefer engaging in social behaviour during school breaks (Roberts et al., 2012) it is possible that the social opportunities associated with introducing the intervention could be a key strategy to developing the physical activity of girls.

The inter-personal (social) themes identified within Bundy's earlier studies (Bundy et al., 2009; Bundy et al., 2008) were evident among students of all age groups during this intervention. Many of the teachers in this study reported that students were using the LEAP intervention materials to play with students they wouldn't generally associate with. Providing equipment to include students of all abilities and backgrounds within school breaks provides

an effective strategy for schools to prevent social isolation, bullying, conflict, injury and peer victimisation that are major barriers to students' physical activity (Parrish, Yeatman, Iverson., & Russell, 2011). The development of social skills such as social modelling, teamwork, negotiation, social inclusion and co-operative play in the intervention are important additional skills that enable students to learn about societal expectations and how to interact with people in a safe and meaningful manner (Boulton, 2005; Pellegrini, Blatchford, Kato, & Baines, 2004; Riley & Jones, 2010), learn conflict resolution skills and to engage in healthy behaviours (Salvy, Roemmich, et al., 2008). Providing a diversity of play options can also break down social hierarchies (Barbour, 1999) to ensure all students have an opportunity to experience the health benefits of play, not just those physically able or popular (Salvy, Wojslawowics, et al., 2008). The many intra-personal and inter-personal benefits identified by the teachers could encourage teacher education programs to ensure pre-service teachers re-think policy changes to eliminate recess time to focus on classroom learning (Clements, 2000) and consider implementing equipment from a student's perspective (Knowles-Yanez, 2005; Sener, 2006).

As all teaching staff supervised the intervention program, the teachers were able to provide insightful suggestions regarding the 'implementation' of the physical environment and policy changes for the school playground. Within the physical environment all materials added to the array of play options except cardboard boxes (didn't last long and their use would require regular replacement) and water containers (no play purpose). Despite 'ball associated' games being regularly seen as popular by school students (Roberts et al., 2012) when play balls were introduced to the field during the LEAP intervention program, students used them as part of imaginary play and construction (e.g. cannon balls) rather than ball sports. There were also some comments from the teachers about the twine from the hay bales as these could be tied to things around the playground and hay bales deteriorated after wet weather. Wrapping hay bales in bubble wrap (Bundy et al., 2009) is an effective idea to also prevent rain damaging the hay bales and to minimise allergic reactions to grasses. Furthermore, despite tractor tyres being a great base for students to play around, there were some concerns about the large size of the tyres if students were to attempt to move them or as a potential home to snakes. Wet weather was only seen to be a concern for cardboard boxes and for the appearance of the playground when materials became wet. Plastic materials can weather quickly and become brittle and therefore need to be regularly checked in case they become cracked and tyre tubes need valves to be covered effectively to avoid potential injury.

The school policy of allowing students the use of equipment for an entire week before returning the materials to the storage area at the conclusion of the week was a success. This weekly policy reduced staff and student demands to pack up regularly and was used to counteract ownership issues that could develop with the materials, as a number of students may want the same material for an extended period. Although teachers in a previous study perceived movable/recycled materials as a safety risk (Bundy et al., 2009), the only policies the intervention school had to introduce were to prevent the stacking of hay bales and crates to unsafe heights, prevent moving tractor tyres and striking each other with the foam swimming noodles.

After the initial intervention period of 13-weeks had concluded, most elements of the program were 'maintained' by the teachers, potentially due to the students' observed enjoyment, enthusiasm, perceived health benefits, cost-effectiveness and sustainability of the movable/recycled materials. All materials were accessible for the students, being found around most home or community settings (Bundy et al., 2009). Funding underpinning any intervention program is important for schools (Cass, Price, & Rimes, 2005) to facilitate the adoption and maintenance of interventions (Reilly & McDowell, 2003). A total of 23 simple, cost-effective, movable/recycled materials from the original 31 materials (74%) introduced were still present within the school playground during a playground audit two and a half years after baseline. The most sustainable materials were solid and resistant to damage such

as treated pine wooden planks, milk crates, pipes and large tyres. Many of the light plastic materials such as buckets and baskets became damaged quite easily and had been removed from the playground. Using plastic, wooden or rubber materials that aren't light or brittle are an important consideration for future replication of the LEAP intervention by teachers in other schools. This durability of the movable/recycled materials over a 2 ½ year period was a major contributor in the provision of play benefits to the primary school students for an extended period of time (maintenance). The wide use of hay bales and milk crates meant the school replaced these materials at the commencement of each school term after the initial 13 week intervention phase.

Direct observation revealed students' adoption of the movable/recycled materials and increased physical activity intensity during the intervention were maintained during both the 8-month and 2 ½ year follow-up periods. This finding is comparable to a similar 13 week movable/recycled materials intervention that revealed initial physical activity intensity increases from the intervention in 5-7 year old students could be maintained for two years (Engelen, et al., 2013). This suggests that a large proportion of the students preferred to engage in physical activity and play that is less competitive during school breaks, an emerging consideration for teachers (Dyment, et al., 2009) when offering activities and equipment for use during school break periods. Strategies to further enhance the successful maintenance of the LEAP intervention could be to include a co-ordinator or key teacher to advocate for the intervention and to monitor the condition of the materials (Hoelscher et al., 2003; Rogers, 2002; Webber et al., 2008). As the LEAP intervention builds upon previous research (Engelen, et al., 2013; Bundy et al., 2009; Bundy et al., 2008) by examining additional health outcomes and a larger age range, future research could investigate the implementation of movable/recycled materials during after school periods and across multiple school environments to complement or replace conventional school playgrounds.

Importantly, the LEAP intervention provided students with the four elements children desire within a playground, a place for 'doing', 'thinking', 'feeling' and 'being' (Titman, 1994, p 58). If students fail to engage in high quality childhood play, a capacity to develop a range of key life skills (e.g. cognitive, spatial awareness) could be diminished. Implementing movable/recycled materials is an important consideration for both current teachers and pre-service teachers within teacher education programs, as many students can become bored of fixed playground equipment and may prefer to create their own play areas. Teachers are the gate-keepers to school playground planning, therefore this study provides a guide for current teachers and teacher education programs to inform pre-service teachers how to implement an effective school playground intervention. Teacher education programs need to develop pre-service teachers to be aware that conventional, fixed equipment within school playgrounds may not be the only answer to providing opportunities for play and physical activity during school break periods and may not cater to the diverse needs of all students.

Limitations

Originally, the LEAP intervention was planned for 13-weeks with a mid-intervention data collection after seven weeks. However, during the winter of 2010 the region experienced the highest rainfall on record (Bureau of Meteorology, 2013) when the post-testing window was originally scheduled (after 13-weeks). This resulted in students being able to play outdoors for fewer days and thus all data was not able to be collected. Due to the wet weather and reduced outdoor play, investigators had to examine the data seven weeks after the commencement of the intervention (as the post-test) and then during two additional follow-up data collection time points.

Although a high proportion of students engaging with the movable/recycled materials was identified, a limitation of the study was that the data collection methods were not sensitive enough to distinguish which individual materials influenced physical activity. However, the qualitative focus groups and field notes were able to provide insight into students' use of the movable/recycled materials. Given the sporadic nature of students' play during school lunchtimes it is possible that some misclassification of activity or intensity type occurred, however to try and address this potential limitation the research team increased the number of scans from the traditional SOPLAY protocol (15 & 25 minutes into lunchtime) to scans every five minutes to capture more detailed physical activity data. It should be noted that gender was unable to be identified via direct observation due to the school's 'no hat, no play' sun-smart policy, although qualitative insight was gained from the teachers.

Although the physical activity benefits from the LEAP intervention observed during the post-test (7-weeks) and 8-month follow-up consisted of the same cohort of students, a different cohort of students were present in the school playground during the 2 ½ year follow-up. However, the purpose of this follow-up was to assess the sustainability and play benefits of the movable/recycled materials over a long-term. The scope of measurements undertaken was already quite comprehensive, however further insight may have been elicited by interviewing the students, parents and non-teaching staff about the LEAP intervention throughout the school year. In addition, any generalising of the findings should be done so with caution as the intervention was conducted within a single catholic primary school.

Practical Implications for Teacher Education

Playing and learning outdoors can inspire students (Hyvonen, 2008), yet teachers often perceive play and learning as differing concepts and find combining them difficult to integrate conceptually and in practice (Pui-Wah & Stimpson, 2004). Findings from this study could be used by teacher education programs to improve pre-service teachers' understanding of the benefits of the 'informal curriculum' of school break periods and to consolidate understanding of school breaks as an opportunity for students to develop skills beyond the classroom, rather than viewing school breaks as having little impact on students' health, learning and development. Rather than a period for students to 'let off steam and energy' (Evans & Pellegrini, 1997), the present study can enhance pre-service teachers' understanding of the value of introducing low cost materials to a school playground for students' educational development.

The multi-level developmental benefits of students' play from the LEAP intervention suggest supervised play with movable/recycled materials should be further explored and replicated by teachers within the educational context. The present study provides impetus for teacher education programs to provide units of study to develop pre-service teachers' awareness of intervention strategies such as the LEAP intervention to lead changes in school playground planning, organisation and implementation of cost-effective equipment. Although

teachers often identify play as teacher driven and miss potential scaffolding opportunities (Pui-Wah & Stimpson, 2004), the movable/recycled materials in the present study demonstrate the potential opportunity for students to develop health behaviours without increasing the demands on already burdened teaching staff.

Conclusions

This research addresses an important gap in the literature by providing useful information for educators currently in schools as well as teacher education programs on the external validity of the LEAP intervention to ensure the different social-ecological benefits within the school environment can be replicated by teachers on a wider scale. Results of this study provide insight for educators that the LEAP intervention can be consistently implemented and maintained for at least a two and a half year period. Reach, efficacy, adoption, implementation and maintenance of the LEAP intervention all proved to be successful. The LEAP intervention provides a model schools and pre-service education providers could adopt as future teachers as a successful alternative to conventional school playgrounds that could be implemented in any school. Cost-effectiveness, diversity, sustainability and positive individual and social engagement were major factors facilitating the success of the LEAP intervention.

As movable/recycled materials are readily accessible within the home and neighbourhood, teachers could encourage students to play with these items at home to enhance the transfer of physical activity behaviour from school to home settings. Further co-operation between pre-service and practicing teachers, educational leaders, teacher training programs, playground designers, researchers and play professionals could further develop the benefits identified in this study on a wider scale in schools to enhance the 'informal curriculum' during school breaks.

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Acknowledgements

The authors thank the primary school students and teachers for adopting, implementing and maintaining the LEAP intervention since the beginning of March, 2010. We are grateful for the positive impact the intervention has had on the intervention school's community. The control school must be thanked for their participation in the LEAP intervention throughout 2010 and the student teachers from both the Australian Catholic University and University of Ballarat for their assistance with data collection. The data collection process for this research was conducted whilst Brendon Hyndman and Amanda Telford were based at the University of Ballarat. The write up of this research was conducted at RMIT University. The authors would also like to thank Professor Caroline Finch for her input into the design of the methodology.